Risky Corporate Customers:

Workplace Safety and Use of Contractors

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Preliminary version. Please do not circulate.

Abstract

This paper studies how the extended liability on workplace safety affects the firms' labor supply chain decisions. Using the amendment of industrial safety law in Korea, this paper identifies the change in the liability of the firms on workplace safety of contractors. I find that the affected firms reduce the number of contractors compared to the unaffected firms. Instead, the firms increase the in-house labor and it is concentrated in the firms with poor workplace safety history. Furthermore, I find that the operating efficiency and investment are reduced in affected firms with bad workplace history. Also, they pay more interest expenses after the regulation change. These results are consistent with firms deliberately exploiting the lower liability of safety associated with contractors.

Keywords: Workplace safety, Labor composition, Financial impact

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1 Introduction

Firms decide the use of contractors to optimally match the quality of the product and the labor cost. Low labor protection of the labor suppliers allows the firms to minimize the labor cost and keep the quality of the product similar to when they use the in-house labor. Some firms deviate from the liability of workplace safety via hiring labor suppliers. Therefore, poor working condition of the labor suppliers has long received a social attention [1]. In this paper, I study how the labor supply chain decision of the firms changes when the liability of workplace safety enhances and its operational and financial impact on the firms.

Workplace riskiness is costly for the firms as it increases risk-wage premium. By hiring contractors, firms can save the risk-wage premium by the lower monitoring cost. Unlike the large firms, the smaller firms can monitor their workers with lower monitoring cost. As the risky tasks need closer monitoring, the smaller size could be optimal. Also, the firms need to pay less overheads for the workplace accidents. As, the small firms have lower legal pocket, and they need to pay a lower insurance cost [2]. However, when the liability of the firms on the workplace enhances, the amount of save in labor cost that firms can realize by hiring contractors reduces.

Increased liability increase the demand of the firms on monitoring the workplace environment of the contractors. It makes easier for legal authorities to define whether the industrial accidents happened because of carelessness of the contractors or the bad working environ-

[1] For example, the biggest shoes companies in the world have been long accused of the poor working conditions of the foreign contractors (https://en.wikipedia.org/wiki/Nike_sweatshops, https://www.oxfam.org.au/what-we-do/economic-inequality/workers-rights/adidas/). Also, in Korea of which this paper studies, the hazardous working condition of the contractors have dragged social attention in 2016 (http://www.koreaherald.com/view.php?ud=20160605000257).

[2] Insurance cost is measured based on the profit of the firms, which is smaller in small firms.

ment provided by the hiring firms. It increases the probability of the reputation risk to the hiring firms on the industrial accidents by the contractors. Overall, the increase liability increases the cost and overheads on hiring contractors. Therefore, the firms would change their decision on the use of contractors to minimize the cost. Sudden change in labor structure would affect the operational and financial performance of the firms. In this paper, I study how the liability of workplace safety affects the firms labor structure and its impact on operational and financial performance.

I exploit the regulation change in Korea to examine a sudden change in liability on workplace safety by the firms. The regulation change on workplace accident investigation system happened in late 2017, Korea. The regulation required the contracting-out firms to publicly report the list of contract companies, contract companies employment and the employees' workplace accidents. This change was applicable for the firms with over 500 employees in manufacturing and rail industries whose subcontractor share the same working place with in-house labor. Before the regulation change, the workplace accidents happened for the contractor was reported by the contract company, so it was difficult to define the responsibility of contracting-out firms who could have shirked on monitoring the working environment.

This paper, first, provides evidence that the workplace risk of the customer firms have positive relationship with the use of contractor. On the other hand, the firms have fewer non-manager in-house labor when their injury rates are high. Such tendency is concentrated in the firms with labor union, which implies that the high bargaining power of the in-house labor over the safety of the workplace induces the firms to contract out the risky tasks. Also, I study whether the wage of contractor changes over the injury rates of the customer firms.

The evidence shows that the average wage of contractor decreases by the injury rates, which means contractor is not compensated for the risk of workplace and the customer firms save the wage cost.

Next, this paper studies the tendency of using contractor reduces when the liability of the firms improves over the working environment. Using the regulation change that increased the competition among the customer firms for good contractor, this paper provides evidence that the customer firms reduce the use of contractor when the contractor gets higher bargaining power over safety. Also, the impact of the risky working environment on the use of contractor weakens. The results show that the decision on the use of contractor was affected by the safety of working environment because the firms could realize the lower wage cost.

Finally, this paper studies whether the financing cost of the firms is affected by the change in the nature of the labor supply chain. Increased liability of the firms affects the operating risk of the customer firms. If the customer firms cannot make agreement on workplace safety with the contractor, their production would be affected. Therefore, the customer firms whose contractor gets higher bargaining power have higher operating risk, which in turn, affects the financial condition of the firms. This paper shows that the interest expense of the affected customer firms increases after the regulation change.

In the recently growing literature on corporate social responsibility of the firms, some of them investigate how the firms' CSR are affected through the supply chain. Dai et al. (2020) and Schiller (2018) provide evidence that the CSR of the firms are positively affected by the corporate customers' CSR performance. Dai et al. (2020) show that customers provide influence on customers' CSR performance through its matching process, where good customer firms are matched with good suppliers. However, these papers do not study the spillover

effects of negative CSR events through the supply chain. This paper provides evidence how the poor employee welfare of the customer firms influences the welfare of the labor suppliers' employees.

This paper is also related to the literature on firms decision on the use of outside contractors. The classic paper, Abraham and Taylor (1996), study what kinds of factors influence firms' use of outside contractors. They argue that lower wage and lower labor protection of contractor play an influential role on firms' decisions. Also, Arruñada et al. (2004) shows a lower legal pocket of the contractor provides the customer firms an incentive to contract out the tasks. Given the advantage of using contractor, some literature shows the contractor allows the customer firms to grow fast Bertrand et al.. However, some other literature shows the poor employee welfare of the contractor given the low wage and low labor protection (Kalleberg et al. (2000)[3], Nenonen (2011)). On top of that, this paper studies whether the risk-wage premium affects the firms' decision on the use of contractor and how such decision changes when the bargaining power on workplace safety of contractor improves.

Lastly, this paper is related to the literature on the relationship between finance and employee welfare. Cohn and Wardlaw (2016) and Boone et al. (2011) show that the financial condition and workplace safety are positively related. Furthermore, Cohn et al. (2020) show that the improvement in workplace safety is benefits the firms as it is positively associated with the probability of IPO. Cho (2018) study how the firms' investment decisions are affected when the minimum wage increases. This paper shows the regulatory requirement on improving employee welfare affects firms' decisions. Also, Akey and Appel (2021) and

[3]In Kalleberg et al. (2000), they study the working environment of non-standard employees. Non-standard employees include on-call work and day labor, temporary-help agency employment, employment with contract companies, independent contracting, other self-employment, and part-time employment in "conventional" job.

Ben-David et al. study the redistribution of the production to minimize the cost of pollution. On top of this literature, I study how the regulatory requirement on workplace safety affects firms' decisions on labor supply chain and further, its impact on firms' operating and financial performance.

2 Data and preliminary results

2.1 Data

The main dataset of this paper is the Workplace Panel Survey by Korea Labor Institute. The survey is done every other year from 2005 and studies total 4985 establishments, both listed and private, in Korea. The survey covers a various factors about employees, for example, the types of labor, the number of employees in each type or level, average wage in each type, the kinds of tasks done by each type of labor, and workplace safety.

Table 1 shows the distribution of the observations in each industry and year and the summary statistics of the data. This paper restricts the sample to the manufacturing industry given the empirical design that I take in the following section is applicable only for that industry.

2.2 Preliminary results

2.2.1 Industrial accidents and contractor

In this paper, I study whether the customer firms' risky working environment has spillover effects on the labor suppliers (contractor). However, it is hard to argue the spillover effects

by studying the relationship between injuries among the in-house labor and contractor. This is because, contractor could be better at monitoring risky jobs so that the contractor could have less injury rates even though the working environment is poor.

In this paper, I rather study the relationship between the injured employees of the customer firms and the decision of the use of contractor. If the firms reduce the in-house labor and increase contractor as the workplace becomes riskier, it implies the firms reduce the exposure of the in-house labor on risky working environment and increase such exposure for the contractor. Also, if the the use of contractor is concentrated on the blue-collar workers rather than the workers in monitoring position, it would rule out the argument that the customer firms contract out the risky tasks to utilize the efficiency of monitoring risky tasks in the small firms.

Panel A of Table 3 shows the positive relationship between the number of injured in-house labor on the use of contractor in the first two columns. In the next two columns, it shows that the relationship is stronger for the number of blue-collar contractor, who are more likely to be exposed to the risky working environment than the white-color workers. On the other hand, the number of non-manager in-house labor decreases, as it is shown in the last two columns.

2.2.2 Cross-sectional test - Labor union

Next, I study whether the relationship between injury rates and the use of contractor differs by the existence of labor union in the customer firms. If the firms increased the use of contractor to minimize the labor cost, the firms with labor union are more likely to adjust their decision on injury rates. Employees with labor union have higher bargaining power,

so that, when the injury rates increase, they would argue for higher risk-wage premium. Therefore, the customer firms would hire more contractor to avoid risk-wage premium.

Panel B of Table 3 shows how the relationship between workplace risk and the use of contractor differs by the existence of labor union in the establishments. Following my prediction, the number of injured in-house labor is positively related to the number of contractor only if the establishments have labor unions.

2.2.3 Industrial accidents and wage of contractor

Lastly, if the firms increase contractor to save labor cost which might be increased by the risk-wage premium, the contractor should be paid less by the increase in injury rate of the customer firms. As shown in the panel C of Table 3, the workplace risk of the customer firms have negative impact on the average wage of contractor. The results imply that the customers firms make decision of the use of contractor to save the wage cost, consistent with the previous literature (Abraham and Taylor (1996)).

3 Empirical design

The relationship between industrial accidents and the firms' use of contractor could be driven by the other factors, for example, the financial condition of the firms. According to Cohn and Wardlaw (2016) and Boone et al. (2011), the poor financial condition of the firms is related to the high injury rates of the employee. Also, financially constrained firms would change their operating structure to reduce in-house labor, and increase contractor, to save the labor cost (Abraham and Taylor (1996)). Therefore, in this section, I introduce a unique

empirical setting to rule out the impact of financial condition of firms on the relationship between workplace safety and labor supply chain decisions of the firms.

I rely on the Occupational Health and Safety Act amendment in May 2017, Korea which made labor regulation more stringent. The amendment required the firms to report the details of the contractors and their workplace safety every year. Also, the amendment required the integrated fatality rate to be available to the public if fatality rate of the contractors is higher than that of the in-house workers. The amended law started being executed from October 19, 2017. Considering that the legislative notice was out in May 19, 2016 and Presidential Decree was amended already in October, 2016, I define the post-event period as from 2017 to make the experiment conservative.

The affected establishments are the ones with more than 500 workers, including both in-house workers and contractors, in manufacturing and rail industry[4]. In this regulation, contractors share the same workplace with the permanent workers. The sample is limited to the firms in manufacturing industry in this paper, given the rail industry is mostly held by government.

The law amendment allowed investigation on the firms and its contractor regardless of industrial accidents as the Department of Labor required all the affected establishments to fill out certain form of document including the list of contractors and their industrial accidents each year. On the other hand, there was no specific changes on investigations for in-house labors' workplace safety.[5]

[4]Korean government announced that it aims to expand the investigation on all establishments with subcontracted labor by 2022. The government argued that no further investigation was needed for other industries for different reasons. For example, in construction industry, the integrated injury rates were already required if the firms apply for public prosecutions. Also, in service industry, the subcontractor is less common (around 10%) than manufacturing (24.4%) or transportation (22.7%) industry in 2016.

[5]Financial burden for the regulation change was limited as the fine for ignoring the report is 10 million

I argue that the regulation change increased the incentive for the firms to adjust the labor structure. The regulation extended the liability of the firms over the workplace safety of contractors. Assuming that the firms do want to keep the in-house industrial accidents low, the firms would invest more on keeping workplace safe. The savings of risk-wage premium that the firms could realize by using the contractors reduce as the cost of keeping workplace safe increase. Therefore, the firms would be less likely to use the contractors after the regulation change.

In sum, using the change in regulatory enforcement, this paper studies whether the increased liability of the firms over the workplace safety affects the firms' decision on the use of contractor. Treated firms are defined as the ones with 500 workers both in 2016 and 2017 and the others are defined as the untreated firms.

Treated firms are the ones whose competition over the good contractor increases so that the bargaining power of the contractor on safety enhances after the regulation change. I do not exclude the firms with no contractor before the regulation change from the treated group. Therefore, I do take consider of the possibility of the firms to start using contractor after the the regulation change. On the other hand, the control firms are the ones whose competition over the good contractor do not increase.

Table 2 shows the comparison between control and treated group before the event over the firm characteristics. They are naturally different in terms of firm size, both the size of financial asset and in-house labor. Other financial characteristics are not statistically different between the control and treated firms before 2017. The reason behind this would be that the survey is done over the firms with the firm characteristics that are similar to the

KRW, which is approximately 0.1 million USD.

average of each industry according to Korea Labor Institute.

4 Main results

4.1 Regulation change and the use of contractor

In this section, I provide the empirical evidence that the liability of the firms over the workplace safety influences the manufacturing firms' decision on the use of contractor. The increase in liability of the firms after the regulation change incentivized the firms to change labor supply chain decision to minimize the monitoring cost. The increased monitoring cost to keep the workplace safety reduces the amount of risk-wage premium that firms can realize. Therefore, the firms are less likely to use the contractor than before the liability was increased.

Table 4 shows the results of how the labor decision changes after the regulation change in two different ways: difference-in-differences (Panel A) and regression discontinuity design (Panel B). In Panel A, the results show that the manufacturing firms whose monitoring costs of workplace increases after the regulation change are less likely to have contractor (column 1, 2) and more likely to have in-house labor (column 7,8). Such tendency is concentrated on the blue-collar contractor (column 3, 4) and non-manager in-house labor (column 5, 6).

In Panel B, Table 4, the estimation results of regression discontinuity design with the labor decisions as dependent variables. I run the following regression to estimate the impact of regulation change on firms' labor decision.

$$Ln(Contractor)_{i,t} = \alpha + f(Size)_i + \beta_1 Treated_i + Treated_i x g(Size)_i + \epsilon_{i,t} \quad (1)$$

Contractor is the number of contractors in establishment i in year t and size is the running variable of this estimation which is the difference between the number of in-house labor in the establishment i and 500 in 2017. This analysis includes the all data for the parametric estimation. For the robustness check, I estimate using four different models: a linear model, a linear interaction, a quadratic model, and a quadratic interaction model.

Table 5 shows the heterogeneity tests for the Panel A, Table 4. The samples are divided by four ways: history of workplace safety, the existence of labor union, the number of other establishments in the same firms and the existence of large foreign investor. The full estimates are in the Table 7.

I expect the firms with riskier working environment would be more incentivized to adjust the labor structure by the regulation change. The cost to construct the safe working environment would be more expensive for those firms. Riskiness of the working environment is measured by the history of the workplace accidents before 2017. The establishment is defined as safe workplace if the establishment did not have any industrial accidents before 2017 and risky workplace otherwise. First row of Table 5 shows the change in labor structure in the firms with safe or risky working environment. The decrease in the use of contract labor is focused on the establishments with risky working environment, especially for the use of workers in production line. On the other hand, the increase in in-house workers is consistent between the firms with safe and risky working environment.

Next, the firms with labor union are more likely to adjust the labor structure as the

liability on contractors increases. Risk-wage premium to pay for the in-house workers is higher if the workers are unionized therefore those firms with labor union are more likely to use contractors as they can save more amount of risk-wage premium. However, as the regulation change, the monitoring cost by the firms increases on the contractors so that the save of risk-wage premium reduces. Second row in Table 5 shows the cross-sectional test on the existence of labor union in the firms and the change in labor structure. The results show that the establishments with labor union are more likely to reduce the contractors after the regulation change. On the other hand, the increase in in-house workers is higher in the establishments without labor union, which supports the argument that the wage cost is higher with the labor union.

Third, I expect the firms with one establishment rather than multiple establishment are less likely to adjust the labor structure. If the firms have more than one establishment, the production process is less likely to be affected for the labor restructuring as the firms can redistribute the production amount. On the other hand, the firms with only one establishment might be reluctant to adjust the labor structure promptly as the production process might be affected. Third row in Table 5 shows the cross-sectional test on the number of establishments in the firms. The establishment is defined as sole if there is no other establishment for the same firm. The results show that the establishments without any other establishment in the same firm are less likely to adjust the number of contractors after the regulation change. Moreover, non-sole establishments increase the number of in-house workers less than the sole-establishments. This shows that those establishments can stabilize the production process by redistributing the production across the other establishments in the same firm.

Finally, the firms with stronger demand of the corporate social responsibility are less likely to adjust the labor structure after the regulation change. Firms with large foreign investors have long-term view and invest more in human capital (Bena et al. (2017)). The establishment is defined to have foreign investor if the firm has foreign shareholders who hold more or equal to 5% of the shareholdings. The last row of Table 5 shows that the labor restructuring is focused on the establishments without foreign investors. Also, those firms increase the in-house workers more to keep the production stable.

4.2 Impact on operating efficiency, investment and financing cost

In this section, I explore the how the operating efficiency, investment and financing condition change as the incentive of the firms to restructure the labor enhances. The firms with poor existing working environment would pay more to restructure, given that they need to pay more risk-wage premium. Along with the cross-sectional results on working environment in Table 5, I test the change in operating efficiency and financing condition on the existing working environment after the regulation change.

First four columns of Table 6 show that the firms with poor working environment increase the investment on the safety of workplace which leads to the higher capital expenditure. However, the increase is weakly significant which supports that the firms might adjust the labor structure rather than adjust the investment on the workplace safety. This argument is further supported by the reduce in investment, shown in column 5 and 6 in the same table.

Last two columns in Table 6 show that the affected customer firms pay higher interest expense after the regulation change. Such tendency is focused on the customer firms with

bad workplace safety history. The results show that the increased liability of the firms affects the operating risk of the firms so that the financing cost for new debt increases. Overall, the results imply that the employee welfare not only affects firms' operating decisions but also affects the financing condition.

5 Conclusion

This paper provides evidence that the firms decision on labor supply chain is affected by the workplace safety. Such relationship is driven by the low liability of the firms over the workplace safety. The distinction of the bargaining power allows the customer firms to reduce risk-wage premium and the risk of getting poor reputation. The results rule out the argument that the customer firms contract out risky jobs to small firms for better efficiency of monitoring workplace safety of the small firms.

Furthermore, this paper provides a little evidence on the discrimination against low-skilled workers. contractor is mostly low-skilled and less educated workforce. They are not paid enough risk premium because of low bargaining power. However, when their bargaining power increases, they are more likely to lose their jobs. In sum, increase in monitoring enforcement by the government is not enough to improve the working condition of the low-skilled workers in the society.

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Table 1: Summary statistics

This table shows the summary statistics of the data. Panel A shows the distribution of the observations (establishments) over the manufacturing industry and the number of in-house labors. Panel B shows the summary statistics of the variables that are used in this paper for analysis. Leverage is the ratio of total debt over total asset, tangible/asset is the ratio of tangible asset over the total asset, and profit margin is operating income over the sales.blue-collar contractor is the number of contractor who work for manual or simple tasks. Injured in-house labor is the number of in-house labors who are injured by the industrial accidents in the establishment. Ratio of injured in-house labor is the ratio of the number of injured in-house labor over the total number of in-house labor. Labor union is a dummy variable which is 1 if a establishment has a labor union and the employees are the member of that or zero otherwise. All the financial variables are winsorized on 0.1%.

Panel A: Distribution of the observations

	Employees				
	30-99	100-299	300-499	Over 500	Total
Total	1,652(6.0)	961(15.3)	643(74.8)	660(81.5)	3,916(11.0)
Manufacturing					
Light Industry	207(5.4)	119(15.3)	95(84.8)	59(95.2)	480(10.0)
Chemical Industry	140(5.7)	98(18.0)	74(88.1)	56(86.2)	368(11.7)
Metal, Automobile, Transportation	214(4.6)	214(4.6)	75(74.3)	99(85.3)	504(8.7)
Electric, Electronic, Precise	147(6.3)	116(13.1)	75(74.3)	99(85.3)	504(8.7)

Panel B: Summary statistics

	N	Mean	std	Min	Med	Max
Ln(Total asset)	5,349	11.10	11.10	1.386	18.86	18.86
Ln(In-house labor)	6,256	4.839	4.839	0.693	9.405	9.405
Ln(contractor)	6,256	0.603	0.603	0	9.490	9.490
Ln(blue-collar contractor)	2,652	0.408	0.408	0	9.325	9.325
Leverage	5,340	1.160	1.160	0	2,294	2,294
Profit margin	5,385	0.0386	0.0386	-0.599	0.415	0.415
Sales/Total asset	5,345	1.231	1.231	0.0790	6.316	6.316
Tangible/Asset	5,333	0.374	0.374	0.00144	0.935	0.935
Injured in-house labor	4,724	1.328	1.328	0	300	300
Ratio of injured in-house labor	4,114	0.00521	0.00521	0	1	1
Labor union	6,256	0.288	0.288	0	1	1

Table 2: Validity check

This table shows the comparison between control and treated group before 2017 in the data in terms of firm characteristics. Leverage is the ratio of total debt over total asset, tangible/asset is the ratio of tangible asset over the total asset, and profit margin is operating income over the sales. All financial variables are winsorized in top 1%.

	Control	Treated	Diff	(t-stat)
Ln(Total asset)	10.678	13.784	3.105	(-30.310)
Ln(In-house labor)	4.583	6.695	2.111	(-43.375)
Ln(contractor)	0.571	1.729	-1.158	(-12.885)
Leverage	0.582	0.467	-0.114	(0.892)
Tangibility	0.403	0.357	-0.0460	(0.808)
Profit margin	0.021	0.034	0.013	(-0.227)
N	2249	354		

Table 3: Workplace risk and the use of contractor

This table shows the preliminary test results on the relationship between workplace risk and the use of contractor. Riskiness of the workplace is measured as the number of injured in-house labor in the year. Panel B shows the cross-sectional test on the relationship between workplace risk and the use of contractor. The sample is divided by the existence of labor union in the establishment. Panel C shows the relationship between the average wage of contractor and the workplace risk of the customer firms. Dummy(Injured) is a dummy variable which is 1 if there is any injured in-house labor in customer firms of the industrial accidents. Injured is the number of injured in-house labor in customer firms of the industrial accidents. The definition of other financial variables are the same as they are explained in Table 1. All financial variables are winsorized in top 1%.

Panel A: Workplace risk and the use of contractor

	Ln(Number of contractor)		Ln(Number of blue-collar contractor)		Ln(Number of non-manager in-house labor)	
Number of injured in-house labor	0.011** (2.171)	0.011** (1.982)	4.741** (2.348)	4.893** (2.406)	-0.819* (-1.747)	-0.745 (-1.588)
Ln(Total asset)	-0.078 (-0.980)	-0.043 (-0.518)	-0.924 (-0.034)	-6.078 (-0.220)	0.125*** (3.597)	0.117*** (3.331)
Profit margin	-0.065 (-0.193)	-0.164 (-0.476)	11.071 (0.109)	12.596 (0.123)	0.328** (2.447)	0.327** (2.408)
Leverage	0.154 (0.685)	0.146 (0.633)	21.956 (0.274)	23.565 (0.290)	0.090 (0.915)	0.114 (1.144)
Ln(In-house labor)	-0.072 (-0.686)	-0.078 (-0.711)	-19.763 (-0.577)	-26.171 (-0.754)		
Constant	1.864* (1.953)	1.497 (1.499)	109.453 (0.331)	196.127 (0.582)	2.453*** (6.137)	2.524*** (6.219)
Year FE	YES	NO	YES	NO	YES	NO
YearxIndustry FE	NO	YES	NO	YES	NO	YES
Establishment FE	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.350	0.355	0.077	0.079	0.893	0.895
Observations	3,490	3,471	1,690	1,688	2,878	2,873

Panel B: Labor union and the relationship between workplace risk and the use of contractor

	Ln(Number of contractor)				Ln(Number of blue-collar contractor)			
Labor union	No	Yes	No	Yes	No	Yes	No	Yes
Number of injured	-0.001	0.014*	0.000	0.014	-0.002	0.075**	-0.002	0.090**
in-house labor	(-0.097)	(1.698)	(0.051)	(1.633)	(-0.198)	(2.065)	(-0.258)	(2.424)
Ln(Total asset)	-0.102	-0.050	-0.058	0.158	0.138	-0.347	0.106	-0.559
	(-1.515)	(-0.225)	(-0.838)	(0.628)	(1.294)	(-0.503)	(0.975)	(-0.759)
Profit margin	0.209	-1.188*	0.246	-1.782**	0.208	-1.274	0.207	-0.847
	(1.311)	(-1.669)	(1.519)	(-2.127)	(0.939)	(-0.799)	(0.927)	(-0.494)
Leverage	-0.006	0.022	0.016	0.040	0.479**	-2.135*	0.461*	-1.801
	(-0.122)	(1.034)	(0.271)	(1.560)	(1.987)	(-1.652)	(1.900)	(-1.312)
Ln(In-house labor)	0.019	-0.283	-0.013	-0.254	-0.157	0.156	-0.188	0.001
	(0.211)	(-1.072)	(-0.145)	(-0.850)	(-1.076)	(0.304)	(-1.262)	(0.003)
Constant	1.335*	3.718	1.012	0.860	-0.725	5.465	-0.248	8.844
	(1.873)	(1.218)	(1.372)	(0.243)	(-0.597)	(0.585)	(-0.200)	(0.891)
Year FE	YES	NO	YES	NO	YES	NO	YES	NO
YearxIndustry FE	NO	YES	NO	YES	NO	YES	NO	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.378	0.294	0.393	0.275	0.332	0.300	0.336	0.315
Observations	2,255	1,172	2,242	1,136	1,202	446	1,202	442

Panel C: Workplace risk of the customer firms and the wage of contractor

	Average wage of contractor			
Dummy(Injured)	-0.057***	-0.047**		
	(-3.084)	(-2.045)		
Injured			-0.007**	-0.005
			(-2.070)	(-1.057)
Ln(Total asset)	-0.011	-0.020	-0.022	-0.021
	(-0.626)	(-0.957)	(-1.006)	(-0.795)
Profit margin	0.017	0.011	0.073	-0.116
	(1.489)	(0.596)	(0.706)	(-0.737)
Leverage	0.033	-0.042	0.032	-0.048
	(0.617)	(-0.592)	(0.415)	(-0.465)
Ln(In-house labor)	-0.025	-0.043*	-0.052*	-0.069*
	(-1.214)	(-1.684)	(-1.784)	(-1.780)
Constant	1.102***	1.344***	1.354***	1.469***
	(4.707)	(4.650)	(4.674)	(4.127)
Year FE	YES	NO	YES	NO
YearxIndustry FE	NO	YES	NO	YES
Establishment FE	YES	YES	YES	YES
Observations	628	577	490	445
Adjusted R-squared	0.212	0.176	0.167	0.101

Table 4: Liability extension and the use of contractor

Both Panel A and Panel B show the estimates of the regression with number of contract and in-house labor as dependent variables. Panel A shows the estimates of the difference-in-differences analysis and Panel B shows the estimates of regression discontinuity design. Treated is a dummy variable which is 1 if the establishment has more than 500 in-house labors in 2016 and 2017 and zero otherwise. Post is a dummy variable which is 1 if the year is 2017 and zero otherwise. Definition of other firm characteristics are the same as Table 1. All financial variables are winsorized in top 1%.

Panel A: Difference-in-differences

	Ln(Number of contractor)		Ln(Number of blue-collar contractor)		Ln(Number of non-manager in-house labor)		Ln(Number of in-house labor)	
Treated x Post	-0.553***	-0.478***	-0.366**	-0.248	0.175***	0.158***	0.155**	0.149**
	(-3.325)	(-2.776)	(-2.118)	(-1.403)	(4.762)	(4.205)	(2.409)	(2.283)
Ln(Total asset)	-0.052	-0.029	0.131	0.097	0.238***	0.217***	0.232***	0.199***
	(-0.677)	(-0.365)	(0.964)	(0.707)	(14.555)	(12.878)	(8.053)	(6.711)
Profit margin	-0.018	-0.038	0.052	0.031	0.066***	0.067***	0.022	0.006
	(-0.196)	(-0.402)	(0.180)	(0.106)	(3.180)	(3.209)	(0.596)	(0.156)
Leverage	0.020	0.022	0.182	0.212	0.011***	0.010***	0.009*	0.007
	(1.545)	(1.639)	(0.590)	(0.685)	(3.927)	(3.540)	(1.757)	(1.484)
Ln(In-house labor)	0.062	0.080	-0.071	-0.083				
	(0.666)	(0.827)	(-0.412)	(-0.481)				
Constant	0.952	0.599	-0.741	-0.325	2.244***	2.475***	1.352***	1.722***
	(1.115)	(0.669)	(-0.450)	(-0.194)	(12.272)	(13.135)	(4.177)	(5.174)
Year FE	YES	NO	YES	NO	YES	NO	YES	NO
YearxIndustry FE	NO	YES	NO	YES	NO	YES	NO	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.341	0.339	0.332	0.340	0.934	0.936	0.871	0.875
Observations	3,453	3,439	1,690	1,688	3,453	3,439	3,357	3,343

Panel B: Regression discontinuity design

Model	Linear	Linear interaction	Quadratic	Quadratic interaction
			Ln(contractor)	
Treated	0.082	-0.473**	-0.415**	-0.268
	(0.500)	(-2.180)	(-2.069)	(-1.219)
Constant	0.558***	0.921***	0.925***	1.492***
	(9.862)	(8.483)	(9.068)	(8.606)
Observations	1,215	1,215	1,215	1,215
Adjusted R-squared	0.039	0.051	0.053	0.065
			Ln(Blue-color contractor)	
Treated	0.059	-0.471**	-0.410**	-0.278
	(0.372)	(-2.254)	(-2.124)	(-1.311)
Constant	0.525***	0.871***	0.871***	1.412***
	(9.631)	(8.332)	(8.864)	(8.454)
Observations	1,215	1,215	1,215	1,215
Adjusted R-squared	0.035	0.046	0.048	0.060

Table 5: Heterogeneity tests

This table shows the heterogeneity tests for the Panel A, Table 4. The samples are divided by four different ways: history of workplace safety, the existence of labor union, the number of other establishments in the same firms and the existence of large foreign investor. The establishment is defined as safe workplace if the establishment did not have any industrial accidents before 2017 and risky workplace otherwise. The establishment is defined as sole if there is no other establishment for the same firm. The establishment is defined to have foreign investor if the firm has foreign shareholders who hold more or equal to 5% of the shareholdings. All financial variables are winsorized in top 1%.

	Ln(Number of contractor)		Ln(Number of blue-collar contractor)		Ln(Number of non-manager in-house labor)		Ln(Number of in-house labor)	
	Workplace							
	Safe	Risky	Safe	Risky	Safe	Risky	Safe	Risky
Treated x Post	-0.200	-0.693***	-0.099	-0.585*	0.187***	0.172***	0.232***	0.196**
	(-0.995)	(-2.809)	(-0.493)	(-1.910)	(3.094)	(3.659)	(2.678)	(2.509)
	Labor union							
	No	Yes	No	Yes	No	Yes	No	Yes
Treated x Post	0.059	-0.719**	0.012	-0.583*	0.256***	0.183***	0.393***	0.137**
	(0.263)	(-2.370)	(0.048)	(-1.825)	(3.257)	(4.554)	(3.333)	(1.971)
	Sole establishment							
	Yes	No	Yes	No	Yes	No	Yes	No
Treated x Post	-0.044	-0.617***	-0.024	-0.415*	0.405***	0.125***	0.382***	0.159**
	(-0.146)	(-2.663)	(-0.080)	(-1.799)	(4.856)	(2.986)	(3.003)	(2.166)
	Foreign investor							
	Yes	No	Yes	No	Yes	No	Yes	No
Treated x Post	0.042	-1.371***	0.222	-1.564***	0.149***	0.220***	0.139*	0.326***
	(0.206)	(-2.997)	(1.129)	(-3.148)	(3.031)	(3.360)	(1.760)	(2.779)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 6: Operating efficiency

This table show whether the operating performance and the financing cost changes as the liability of the firms over workplace safety increases over the workplace safety. Investment on working environment is scaled by total asset. CAPX is the change in tangible asset scaled by total asset. R&D is the cost of investmetn in RD scaled by total asset. Interest expense is scaled by total debt. Treated is a dummy variable which is 1 if the establishment has more than 500 in-house labors in 2016 and 2017 and zero otherwise. Post is a dummy variable which is 1 if the year is 2017 and zero otherwise. Definition of other firm characteristics are the same as Table 1. All financial variables are winsorized in top and bottom 1%.

	Investment on working environment		CAPX		R&D		Interest expense	
Treated x Post x Risky	0.010*	0.011*	0.035*	0.030	-0.005**	-0.004*	0.004**	0.005**
	(1.686)	(1.744)	(1.694)	(1.444)	(-2.170)	(-1.654)	(2.036)	(2.317)
Treated x Post	-0.002	-0.003	-0.037**	-0.038**	0.003**	0.003*	0.000	-0.000
	(-0.673)	(-0.964)	(-2.141)	(-2.190)	(2.306)	(1.781)	(0.022)	(-0.291)
Post x Risky	-0.007	-0.006	0.002	0.000	0.002**	0.001	-0.001	-0.001
	(-1.190)	(-1.053)	(0.227)	(0.026)	(1.973)	(1.021)	(-1.095)	(-1.357)
Ln(Total asset)	-0.008	-0.009	0.051***	0.051***	-0.002	-0.003*	-0.003*	-0.003*
	(-1.084)	(-1.089)	(6.068)	(6.102)	(-1.536)	(-1.653)	(-1.761)	(-1.808)
Profit margin	0.012	0.010	0.105***	0.099***	-0.002	-0.001	-0.002	-0.002
	(1.147)	(0.972)	(2.930)	(2.726)	(-0.571)	(-0.191)	(-0.349)	(-0.414)
Leverage	0.021*	0.018	0.046*	0.042*	0.001	0.001	0.003	0.003
	(1.719)	(1.472)	(1.856)	(1.707)	(0.241)	(0.236)	(0.675)	(0.723)
Constant	0.081	0.090	-0.582***	-0.585***	0.031**	0.036**	0.049***	0.049***
	(1.017)	(1.041)	(-6.364)	(-6.374)	(2.000)	(2.092)	(2.686)	(2.743)
Observations	1,684	1,682	2,540	2,534	2,545	2,539	2,432	2,423
Adjusted R-squared	0.029	-0.005	0.187	0.173	0.812	0.807	0.652	0.647
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	NO	YES	NO	YES	NO	YES	NO
YearxIndustry FE	NO	YES	NO	YES	NO	YES	NO	YES

Table 7: Appendix. Heterogeneity tests

This table shows the full estimates of the Table 5.

	Ln(Number of contractor)		Ln(Number of blue-collar contractor)		Ln(Number of non-manager in-house labor)		Ln(Number of in-house labor)	
	Workplace							
	Safe	Risky	Safe	Risky	Safe	Risky	Safe	Risky
Treated x Post	-0.200	-0.693***	-0.099	-0.585*	0.187***	0.172***	0.232***	0.196**
	(-0.995)	(-2.809)	(-0.493)	(-1.910)	(3.094)	(3.659)	(2.678)	(2.509)
Ln(Total asset)	-0.028	-0.140	0.127	0.061	0.259***	0.197***	0.233***	0.184***
	(-0.305)	(-1.307)	(1.024)	(0.151)	(9.772)	(9.938)	(6.100)	(5.622)
Profit margin	0.207	-0.190	0.328	-1.501	0.388***	-0.075	0.534***	0.007
	(0.624)	(-0.372)	(0.699)	(-1.099)	(3.886)	(-0.772)	(3.589)	(0.042)
Leverage	0.099	-0.071	0.336	-0.848	-0.237***	0.052	-0.269**	-0.075
	(0.380)	(-0.227)	(0.853)	(-0.935)	(-3.007)	(0.872)	(-2.367)	(-0.758)
Ln(In-house labor)	0.039	0.135	-0.045	-0.320				
	(0.351)	(0.938)	(-0.273)	(-0.507)				
Constant	0.396	1.994	-1.052	2.233	1.973***	2.883***	1.739***	2.626***
	(0.407)	(1.516)	(-0.716)	(0.401)	(6.910)	(12.091)	(4.215)	(6.660)
Observations	1,730	1,723	1,180	510	1,730	1,723	1,692	1,703
Adjusted R-squared	0.235	0.367	0.209	0.388	0.919	0.937	0.866	0.862
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES
	Labor union							
	No	Yes	No	Yes	No	Yes	No	Yes
Treated x Post	0.059	-0.719**	0.012	-0.583*	0.256***	0.183***	0.393***	0.137**
	(0.263)	(-2.370)	(0.048)	(-1.825)	(3.257)	(4.554)	(3.333)	(1.971)
Ln(Total asset)	-0.082	-0.204	0.128	-0.164	0.267***	0.105***	0.242***	0.106**
	(-1.315)	(-1.115)	(1.238)	(-0.254)	(12.922)	(4.344)	(7.752)	(2.516)
Profit margin	0.226	-0.648	0.377	-1.872	0.158*	0.121	0.215	0.296
	(0.901)	(-0.735)	(0.970)	(-1.037)	(1.817)	(1.028)	(1.597)	(1.447)
Leverage	0.208	-0.520	0.550*	-3.092**	-0.119*	0.002	-0.221**	-0.005
	(1.154)	(-0.997)	(1.788)	(-2.123)	(-1.890)	(0.035)	(-2.306)	(-0.040)
Ln(In-house labor)	0.042	0.298	-0.154	0.343				
	(0.547)	(1.124)	(-0.993)	(0.700)				
Constant	0.866	2.564	-0.686	2.696	1.771***	4.414***	1.547***	3.996***
	(1.352)	(0.960)	(-0.570)	(0.312)	(8.138)	(13.719)	(4.707)	(7.175)
Observations	2,287	1,121	1,202	446	2,287	1,121	2,233	1,117
Adjusted R-squared	0.322	0.266	0.329	0.297	0.888	0.940	0.803	0.848
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES

	Sole establishment							
	Yes	No	Yes	No	Yes	No	Yes	No
Treated x Post	-0.044	-0.617***	-0.024	-0.415*	0.405***	0.125***	0.382***	0.159**
	(-0.146)	(-2.663)	(-0.080)	(-1.799)	(4.856)	(2.986)	(3.003)	(2.166)
Ln(Total asset)	-0.135*	-0.081	-0.057	0.205	0.304***	0.106***	0.314***	0.092**
	(-1.667)	(-0.634)	(-0.351)	(1.027)	(14.818)	(4.619)	(9.941)	(2.290)
Profit margin	0.194	-0.252	0.698	-0.629	0.017	0.056	0.178	0.119
	(0.638)	(-0.408)	(1.464)	(-0.700)	(0.208)	(0.502)	(1.349)	(0.605)
Leverage	-0.026	-0.134	-0.020	0.190	-0.151***	0.100	-0.260***	-0.029
	(-0.125)	(-0.337)	(-0.057)	(0.254)	(-2.634)	(1.398)	(-2.911)	(-0.233)
Ln(In-house labor)	-0.007	0.188	-0.059	-0.087				
	(-0.066)	(1.200)	(-0.308)	(-0.283)				
Constant	1.725**	1.057	1.075	-1.467	1.471***	4.026***	0.916***	3.787***
	(2.259)	(0.607)	(0.639)	(-0.511)	(7.136)	(13.708)	(2.878)	(7.372)
Observations	1,630	1,743	806	842	1,630	1,743	1,598	1,718
Adjusted R-squared	0.329	0.297	0.398	0.267	0.927	0.927	0.872	0.833
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES
	Foreign investor							
	Yes	No	Yes	No	Yes	No	Yes	No
Treated x Post	0.042	-1.371***	0.222	-1.564***	0.149***	0.220***	0.139*	0.326***
	(0.206)	(-2.997)	(1.129)	(-3.148)	(3.031)	(3.360)	(1.760)	(2.779)
Ln(Total asset)	-0.085	0.083	0.143	0.419	0.234***	0.115***	0.227***	0.089
	(-1.140)	(0.318)	(1.256)	(0.419)	(13.434)	(3.089)	(8.139)	(1.340)
Profit margin	-0.183	0.745	0.196	0.929	0.086	-0.028	0.301**	-0.317
	(-0.606)	(0.586)	(0.446)	(0.377)	(1.168)	(-0.154)	(2.505)	(-0.947)
Leverage	0.024	0.506	0.105	4.352	-0.081	0.007	-0.162*	-0.160
	(0.112)	(0.631)	(0.305)	(1.492)	(-1.569)	(0.057)	(-1.937)	(-0.770)
Ln(In-house labor)	0.079	0.044	-0.116	-0.883				
	(0.845)	(0.123)	(-0.742)	(-0.882)				
Constant	1.054	-0.126	-0.720	-0.772	2.231***	4.393***	1.843***	4.337***
	(1.304)	(-0.033)	(-0.525)	(-0.055)	(11.688)	(8.635)	(6.015)	(4.751)
Observations	2,794	523	1,382	148	2,794	523	2,737	522
Adjusted R-squared	0.313	0.344	0.372	0.340	0.924	0.935	0.851	0.862
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Establishment FE	YES	YES	YES	YES	YES	YES	YES	YES