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INDUSTRIAL AGGLOMERATION AND EMPLOYER COMPLIANCE WITH SOCIAL SECURITY CONTRIBUTION: EVIDENCE FROM CHINA*

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ABSTRACT. This paper, by using annual surveys of Chinese manufacturing firms from 2001 to 2007, investigates the relationship between industrial agglomeration and employer compliance with required pension contributions. The result of panel fixed-effect estimation shows that in the more agglomerated industrial areas, firms comply with pension mandates at a higher level. Our finding is robust to various specifications and estimations employing instrumental variables.

1. INTRODUCTION

China reformed its social security system during the late-1990s, extending the coverage of the pension system to both the state-owned enterprises (SOEs) and non-SOEs in China. Employers were instructed to contribute an amount equivalent of 20 percent of their total wage bills to pension funds.[1] However, according to Nielsen and Smyth (2008, p. 231), "employer compliance with social security obligations cannot be assumed in transitional economies such as China, where monitoring and enforcement is weak." As Nyland, Smyth, and Zhu (2006) reported, in Shanghai, 71 percent of employers paid less than their mandated pension contributions in 2001. Moreover, a noticeable feature of this ongoing pension reform is that the average level of firms' compliance with mandated pension contribution is not only low but also uneven across regions. For instance, the contribution rate (as a share of wage) is 9.8 percent in Shanghai and is merely 6.1 percent in Guangdong province in 2001, although both are the most developed regions of China (see Figure 1 for average contribution rates by provinces).

On the other hand, as documented by Bai et al. (2004) and Lu and Tao (2009), China was experiencing an increasing trend of industrial agglomeration in the 1990s and the early-2000s. This significant change of economic environment, together with the fact that employer compliance with mandated pension contribution varies across regions, prompts us to explore the relationship between industrial agglomeration and

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[1]This was first proposed in State Council Document No. 26 (1997) and regulated in "The Notice of Adjusting the Contribution Rate to Basic Pension Fund for Firms" issued in 2003 by the Ministry of Labor and Social Security and Ministry of Finance.

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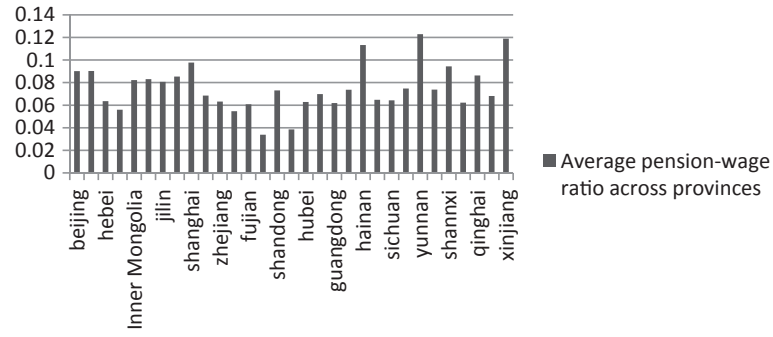

FIGURE 1: Average Pension–Wage Ratio across Provinces.

firms' pension contributions. So the goal of this study is to empirically estimate this linkage.

In order to examine the relationship between employer-provided pension and industrial agglomeration, this paper uses annual surveys of Chinese manufacturing firms from 2001 to 2007. This data set, which is compiled by the National Bureau of Statistics of China (NBSC), covers the universe of medium and large manufactures (around 190,000 each year) of China. Our empirical tests employ the full sample, including about 40 percent of firms that make zero pension payments. The findings can be summarized as follows.

First, by using panel fixed-effect estimation, our empirical results support the positive and significant correlation between industrial agglomeration and firm's pension contribution. In particular, as the firm's neighboring employment within the same city and the same four-digit industry increases by 1 percent, we find that (1) the likelihood of contributing a positive amount of pensions increases by 0.014, or that (2) the ratio of pension payments over wage bills increases by 0.025, or that (3) firm's pension contribution per employee increases by 0.009 percent (given that the firm does make positive pension payments). For a robustness check, we replace the original measure of industrial agglomeration with the model-based index of geographic concentration constructed by Ellison and Glaeser (1997), and also find positive and significant correlation between industrial agglomeration and firm's pension contributions.

Second, we investigate whether industrial agglomeration has a causal effect on the firms' contribution of pension by using instrumental variable estimation. This method intends to deal with the potential problems of omitted variables, measurement errors, reverse causality, etc. Specifically, we use both the cross-city population of China in 1986 and the number of manufacturing firms that were established before 1978 (in the same city and the same industry) to instrument China's industrial agglomeration from 2001 to 2007. The two-stage-least-squares (2SLS) of pooled data and the panel instrumental variable estimation substantiate our early findings, showing that industrial agglomeration leads firms to be more willing to contribute pension. Moreover, the effect is much stronger than what is captured by the panel fixed-effect estimate. It implies that endogeneity problems may cause the estimated coefficient to be biased downward. Finally, we perform the over-identification test, with the result suggesting that the instrumental variables that were used in our estimations are valid.

The remainder of this paper is structured as follows. Section 2 describes how the Chinese pension system operates. Section 3 elaborates how industrial agglomeration affects firms' pension contribution. Section 4 summarizes the related literature. Section 5

introduces data used in our analysis. Section 6 presents the empirical model and empirical results. Section 7 reports the robustness checks. Section 8 concludes.

2. CHINESE PENSION REFORM

From the 1950s to the early-1990s, China maintained a Soviet-type pension system, which only covered the employees of SOEs. With the structural economic transition since 1978, the SOE-based pension provision became an obstacle to SOE reform and labor mobility (Naughton, 1995; Feldstein, 1999). The first wave of large-scale pension reform was initiated in 1995, and two proposals were raised for pension reform in 1997.[2] This reform was limited to SOEs, and there were no strict regulations for the pension provision in non-state-owned firms. The second wave of pension reform formally started in 2003, extending the coverage of the pension system to non-SOEs. Moreover, the mandated contribution ratios were also unified across China. In particular, all employers, no matter SOEs or non-SOEs, were required to contribute pension funds equivalent to 20 percent of their wage bills, while employees should contribute 8 percent of their wages to their own individual accounts. The 2003 reform made rapid progress for the first several years. In 2005, the total urban pension funds increased by 19.6 percent, reaching 509.3 billion yuan. By 2011, the total pension funds reached 1,690 billion yuan.[3]

The progress of the reform, however, varied remarkably across regions. As reported by Oksanen (2010), regions with stronger local governments may have faster progress, because their better financial situations enhance the enforcement of pension reform. Moreover, Nielsen and Smyth (2008) indicate that there is little incentive for employers to comply with the pension mandates because of the difficulty to transfer the burden to employees or consumers. According to Li and Wu (2013), raising the pension contribution by 1 percent would reduce firms' profit by 1.46 percent. Hence, the progress of the reform depends on idiosyncratic factors that can defy employers' reluctance and push the reform forward.

We emphasize the following features that are relevant to this study. First, employers are the major contributors to the pension fund in China. Second, although the mandated contribution rate is similar across China, the effective contribution rates vary greatly across regions. Third, similar to the regulation in other countries, paying fringe benefits, such as pension and medical insurance, has a tax advantage over paying wages in China, because the former are exempted from personal income tax.[4] Accordingly, the fringe benefits are comparable to wages and account for a sizable share in the employee's compensation package.[5]

3. INDUSTRIAL AGGLOMERATION AND FIRMS' PENSION CONTRIBUTIONS

We pay particular attention to the impacts of agglomeration economics on the firms' pension contributions, for two reasons. First, by following Marshall (1920), a large literature provides the careful analysis of agglomeration economics, arguing that agglomeration

[2]Two proposals on the pension contribution years, contribution rates, and related arrangements were raised for the combination of basic pension account and the individual account.

[3]Source: The statistics of the "Ministry of Human Resources and Social Security of the People's Republic of China." Website: http://www.mohrss.gov.cn/

[4]The deduction policy has changed over time but it is generally the case that the mandated contribution to fringe benefits is exempted from personal income tax.

[5]According to Nielsen and Smyth (2008, p. 230), "in many cities in China non-salary costs to employers are equivalent to 40-50 percent of an employee's salary."

improves efficiency by allowing for labor market pooling, input sharing, and technological spillover.[6] The positive agglomerated externalities can enhance the marginal productivity of labor. Moreover, the more firms there are in the same area, the greater the competition is to obtain workers. Consequently, the worker with similar skill may be better compensated in the more agglomerated industrial areas. Given that pension contribution is tax-deductible and the income tax schedule is progressive in China, employers may find that using pensions is more attractive than using wages to compensate workers. Therefore, employers in the more agglomerated industrial areas may possess a higher motive of contributing to pensions.

Second, we also emphasize a mechanism that underlies the compliance of employers. From the localization of firms emerges labor market pooling. A large population of skilled laborers enter the area and are able to exchange knowledge, ideas, and information. In the more agglomerated industrial areas, employees might be more knowledgeable of evolving pension policies, and also have higher mobility (Freedman, 2008). Therefore, they may enjoy stronger bargaining powers when securing the pension and medical insurance from their employer. This explains that industrial agglomeration can result in a higher level of employer compliance with pension mandates.

In summary, we propose the main hypothesis as follows: *Employers in the more agglomerated industrial areas comply with the mandated pension contribution at a higher level*.

4. RELATED LITERATURE

This paper is related to the empirical works that examine how agglomeration affects wages and the regional income levels.[7] Most of the findings support the viewpoint that industrial agglomeration has positive and significant impacts on employee wages. For example, Melo, Graham, and Noland (2009) find that doubling labor market's employment density can raise hourly earnings by nearly 1 percent, while halving the distances to other markets produces an increase of hourly wages of nearly 3 percent. Using data in the United States, Glaeser and Mare (2001) report a substantial wage premium in larger cities. Wheaton and Lewis (2002) further interpret the wage premium as the evidence of agglomeration economies in urban labor market, because they observe that equivalent workers earn higher wages in labor markets that have a larger share of national or metropolitan employment in the same occupation and industry groups. Moreover, Freedman (2008) investigates the implications of agglomeration for labor mobility and earnings dynamics in the software publishing industry. As shown in his paper, industrial clustering improves labor mobility and raises workers' earnings, because agglomeration improves labor market coordination and facilitates human capital formation.

However, the positive impacts of agglomeration economics on employee's compensation go beyond the gain in wages. In this study, we show that industrial agglomeration

[6]Although bad outcomes of agglomeration are often stressed, even cautious econometric approaches all conclude to a positive impact of the size of the local economy on local productivity (see, e.g., Ciccone and Hall, 1996). It implies that more agglomeration, that is, larger cities, would improve efficiency. Combes, Démurger, and Li (2012) also find the existence of agglomeration economics in China.

[7]Two methods, which are based on Krugman's (1991) well-known New Economic Geography (NEG) model, are widely used in the according empirical test: the market-potential method (Brakman et al., 2006; Hanson, 2005) and the market-access method (Redding and Venables, 2004). Recent papers have suggested that models deriving from urban economics may provide a better explanation of spatial variation in wage levels over short distances than NEG wage equation (Combes, Duranton, and Overman, 2005; Brakman, Garretsen, and Van Marrewijk, 2009; Fingleton, 2011).

improves employer compliance with required pension contribution. Importantly, given that the implementation of pension mandate rules is pretty weak in China (Nielsen and Smyth, 2008), the increase in pensions that is resulted from industrial agglomeration can be as sizable as the gain in wages.

Besides investigating the linkage between agglomeration and firms' pension contribution, another contribution of our study is to provide an alternative explanation of the interregional or interindustry variation in the employer compliance with pension requirements in China. A few extant studies investigate the dispersion of firms' compliance rates. Oksanen (2010) argues that different capacities to enforce the pension reform, which are further reliant on the financial positions of local governments, give rise to variation of firms' compliance rates across regions. Li and Wu (2013) find that different intensity of competition among firms is another source of compliance dispersion across regions and industries. To our knowledge, no previous studies have ever related the level of industrial agglomeration to variation of firms' pension contribution in China.

5. DATA AND DESCRIPTIVE

The data set that we use is surveys of manufacturing firms that NBSC conducted from 2001 to 2007. We exclude the data in 2003, where the information on firms' pension and medical insurance payments is missing. The data in the remaining years provide detailed information on firms' pension and medical insurance payments, wage bills, and other characteristics, such as ownership, industry, location, etc. In each year, about 190,000 firms are surveyed, covering both SOEs and non-SOEs with annual sales of 5 million yuan or above. The same data set was also used by Cai and Liu (2009), Li, Lu, and Wu (2012), Song, Storesletten, and Zilibotti (2011), Hsieh and Klenow (2009), etc.

The number of total observations in our sample is 1,178,606. Like Cai and Liu (2009), we first eliminate the firms with negative level or missing information of the key variables, such as pension and health payments, wage bills, and number of employees. Moreover, the observations with extreme values are dropped; for example, we eliminate the firms with the pension and health payments that are greater than 99th percentile. After these two steps, we obtain a sample with 1,058,073 observations. From 2001 to 2007, there are some changes in the codes of counties/cities and the codes of industry classification. To keep consistency, we convert these codes to the standard in the year of 2001.[8] Moreover, like Lu and Tao (2009), if a firm has other branches in regions out of the registration county, they are treated as separate observations.

Because the data do not distinguish firms' contributions to medical insurance from those to pensions, the policy on medical insurance is relevant to this study. The financing structure of medical insurance is similar to that of pensions: firms are mandated to pay around 6 percent of their wage bills to medical insurance, while individuals pay 2 percent of their wages.[9] To simplify our narration, we call the firm's contribution to both the pension and medical insurance as pension payments.

[8]In China, an administrative "city" is usually composed of several counties. To achieve consistency in the whole sample period (2001–2007), we transform the first six digits of location code of all firms according to the standard of year 2001 issued by the NBSC: http://www.stats.gov.cn/tjbz/xzqhdm/index.htm. The first four digits represent a city, while the first six digits represent a county. So our transformation involves the change of city code. For industry code, a new classification system of industry codes (GB/T 4754-2003) was adopted in 2003 to replace the old classification system, which was used from 1995 to 2002. To achieve consistency in the sample, we transform the industry code according to the standard of 2001.

[9]It is regulated by "The Decision of State Council in Building Basic Medical Insurance for Urban Employees" issued in 1998. About 30 percent of the amount paid by the firm was originally transferred to the individual account conditional on different circumstances in different regions. Since 2000, however,

TABLE 1: The Percentile Distribution of Pension–Wage Ratio in the Sample

Percentile	Pension–Wage Ratio
1	0
5	0
10	0
25	0
50	1.79%
75	9.40%
90	20.89%
95	29.38%
99	52.01%
Observations	1,178,606
Average pension–wage ratio	6.87%
Std. Dev.	11.27%

TABLE 2: Summary Statistics of Pension–Wage Ratio

Year	Mean	Std. Dev.	Median	Min	Max	Observations
2001	6.59%	12.48%	0.00%	0.00%	99.78%	118,794
2002	6.84%	12.51%	0.36%	0.00%	99.87%	126,787
2004	5.61%	9.50%	1.20%	0.00%	99.86%	185,406
2005	7.60%	11.72%	2.61%	0.00%	99.89%	192,415
2006	7.12%	11.18%	2.41%	0.00%	99.89%	205,650
2007	7.12%	10.79%	2.82%	0.00%	99.98%	229,021
Total	6.87%	11.27%	1.79%	0.00%	99.98%	1,058,073

To illustrate the variation of employer compliance with pension mandates, we construct a new variable that is called pension–wage ratio by using firm's pension payments to divide its wage bills. Table 1 shows the firm's average pension–wage ratio from 2001 to 2007 by percentiles for the whole sample before we delete the extreme values. Note that the distribution of pension-wage ratio is skewed to the right; in particular, around 40 percent of firms in our sample contribute zero pensions, and most of firms do not comply with the required pension–wage ratio (i.e., 20 percent). In Table 2, we report the summary statistics of the pension–wage ratio in each year after eliminating the firms with extreme values, which witness a steady increase in pension–wage ratio from 2001 to 2007.

6. EMPIRICAL RESULTS

Empirical Model

To investigate the effect of industrial agglomeration on firm's pension provision, we estimate the following Equations (1) and (2):

$$(1)\quad Pension\_Wage\_Ratio_{frit} = \alpha'_f + \beta' * Agglomeration_{frit} + \eta' * \gamma_t + \omega' * X + \epsilon'_{frit},$$

$$(2)\quad \ln Pension\_per\_Employee_{frit} = \alpha''_f + \beta'' * Agglomeration_{frit} + \eta'' * \gamma_t + \omega'' * X + \epsilon''_{frit}.$$

firm contributions have no longer been transferred to the individual account, according to the regulation entitled "The Experimental Plan for Completing the Urban Social Security System."

There are two alternative measures of firm's pension provision: (1) pension-wage ratio, which is denoted by $Pension\_Wage\_Ratio_{frit}$ and calculated by the pension payment of firm f (that belongs to industry i and is located in city r) over the wage bills in year t; (2) the logarithm of firm f's average pension payments per employee in year t, which is denoted by $\ln Pension\_per\_Employee_{frit}$.

$Agglomeration_{frit}$ measures the degree of industrial agglomeration, which is logarithm of firm f's total neighboring employment in the same four-digit industry i, the same city r, and the same year t. Specifically, the neighboring employment means the employment in the industry i, city r in year t excluding the own employment of firm f ; γ_t is the time dummy, capturing all the effects that affect firms in the same year t; α'_f and α''_f are the firm dummies, capturing all time-invariant firm characteristics; ϵ'_{frit} and ϵ''_{frit} are the error terms. Standard error is clustered at the firm level to deal with the potential heteroskedasticity problem.

X is a vector representing the set of control variables that might be other determinants of firm's pension provision. Various measures of firm's characteristics, such as firm size (*Size*), wage bills (*Wage*), firm ownership structure (*Ownership*), capital labor intensity (*Intensity*), are included in the regression. *Size* is measured by logarithm of the number of employees of firm f. *Wage* is the logarithm of firm f's wage bills. *Ownership* takes the value of 1 if the firm is SOE or collectively owned enterprise (COE), and takes the value of 0 otherwise.[10] *Intensity* is the ratio of fixed capital over the number of employees in firm f. The values of *Wage* and *Intensity* are deflated with consumer price index (CPI), and we use the CPI of the year 2000 as a benchmark.[11] The time-varying characteristics of industries and regions may also have impacts on firms' pension provision, so when estimating Equations (1) and (2), we control the competition level in each industry (*Competition*), pension policy changes (*Policy*), as well as social security enforcement (*Enforcement*). Specifically, *Competition* is measured by the Hefindahl index, which is the sum of the squares of the market shares of all firms in the same four-digit industry i in year t.[12] *Policy* is a dummy variable, which equals to 1 if the pilot program was implemented in the province where firm f is located, and equals to 0 otherwise. This pilot program aims at reforming the individual account in the social security system.[13] *Enforcement* is

[10]The measure of ownership structure that Demsetz and Lehn (1985) and other scholars use are based on the fraction of shares owned by the firm's most significant shareholders.

[11]The CPI data are collected from the China statistical yearbooks 2000–2007 that are issued by NBSC. We normalize the price level of year 2000 to be 100.

[12]Existent studies have investigated the effects of competition on firms' behaviors (see Shleifer, 2004; Cummins and Nyman, 2005; and Cai and Liu, 2009). To pursue higher profits, firms under large competition pressures are more likely to use abnormal ways, such as avoiding taxes or reducing labor costs.

[13]A nation-wide pension system with three pillars has been designed in the above social and economic background by the central government. Pillar I is based on the National Social Security Fund and includes two tiers, a social pool and an individual account. The first tier, or the social pool, is a pay-as-you-go basis that is financed by employers, who contribute 20 percent of the employee's wages to the pool. The second tier, or the individual account, is financed with 8 percent of individuals' wages. In practice, 5 percent are from the state and 3 percent from individuals' contributions. Pillar II is a voluntary contribution-based insurance financed by employers or employees while Pillar III is a voluntary private savings account. In 2000, an experiment, called "the Pilot Program for Improving Urban Security System," was proposed first in Liaoning province. According to the regulation, the transfer to the individual account in Pillar I was decreased from 11 percent to 8 percent of the employee's wage. Employers no longer made any contribution to the second tier of Pillar I, although they still contributed to the first tier. Since the beginning of 2006, the reform has been put into practice in another 10 provinces, including Jilin, Heilongjiang, Henan, Hubei, Hunan, Shandong, Shanghai, Shanxi, Tianjin, and Xinjiang. *Policy* equals to 1 for these 11 provinces, and equals to 0 otherwise.

TABLE 3: The Panel Fixed-Effect Estimation Results

Whole Sample Dependent Variables	(1) Pension–Wage Ratio	(2) Log of Pension per Employee
Agglomeration	0.025*	0.009***
	(0.013)	(0.002)
Wage	−1.231***	0.458***
	(0.021)	(0.004)
Size	0.315***	−0.814***
	(0.028)	(0.005)
Ownership	0.355***	0.073***
	(0.057)	(0.009)
Intensity	0.002	0.001***
	(0.003)	(0.000)
Competition	−0.631	−0.066
	(0.507)	(0.074)
Policy	0.133	0.266
	(2.076)	(0.348)
Enforcement	2.683***	0.088*
	(0.308)	(0.045)
Constant	3.779***	−2.975***
	(0.675)	(0.092)
Observations	965,306	547,640
R-squared	0.043	0.223
Year Dummy	Yes	Yes
Firm Dummy	Yes	Yes
P-value of *F* test	0.000	0.000

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and * indicates the statistical significance at 10 percent level.

measured by the share of population who are covered by the social security system in year t in the province where firm f is located.

Panel fixed-effect model is used to estimate Equations (1) and (2). The advantage of this method is to control for the time-invariant and unobserved characteristics of a firm that correlate with both industrial agglomeration and pension contributions. The results are shown in Table 3. In column (1), the dependent variables is pension–wage ratio; in column (2), the dependent variable is the logarithm of pension payment per employee. In both columns, the coefficients of industrial agglomeration are positive and statistically significant. In particular, if the own industry neighboring employment increases by 1 percent, the firm's pension–wage ratio increases by 0.025 (column 1), or the firm's pension payments per employee increase by 0.009 percent given that the firm does make positive pension payments (column 2).

In Table 3, the estimated coefficients of control variables are explained as follows. First, consider the estimation results in the first column, where the dependent variable is pension–wage ratio. Firm *size* and *ownership* both have positive and significant impacts on pension–wage ratio. These results mean that if the firm has a larger workforce, or if the firm belongs to SOEs or COEs, the firm complies with the pension mandates at a higher level. The coefficient of *wage* is negative. The coefficient of capital labor intensity is negligible in magnitude and not significant. Moreover, the coefficient of *enforcement* is positive and significant, indicating that if the social security system covers a larger population in the province where the firm is located, the firm complies with the required

TABLE 4: The Probit Model Estimation Results

Sample	(1) Whole	(2) Whole
Agglomeration	0.014***	
	(0.001)	
EG index		0.028***
		(0.002)
Wage	0.485***	0.490***
	(0.002)	(0.002)
Size	−0.281***	−0.280***
	(0.003)	(0.002)
Ownership	0.093***	0.106***
	(0.004)	(0.004)
Intensity	−0.000	−0.001***
	(0.000)	(0.000)
Enforcement	0.823***	0.851***
	(0.009)	(0.009)
Policy	−0.458***	−0.450***
	(0.003)	(0.003)
Competition	0.491***	0.236***
	(0.050)	(0.039)
Constant	−0.194***	−0.100***
	(0.012)	(0.010)
Observations	965,306	1,058,066
Year dummy	Yes	Yes
Industry dummy	Yes	Yes

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and * indicates the statistical significance at 10 percent level. The dependent variable denotes whether the firm made positive pension payment or not.

pension–wage ratio at a higher level. The impacts of *competition* on the pension–wage ratio is negative, which implies that the firm, if facing fierce competition from other firms in the same industry, is less likely to comply with pension mandates (Cai and Liu, 2009).[14] Second, let us turn to the estimation results in the second column, where the dependent variable is the logarithm of a firm's pension payment per employee. Firm *size* has negative and significant impacts on pension payment per employee, while the coefficient of *wage* is positive and significant. The impacts of other control variables are much similar, and hence discussions are omitted.

To explore how industrial agglomeration affects the probability of a firm contributing pension, we use a probit model, where the dependent variable is a dummy denoting whether the firm f (that is located in industry i in city r) made positive pension payments in year t: if a zero amount is paid, the dependent variable takes the value of 0; if a positive amount is paid, it takes the value of 1. The according estimation results are shown in Table 4. In column (1), the industrial agglomeration is measured by $Agglomeration_{frit}$. We find that when the own industry neighboring employment increases by 1 percent, the probability of providing pension increases by 0.014.

[14]This result shares some similarities with Cai and Liu (2009): fierce competition leads to a low level of social responsibility.

With regard to the control variables in Table 4, firm size has a negative and significant effect on the probability of providing pension. The pilot program (*policy*) has a negative and significant impact, indicating that as the employers in those provinces are no longer required to make contributions to the second tier of Pillar I of the pension system, the probability of providing pension decreases accordingly. The coefficient of *wage* is positive and statistically significant, while the coefficient of the *competition* level proves to be positive and significant. The effects of other control variables, such as ownership, enforcement level of social security system, are similar as those found in Table 3.

Identification

The panel fixed-effect estimation in the above-mentioned section could be biased due to some reverse causality or omitted variables problem. For example, it is possible that the employers who better comply with pension mandates choose to locate in more agglomerated industrial areas. Meanwhile, employer compliance with pension contribution and industrial agglomeration could be affected by some common factors that we fail to control for.

To deal with the potential endogeneity problem, we adopt the instrumental variable (IV) approach. Two IVs are used to instrument China's industrial agglomeration from 2001 to 2007: the cross-city population of China in 1986 (*Population*) and the number of manufacturing firms that were established before 1978 in city r and four-digit industry i (*Firm number*).[15] While similar IV strategy is adopted by Li and Lu (2009) and Li et al. (2012), it is still worthwhile to clarify the following premises that validate the use of these IVs in our setting: (1) the demand of a larger population attracts more manufacturers in each industry (Krugman, 1980; Davis and Weinstein, 2003; Hansen, 2005), and given the long-term impacts of population, the distribution of population in 1986 may affect the pattern of industrial agglomeration after 2000. (2) According to Krugman (1991), the historical condition has impacts on the current situation; in particular, though the economic environment prior to 1978 was very different from that in the 2000s, a larger number of firms established before 1978 laid a better foundation for developing manufacturing industries in the particular region during the economic reform. So the historical regional distribution of firms may be correlated with the current industrial agglomeration. (3) The population in 1986 and the number of firms in the pre-1978 era do not directly affect the employer compliance with the pension mandates that were enacted in the late-1990s through channels other than current industrial agglomeration.

As these two IVs do not change with time, first, we pool the data in different years to perform the 2SLS estimation. The result is shown in columns (1) and (2) of Table 5. The first stage result, which is reported in Panel B, suggests that both IVs (i.e., *Population* and *Firm number*) have positive and significant effects on industrial agglomeration. We also note that the underidentification test yields significant results, suggesting that those IVs are highly correlated with the measure of industrial agglomeration, $Agglomeration_{frit}$. The partial F-statistics are statistically significant and greater than the critical value 10,

[15] *Population* is collected from China city yearbook 1986. The data are at administrative city level, which consist of several counties and cover both urban area and rural area. Moreover, to match with our main data set, the city code in 1986 is transformed according to the standard of 2001. The changes of the city code between 1986 and 2001 could be found in this link: http://www.gov.cn/test/2006-02/27/content_212020.htm. *Firm number* (number of firms established before 1978) is counted by using the main data set (surveys of manufacturing firms that NBSC conducted), which contains the information about the time when each firm was set up. We count the number of firms that were established in each city and each industry before 1978.

TABLE 5: The IV Estimation Results

Whole Sample Estimation	(1) 2SLS of Pooled Data	(2)	(3) Panel IV	(4)	(5) Lagged Agglomeration as IV	(6)
Dependent Variable	Pension–Wage Ratio	Log of Pension per Employee	Pension–Wage Ratio	Log of Pension per Employee	Pension–Wage Ratio	Log of Pension per Employee
Panel A: Second stage:						
Agglomeration	0.112***	1.026***	0.013***	0.704***	0.023***	0.027
	(0.012)	(0.115)	(0.004)	(0.065)	(0.009)	(0.116)
Wage	0.004***	0.807***	−0.012***	0.438***	−0.019***	0.421***
	(0.001)	(0.013)	(0.000)	(0.005)	(0.000)	(0.006)
Size	−0.021***	−1.095***	0.002***	−0.858***	0.003***	−0.882***
	(0.002)	(0.025)	(0.000)	(0.006)	(0.001)	(0.008)
Ownership	0.035***	0.420***	0.003***	0.045***	0.001	0.024
	(0.002)	(0.021)	(0.001)	(0.011)	(0.001)	(0.019)
Intensity	0.001***	0.015**	0.000	0.001**	−0.000***	0.001
	(0.000)	(0.006)	(0.000)	(0.001)	(0.000)	(0.001)
Competition	1.307***	12.601***	0.079***	4.643***	0.140**	−0.196
	(0.149)	(1.414)	(0.025)	(0.448)	(0.056)	(0.728)
Policy	0.231***	2.004***	0.013	0.998**	−0.046	
	(0.023)	(0.206)	(0.021)	(0.408)	(0.071)	
Enforcement	−0.076***	−0.167	0.019***	−0.213***	−0.121***	−2.639***
	(0.018)	(0.154)	(0.004)	(0.057)	(0.020)	(0.273)
Observations	935,216	505,324	920,739	505,324	337,557	210,260
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Firm dummy			Yes	Yes	Yes	Yes
Province dummy	Yes	Yes				
Industry dummy	Yes	Yes				

Continued

TABLE 5: Continued

Whole Sample	(1)	(2)	(3)	(4)	(5)	(6)
Estimation	2SLS of Pooled Data		Panel IV		Lagged Agglomeration as IV	
Dependent Variable	Pension–Wage Ratio	Log of Pension per Employee	Pension–Wage Ratio	Log of Pension per Employee	Pension–Wage Ratio	Log of Pension per Employee
Panel B: First stage, dependent variable is "agglomeration"						
Firm number	0.089***	0.087***				
	(0.002)	(0.002)				
Population	0.047***	0.007***				
	(0.002)	(0.002)				
Lagged agglomeration					−0.023***	−0.022***
					(0.001)	(0.002)
Hausman test	(2495.86)***	(1310.76)***	(234.06)***	(307.38)***		
Underidentification test	(2734.31)***	(1455.98)***	(827.97)***	(466.74)***	(237.90)***	(139.91)***
Partial *F*-statistics	(1371.01)***	(729.81)***	(138.17)***	(77.89)***	(238.16)***	(140.05)***
Overidentification test	(2.17)	(0.52)	(0.81)	(0.57)		

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and *indicates the statistical significance at 10 percent level. The first stage results of the panel IV estimation are omitted in columns (3) and (4) to save space.

suggesting strong IVs (Straiger and Stock, 1997). Moreover, the overidentification test (the Sargan test) is performed, which fails to reject the null hypothesis that our IVs are properly specified. Hence, *Population* and *Firm number* are valid IVs.

Panel A of Table 5 reports the second stage result. After being instrumented, $Agglomeration_{frit}$ still has a positive and statistically significant effect on pension–wage ratio and the firm's pension payment per employee. In particular, if the own industry neighboring employment increases by 1 percent, the firm's pension–wage ratio increases by 0.112 (column 1), or the firm's pension payment per employees increases by 1.026 percent (column 2).[16] With regard to the control variables, most of them have expected effects on pension provisions.

For the robustness check of IV estimation, we perform the 2SLS estimation by using data in each year, rather than using the pooled data of all the observations in all years. Hence, the corresponding results are reported in the six columns of Table 6, separately. The dependent variable is either pension–wage ratio or logarithm of a firm's pension payments per employee. The coefficients of $Agglomeration_{frit}$ are statistically significant and positive in each year, which confirms our findings in Table 5.

We can also perform the panel IV estimation. However, because *Population* and *Firm number* are time-invariant, they should enter the panel IV estimation interacted with year dummies. Similar IV strategy is employed by Li et al. (2012). The estimated results are reported in columns (3) and (4) of Table 5. The coefficients of agglomeration are still positive and significant in the second stage. If the own industry neighboring employment increases by 1 percent, the firm's pension–wage ratio increases by 0.013 (column 3), or the firm's pension payment per employee increases by 0.704 percent (column 4). The first stage results show that the IVs are positively and significantly correlated with the endogenous variable, but we don't report them in Table 5 to save space.[17]

In the last two columns of Table 5, we replace the IVs by the lagged agglomeration. Lagged agglomeration is negatively and significantly related with agglomeration in the first stage estimation. The speed of agglomeration is slower in more agglomerated regions and industries. In the second stage, agglomeration has a positive and significant effect on pension–wage ratio (column 5), while agglomeration has a positive but insignificant effect on pension payment per employee (column 6).

Note that the estimates in the IV regression are much larger than the estimates in the panel fixed-effect regression. We conjecture that the endogeneity problem causes the estimated coefficients to be biased downward (Angrist and Pischke, 2009; Hauk and Wacziarg, 2009). There are two potential sources of the endogeneity problem. First, in the panel fixed-effect estimation, there may exist omitted variables that affect the dependent variable and independent variables in opposite directions, and if it was the case, the estimates could be biased downward. For example, if the local government has poor administrative power, firms are less likely to comply with the pension contribution requirement, hence the average pension–wage ratio is lower in that city; on the other hand, given low government capacity in monitoring taxable activity, firms may find easy ways to evade taxes or commit fraud, hence a weak government may attract firms to localize

[16]Note that in each city r and four-digit industry i, there may be many observations (i.e., firms), but IVs are the city level *Population* or the city–industry level *Firm number*. In this sense, the estimated coefficients reflect the regional/industrial average effect, instead of firm-level variations.

[17]When IVs enter the panel estimation interacted with year dummies, people may have concerns on IVs, because the IVs that we use don't have many time variations across years. In particular, it may result in the weak instrument problem. However, this is not the case in our regression. As shown in the first stage results, the coefficients of IVs are highly significant, and the partial F-statistics are statistically significant and greater than the critical value 10, suggesting strong IVs (Straiger and Stock, 1997).

TABLE 6: The IV Estimation Results by Using the Data in Each Year

	(1)	(2)	(3)	(4)	(5)	(6)
Sample year	2001	2002	2004	2005	2006	2007
Dependent Variable	Pension–Wage Ratio					
			Panel A: Second stage			
Agglomeration	0.080***	0.081***	0.143**	0.156***	0.105***	0.128***
	(0.006)	(0.007)	(0.065)	(0.026)	(0.031)	(0.044)
Wage	0.001	0.003**	0.011***	0.011***	0.003	−0.005
	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.004)
Size	−0.005***	−0.007***	−0.038***	−0.032***	−0.018***	−0.016***
	(0.002)	(0.002)	(0.009)	(0.005)	(0.004)	(0.005)
Ownership	0.018***	0.023***	0.044***	0.060***	0.038***	0.046***
	(0.002)	(0.002)	(0.009)	(0.004)	(0.004)	(0.007)
Intensity	0.001***	0.001**	0.003***	0.001	0.001**	0.002***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Competition	0.761***	0.859***	2.858**	1.618***	1.236***	1.487***
	(0.067)	(0.080)	(1.296)	(0.278)	(0.366)	(0.491)
Policy	0.113***	0.119***	0.250***	0.241***	0.180***	0.166***
	(0.016)	(0.014)	(0.096)	(0.037)	(0.042)	(0.049)
Enforcement	−0.200***	−0.321***	−0.692**	−0.432***	−0.428***	−0.554***
	(0.052)	(0.074)	(0.345)	(0.112)	(0.156)	(0.215)
Observations	97,473	107,016	158,730	180,029	182,912	209,056
Year dummy	YES	YES	YES	YES	YES	YES
Province dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
			Panel B: First stage			
Firm number	0.108***	0.100***	0.043***	0.067***	0.055***	0.053***
	(0.007)	(0.006)	(0.007)	(0.005)	(0.005)	(0.005)
Population	0.092***	0.091***	0.025	0.058***	0.055***	0.045**
	(0.017)	(0.016)	(0.022)	(0.019)	(0.021)	(0.021)
Underidentification test	(204.22)***	(150.40)***	(10.00)**	(66.09)***	(17.78)***	(15.07)***
Partial *F*-statistics	(590.40)***	(522.06)***	(35.45)***	(233.82)***	(122.49)***	(96.98)***
Overidentification test	(2.76)	(2.29)	(0.02)	(1.33)	(2.40)	(0.34)
Dependent Variable	Log of Pension Per Employee					
			Panel A: Second stage			
Agglomeration	0.762***	0.794***	0.939***	1.552***	2.104***	1.425***
	(0.073)	(0.092)	(0.343)	(0.21 0)	(0.715)	(0.398)
Wage	0.705***	0.745***	0.908***	0.863***	0.725***	0.710***
	(0.019)	(0.017)	(0.020)	(0.029)	(0.067)	(0.033)
Size	−0.880***	−0.933***	−1.292***	−1.209***	−1.203***	−1.055***
	(0.025)	(0.024)	(0.064)	(0.047)	(0.093)	(0.060)
Ownership	0.264***	0.320***	0.451***	0.615***	0.449***	0.515***
	(0.023)	(0.022)	(0.053)	(0.046)	(0.078)	(0.077)
Intensity	0.032***	0.041***	0.044***	0.008	0.011	0.037***
	(0.012)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)
Competition	7.808***	8.846***	19.036***	16.078***	26.334***	17.055***
	(0.830)	(1.080)	(6.693)	(2.303)	(8.738)	(4.665)
Policy	0.841***	0.887***	1.506***	2.097***	3.002***	1.634***
	(0.183)	(0.169)	(0.490)	(0.299)	(0.920)	(0.429)

Continued

TABLE 6: Continued

Sample year	(1) 2001	(2) 2002	(3) 2004	(4) 2005	(5) 2006	(6) 2007
Enforcement	−1.322*	−2.240**	−3.924**	−3.929***	−9.862***	−6.401***
	(0.680)	(0.938)	(1.767)	(1.017)	(3.517)	(1.999)
Observations	37,123	46,183	83,240	104,861	105,411	128,502
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Province dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: First stage						
Firm number	0.1068***	0.103***	0.045***	0.071***	0.054***	0.052***
	(0.008)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)
Population	0.061***	0.057***	0.001	0.011	0.023	0.005
	(0.019)	(0.018)	(0.023)	(0.021)	(0.023)	(0.024)
Underidentification test	(107.19)***	(80.57)***	(10.00)**	(50.98)***	(10.00)**	(10.00)**
Partial F-statistics	(303.18)***	(289.37)***	(15.68)***	(114.92)***	(40.46)***	(26.73)***
Overidentification test	(1.77)	(0.59)	(4.17)	(4.55)	(2.39)	(1.94)

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and * indicates the statistical significance at 10 percent level.

and increase the level of agglomeration due to a lower level of real tax (Gordon and Li, 2009). Thus, failing to control for these factors, such as local government's administrative quality, may cause the panel fixed-effect estimates to be biased downward. Second, in addition to the omitted variables, measurement errors can also bias estimates. The agglomeration levels are likely to be measured with large measurement errors, because they are only proxies instead of direct measures of agglomeration rents. When large measurement errors are present, fixed-effect models can exaggerate the inconsistency due to measurement errors (attenuation bias).[18]

7. ROBUSTNESS CHECKS

Alternative Measure of Industrial Agglomeration

As an alternative measure of industrial agglomeration, we use the model-based index that is constructed by Ellison and Glaeser (1997). It is called the EG index and calculated as follows:

$$EG_{rit} = \frac{G_{rit} - (1 - \sum_r x_{rt}^2)H_{it}}{(1 - \sum_r x_{rt}^2)(1 - H_{it})}, \tag{3}$$

$G_{rit} = \sum_r (x_{rt} - s_{rt})^2$ is the spatial Gini coefficient, where x_{rt} is the share of total employment of all industries in the city r and year t and s_{rt} is the share of employment in city r and year t ; $H_{it} = \sum_i y_{it}^2$, is the Herfindahl index of industry i in year t, where y_{it} is

[18]According to Wooldridge (2002, p. 311), "Measurement error in panel data was studied by Solon (1985) and Griliches and Hausman (1986). It is widely believed in econometrics that the differencing and fixed-effect transformations exacerbate measurement error bias (even though they eliminate heterogeneity bias)." Moreover, Freeman (1984) shows that fixed-effect estimations, suffering from possible measurement errors, bias downward the estimation results.

TABLE 7: The Panel Fixed-Effect Estimation Results Using EG Index as the Measure of Agglomeration

Whole Sample Dependent Variables	(1) Pension–Wage Ratio	(2) Log of Pension per Employee
EG index	0.085***	0.012
	(0.012)	(0.020)
Wage	−1.218***	0.460***
	(0.020)	(0.003)
Size	0.348***	−0.807***
	(0.027)	(0.004)
Ownership	0.403***	0.078***
	(0.054)	(0.009)
Intensity	−0.001	0.001***
	(0.003)	(0.000)
Competition	−0.919**	−0.061
	(0.396)	(0.058)
Policy	−0.304	0.296
	(1.885)	(0.292)
Enforcement	3.301***	0.249***
	(0.300)	(0.043)
Constant	3.971***	−2.945***
	(0.621)	(0.079)
Observations	1,058,066	593,249
R-squared	0.042	0.221
Year Dummy	Yes	Yes
Firm Dummy	Yes	Yes
P-value of F test	0.000	0.000

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and *indicates the statistical significance at 10 percent level.

the output share of a particular firm in industry i and year t (the output is measured by the firm revenue).

For the robustness check, we replace $Agglomeration_{frit}$ in Equations (1) and (2) by EG_{rit}. Table 7 reports the estimation results. In column (1), the dependent variable is pension–wage ratio, and the coefficient of EG index is 0.085 and statistically significant. In column (2), the dependent variable is logarithm of pension payment per employee, and the coefficient of EG index is 0.012 but is not statistically significant.

In the probit model estimation, which is shown in column (2) of Table 4, we replace the measure of agglomeration by the EG index EG_{rit}, and still find positive and statistically significant impacts of industrial agglomeration on firm's pension contribution, with the coefficient equal to 0.028.

Subsample Estimation

From Table 1, we know that around 40 percent of firms in our sample contribute zero pension. In this sense, the coefficient of agglomeration may be underestimated in the previous analysis. For the robustness check, we exclude the firms that have zero pension payment. However, when calculating $Agglomeration_{frit}$, we still include all these firms due to the spillover effects that they produce. The panel fixed-effect estimates are shown in column (1) of Table 8. The coefficient of agglomeration is 0.025. To deal with the potential endogeneity problem, we perform the 2SLS estimation by using *Population* and

TABLE 8: The Estimation Results Excluding the Firms That Make Zero Pension Payments

Dependent Variables	(1) Pension–Wage Ratio	(2)
	Panel Fixed Results	IV Results for the Pooled Data
Agglomeration	0.025	0.120***
	(0.018)	(0.014)
Wage	−4.311***	−0.019***
	(0.032)	(0.001)
Size	1.269***	−0.010***
	(0.041)	(0.003)
Ownership	0.452***	0.048***
	(0.082)	(0.002)
Intensity	0.016***	0.001**
	(0.004)	(0.001)
Competition	−0.344	1.444***
	(0.667)	(0.170)
Policy	7.394**	0.222***
	(3.124)	(0.025)
Enforcement	2.565***	−0.054***
	(0.407)	(0.018)
Constant	10.238***	−0.643***
	(0.824)	(0.086)
Observations	579,183	505,322
Year dummy	Yes	Yes
Firm dummy	Yes	
Province dummy		Yes
Industry dummy		Yes
P-value of *F* test	0.000	0.000
Underidentification test		(1455.98)***
Partial *F*-statistics		(729.81)***

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.
***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and *indicates the statistical significance at 10 percent level.

Firm number as instruments for agglomeration. Column (2) reports that the coefficient of agglomeration is 0.120 and statistically significant. It means that, if the own industry neighboring employment increases by 1 percent, the firm's pension–wage ratio increases by 0.120.

Ownership Difference

So far we have included all types of enterprises into our estimations. However, the Chinese SOEs and COEs may receive special treatment from the government, in contrast with the private and foreign enterprises. Moreover, SOEs and COEs have provided pension to their employees since the early-1950s, while other types of firms started to join the social security system only in recent years. Thus, given different ownership types, the linkage between industrial agglomeration and pension provision may be different.

Therefore, we apply IV estimations of pooled data for the subsample of SOEs and COEs, and private and foreign firms, respectively. The IVs and the methodology that we use are similar to those described in Section 6. The results are shown in Table 9. Noticeably, industrial agglomeration has a positive and significant effect on the pension

TABLE 9: The IV Estimation Results of Pooled Data for SOEs and COEs, Private, and Foreign Firms

Sample	(1) SOEs & COEs	(2) Private & Foreign	(3) SOEs & COEs	(4) Private & Foreign
Dependent Variable	Pension–Wage Ratio		Log of Pension per Employee	
	Panel A: Second stage			
Agglomeration	0.084***	0.132***	0.708***	1.508***
	(0.008)	(0.024)	(0.082)	(0.151)
Wage	0.008***	0.000	0.804***	0.755***
	(0.001)	(0.002)	(0.015)	(0.020)
Size	−0.010***	−0.023***	−0.933***	−1.155***
	(0.002)	(0.004)	(0.021)	(0.031)
Intensity	0.000*	0.003***	0.002	0.047***
	(0.000)	(0.000)	(0.001)	(0.005)
Competition	0.899***	1.548***	7.670***	18.422***
	(0.084)	(0.286)	(0.906)	(1.978)
Policy	0.207***	0.250***	1.551***	2.706***
	(0.021)	(0.042)	(0.206)	(0.278)
Enforcement	−0.079***	−0.077***	−0.719***	−0.231
	(0.018)	(0.024)	(0.177)	(0.229)
Constant	−0.488***	−0.778***	−7.124***	−12.335***
	(0.048)	(0.153)	(0.503)	(0.955)
Observations	141,149	794,067	49,768	455,556
Year dummy	Yes	Yes	Yes	Yes
Province dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes
	Panel B: First stage, dependent variable is "agglomeration"			
Firm number	0.084***	0.088***	0.084***	0.089***
	(0.008)	(0.004)	(0.003)	(0.004)
Population	0.102***	0.042***	0.065***	0.004*
	(0.018)	(0.034)	(0.007)	(0.003)
Hausman test	(1196.53)***	(1015.67)***	(1193.63)***	(3625.22)***
Underidentification test	(103.19) ***	(105.96)***	(55.39)***	(82.01)***
Partial *F*-statistics	(885.34)***	(535.73)***	(494.57)***	(230.40)***
Overidentification test	(4.51)	(0.57)	(0.48)	(4.87)

Notes: Standard errors are clustered at the firm level and are reported in the parenthesis.

***Indicates the statistical significance at the 1 percent level; **indicates the statistical significance at the 5 percent level; and * indicates the statistical significance at 10 percent level. Similar results are obtained if we perform the panel IV estimation or replace the IVs by the lagged agglomeration.

contribution in both subsamples: private and foreign firms, and SOEs and COEs. In particular, columns (1) and (2) in Panel A shows that if the own industry neighboring employment increases by 1 percent, the pension–wage ratio increases by 0.084 in the SOEs and COEs, while the pension–wage ratio increases by 0.132 in the private and foreign firms. Columns (3) and (4) in Panel A demonstrate similar pattern of coefficients with the dependent variable replaced by pension payment per employee.[19]

[19]We also implement the system–Generalized Method of Moments estimation as another robustness check. The coefficients of industrial agglomeration are positive, and it is statistically significant when the dependent variable is log of pension per employee. The results are not shown to save space.

8. CONCLUSION

In this paper, we investigate the impacts of industrial agglomeration on firm's pension provision in a transitional economy like China's. Using the data of large and median manufacturing firms between 2001 and 2007 in China, we first find a positive correlation between industrial agglomeration and employers' pension payments. Second, by using the IV estimation, we identify that industrial agglomeration has a positive and significant causal impact on employers' pension contributions. Given that monitoring and enforcement of ongoing pension reforms are pretty weak in China (Nielsen and Smyth, 2008), our results also imply that firms in more agglomerated industrial areas comply with mandated pension contributions at a higher level.

Some policy implications can be derived for the pension reform in China. First, to promote the effectiveness of pension reform, the current design may need to be adjusted according to different levels of industrial agglomeration across regions. For example, emphasizing individual contribution and reducing the role of the enterprise pension mandate may be useful to improve the efficiency and sustainability of pension reform in the less agglomerated industrial areas. Second, the pension reform may enlarge interregional income inequality, which is already high in China. In the more agglomerated industrial areas, the workers are better compensated, not only due to a higher wage level, but also due to a higher level of employer compliance with pension mandates. Third, given that the implementation of pension reform is pretty weak and uneven, the firms in more agglomerated industrial areas may bear a heavier burden of pension contributions; in other words, the pension mandates raise the real labor costs of employers in the more agglomerated industrial areas. Our finding may also help explain the phenomenon that some local governments subsidize firm's pension contributions to maintain the regional competitiveness and attract investment, as documented by Li and Wu (2013).

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