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Education and welfare program compliance: Firm-level evidence from a pension reform in China☆

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ABSTRACT

This study examines how firms with heterogeneous human capital quality respond differently to a welfare policy shock. In 2002, China expanded pension mandates from state-owned enterprises (SOEs) to private enterprises. Based on data covering all median and large manufacturers in China (around 250,000 firms), we find that their compliance rates varied widely across firms and increased in the average education level of employees. Utilizing these heterogeneous responses at the firm level, we estimate that the pension reform might have increased the return to education of employees by 8.75%. To address endogeneity in firms' human capital levels, we exploit the historical scale of local university as an instrumental variable. Moreover, we use SOEs as a control group, which was not directly affected by the policy shock. We find our empirical estimates robust to both measures.

1. Introduction

Education may help improve policy enforcement, a typical challenge in developing economies. The case examined in this study is a nation-wide reform in China that mandates privately owned firms to contribute to the pension fund of 34 million employees, amounting to 2.7 billion USD.[1] This reform was intended to benefit employees but increases the financial burden of firms and local governments, thus has encountered great difficulty in implementation (Li & Wu, 2013). Interestingly, we observe that the pension mandate has higher compliance rates in firms with better educated workforce, especially for private firms (Fig. 1). The objective of this study is to provide empirical evidence to quantify this pattern and shed light on the underlying causality.

This recent pension reform of China is a significant one. After three decades of implementing the one-child policy, ageing has been rapidly becoming an important issue in China. This pension reform in 2003 has three important features. First, it targets non-State enterprises only, as State-owned enterprises (SOEs) had already been covered by a pension system. Second, the mandated pension contribution by employers is significant: each enterprise is required to contribute an amount equivalent to nearly 20% of its wage bill

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[1] According to China Statistics Yearbooks, the private sector in both urban area and rural area in China employed employees around 34.10 million in 2002. The average wage is 3384 for unit of other types of ownership except state-owned units and urban collective owned units. This generates a total wage bill of 115.4 billion Yuan (13.9 billion USD by exchange rate of 2002). Private enterprises are mandated to contribute 20% of wage bill to pension funds.

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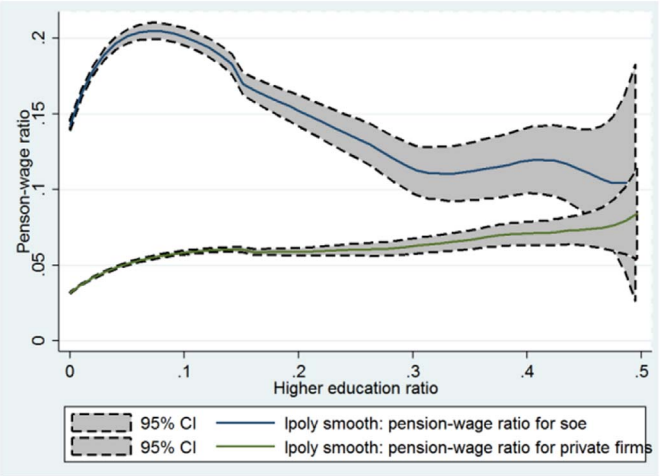

Fig. 1. Pension-wage ratio and educated ratio for SOEs and private enterprises.
Note: Higher education ratio is the fraction of employees with bachelor degree or above in a firm. Pension-wage ratio is the ratio of pension to wage. The plots are based on the local polynomial smoothing of pension-wage ratios for SOE and private firms, with the 95% confidence bands.

to pension fund, while employees' own contribution is only 8% of their wage. This makes employer-provided pension a pillar of the pension system of China.[2] Third, the compliance rates of this pension reform were low and highly variant across firms. According to our sample, the average pension-wage ratio by non-State employers in 2004 was 5.71%, well below the 20% target of government. Hence, the potential gain to employees from improving pension compliance can be sizable. Empirical literature on this pension reform of China is limited. Li and Wu (2013) and Chen and Wu (2014) find that the agglomeration level of local economy affects compliance rates. Alternatively, Oksanen (2010) argues that the financial position of local governments varies by regions, giving them different capacities to enforce the pension reform.

To motivate our empirical model, we establish a simple framework to illustrate how the education of employees can affect their total compensation under the pension reform. In this framework, besides increasing wage return, education can affect pension provision through two channels: one is to raise the pension-wage ratio, which is the policy target of the reform; the other is to prevent employers from passing through the pension costs to employees through wage-cutting.

The association between education and compliance could be “spurious” if it is driven by other factors. For example, firms with more educated workforce may also be larger, making policy enforcement easier. Also, firms that attract more human capital could also have more formal corporate governance. To address this endogeneity issue, we control for firm size in the model and conduct two additional identification exercises. First, we propose an instrumental variable (IV) for the workforce quality of firms by exploiting a unique institutional feature of China: the history-dependent spatial distribution of universities across provinces and the highly localized university admission system. We show that this IV has high predictive power of the actual bachelor ratio of workers at the firm level. Second, as SOEs are not directly affected by the pension reform, we also consider SOEs as a control group. We do not expect to see that the pension contribution of SOEs with different education level react positively to the pension reform.

We apply our empirical strategy to a large data set covering the universe of medium and large manufactures (around 250,000) of China in 2004. This data set, compiled by the National Bureau of Statistics of China, is becoming a major database for researchers, such as Cai and Liu (2009) and Song, Kjetil, and Fabrizio (2012). The data suggest wide variation in the compliance of pension reform across China (see Table 1 for the pension-wage ratio by province). For example, the average pension-wage ratio for private enterprises[3] ranged from 1.18% in Jiangxi province to 7.99% in Jilin province. Private enterprises with more educated workforce have higher pension contribution, but we do not find this for SOEs (Fig. 1). Specifically, the firm-level raw correlation between higher-education ratio (bachelor and above) and pension-wage ratio, is 0.09 for private enterprises, and -0.03 for SOEs.

Our empirical estimates, with and without IV, both confirm that the pension policy “shock” had larger impact on private firms with more educated workforce. Specifically, our IV estimates suggest that, for private enterprises, increasing the higher education ratio of a firm by 1 percentage point would increase its pension-wage ratio by around 1.363 percentage point. In contrast, we do not find similar effects for the SOEs. This finding is novel to the literature as little evidence is available on the effect of education on policy enforcement. In a related study, Royalty (2000) presents some evidence on the relationship between education and health insurance provision, but it is not because of enforcement but because of eligibility of the policy.

With the caveat in mind that our identification strategy may not fully address the endogeneity issue, we provide further estimates regarding the effect of education on the policy costs of firms. Inferring the net effect of the pension reform on employers' labor costs is complicated because employers may cut wage to offset their increased pension costs (Montgomery, Shaw, & Benedict, 1992;

[2] Compared to other countries, in Switzerland, employers contribute 8.78% of total wages to occupational pensions (Knuuti, 2009). In Singapore, employers contribute 17% of total wage to pension system.

[3] We define private enterprises as all firms that are registered as private firms in State Administration for Industry & Commerce of China.

Table 1
Average pension-wage ratio and education ratio in each province.

Province	Pension SOEs	Pension private	Education SOEs	Education private	Number of universities 1998	Ratio of universities teachers_1950	Ratio of universities teachers_2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Nation average	16.45%	3.80%	4.86%	2.56%	43	3.85%	3.33%
Beijing (BJ)	15.12%	4.14%	11.43%	13.60%	63	14.70%	7.68%
Tianjin (TJ)	23.83%	2.14%	6.51%	5.25%	20	4.16%	2.23%
Heibei (HB)	16.93%	1.46%	3.71%	1.82%	46	1.10%	4.27%
Shanxi (SX)	10.51%	1.55%	2.52%	2.30%	23	0.88%	2.30%
Inner Mongolia (IM)	14.81%	5.80%	4.18%	2.17%	19		1.95%
Liaoning (LN)	13.72%	4.52%	7.62%	5.16%	61	5.98%	6.05%
Jilin (JL)	15.28%	7.99%	5.85%	4.94%	41	2.40%	3.84%
Heilongjiang (HLJ)	17.19%	3.02%	5.55%	6.35%	38	4.35%	3.55%
Shanghai (SH)	25.08%	5.35%	4.51%	3.78%	40	11.29%	4.50%
Jiangsu (JS)	19.76%	4.51%	4.62%	1.81%	66	8.35%	7.27%
Zhejiang (ZJ)	17.89%	5.13%	5.76%	1.36%	32	3.43%	4.17%
Anhui (AH)	18.39%	2.33%	4.50%	2.74%	34	1.31%	3.31%
Fujian (FJ)	20.21%	2.60%	3.40%	2.16%	29	2.21%	2.15%
Jiangxi (JX)	11.09%	1.18%	2.81%	2.12%	31	2.21%	2.29%
Shandong (SD)	17.55%	2.29%	5.89%	2.26%	49	3.59%	5.44%
Henan (HN)	13.13%	1.26%	3.71%	1.69%	51	1.62%	4.44%
Hubei (HB)	16.03%	3.38%	4.39%	3.40%	54	3.71%	6.67%
Hunan (HN)	15.23%	2.92%	3.41%	2.67%	47	3.31%	4.47%
Guangdong (GD)	15.18%	4.10%	3.76%	3.11%	43	12.14%	4.48%
Guangxi (GX)	16.80%	3.26%	3.16%	3.82%	28	0.73%	2.05%
Hainan (HN)	16.49%	5.13%	2.84%	4.82%	5	0.23%	0.35%
Chongqing (CQ)	18.13%	1.98%	4.25%	2.68%	22		
Sichuan (SC)	18.16%	3.05%	6.02%	3.37%	43	4.67%	4.05%
Guizhou (GZ)	17.23%	2.11%	3.17%	2.16%	20	1.34%	1.59%
Yunnan (YN)	23.72%	4.77%	4.01%	2.73%	26	1.84%	2.03%
Tibet (TB)	11.68%		1.45%	9.30%	4		0.18%
Shaanxi (SX)	17.42%	2.06%	4.03%	4.34%	42	2.99%	4.55%
Gansu (GS)	15.03%	2.03%	3.58%	1.93%	17	1.39%	1.52%
Qinghai (QH)	15.55%	2.85%	2.28%	3.57%	6		0.46%
Ningxia (NX)	15.18%	2.92%	2.86%	3.07%	5		0.42%
Xinjiang (XJ)	19.30%	6.73%	4.36%	3.07%	17	0.07%	1.74%

Note: (1) “Education SOEs” refers to the average percentage of employees with bachelor's degree or above over the total number of employees per SOE, and “Education private” refers to the average percentage of employees with bachelor's degree or above over the total number of employees per private firms. (2) In column (8), we do not have information for ratio of university teachers in 1950 in Inner Mongolia, Chongqing, Qinghai, Tibet and Ningxia. (3) Ratio of universities teachers in column (8) and (9) means the ratio of university teachers to the total number of teachers in all educational institutions.

Woodbury, 1983).[4] To account for this endogenous reaction of firms, we estimate a system of equations on wage and on total labor costs. Our estimates imply that private enterprises may transfer at least 10% of pension costs to workers through their wage reduction. This estimate is much higher than existing estimates for China (Li & Wu, 2013; Nielsen & Smyth, 2008), but is comparable to the estimates in the US (Gunderson, Hyatt, & Pesando, 1992; Olson, 2002; Smith, 1981). Accounting for the pension-wage substitution, the pension reform would have increased the return to education of employees by 8.75%.

The remainder of this paper is structured as follows. Next section proposes a framework for analyzing the effect of education on firms, and Section 3 provides the background of the pension system and reforms in China, as well as its university system. Section 4 introduces an empirical framework to estimate the effect of education on the pension provision of firms. The data and empirical findings are summarized in Sections 5 and 6. The last section concludes.

2. Research framework

In this section, we use a simple framework to demonstrate the channels for education to affect pension. This helps us to motivate our empirical models and interpret model estimates.

Suppose there are two periods. In period one, a pension system is absent, and workers' compensation includes only wage. The employment cost of a representative firm in this period, C_1, equals the wage bill, w_1:

$$C_1 = w_1 \tag{1}$$

[4] In the case of China, existing empirical evidence suggests that this substitution is limited (Li & Wu, 2013; Nielsen & Smyth, 2008), possibly because of the limited pension portability, the omitted factor of inflation, the compensation of government subsidies, etc.

In period two, a pension system is established. Firms are mandated to contribute pension for their workers. The total labor cost of the firm in this period, C_2, consists of two components: wage (w_2) and pension benefits (p_2).

$$C_2 = w_2 + p_2 = w_2 + \tau w_2 = (1 + \tau)w_2 \tag{2}$$

Here τ is the pension-wage ratio of the firm.

Importantly, the pension reform not only affects the pension-wage ratio, τ, but may also affect the wage of workers. According to theory (Montgomery et al., 1992; Woodbury, 1983), wage and pension benefits are substitutes: when pension benefits increase, firms have incentive to lower wage so as to maintain the optimal compensation package for employers. The rate of substitution depends on the age of employees, the marginal tax brackets and the time preference (Montgomery et al., 1992).

In this study, we do not explicitly model factors that determine the substitution rate, but assume a reduced-form substitution relationship, as follows:

$$w_1 - w_2 = \lambda \cdot p_2 \text{ or } w_1 = (1 + \lambda \cdot \tau) \cdot w_2 \tag{3}$$

The substitution rate λ ranges between zero (pension burden fully passed to workers) and one (pension burden fully on employers). Given Eqs. (2) and (3), total compensation after the pension reform is as follows:

$$C_2 = (1 + \tau)\frac{w_1}{1 + \lambda\tau} \tag{4}$$

Based on Eq. (4), the full rate of return to education in terms of total compensation can be obtained by differentiating the logarithm of compensation with respect to the number of years of schooling, denoted by s:

$$\frac{\partial \ln(C_2)}{\partial s} = \frac{\partial \ln(w_1)}{\partial s} + \left(\frac{1}{1 + \tau} - \frac{1}{1/\lambda + \tau}\right)\frac{\partial \tau}{\partial s} - \frac{1}{1/\tau + \tau}\frac{\partial \lambda}{\partial s} \tag{5}$$

Note that the education of employees not only affect their wage bill, but may also affect τ and λ, for several reasons. Firstly, educated employees may be more knowledgeable of on-going reform policies, thus may better monitor their employers' compliance. Secondly, educated employees could be more mobile in the labor market, thus giving them stronger bargaining power in forcing firms to provide pension. Thirdly, given the progressive income tax schedule[5] and that pension contribution is tax-deductible,[6] firms may find it more attractive to compensate educated workers in the form of pension but not wage.

When τ is small, i.e. if τ is close to 0, the above equation can be approximated by a simpler one:

$$\frac{\partial \ln(C_2)}{\partial s} = \frac{\partial \ln(w_1)}{\partial s} + (1 - \lambda)\frac{\partial \tau}{\partial s} - \tau\frac{\partial \lambda}{\partial s} \tag{6}$$

Eqs. (5) and (6) suggest three channels for education to benefit workers. The first is the commonly studied wage return to education. The second channel is improving the compliance through raising pension-wage ratio. This term is normally zero in most economies because in most public pension systems the pension contribution rate is fixed. In the case of China, we expect this effect to be positive, as long as employee education can affect τ and λ is less than one. The higher the pension-wage substitution rate, the smaller the effect of second channel, as workers bear more pension burden. The third channel reflects the effect of education on the wage-pension substitution rate. If education prevents firms from transferring the pension costs to workers, then $\frac{\partial \lambda}{\partial s}$ is negative and workers benefit from education increase, as τ is positive.

3. Institutional background

In this section, we summarize relevant institutional background information. We first review the history of pension reform in China, which provides a unique opportunity for us to test the theoretical implications. In addition, we also introduce the higher education system of China, which is crucial for our identification strategy.

3.1. Pension reform

The current pension system of China mainly covers the urban area,[7] According to Wang, Béland, and Zhang (2014), there are four types of pension schemes in urban China. The first one is the basic old-age insurance system for enterprise employees. The second type is basic old-age insurance system for public institutions employees. The third one is old-age insurance system for urban residents, and the four one is designed for civil servants. We focus on the first type of pension scheme, and the following major features are relevant to this study. First, employers are the major contributors to the pension fund. Second, although the mandated contribution

[5] Personal income tax law of\China was officially implemented in 1980, and six amendments were released afterwards, which took place in 1993, 1999, 2005, 2006, 2007, and 2011. Based on the most updated law amendment in 2011, the starting point for the progressive personal income tax is 3500 yuan, and the income tax rate is between 3% and 45%.

[6] In 1995, it is regulated that the basic pension provided by firms would be tax deductible, and individuals do not need to pay tax for pension. In 2000, an updated policy regulated that complementary pension could be tax deductible to some extent of 4% in the experimented area. And it is summarized in 2006 that the basic pension and health insurance contributed by the firms are tax deductible, while if the contribution is beyond the regulated rates, they would have to pay the tax.

[7] Rural area is only partially covered in the pension system, and the ratio of the accumulated pension fund in rural area to urban area is around 6%, according to the Annals of the development for labor and social security in 2006.

rate is similar across China, the effective contribution rates vary widely, not only by region, but also by the form of ownership, with State-own enterprises generally complying much better. Below we provide a brief review of how the pension system in China has developed into the current form.

From 1950s to early 1990s, China maintained a Soviet-type pension system that covered only the employees of state-owned enterprises (SOE). As China transformed from a planning system to a market-oriented one since 1978, there was increasing need for pension provision for non-SOEs (Feldstein, 1999; Naughton, 1995). At the same time, the ageing of population has accelerated as the consequence of the one-child policy implemented around 1978 in China. Until the end of 2011, the aged population (over 60 years old) reached around 0.19 billion, which accounted for 13.7% of the population of China. Moreover, it is projected that this aged population share will increase to one third by 2050s, if there were no major relaxation of the one-child policy.[8] The rapidly growing retirees in non-SOEs of urban China thus press the government to reform the old pension system, which cover only SOEs.

In 1998, the state council proposed to establish a modern pension system that covers firms with different types of ownerships.[9] In 2003, a pension reform was formally started to extend the coverage of the pension system to non-state enterprises. The mandated contribution ratios were uniform across China. In particular, firms in all forms of ownership were required to contribute amount equivalent to 20% of their wage bills to the government-controlled pension fund, while employees should contribute 8% of their wages to their own individual accounts which were managed by the government.[10] The pension fund has increased rapidly since. In 2004, the outstanding stock of pension fund in urban China increased by 15.7%, reaching RMB 425.8 billion. By 2010, the total pension fund size has almost tripled to RMB 1342 billion.

Despite the rapid progress of the pension reform, the pension-wage ratios of private enterprises were still well below those of SOEs and were far from the official target of 20%.[11] While the national average pension-wage ratio of SOEs was as high as 16.5% in 2004, that of private enterprises was merely 3.8% (Table 1). Moreover, the actual pension-wage ratios varied remarkably across China, ranging from almost zero in Tibet to 7.99% in Jilin. In the two most developed cities of China, Beijing and Shanghai, their average pension-wage ratios for private enterprises were 4.14% and 5.35%, barely above national average.

There have been some studies on the low and variant contribution rates by private enterprises in China. Li and Wu (2013) find that the contribution rates varied by the agglomeration level of local economy. Oksanen (2010) pointed out that the varying compliance rates across regions may be driven by the different financial situations of location governments, which leads to heterogeneous implementation of the pension reform.

The scheme related to the pension reform is the personal income tax scheme in China. Similar to other countries, pension contribution by firms can be deducted for the purpose of individual income tax. In theory, this deductibility may motivate firms to contribute to the pension fund, but this effect should be limited in China due to the slow progress in enforcing the personal income tax scheme. The national income tax revenue accounted for merely 1.6% of the total tax revenue in 1994, and grows slowly to 6.5% by 2003 and 6.75% in 2004.

In rural regions, the elderly have to work throughout old age until they are no longer physically capable (Ning, Gong, Zheng, & Zhuang, 2016). Until late 2009, Chinese government launched the National Rural Pension Scheme for rural residents, and extended the coverage to rural China by the end of 2012. It is voluntary for rural residents to participate in this program, and the program provides for individual pension accounts with matching contributions and a basic flat pension for participants who have contributed for 15 years.

3.2. Higher education system

Before the 1900s, it was Confucius doctrines that dominate the Chinese education system. In 1912, there was one university and 35 training institutions. The modern Chinese higher education system was started following the foreign countries, such as Japan and US. After the war with Japan and the civil war in China in 1940s, the new People's Republic of China re-established its higher education system following that of Soviet Union. College enrolment grew steadily in the 1950s. From 1958 to 1961, the development of higher education was interrupted by the activity of Great Leap Forward, and from 1966 to 1976, was interrupted by the Cultural Revolution. Despite these interruptions, the geographic distribution of universities and colleges has been stable since 1950. The correlation coefficient between the province-level ratio of university teachers to all teachers between 1950 and 2000 is 0.69. In Table 1, the last two columns report the ratios of university teachers to total number of teachers in each province in 1950 and 2000 respectively.

The university admission system of China has been highly rigid and significantly affected the distribution of human capital across China. The likelihood for students to apply for universities in non-local provinces is significantly limited by a quota system. For each university or college, the central government assigns quota that stipulate the numbers of admitted students from each province of China. Typically, the majority of the quota is assigned to local students. As a result, high school students in provinces with more universities and colleges are also more likely to obtain higher education (Bratti, Checchi, & Blasio, 2008). Furthermore, due to the less developed labor market of China, university graduates tend to find jobs where they obtain higher education. This tendency, together with the quota system of China, is likely to lead to a larger supply of higher education human capital in provinces with a larger number of universities or colleges.

[8] http://society.people.com.cn/n/2012/1023/c1008-19353347-1.html.

[9] See “the Notice of Assigning Employees' Pension at Province level and Industry Level to Regional Government” in July 1998.

[10] The contribution rates for Shanghai and Guangdong are 22.5% and 18% respectively.

[11] Jia (2017) shows that since 2005 pension benefit in private sector has been less than half of the social average wage, and the public sector pension system did not experience such substantial changes until 2015.

4. Empirical strategy

In this section, we propose a system of equations based on the framework in section two to estimate the effect of education on the pension contribution of employers, through different channels. We are interested in the following questions. Can education promote the compliance to pension provision? How much can employers pass the pension burden to employees? What is the net increase in workers' compensation due to the pension reform, after accounting for the effect of alternative channels?

4.1. Baseline specifications

To assess the compliance effect of education, we propose the following specification for the effect of education on pension-wage ratio after the reform:

$$\tau_i = \alpha_0 + \alpha_1 E_i + \alpha_2 X_i + \alpha_r + \alpha_s + \varepsilon_i \tag{7}$$

where τ_i is the pension-wage ratio of firm i, calculated by the firm's pension contribution divided by the wage bill. E_i is the average education level of the employees of firm i. The coefficientα_1 reflects the effect of employee education on the pension-wage decision of their employers, which shed light on our first question. In our empirical exercises, we will measure E_i with the fraction of employees with bachelor degree or above. In terms of control variables, X_i includes other firm-specific attributes that can affect the pension contribution of firms. In particular, we consider firm size, within-firm union scale, and the profitability of firms. Firm size is measured by the logarithm of the number of employees in each firm. Union status is measured by the share of employees that join the union in each firm. This variable is included because it may reflect the bargaining power of employees. Furthermore, as the pension-wage ratio may also be affected by the financial conditions of a firm, we also include an indicator of whether a firm makes profit. Besides these control variables, we also controls for industry- and location-specific fixed effects, α_r and α_s, to account for unobserved heterogeneity at industry and location level, such as industry specific policy shocks and local governance quality. Firm-level fixed effect is not considered because our data is cross-sectional.

As mentioned, the coefficient α_1 reflects the effect of employee education on the pension-wage ratio of firms. According to Eq. (6), the relative importance of this effect can be assessed by comparing it with the before-reform wage return to education, $\frac{\partial \ln(w_1)}{\partial s}$:

$$\frac{\partial \tau / \partial s}{\partial \ln(w_1)/\partial s} = \frac{\alpha_1}{\beta_1} \tag{8}$$

Here β_1 is the estimate of $\frac{\partial \ln(w_1)}{\partial s}$, which can be estimated by the following model:

$$\ln(wage_{1i}) = \beta_0 + \beta_1 E_{1i} + \beta_2 X_{1i} + \beta_r + \beta_s + \xi_i \tag{9}$$

Note that the figure "1" in the subscript indicates that the variable is measured before the pension reform. For example, $wage_{1i}$ is the wage bill of firm i before the pension reform. It is crucial to focus on wage before the reform because the wage level after the reform can reflect the effect of education due to the pension-wage substitution effect. Note that the model controls for location fixed effects, so we are comparing the wage of firms within the same location. The difference in inflation and living standards between different locations of China does not affect our estimates.

In order to further estimate the net effect of education on the compensation of employees, we propose the following specification:

$$\ln(compensation_{2i}) = \chi_0 + \chi_1 E_i + \chi_2 X_i + \chi_r + \chi_s + \varsigma_i \tag{10}$$

Again based on Eq. (6), the relative importance of the net effect of the pension reform on the employee compensation can be measured as follows:

$$\frac{\partial \ln(C_2)/\partial s - \partial \ln(W_1)/\partial s}{\partial \ln(W_1)/\partial s} = \frac{\chi_1}{\beta_1} - 1 \tag{11}$$

Moreover, Eq. (6) also suggests the following

$$\lambda = 1 - \left(\frac{\partial \ln(C_2)}{\partial s} - \frac{\partial \ln(w_1)}{\partial s} + \tau \frac{\partial \lambda}{\partial s} \right) / \frac{\partial \tau}{\partial s} = 1 - \left(\chi_1 - \beta_1 + \tau \frac{\partial \lambda}{\partial s} \right) / \alpha_1 \tag{12}$$

This suggests that pension-wage substitution rate λ may be inferred based on our empirical model estimates α_1, β_1 and χ_1, if information is available on $\frac{\partial \lambda}{\partial s}$, which is the effect of education on the pension-wage substitution by employers.

4.2. Estimation and identification

A key identification issue in the estimation is that the education level of employees may be endogenous. For instance, a firm that provides more generous pension benefits may attract employees of higher quality. This reverse causation would bias the estimate of coefficient α_1 (Gruber & Krueger, 1991; Montgomery et al., 1992; Woodbury, 1983). Second, certain firm attributes may affect both the pension contribution and the education level of its employees. Some of these attributes are observed, such as firm size, and may be addressed by controlling for them in the model. Other confounding attributes may be unobserved. For example, the quality of corporate leadership may affect both pension provision and recruitment of high-quality employees. This can generate a spurious correlation between pension contribution and education. Third, the measure of education level in our regressions may contain

measurement errors, which can also bias the estimate of α_1 (the classical measurement error issue). For the same reasons, these issues can also affect the wage and compensation regressions.

Although unable to fully address all these endogeneity issues, in this study we tried to weaken their effects with alternative identification approaches exploiting the unique higher education system of China and the design of the pension reform. First, we propose an instrumental variable that can predict the share of workers with higher education in firms. Specifically, this variable is the product of industry-specific human capital intensity (industry is indexed by r) and the human capital supply at the province-level (province is indexed by s):

$$IV_{rs} = \text{human capital usage intensity}_r * \text{human capital supply}_s \quad (13)$$

The human capital intensity of an industry r can be measured by its share of employees with higher education (bachelor or above). We use it to indicate skill demand driven by industry-specific technology. As to the supply of higher education labor, we propose to use the number of local universities to exploit the unique university admission system of China. As discussed in Section 3, unlike in most of other countries, where high-school graduates can apply for non-local universities without much administrative restrictions, in China university admission is highly localized. The admission quota that is allocated by local universities to non-local applicants is only a small fraction of slots available. Moreover, as universities are publicly owned, they can rarely relocate according to evolving economic conditions. Consequently, the supply of local universities has been highly inelastic to changing economic environment and is largely history-dependent. Therefore, high-school graduates in provinces that are endowed with more universities historically have higher chances of obtaining higher education. Firms in these provinces thus have a larger supply of higher educated labor. We show that this IV has high predictive power of actual education level of workers at the firm level.

Both the industry-level education demand and the local supply of university are relatively stable over time and largely exogenous to a firm, and thus can address the reverse causation from pension provision of a firm to the education level of its employees. Moreover, estimation bias due to classical measurement errors can also be addressed, as the measurement errors of education levels at the firm level should be unrelated with the measurement errors of education demand and supply at the industry and province level.

Nevertheless, we have to admit that this IV approach may not fully address the potential endogeneity issue. For example, in firms that belong to industries that are more education-intensive and locate in provinces with high university endowment, the firms' managers may also have higher quality and may affect the pension contribution of the firm. Moreover, firms' self-selection regarding whether to enter a local market can be affected by unobserved factors that are related with the IV. For example, local government in provinces with lower university endowment may provide more preferential policies, which may reduce pension costs for firms, to attract more human-capital-intensive firms. To address these remnant endogeneity issues, we propose to use state-owned enterprises (SOEs) as a control group. As shown in Section 3.1, the current pension reform does not directly affect the pension contribution of SOEs. If the aforementioned endogeneity issues do exist, they should also reflect on the estimates of model (7) for SOEs. Therefore, we can estimate model (7) using the sample of SOEs to test whether the conjectured endogeneity issue is present. If we find the effect of education on the pension contribution of SOEs insignificant, this would be evidence against unobserved heterogeneity. We acknowledge that the key assumption here is that SOEs behave similar to private enterprises, which may not be valid. Hence, using SOEs as control group provide suggestive evidence but may not provide conclusive evidence on the causality of education on policy enforcement.

5. Data and measurement issues

The data set that we use is the Survey of Large and Medium Enterprises by the National Bureau of Statistical (NBS) of China. The data include the major characteristics of firms and the statistics of firm performance. Although the database available contains observations since 1998, only the 2004 patch contains information on both the education level of employees and employers' pension contribution. Hence, the sample used in our regressions of pension contribution is limited to the data in 2004. The original 2004 industrial data includes 256,173 manufacturers, among which, 7.77% are solely owned by the State and 43.5% are domestic private enterprises. The rest of firms are either foreign firms or have mixed ownership. In this study we focus on the domestic private enterprises (treatment group) and SOEs (control group). Human capital of foreign firms may be much less localized, and they may benefit more from special preferential policies offered by local governments. Hence, we do not include them in this study, as they may complicate the interpretation of our regression estimates. Moreover, firms with mixed ownership are also excluded because of the complexity in ownership structure and its potential effect on our estimates.

5.1. Measurement issue 1: pension-wage ratio

Ideally, we can obtain the pension-wage ratio dividing the pension contribution of firms by the wage used by government to mandate pension contribution. This encounters two issues due to data limitation. First, in the industrial database, firms report their contributions to pension fund and to health insurance together. Hence, our reported effect of education is on firms' contribution to both pension and health insurance. Our analysis framework is not limited to pension, though, so our empirical findings are not affected by this measurement issue. Moreover, as the mandated contribution of health insurance is much smaller than that of pension[12] in our discussion, below we refer to pension-wage ratio even though our results also reflect partially firms' spending on

[12] The employer's required contribution rate for the health insurance is 6% of the total wage, compared to the according required contribution rate of pension,

Table 2
Summary statistics.
Data source: (1) Survey of Large and Medium Enterprises by the National Bureau of Statistical (NBS) of China 2001 and 2004. (2) China Statistical Yearbook 2000.

Variables	Description	Mean/Std
Pension-wage ratio	Pension contribution of a firm divided by its total wage bill	5.71%/11.25%
Ln(wage), 2001	Logarithmic of total wage bill in 2001	6.88/1.33
Ln(compensation)	Logarithmic of total compensation	6.74/1.20
Higher education ratio	Ratio of employees with bachelor degree or above in a firm's total employment	2.91%/7.67%
IV	Multiplying 4-digit industry level average higher education ratio and province level number of universities in 1998	2.00/1.91
Ln(employment)	Logarithmic of number of employment	4.71/1.13
Union ratio	Ratio of employees in the union	0.25/0.32
Profitability	Whether one firm reports positive profit or not. It is 1 if firm is making positive profit and 0 otherwise.	0.78/0.41

Note: (1) The sample includes only domestic SOEs and private enterprises. (2) "Ln(wage), 2001" is larger than "Ln(compensation)" because "Ln(wage), 2001" is the average value based on the balanced sample in both 2001 and 2004, while "Ln(compensation)" is the average value in 2004.

health insurance.

A more challenging measurement issue is that local government could use different wage base to calculate the mandated pension ratio. Our data report the total wage bill of each firm, which include base wage and bonus. As the central government did not make it explicit whether the total wage bill or only base wage is used to calculate the pension-wage ratio for the purpose of the mandate, our empirical estimate could be misleading if (1) only base wage is used to calculate the pension-wage ratio, and (2) firms endogenously choose their bonus-wage structure. For example, if firms with more educated workers have systematically smaller share of bonus in total wage bill, then this introduces a positive relationship between education and the share of pension in total wage bill. To address this issue, we shall conduct a robustness check, replacing the pension-wage ratio in our regressions by an indicator that is zero if a firm does not contribute to pension fund at all, and is one otherwise. Using this indicator as dependent variable can avoid the issue of endogenous denominator in pension-wage ratio, and thus provide a robustness check of whether our findings using pension-wage ratio as dependent variable is driven by mismeasurement.

The first two columns of Table 1 summarize province-level average pension-wage ratio for domestic private enterprises and SOEs, respectively. The national average of pension-wage ratio for domestic private firms is 3.80%, well below the required ratio of 20%. In contrast, the pension-wage ratio for SOEs is 16.45%. Before the regulation of 2003, the private employers have the freedom of contributing to pension or not, since it is not compulsory for private firms to make contributions to pension in 2002.

5.2. Measurement issue 2: wage

To estimate model (9), we also use the industrial data in 2001 to estimate the wage return to education before the pension reform of 2002. A problem with the 2001 data is that the education level of workers is not available. To address this issue, we match the same firms in the 2001 and 2004 data, and then use the education level in the 2004 as the proxy of education level in the 2001 sample. As some firms that were in 2001 data were absent from the 2004 sample, our sample size of 2001 decreased from 171,226 to 86,219 after merging the education information. This introduces two empirical issues. One is sample selection, as firms that were in the 2001 sample but exit the 2004 sample may be affected by factors that change the wage return to education, such as lower productivity. To address this issue, we apply the Heckit method to address the sample selection issue. Another problem is that using the 2004 education to approximate that of 2001 introduces measurement errors, which can bias the estimates. Moreover, education level in 2004 may be affected by the wage level in 2001: a firm with higher wage in 2001 may raise the education level of the firm by 2004. To address both the measurement errors and reverse causation biases, we shall apply the same IV as we use for the pension regression (Eq. (13)).

5.3. Measurement issue 3: education

Our key variable in the regression is the education level of employees, measured by the firm-level higher education ratio. It is calculated as the number of employees with bachelor degree or above divided by the total number of employees of a firm. Columns (3) and (4) of Table 1 report the average higher education ratio of private and State-owned manufacturers, respectively, for each province of China. The education level is much higher in SOEs, 4.86%, while in private firms this ratio is only 2.56%. To provide a preliminary assessment of the relationship between pension contribution and education level, in Fig. 1, we plot the average pension-wage ratio against higher education ratio. It shows a positive relationship between the two variables for private firms rather in SOEs.

Our instrumental variable is constructed by multiplying 4-digit industry level average higher education ratio and province level number of universities. We use the number of universities in 1998 (column (5) in Table 1), as reported by National Statistics Yearbook. The number of university is much larger in more developed regions than less developed regions. The obtained IV is highly

(*footnote continued*)
around 20%. This regulation was issued in 1998 December 14 by the State Council by "The State Council's Decision of Building the Basic Health Insurance for Urban Employees".

Table 3
Baseline regression results.

Estimation	(1)	(2)	(3)	(4)	(5)
	OLS	Tobit	Tobit	IV-Tobit	IV-Tobit
Dependent variable: pension-wage ratio	Private firms	Private firms	Private firms	Private firms	SOEs
Higher education ratio	0.069***	0.055***	0.055***	1.363***	0.236*
	(0.004)	(0.002)	(0.002)	(0.064)	(0.152)
Ln(employment)	0.002***	0.004***	0.004***	0.038***	0.081***
	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)
Union ratio			− 0.000**		
			(0.000)		
Profitability			0.001***		
			(0.001)		
Constant	0.008**	− 0.112***	− 0.114***	− 0.122***	− 0.106***
	(0.003)	(0.009)	(0.009)	(0.007)	(0.025)
Observations	109,256	109,256	109,256	109,256	16,048
R-squared	0.141	0.408	0.306	0.245	0.215

Note: (1) All regressions control for industry and prefecture fixed effects.
(2) The coefficients reported in Columns (2), (3), (4) and (5) are marginal effects, which are obtained after Tobit or IV-Tobit regression.
(3) Robust standard errors clustered at industry-province in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

correlated with firm-level higher education ratio. The raw correlation is 0.40.

Table 2 summarizes the description and key statistics of all variables in our regressions. The average level of pension-wage ratio is 5.71% in the sample. The log wage in 2001 and log total compensation in 2004 are 6.88 and 6.74. The average higher education ratio is 2.91% in the whole sample. The log of total employment is 4.71. The average rate of union number in the total employment is 0.25. Variable "Profitability" indicates whether a firm is profitable. It is equal to 1 if the firm is making positive profit, and 0 if the firm's profit is 0 or negative. Its mean is 0.78. Finally, the instrument we use for education is the product of the average higher education ratio at 4-digit industry level and the number of universities at province level, and its mean value is 2.

6. Empirical findings

We first estimate models (7), (9), and (10) for the effects of education on pension, wage, and total compensation. With the estimated key parameters, we then assess the significance of alternative channels of the education effect through measures (8), (11), and (12). All regressions control for industry-specific and prefecture-specific fixed effects. Huber-White standard errors with clustering at industry-province level are reported for all the regressions.

6.1. Effect on pension-wage ratio

We first consider a parsimonious specification of model (7), in which we include log employment, as well as industry and prefecture fixed effects. The estimated coefficient of education ratio is 0.069 and highly statistically significant (Table 3, column 1). This suggests that increasing the share of workers with bachelor degree or above by 1 percentage point is associated with 0.069 percentage point increase in pension-wage ratio. Moreover, we also find that firms with more workers increases pension provision, possibly because the larger body of workers increases their bargaining power, or because enterprises with more workers are more prone for government monitoring for compliance.

A major issue with the OLS regression is that a large share of dependent variable is zero, which may bias the estimates due to mis-specification. To address this concern, we re-estimate the model with Tobit approach (Table 3, column 2). The marginal effect of higher education ratio is 0.055, which is similar as the estimate in OLS model, and remains highly significant. Given the large bias of the linear specification, in the remaining regressions in Table 3 we shall apply Tobit model.

In column (3) of Table 3, we conduct sensitivity checks by adding other control variables that may also affect the pension contribution of firms, including an indicator of whether a firm is profitable and the share of employees in who are union members. Adding the control variables has little effect on the effect of education. The coefficients of the control variables are all significant and have expected signs. Specifically, more profitable firms are likely to comply better as they show higher pension-wage ratio. Moreover, pension-wage ratio decreases in union rates, since the existence of union is more likely to increase more wage than pension. As adding control variables have little effect on the estimate of the education effects, in the following regressions we only report estimates of the parsimonious specification.

As discussed in the methodology section, a key issue with the cross-sectional regressions above is the potential endogeneity in the education level of workers, which may bias its coefficient estimate. To address this issue, we apply IV-Tobit approach. As discussed in

Table 4
Regression results with pension contribution indicator as dependent variable.

Estimation	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
Dependent variable: dummy of whether providing pension	Private firms	Private firms	Private firms	SOE
Higher education ratio	0.645***	0.633***	1.456***	0.229***
	(0.025)	(0.025)	(0.076)	(0.192)
Ln(employment)	0.065***	0.056***	0.061***	0.071***
	(0.002)	(0.002)	(0.002)	(0.003)
Union ratio		0.207***	0.204***	0.247***
		(0.007)	(0.005)	(0.011)
Profitability		0.024***	0.026***	0.041***
		(0.004)	(0.004)	(0.007)
Constant	− 0.020	− 0.031	− 0.141***	0.199***
	(0.026)	(0.026)	(0.020)	(0.029)
Observations	110,782	110,782	110,782	17,306
R-squared	0.197	0.211	0.199	0.150

Note: (1) All regressions control for industry and prefecture fixed effects.
(2) Robust standard errors clustered at industry-province in parentheses.
*** p < 0.01.
** p < 0.05.
* p < 0.1.

Section 4.2, our IV is the product of industry-specific human capital intensity and the number of province-level universities. The first-stage regression confirms that the IV is highly relevant to their corresponding independent variables: when the IV increases by 1% (e.g. the number of universities increases by 1%), the actual education ratio of a firm increases by 0.031 percentage point.[13]

In the second stage regression, the marginal effect of IV-Tobit estimation of education is 1.363, which is highly statistically significant and the magnitude is larger than the OLS estimate (column 4 of Table 3). This suggests that the endogeneity in education actually bias the estimate towards zero, which is consistent with a classical measurement error bias. Hausman test implies that the instrumental variable estimation is statistically different from the OLS results.

As an additional identification check, we next apply the same model (7) to SOEs. As discussed in Section 3.2, SOEs are not directly affected by the recent round of pension reform, which target non-SOEs. Hence, SOEs can be considered a control group. If our estimates for the private firms are spurious and reflect the effects of unobserved heterogeneity, such as unobserved local government quality, we should also see similar pattern in the regressions for SOEs. This does not appear to be the case. In contrast to the finding for private firms, the effect of education on pension is highly insignificant for SOEs (last column of Table 3).

As discussed, the regression results with pension-wage ratio as dependent variable would be misleading if the bonus share of total wage bill is also affected by education. To show that the effect of education on pension contribution is not spurious, we conduct additional regressions with the dependent variable replaced by an indicator of whether a firm contributes to the pension fund (Table 4). Similar to previous regressions, we find that the effect of education on the pension contribution of private enterprises to be highly significant for both OLS and IV regressions (the effect is more significant for IV estimates). Moreover, we do not find significant education-pension linkage for SOEs.

Taken together, our empirical results provide suggestive evidence that education might raise the pension contribution of firms. Specifically, increasing the higher education (bachelor and above) ratio by 1 percentage point can increase the pension-wage ratio of a firm by 1.363 percentage point.

6.2. *Effect on wage*

To provide a more intuitive measure of the magnitude of the education-pension linkage, we shall compare it with the wage return to education based on formula (8). We first estimate the wage return to higher education before the pension reform with a parsimonious OLS model, which include the higher education ratio, log employment, as well as industry-specific and prefecture-specific fixed effects. As expected, the estimated effect of education on wage is highly significant: the total wage bill would increase by 0.853% if the higher education ratio of employees increased by 1 percentage point (Column 1 of Table 5).

As we use higher education ratio, but do not observe the years of schooling of the workers, we cannot directly convert the estimate to typically wage return to school. Nevertheless, to provide a rough idea about the magnitude of the wage return to schooling, we can do the following back-of-envelope calculation. Suppose that the higher education workers on average spend six more years in schools than the rest of workers, then increasing the higher education ratio by 1 percentage point is equivalent to raise the average years of schooling of all workers by 6 percentage points.[14] As this would increase total wage bill of the firm by 0.853% according to our estimate, it suggests that each year of

[13] The weak instrument, Kleibergen-Paap rk Wald F statistic is 8529 which rejects the null hypothesis of weak instrument. Moreover, the underidentification test (Kleibergen-Paap rk LM statistic) is 7944, also rejects the null, implying full rank and identification.

Table 5
Regression results on wage in 2001 for private firms.

Estimation	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
Dependent variable Ln(wage), 2001				
Higher education ratio	0.853***	0.828***	1.449*	1.434***
	(0.120)	(0.119)	(0.767)	(0.760)
Ln(employment)	0.675***	0.675***	0.675***	0.675***
	(0.008)	(0.008)	(0.008)	(0.008)
Union ratio		0.196***		0.195***
		(0.017)		(0.017)
Profitability		− 0.153***		− 0.154***
		(0.015)		(0.015)
Constant	3.766***	3.848***	3.729***	3.810***
	(0.102)	(0.103)	(0.113)	(0.112)
Observations	22,905	22,905	22,905	22,905
R-squared	0.519	0.529	0.519	0.528

Note: (1) All regressions control for industry and prefecture fixed effects.
(2) Robust standard errors clustered at industry-province in parentheses.
*** p < 0.01.
** p < 0.05.
* p < 0.1.

school will increase wage bill by 0.853%/6%, or 14.2%. This appears to be within the ranges of estimates by more rigorous estimates of wage return to education in China, such as the estimated return to wage as 7% in Heckman and Li (2004).

We then augment the regression model by adding a series of control variables (Column 2 of Table 5). This has little effect on the coefficient of the higher education ratio. The coefficient estimates of the control variables suggest that workers in firms with stronger union are more likely to have higher wage. Moreover, the effect of profit dummy is negatively associated with the wage of workers, which may suggest that higher labor costs reduce the competitiveness of firms.

To check the effect of potential endogeneity in education, we follow the previous section to use the predicted education level as the IV. The estimates with and without control variables are again very similar and they are significantly higher than the OLS estimates (columns 3 and 4 in Table 5). Take the estimate without control variable for example. The IV estimate of education effect on wage is 1.449, which is about 75% higher than the OLS estimate. Applying the same back-of-envelope calculation above, the IV estimate suggests that each additional year of schooling can increase the wage by around 24%.

6.3. Effect on the pension cost of firms

With the estimated wage return to higher education ratio, we can now apply Eq. (8) to gauge the relative importance of the effect of education on employee pension through raising the pension-wage ratio:

$$\frac{\alpha_1}{\beta_1} = \frac{1.363}{1.449} = 0.94\%$$

Hence, from the viewpoint of employers, without wage-pension substitution, the cost premium of year of schooling would increase by 0.94%.

In reality, firms can reduce its pension burden by substituting wage for pension. According to Eq. (11), we can estimate the net effect of education on the pension costs of firms, accounting for the wage-pension substitution. For this purpose, we need to estimate the effect of education on total compensation (model 10), which replaces the dependent variable of the wage regression by the log of the sum of wage and pension contribution at the firm level. Columns 1 and 2 of Table 6 report the estimation results with parsimonious and full specifications. The estimated education effect on total compensation is 1.588 (the parsimonious specification). According to Eq. (11), the net effect of education on the pension costs of firms is (1.588 − 1.449) / 1.588, or an increase of 8.75% from the compensation package before the reform. This is significantly lower than the cost when there is no pension-wage substitution, implying that firms in China did reduce wage for workers when they are mandated to contribute to pension.

To provide a rough gauge of the magnitude of this pension-wage substitution, we assume that the effect of education on pension-wage substitution is negative. In other words, better education workforce can prevent employers from reducing wage when mandated to contribute to pension. Based on Eq. (12) and our estimation result, we can impute that the pension-wage substitution rate for private enterprises in our sample is > 0.90, which is larger than the estimates available for China (Nielsen & Smyth, 2008; Li & Wu,

[14] Suppose the share of higher education workers in a firm is v, the average years of schooling for low-education workers is s, and the average years of schooling for higher education workers is $s + 6$, then the average years of schooling for the firm is $(1 - v)s + v(s + 6)$. When v increases by 1 percentage point, average years of schooling increases by 0.06.

Table 6
Regression results on total compensation for private firms.

Estimation	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
Dependent variable: Ln(compensation)				
Higher education ratio	0.947***	0.949***	1.588***	1.571***
	(0.037)	(0.037)***	(0.188)	(0.187)
Ln(employment)	0.889***	0.889***	0.892***	0.892***
	(0.003)	(0.003)	(0.003)	(0.003)
Union ratio		0.000***		0.000***
		(0.000)		(0.000)
Profitability		0.041***		0.042***
		(0.005)		(0.005)
Constant	3.116***	3.082***	3.040***	3.007***
	(0.040)	(0.040)	(0.046)	(0.046)
Observations	111,493	111,493	111,493	111,493
R-squared	0.775	0.776	0.774	0.774

Note: (1) All regressions control for industry and prefecture fixed effects.
(2) Robust standard errors clustered at industry-province in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

2013), but is comparable to the estimate in the literature (Gunderson et al., 1992; Olson, 2002; Woodbury, 1983).[15]

7. Conclusion

This study provides new evidence on the benefits of education via a case of pension reform in China. We find that increasing the education level of employees is positively associated with better enforcement of the pension reform. To shed light on causality, we further show evidence suggesting that this positive association between compliance and education may not be driven by firm size, measure errors, or reverse causation. Although endogeneity issue cannot be completely ruled out, the evidence presented is indicative of the effect of education on the enforcement of the pension policy.

The estimates suggest economically sizable effects. Specifically, we find that increasing the higher education ratio (bachelor and above) by 1 percentage point can raise the pension-wage ratio by 1.363 percentage point. This effect is non-trivial. Accounting for the fact that firms can partially offset the pension costs by cutting the wage of workers, the pension reform could have increased the education premium of employees by 8.75%. Moreover, our estimates also imply that the pension-wage substitution rate of private enterprises of China is about 0.90.

Our findings support investment in education in developing economies, where weak enforcement of policies is common. In China, the college expansion program since 1998 has significantly lowered the threshold for obtaining college education, and college graduates increase 1.81 times between 1999 and 2004.[16] This college expansion program has been heavily criticized and a major argument was that the production structure of the Chinese economy does not require a large amount of higher education workers. This study provides an alternative view, as access to higher education could promote social development through various channels, in our case better enforcement of welfare programs.

References

Bratti, M., Checchi, D., & Blasio, G. D. (2008). Does the expansion of higher education increase the equality of educational opportunities? Evidence from Italy. LABOUR, special issue. *The evolution of labour market inequalities. 22, Issue Supplement s1. The evolution of labour market inequalities* (pp. 53–88).
Cai, H., & Liu, Q. (2009). Competition and corporate tax avoidance: Evidence from Chinese industrial firms. *The Economic Journal, 119*, 764–795.
Chen, B., & Wu, M. (2014). Industrial agglomeration and employer compliance with social security contribution: Evidence from China. *Journal of Regional Science, 54*(4), 586–605.
Feldstein, M. (1999). Social security pension reform in China. *China Economic Review, 10*, 99–107.
Gruber, J., & Krueger, A. B. (1991). The incidence of mandated employer-provided insurance: Lessons from workers. *Compensation insurance, NBER chapters in tax policy and the economy. 5. Compensation insurance, NBER chapters in tax policy and the economy* (pp. 111–144). National Bureau of Economic Research, Inc.
Gunderson, M., Hyatt, D., & Pesando, J. E. (1992). Wage-pension trade-offs in collective agreements. *Industrial and Labor Relations Review, 46*(1), 146–160.
Heckman, J., & Li, X. (2004). Selection bias, comparative advantage and heterogeneous returns to education: Evidence from China in 2000. *Pacific Economic Review, 9*(3), 155–171.
Jia, H. (2017). An evaluation of pension differentials between Chinese private and public sector from perspective of protection and incentives over the lifecycle. *China Economic Review, 44*, 16–29.
Knuuti, J. (2009). *Pension contribution level in Switzerland. 2009*, Finnish Center for Pensions Reviews9.

[15] According to our estimates, we assume α_1 as1.363, β_1 as 1.449, χ_1 as 1.588.
[16] China statistical yearbook in 2005 and 2000.

Li, Z., & Wu, M. (2013). Estimating the incidences of the recent pension reform in China: Evidence from 100,000 manufacturers. *Contemporary Economic Policy, 31*(2), 332–344.
Montgomery, E., Shaw, K., & Benedict, M. E. (1992). Pensions and wages: An hedonic price theory approach. *International Economic Review, 3*, 111–128.
Naughton, B. (1995). *Growing out of the plan.* New York: Cambridge University Press.
Nielsen, I., & Smyth, R. (2008). Who bears the burden of employer compliance with social security contributions? Evidence from Chinese firm level data. *China Economic Review, 19*, 230–244.
Ning, M., Gong, J., Zheng, X., & Zhuang, J. (2016). Does new rural pension scheme decrease elderly labor supply? Evidence from CHARLS. *China Economic Review, 41*, 315–330.
Oksanen, H. (2010). The Chinese pension system: First results on assessing the reform options. Directorate-General for Economic and Financial Affairs, European Commission. *Economic Papers, 412*.
Olson, C. A. (2002). Do workers accept lower wages in exchange for health benefits? *Journal of Labor Economics, 20*, S91–S114.
Royalty, A. B. (2000). Tax preferences for fringe benefits and workers' eligibility for employer health insurance. *Journal of Public Economics, 75*, 209–227.
Smith, R. (1981). Compensating differentials for pensions and underfunding in the public sector. *The Review of Economics and Statistics, 63*, 463–467.
Song, Z., Kjetil, S., & Fabrizio, Z. (2012). Growing like China. *American Economic Review, 101*(1), 196–233.
Wang, L., Béland, D., & Zhang, S. (2014). Pension fairness in China. *China Economic Review, 28*, 25–36.
Woodbury, S. A. (1983). Substitution between wage and nonwage benefits. *The American Economic Review, 73*, 166–182.