Estimating the Incidences of the Recent Pension Reform in China: Evidence from 100,000 Manufacturers

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Abstract

An ongoing reform in China mandates employers to contribute significant amounts to employee pension funds. The current study estimates the impact of this reform on the wage, employment and performance of firms using data from over 140,000 medium and large manufacturers in China during 2004 and 2006. We find that the nominal wages of employees were rigid but their real wages may have declined due to the pension reform. In addition, we find an interesting dichotomy in the incidences of pension reform. In localities with high agglomeration levels, firms' profits declined because the pension burden could not be fully transferred to employees. In less agglomerated jurisdictions, firms responded positively to pension reform, possibly because local governments over-subsidized the pension costs as a way to attract investment.

Introduction

China launched an ambitious pension reform during the late 1990s, extending the coverage of the pension system to non-state enterprises. Firms were instructed to contribute the equivalent of 20 percent of their total wage bills to pension funds. The reform has made steady progress since, with national pension funds increasing by around 25 percent annually, reaching 2 percent of GDP by 2007. The unusually large scale of pension reform in China could have had a significant impact on the economy. The goal of this study is to empirically estimate that impact.

A feature of this ongoing pension reform is that its compliance varied across regions, making it possible to estimate the effect of the reform. In particular, we provide empirical evidence utilizing a large data set that covers over 140,000 firms (the population of medium and large firms in China) in 2004 and 2006. We first follow the existing literature to test whether the increased pension costs have reduced the wage expenses of firms (Summers, 1989; Montgomery et al., 1992; Olson, 2002). Following Card (2009), we use the change of the pension contribution rate of firms of the same industry in neighboring jurisdictions as the instrument. Although there is no evidence of a trade-off between pensions and the nominal wage, we find that the pension contribution increased faster in regions with higher inflation rates. Hence, a significant amount of the pension cost might have been transferred to employees through reducing their real wages. This is consistent with a model of pension-wage trade-off with a sticky nominal wage, as in Sommers (2005).

We further divide jurisdictions by their agglomeration levels (measured by the number of firms) and estimate the impact of the pension reform. We find that in more agglomerated regions, firms could not fully transfer the pension burden to the employees so their profits significantly declined: increasing the pension-wage ratio by one percentage point would have reduced the profit by 1 percent. In contrast, in less agglomerated regions, the change of the pension-wage ratio actually increased wages, employment, and profit. We argue that this was because local governments in less agglomerated regions had stronger incentives to attract investors by providing them with subsidies to reduce pension burden. In fact, our estimates suggest that the local governments may have over-subsidized firms: the implied "leakage" of government subsidies to wages and profit amounted to around 9 billion yuan (over 1 billion US dollars) during 2005 and 2006.

In a similar attempt to ours, Neilsen and Smyth (2008) focused on the trade-off between wages and employer-provided social insurance in Shanghai. They found a minor substitution effect between the nominal wage and social security contributions. In comparison, our study uses different instrumental variables, and examines the effects not only on wage but also the employment and performance of firms. Moreover, we use data on all median and large firms in China.

The remainder of this paper is structured as follows. The next section introduces Chinese pension reform and other relevant policies. In the third section, we propose an empirical framework to estimate the effect of pension provision on firms. The data and empirical findings are summarized in sections four and five. The sixth section concludes the paper.

Pension reform in China

In this section, we introduce the recent pension reform and other relevant changes to the Chinese social welfare and tax systems.

The pension reform

China maintained a Soviet-type pension system between the 1950s and 1991, covering only the employees of state-owned enterprises. In 2003, a major reform imposed uniform pension mandates on all firms (both state-owned and non-state-owned). In this system, firms will be obliged to contribute 20% of their wage bills to pension funds when the reform process is completed. In addition, employees should contribute 8% of their wages. The new system is comparable to that of Singapore, where both employers and employees contribute to the pension fund. In Singapore, employers are required to contribute the equivalent of 17 percent of their wage bill, similar to the Chinese system. The system is also similar to that of Switzerland.

The national pension fund in China has grown steadily since the advent of reform, increasing by 25% annually. By 2007, the total fund reached 783 billion yuan, or approximately 110 billion US dollars. A key feature of this reform process is that its compliance rates have been uneven across regions. This could have occured because the financial position of local governments varies across regions, giving them different capacities to enforce the pension reform (Oksanen, 2010). This variation in pension reform is necessary for us to estimate incidences in the empirical exercise.

Besides firms and employees, the Chinese government also contributes to pension funds. According to the statistics of the Labor and Social Security Ministry, total government subsidies reached 97 billion yuan (around 14 billion US dollars) by 2006. Among these subsidies, those by local governments were 20 billion yuan in 2006, up from 11 billion yuan in 2005. Subsidies by the central government were about four times the contribution of local governments. Oksanen (2010) finds that subsidies or transfers from local government to pension funds have become indispensable and permanent.

A drawback of the pension system in China is the lack of portability. Although individual contributions are generally portable when employees change their jobs, the firm contributions are still not portable. There is a formal regulation that allows employees to transfer only 60% of the pension funds contributed by employers.

Other fringe benefits

Health insurance is relevant to this study because the data do not distinguish firms' contributions to it from those to pensions. The financing structure of health insurance is similar to that of pensions: firms are mandated to pay around 6% of their wage bills to health insurance, while individuals pay 2% of their wages. Unlike the pension system, though, the government does not directly subsidize contributions to health insurance funds.

Besides pension and medical insurance, social insurance also includes unemployment insurance, work injury insurance, and childbearing insurance. In this paper, we mainly focus on pensions and medical insurance.

Taxes

Similar to the regulation in other countries, paying fringe benefits has a tax advantage over paying wages in China because the former are exempted from personal income tax. 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. Effective personal income tax rates have gradually increased since 2002 in China, reaching an average of about 5 percent in 2006 according to our dataset on medium and large manufacturers.

Empirical Strategy

This section introduces the empirical strategy to estimate the effect of pension reform on firms in China. There is a sizable literature on the incidence of mandated fringe benefits. Most studies have focused on the wage-benefit trade-off, some using firm-level data and others examining individual accounts. Empirical findings commonly support the presence of a wage-benefit trade-off, but the substitution is typically imperfect: i.e., the impact of benefits does not completely fall on the wage of workers (e.g., Montgomery et al., 1992; Gruber and Poterba, 1994; Olson, 2002; Baiker and Chandra, 2006).

Baseline model

Following Montgomery et al. (1992), we specify the baseline model as follows:

(1)
$$W_{it} = \alpha_0 + \alpha_1 BW_{it} + X_{it}^{'}\alpha_2 + \alpha_i + \alpha_{tr} + \alpha_{ts} + \varepsilon_{it}$$

This is a fixed-effect panel data model in which time trends can vary by industry r and locality s. In the existing literature, the dependent variable W_{it} is the total real wages (excluding fringe benefits) of firm i at time t. The main independent variable BW_{it} is the pension-wage ratio for firm i at time t.

Following Montgomery et al (1992), we interpret the coefficient   as the marginal rate of substitution between pensions and wages for employers.   is normally negative with its magnitude depending on employees' preference for wage and pension. When wage and pension are not perfectly substitutable,   is different from -1. X_{it} includes other firm-specific attributes that are relevant. We control for the logarithm of the firm's employment. Hence, our dependent variable is effectively the wage per worker. Following the literature, we also include firm size (Olson, 2002, Smith and Ehrenberg, 1983), fixed capital (Collard et al. 2005, Long and Scott, 1982), and production materials as control variables. In addition, to address the concern that ownership change during the sample period may also affect pension-wage ratios and the wage, we consider a dummy variable that reflects the change of ownership and include it in our regressions. This variable is 1 if the firm's ownership changed during our sample period, and is 0 if there is no change in ownership.

Firm-specific fixed effect α_i may mitigate any bias due to time-constant omitted variables, such as the skill level of workers (Epple, 1987; Biddle and Zarkin, 1988). Moreover, note that reflects the relative costs of pensions for each firm, so it may be heterogeneous and correlated with the firm-specific pension-wage ratio (Woodbury, 1983; Gruber and Krueger, 1991; Montgomery et al., 1992). This may bias the estimate of the mean of , but that bias would be eliminated by the firm-specific fixed effect if the firm-specific is stable over time (Wooldridge, 2002).

The empirical model also uses fixed effects α_{tr} and α_{ts} that are specific to industry r and locality s at time t to control for common shocks to firms in the same industry or locality (e.g. the aggregate demand shocks for the products of specific industries).

Taking the first-difference of model (1), we have the following standard model, which accounts for firm-specific factors that are constant over time:

(2) $$\Delta W_{it} = \alpha_1 \Delta BW_{it} + \Delta X_i' \alpha_2 + \alpha_r + \alpha_s + \Delta \varepsilon_{it}$$

Note that we are only estimating the short-term impact of the pension contribution on firms. If the realization of their impact took longer than our sample period, they might not be captured by the current model.

Identification issues

Even with the first-difference model (2), the estimate of   may still be biased for the following reasons. First, classical measurement errors in the change of benefit-wage ratio ΔBW_{it} may still be present. Second, note that the denominator of the pension-wage ratio BW_{it} is the wage itself. Hence, any omitted variables (that vary over time) may be correlated with BW_{it} and bias the estimate of. This endogeneity bias is an example of the mean-reversion problem. Third, the frictions for firms to reduce workers' wages may be heterogeneous. When the government mandates pension contributions, those firms that find it easier to reduce wages (e.g. due to less restrictive labor contracts) may increase their pension contributions earlier than other firms. This endogenous selection of the timing of obeying the government may thus exaggerate the estimate of.

To address these endogeneity problems, recent studies have introduced various instrumental variables for BW_{it}. For example, Smith and Ehrenberg (1983) use the predicted value of pensions given the contribution rule and information on wage and pension attributes as instrument. In our study, we follow the approach of Gruber and Mcknight (2003). In studying the effect of Medicaid, they use the average Medicaid eligibility share for each income decile/marital status/state/year cell as an instrumental variable for the pension-wage ratio. Similarly, we use the average change of the pension-wage ratio for each industry/city (or county) cell to instrument the change in the pension-wage ratio of each firm in the cell (we exclude the firm's own pension-wage ratio in calculating the average). Our rationale is that the pension-wage ratios of different firms within the same jurisdiction should be correlated because they are governed by the same government. In China it is the local government that enforces the pension reform. Hence, the IV and the pension-wage ratio should be correlated. Moreover, since the IV is constructed using information on other firms, it should not be associated with the idiosyncratic errors specific to the firms considered, such as measurement errors. Therefore, the IV may be used to address the identification issues discussed above.

A further concern is that the local pension reform might be correlated with other local policies that affect the wages of firms. To address this issue, we also consider an alternative instrument variable, IV2, which is the change of the pension-wage ratio for the same industry in other counties within the same prefecture. Local governments in China are hierarchical. In most provinces, provincial governments are on the top, prefecture at the middle, and county government below. For IV2 to be valid, our assumption is that the pension reform is controlled by the prefecture-level government while other confounding policies that affect the wage of firms are mainly affected by county-level governments. Card et al. (2009) use a similar instrument (with a different economic rationale).

If applying both IV1 and IV2 generates similar estimates, the method of Acemoglu et al (2001) can be applied to test whether the exclusion restriction assumption is satisfied. We will discuss this in more detail in the empirical section.

Accounting for the effect of inflation

Note that the change of the real wage ΔW_{it}^* is the change of the nominal wage ΔW_{it} subtracted by the inflation rates. Hence, firms in regions with higher inflation rates may find it easier to transfer the pension burden to employees by hindering the growth of their nominal wages. The existing literature offers limited evidence on this effect, with the exception of that provided by Sommers (2005).

If the inflation rate is region-specific, then it will be absorbed in the region-fixed effect α_s in model (2). As a result,   only reflects the trade-off between the nominal wage and the pension contribution. To test the trade-off between the pension and the real wage through the inflation channel, we can estimate the following model:

(3) $$\Delta BW_{it} = \beta_1 f_{st} + \Delta X_i^{'}\beta_2 + \beta_r + \Delta \varepsilon_{it}$$

Here, f_{st} is the inflation rate of region s at time t. Note that the region-specific fixed effects are eliminated by the first-differencing. If the inflation effect is present, we expect   to be positive: pension contributions increase faster in regions with higher inflation rates. For instance, if   equals one and firm i freezes its nominal wage W_{it-1}, the real wage of employees declined by a share of $f_{st}/(f_{st}+1)$.

Although inflation is exogenous to a firm, local factors and policies unobserved to researchers may be correlated with local inflation rates. Hence, we acknowledge that, if these omitted factors also affect firm's pension contributions, the estimates of the model may be biased.

Data

The data set that we use is the Survey of Large and Medium Size Enterprises that China's National Bureau of Statistical (NBS) conducted in 2004 and 2006. The data includes accounting information and the major characteristics of firms. The original data includes 279,092 manufacturers in 2004 (23,407 SOEs among them) and 301,961 firms in 2006 (14,549 SOEs among them). In cleaning the data, we exclude firms with less than eight employees and counties with less than two firms. Moreover, we also drop firms that report pension-wage ratios beyond the range of [0, 0.5] and tax rates beyond the range of [0, 1]. As a result of this, we have 195,859 firms in 2004 (9,925 SOEs) and 217,232 firms in 2006 (6,591 SOEs). Furthermore, since our panel regressions only include firms that appear both in 2004 and 2006, the number of firms in our regression sample decreases to 141,450. We conduct robustness checks for different thresholds of excluding the firms and the empirical findings are robust.

Table 1 summarizes main statistics of relevant variables (the logarithmic value of all variables but the pension-wage ratio). The average pension-wage ratio is around 5.07 percent, still far below the 20 percent target set by most local governments. The variation of the pension-wage ratio is large, 7.35 percent. The variation is necessary for our empirical estimation.

Table 2 provides further information on the pension-wage ratios and their changes over time. Several interesting observations can be found. First, the distribution of pension-wage ratio is highly skewed to the left, so the median pension-wage ratio is much smaller than the average. Second, the pension-wage ratios significantly increased from 2004 to 2006, both in the mean and the median. For the balanced sample (firms that are present in both years), the mean pension-wage ratio increased from 4.25 to 5.88 percent over the two years, and the median ratio increased from

0.97 to 2.70 percent. Third, pension provision was significantly higher in SOE than in non-SOEs. This is expected because SOEs had already provided pensions to employees before the reform in 2002, whereas the non-SOEs had not. The average pension-wage ratio for SOEs changed little during the sample period, while that of the non-SOEs increased by over 40% from 2004 to 2006.

Table 1
Summary statistics

Variable	Mean (1)	Std Dev (2)	Min (3)	Max (4)	N
Pension-wage ratio	5.85%	8.72%	0.00%	49.99%	1,250,604
Wage	7.20	1.27	0.00	15.79	1,250,488
Benefits	5.04	1.43	0.00	14.37	1,018,221
Number of employees	4.72	1.10	2.20	13.25	1,250,593
Revenue	10.00	1.34	0.00	19.09	1,248,175
Profit	6.74	1.98	0.00	18.59	818,391
Fixed capital	8.42	1.74	0.00	18.87	1,244,791
Materials	9.69	1.40	0.00	18.97	1,247,539

Note: The logarithmic value of wage, benefits, number of employees, revenue, profits, fixed capital, and materials is used in calculating the summary statistics. Pension-wage ratio is calculated as pension and health insurance divided by the sum of basic wage and other benefits. Firms reporting pension-wage ratio less than zero or greater than fifty percent are excluded in calculating the summary statistics.
Source: by authors' estimation

Table 2
The pension-wage ratios in different samples (%)

	Mean (1)	Std. Dev (2)	Median (3)	Min (4)	Max (5)	N
Full sample	5.07	7.35	1.75	0	50	282,900
Balanced panel, 2004	4.25	6.64	0.97	0	50	141,450
Balanced panel, 2006	5.88	7.92	2.70	0	50	141,450
Balanced, SOE, 2004	10.17	10.49	7.73	0	50	5,081
Balanced, SOE, 2006	11.57	11.58	9.25	0	50	4,814
Balanced, NSOE, 2004	4.03	6.34	0.80	0	50	136,369
Balanced, NSOE, 2006	5.67	7.69	2.61	0	50	136,636

Note: Firms reporting pension-wage ratios less than zero or greater than fifty percent have been excluded.
Source: by authors' estimation

Empirical Findings

In this section, we first discuss our estimate of the wage-pension trade-off. We then present additional evidence on other incidences of the pension mandates. Huber-White standard errors with clustering over prefecture are reported for all the regressions.

Zero trade-off between pension and wage in China

Table 3 summarizes the estimates of the pension-wage trade-off. Column 1 reports the pooled OLS estimates of model (1) without controlling for firm-specific fixed effects. The estimated coefficient of the wage-pension ratio is positive, against the trade-off hypothesis. However, when the first-difference model (2) is applied, the coefficient becomes negative and significant, suggesting a trade-off between wage and pension (column 2). The magnitude of the trade-off is less than one, suggesting imperfect substitution, as is consistent with prior studies. The first-difference estimate is robust to the inclusion of province- and industry-specific time trends (column 3).

The first-difference estimate, however, may suffer from measurement errors, endogeneity bias due to mean-reversion or endogenous timing in the adoption of pension reform. To address this issue, we use the average change of the pension-wage ratio of firms in the same industry and locality as the instrumental variable (IV1) for a firm's change of pension-wage ratio. The first-stage estimates show strong relevance of the instrument: when the industry-prefecture pension-wage ratio increases by one percentage point, the pension-wage ratio of a firm in the same industry and

prefecture increases by 0.44 percentage point (column 4 of Table 3). This estimate is statistically significant. The F value of IV1 in the first stage regression is around 36.96, much larger than 10, suggesting that the instrumental variable is not weak (Stock and Watson, 2003).

In sharp contrast to the first-difference estimate, the 2SLS estimate of the pension-wage trade-off rate becomes insignificant despite the large number of observations (column 4 of Table 3). In other words, the pension mandates have not induced the Chinese manufacturers to reduce the nominal wage of workers. We conducted standard Wu-Hausman F test and found that the IV estimate is significantly different from the first-difference estimate. This suggests that the pension-wage ratio is endogenous and the IV method is needed. The estimates of other coefficients change little when the 2SLS method is applied. The fixed capital, intermediate inputs, number of employees and the history of firms are all positively associated with the wage.

In all these regressions we have included the ownership change dummy. We find that 267 SOEs in our sample have changed to non-SOEs. Our estimates suggest that the change of ownership is positively related to the pension-wage ratio of a firm. In other words, privatization may increase the pension provision. This is consistent with the purpose of the reform, which mainly targets the coverage of pension provision in non-SOEs.

Robustness checks

We conduct a series of checks to confirm that our findings above are robust. First, we try a different outlier threshold by excluding observations with reported pension-wage ratios greater than 15 percent (column 1 of Table 4). Despite this large change in the sample, the IV estimate remains qualitatively the same.

We then consider an alternative instrumental variable, the average change of the pension-wage ratio for firms in the same industry but different counties of the same prefecture (IV2). The first stage result also shows a strong correlation between IV2 and the pension-wage ratio. Consistent with the earlier findings, the trade-off effect is still insignificant when IV2 is used (column 2 of Table 4). Since we have two IVs, we also conduct an over-identification test and can not reject the hypothesis that the estimates with different IVs are consistent.

We then follow the method of Acemoglu et al (2001) to provide a check of whether the exclusion restriction assumption is satisfied. Our purpose is to test whether the IVs affect the dependent variable only through affecting the pension-wage ratio. If this is true, then the exclusion restriction for the instrumental variables is satisfied. In column (1) of Table 5, we report the result when the pension-wage ratio is instrumented using IV1, and IV2 is included as a regressor. If IV2 had a direct effect on wage, the coefficient of IV2 should be significant. It turns out to be insignificant. In column (2) of Table 5, we switch IV1 and IV2 and obtain a similar result. These findings are consistent with the exclusion restriction assumption.

As a final check, we exclude those industry-county cells that contain less than five firms. This improves the relevance of our IVs to the pension-wage ratios of individual firms. Nevertheless, the 2SLS estimates change little (column 3 of Table 4).

Table 3

The wage-pension trade-off

Estimators	Pooled OLS (full sample)	First Diff. (full sample)	First Diff. (full sample)	First Diff. 2SLS (full sample, IV1)
	Dependent variable: ln(total wage bill at the firm level)			
	(1)	(2)	(3)	(4)
First-stage relevance of the IV				0.438*** (0.006)
Pension-wage ratio	0.934*** (0.144)	-0.333*** (0.107)	-0.443*** (0.090)	0.624 (0.455)
Ln(fixed capital)	0.052*** (0.005)	0.042*** (0.005)	0.043*** (0.004)	0.041*** (0.004)
Ln(materials)	0.102*** (0.005)	0.128*** (0.005)	0.124*** (0.005)	0.123*** (0.005)
Ln(employees)	0.878*** (0.009)	0.772*** (0.010)	0.768*** (0.009)	0.777*** (0.010)
Ln(age)	0.039*** (0.007)	0.012 (0.010)	0.016** (0.008)	0.015* (0.009)
Ownership change	-0.200** (0.012)	-0.047** (0.024)	-0.036 (0.024)	-0.042* (0.025)
Constant	1.763*** (0.045)	0.221*** (0.012)	0.215*** (0.033)	0.205*** (0.034)
Province fixed effect	no	no	yes	yes
Industry fixed effect	no	no	yes	yes
Observations	280,990	139,598	139,598	138,036
R-squared	0.78	0.45	0.46	0.45

Note: Robust standard error clustering at the prefecture level is reported. * significant at 10%; ** significant at 5%; *** significant at 1%. Ownership change is 1 if the firm's ownership changes from non-SOE or the other way around and 0 if there is no change of the ownership between the two years. Pension-wage ratio=pension /(wages + benefits). Pension includes both pension and health insurance contributions. The total wage bill is the sum of wages and benefits that should be paid to employees. IV1 is the average change of the pension-wage ratio for each industry-prefecture cell excluding the firm that is considered. Other control variables are excluded in the first stage result.
Source: by authors' estimation

Table 4

The wage-pension trade-off

Estimators	First Diff. 2SLS (PWR<0.15, IV1)	First Diff. 2SLS (full sample, IV2)	First Diff. 2SLS (IV1, industry–prefecture cell with more than five firms)
	Dependent variable: ln(total wage bill at the firm level)		
	(1)	(2)	(3)
First-stage relevance of the IV	0.342*** (0.004)	0.260*** (0.006)	0.496*** (0.006)
Pension-wage ratio	0.564 (0.591	1.411 (0.905)	0.646 (0.466)
Ln(fixed capital)	0.040*** (0.004)	0.042*** (0.004)	0.041*** (0.004)
Ln(materials)	0.126*** (0.005)	0.122*** (0.005)	0.123*** (0.005)
Ln(employees)	0.773** (0.009)	0.787*** (0.013)	0.777*** (0.010)
Ln(age)	0.017* (0.010	0.014 (0.010)	0.015* (0.009)
Ownership change	-0.020 (0.034	-0.045* (0.011)	-0.046* (0.025)
Constant	0.231** (0.034	0.200*** (0.037)	0.203*** (0.035)
Province fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Observations	121,397	132,903	135,971
R-squared	0.46	0.43	0.45

Note: Robust standard error clustering at the prefecture level is reported. * significant at 10%; ** significant at 5%; *** significant at 1%. Ownership change is 1 if the firm's ownership changes from non-SOE or the other way around and 0 if there is no change of the ownership between the two years. Pension-wage ratio=pension /(wages + benefits). Pension includes both pension and health insurance contributions. The total wage bill is the sum of wages and benefits that should be paid to employees. IV1 is the average change of the pension-wage ratio for each industry-prefecture cell excluding the firm that is considered. IV2 is the average change of pension-wage ratio for each industry-prefecture cell excluding the county of the industry that is considered.
Source: by authors' estimation

Table 5
Second stage result with instrument variables as exogenous variables

	Dependent variable: ln(total wage bill at the firm level)	
	(1)	(2)
Pension-wage ratio	0.534	0.108
	(0.313)	(0.447)
IV1		0.415
		(0.245)
IV2	0.228	
	(0.153)	

In column (1), IV1 is used as the instrumental variable for pension-wage ratio, and IV2 is included as exogenous variable. In column (2), IV2 is used as the instrumental variable for pension-wage ratio, and IV1 is included as exogenous variable.
Source: by authors' estimation

Why no trade-off between pension and wage?

In contrast to the findings in the literature, the IV estimates suggest that there is no trade-off between wage and pension contribution. This could be due to the following reasons: the omitted factor of inflation, the limited pension portability, the restriction of labor contract, the productivity effect, and the compensation of government subsidies. In the following analysis, we first discuss these alternative explanations and implications. We then present evidence of their relevance.

Was real wage affected?

As discussed previously, the dependent variable in our regressions is the nominal wage. Even if the nominal wage is not affected by the pension mandate on firms, the real wage may be. When the local economy experiences inflation, a firm can freeze the nominal wage, effectively reducing the real wage of employees. In regions where the inflation rate is higher, a firm may have more room to reduce the real wage and can thus transfer more burden of the pension to the employees. Hence, we predict that local inflation rates are positively associated with the change in the pension-wage ratio of local firms.

Ideally, we would like to test the causal effect of inflation rates on the change of pension-wage ratios, as is much more demanding. Due to data limitation, in this study we can only provide evidence on the association between the change of pension-wage ratio and the inflation rate. In particular, we estimate model (3) and use the consumer price index at the province level to calculate inflation (Table 6).

Table 6
The effect of inflation on change in the pension-wage ratio

	Dependent variable: Changes in the pension-wage ratio		
	(1)	(2)	(3)
CPI	0.181***	0.181***	0.202***
	(0.028)	(0.028)	(0.028)
Ln(fixed capital)		0.002***	0.002***
		(0.000)	(0.000)
Ln(materials)		0.001***	0.001***
		(0.000)	(0.000)
Ln(employees)		-0.009***	-0.009***
		(0.000)	(0.000)
age		0.000	0.000
		(0.000)	(0.001)
Ownership change	0.002	0.001	0.001
	(0.003)	(0.003)	(0.003)
Constant	0.010***	0.010***	-0.001
	(0.001)	(0.001)	(0.002)
Industry fixed effect	no	no	yes
Observations	141,450	139,598	139,598
R-square	0.001	0.004	0.010

* significant at 10%; ** significant at 5%; *** significant at 1%. Ownership change is 1 if the firm's ownership changes from non-SOE or the other way around and 0 if there is no change of the ownership between the two years.
Source: by authors' estimation

Consistent with our expectation, we find that inflation rates and the over-time change of pension-wage ratios are positively and significantly associated. For column 1 of Table 6, we regress the change of the pension-wage ratios from 2004 to 2006 on the province-level inflation rates during the period. The estimated coefficient is around 0.18 and is highly significant. This estimate implies that the inflation alone can explain 0.60 percentage point of the increase in the pension-wage ratio (the national inflation rate was around 3.3 percent between 2004 and 2006). This predicted increase is over one third of the actual increase of the pension-wage ratio during the period (Table 2). Hence, firms' pension expenses could have been partly transferred to the employees through the inflation channel. In columns 2 and 3, we add more control variables, including industry-specific dummies, but they have little effect on our estimate earlier.

A potential concern for the exercise above is that pensions could be indexed against inflation, thus generating a correlation between the pension-wage ratio and inflation. This is not the case in China, though. As introduced in section 2.1, pension contribution is a fraction of the wage bill of a firm according to government regulations in China. The pension-wage ratio, which is the fraction, is not related to inflation by regulation.

Why was the nominal wage rigid?

Table 7 summarizes potential reasons for the lack of a trade-off between the nominal wage and the pension mandate. First, the pension portability is still limited in China. When employees leave a firm in one province, it is difficult for them to take the pension fund contributed by the original firm to his/her new work in another province. This restriction may reduce the value of pensions relative to wages. As a result, employees would be reluctant to accept a cut to their nominal wage as an exchange for additional pension contribution by their employers. If this were the case, the total labor costs would increase, implying a reduction in the profitability of firms. The layoffs may also increase.

Table 7
The effects of pension reform: Hypotheses and evidence

	Literature (1)	Portability Limit (2)	Contract rigidity (3)	Productivity (4)	Government Subsidy (5)
Wage	Decrease	Unaffected	Unaffected	Ambiguous	Ambiguous
Profit		Decrease	Decrease		Ambiguous
Productivity				Increase	
Employment		Decrease			

Source: by authors' summary

Second, in the short term, firms may find it difficult to reduce wages due to the restriction of labor contracts. Similar to the portability explanation, contract rigidity also implies reduced profitability. Unlike the previous explanation, however, firms may not be able to lay off workers due to labor contract restrictions.

Third, if pension provision strengthens the incentive for employees to work, their increased productivity may mitigate the need for a wage reduction.

Finally, local governments may have directly subsidized firms' pension contribution as an instrument to jump-start the reform. In other words, the burden of pension provision may have been transferred back to the government and tax-payers. This is consistent with Oksanen (2010), which suggests that subsidies or transfers from local government to pension fund have been indispensable and permanent.

Given the firm-level data, we are able to empirically estimate the response of firms to the pension mandate so as to shed light on the relevance of the explanations above (Table 7).

Using the full sample, we find no evidence that the pension reform has significantly affected the profitability, productivity, or employment of firms (Table 8). This finding is inconsistent with several of the listed hypotheses. Specifically, labor contract rigidity implies a decrease in profit. The limited portability hypothesis implies a decrease in both profit and employment. Neither is supported by the data. Firm productivity also has not changed, which is inconsistent with the productivity explanation. When we apply the alternative IV, we obtain the similar result that pension-wage ratio does not have significant effects on wages and firm performance.

We further divide the sample into jurisdictions with more than 800 firms (referred to as "agglomerated regions") and those with less than 800 firms (referred to as "less agglomerated regions"). For the agglomerated regions, the estimates are now consistent with the predictions of the rigid labor contract story: the wage and employment of firms were not affected but their

profits significantly declined (the top panel of Table 9). Specifically, firms' profits decreased by about 1.46 percent when the pension-wage ratio increased by one percentage point.

In sharp contrast, the pension reform in less agglomerated regions actually benefited the firms: for a firm to increase its pension-wage ratio by one percentage point, its wage bill increased by 1.31 percent, employment increased by 0.72 percent, and profit increased by over 2 percent (the second panel of Table 9). This may imply that local governments subsidized the firms to the extent that some of the subsidies leaked to wages and profit.

Why is the subsidy effect more significant in less agglomerated regions? This may be because the local governments have stronger incentives to attract outside investors. In contrast, in more agglomerated regions the positive externalities of agglomeration may have been able to attract investment without the need for extra government subsidies.

Table 8
Full sample estimates with instrumental variable

Dependent variables:	Change in Wage (1)	Change in Profit (2)	Change in Output (3)	Change in Employment (4)
D. pension-wage ratio	0.366 (0.412)	1.124 (1.147)	0.072 (0.134)	0.310 (0.230)
D. ln(capital)	0.040*** (0.004)	0.113*** (0.011)	0.048*** (0.003)	0.097*** (0.003)
D. ln(intermediate inputs)	0.118*** (0.004)	0.680*** (0.021)	0.658*** (0.013)	0.183*** (0.008)
D. ln(employment)	0.781*** (0.010)	0.207*** (0.018)	0.163*** (0.008)	
Age	0.015* (0.008)	-0.032 (0.029)	0.007 (0.006)	-0.000 (0.009)
Ownership change	-0.037* (0.023)	0.117 (0.097)	0.014 (0.022)	-0.048*** (0.018)
Constant	0.205*** (0.031)	-0.141** (0.062)	0.042** (0.021)	-0.037** (0.018)
Province fixed effect	yes	yes	yes	yes
Industry fixed effect	yes	yes	yes	yes
Observations	138,036	100,155	138,036	138,036
R-squared	0.46	0.18	0.72	0.13

Note: The instrumental variable is IV1, the average of the change of the pension-wage ratio for each industry-prefecture cell excluding the firm that is considered. All regressions control for industry- and province-specific fixed effects. Robust standard error clustering at the prefecture level is reported. * significant at 10%; ** significant at 5%; *** significant at 1%. Ownership change is 1 if the firm's ownership changes from non-SOE or the other way around and 0 if there is no change of the ownership between the two years. Pension-wage ratio=pension /(wages + benefits). Pension includes both pension and health insurance contributions. Change in wage is the change in wages that should be paid to employees, and does not include benefits.
Source: by authors' estimation

Implied and actual government subsidy for pension

To provide further evidence on government's subsidizing firms, we use the firm-level data to calculate the subsidy that would be needed to generate the estimates that we have obtained. Then we compare this imputed subsidy with the officially announced subsidies by local governments for the pension reform.

First, we suppose that there was no leakage of government subsidy to the wage or profit of firms. In this case, if all of the increase of the employer-provided pension between 2004 and 2006 was paid by governments, then the amount of subsidy needed would be around 8.74 billion yuan (0.16% of industrial output).

In addition, if we further allow the leakage of some subsidies to other uses, we can calculate the amount of leakage as follows. We first multiply the coefficients of wages and profit in the regression with less agglomerated regions by the wages and profit of each firm to obtain its leakage size. We then sum them up to obtain the total leakage. This amounts to around 9.61 billion yuan. Adding this leakage to the amount of subsidy calculated earlier (8.74 billion yuan), the total government subsidy between in 2005 and 2006 may have been around 18 billion yuan.

According to the Labor and Social Security Ministry, subsidies from local governments amounted to around 31 billion yuan in 2005 and 2006. Hence, our estimated government subsidies are within the ballpark of the official figures (note that our data only cover medium and large firms).

Table 9

Estimates by small and large industrial clusters

Dependent variables:	Change in wage (1)	Change in profit (2)	Change in output (3)	Change in employment (4)
	Prefectures with more than 800 firms			
D. pension-wage ratio	-1.059	-1.456**	0.054	-0.088
	(0.920)	(0.687)	(0.169)	(0.150)
Observations	44,992	34,462	44,992	44,992
R-squared	0.52	0.15	0.74	0.18
	Prefectures with less than 800 firms			
D. pension-wage ratio	1.314***	2.656**	0.062	0.715*
	(0.362)	(1.187)	(0.179)	(0.411)
Observations	93,044	65,693	93,044	93,044
R-squared	0.42	0.17	0.71	0.10
	Prefectures with more than 800 firms, Non-SOEs			
D. pension-wage ratio	-1.040	-1.391*	0.061	-0.073
	(0.918)	(0.689)	(0.167)	(0.148)
Observations	44,617	34,260	44,617	44,617
R-squared	0.52	0.16	0.75	0.18
	Prefectures with less than 800 firms, Non-SOEs			
D. pension-wage ratio	1.392***	2.504**	0.089	0.689*
	(0.373)	(1.153)	(0.167)	(0.428)
Observations	88,906	63,999	88,906	88,906
R-squared	0.43	0.18	0.73	0.11
	Prefectures with more than 800 firms, SOEs			
D. pension-wage ratio	-2.482	-22.067	1.414	-4.318*
	(2.310)	(38.05)	(2.484)	(2.482)
Observations	375	202	375	375
R-squared	0.34	0.22	0.46	0.11
	Prefectures with less than 800 firms, SOEs			
D. pension-wage ratio	-2.375	29.094	-0.955	3.364
	(3.210)	(32.162)	(3.369)	(4.207)
Observations	4,138	1,694	4,138	4,138
R-squared	0.19	0.08	0.38	0.03

Note: The instrumental variable is IV1, the average of the change of pension-wage ratio for each industry-prefecture cell excluding the firm that is considered. All regressions control for industry- and province-specific fixed effects.
Robust standard errors clustering at the prefecture level are reported. * significant at 10%; ** significant at 5%, *** significant at 1%.
Pension-wage ratio=pension /(wage + benefit). Pension includes both pension and health insurance.
Source: by authors' estimation

Estimates by different forms of ownership

We further provide estimates for SOEs and non-SOEs separately (the lower four panels of Table 9). They may have behaved differently because the pension reform after 2002 mainly targeted non-SOEs.

Our estimation results for the non-SOEs are generally very similar to the full-sample estimates. This is expected because the non-SOEs account for 95 percent of our sample. The estimates for the SOEs provide an interesting contrast. Unlike the non-SOEs, the SOEs have not benefited from the pension reform in the less agglomerated regions. This may be because SOEs are less mobile than non-SOEs, so local governments had little incentive to subsidize them. In more agglomerated regions, there are signs that SOEs suffered from the pension reform: they laid off over 4.32 percent of employees when the pension-wage ratio increased by one percentage point. The estimated effect on wages and profit are negative but insignificant, which may be due to the lack of variation in the pension-wage ratios of SOEs because the reform mainly affected non-SOEs.

Conclusion

Using information on median and large Chinese manufacturers after 2004, we provide new evidence showing complicated incidences of employer-provided pension in China. There are three types of incidences. First, although the nominal wage of workers was rigid and not affected by employers' pension mandate, the real wage may have been affected negatively. We find evidence consistent with this incidence: firms in provinces with lower inflation rates tended to make slower progress in pension contributions. This is consistent with the model of sticky wages when inflation is present (Sommers, 2005).

The second incidence is on the firms because they were not able to fully transfer the burden of pension to employees. We find that firms in agglomerated regions suffered significantly from the increased pension contribution. Their profit declined by over one percent when the pension-wage ratio increases by one percentage point.

The third incidence may be on local governments. We find that firms in less agglomerated regions were not affected negatively by the pension reform. We argue that this could be due to the subsidies from local governments as one way of attracting investment. This argument is consistent with the findings of Oksanen (2010).

Our study has potentially important policy implications for the ongoing pension reform of China. Depending on the purpose of the reform, the current design may need to be adjusted in different dimensions. If the purpose of the reform is to force people to save, then the current design may not be efficient because the reform also affects the performance of firms. In the rigid wage and low-inflation environment of China, enterprises find it difficult to fully transfer the burden of pension contributions to employees. The pension mandate thus raises the real labor costs of Chinese firms and reduces their international competitiveness. A linear extrapolation of our estimates suggests that achieving the goal of a pension-wage ratio of 20 percent would reduce the profit of firms by over 20 percent, a non-trivial impact. A more efficient way to achieve the reform objective may be to rely more on individuals but not firms for the pension contribution. In other words, the weight of individual contribution in the current system should be larger, as in the developed economy.

In contrast, if the purpose of the reform is to increase the total compensation for employees, mandating the pension on firms might be superior to putting the burden fully on individuals. However, our study does suggest caution in using this reform to increase employees' income. First, due to the variation of inflation rates across China, the reform may enlarge inter-regional inequality, which is already high in China. Second, our evidence suggests that local governments may also subsidize firms as one way of attracting investment, especially in underdeveloped areas. This not only generates an inter-regional inequal burden on firms, but may also induce competition by local governments at the expense of local fiscal conditions. Moreover, the sustainability of the current pension reform would be dubious if the fast progress at the beginning was due to the help of local governments. Oksanen (2010) expresses a similar concern about the sustainability of the pension reform in China because its contribution rate may be too high to comply with.

In sum, the current pension reform has generated complicated incidences in China and may not be an efficient way of achieving the Chinese government goal. Hence, a revision of the reform design may be needed. For example, emphasizing individual contribution and reducing the role of the enterprise pension mandate may be necessary to improve the efficiency and sustainability of the current reform.

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