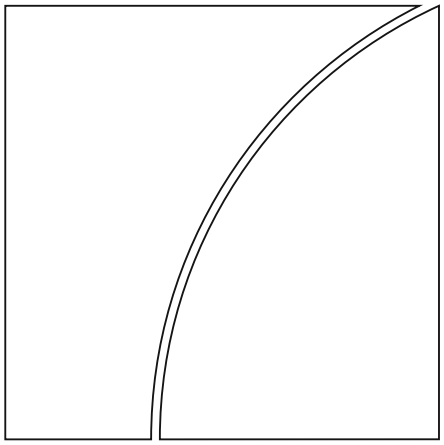

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Monetary and Economic Department

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How much do firms need to satisfy employees? – Evidence from credit spreads and online employee reviews *

Koji Takahashi† and Sumiko Takaoka‡

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Abstract

Using employee reviews accumulated in online platform service and ESG scores, this paper studies the relationship between firms' workforce benefits and their credit risk. We provide evidence that the sign of the effect of employee treatment on credit spreads depends on the sectoral intensity of human capital. In a sector with high intensity of human capital, especially in the manufacturing sector, more generous benefits for workers lead to lower credit spreads. In contrast, in a sector with low intensity, they are associated with larger credit spreads. We also find evidence that the lowering effect on credit spreads in sectors with high human capital intensity is mainly due to increased labor productivity.

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Keywords: Employee satisfaction, Online employee review, Credit risk, Labor risk

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1 Introduction

The relationship between employees and firms has been a major social and economic issue for more than a century, and it currently attracts increasing interest from the media, policymakers, and researchers in discussions on environmental, social, and corporate governance (ESG) issues. Particularly, owing to the rapid development of information technology, information transparency in the working environment has increased substantially. In addition to the ESG scores provided by analysis firms, voluntary disclosure of an employee's evaluation of their workplace on an online platform, that is, online employee reviews, enables the quantification of employee satisfaction at the firm level. Against this backdrop, the link between working environment and corporate performance has been studied extensively. Previous studies have proposed two seemingly conflicting views on this link. On the one hand, they find that employee satisfaction seems to run high with wages, benefits, and job security; thereby, firms can retain workers or raise workforce motivation and commitment, which is called fair wage-effort hypothesis. On the other hand, a growing number of studies emphasize that high labor compensation, the main expense for firms, can lead to high labor leverage and higher credit risk (Favilukis et al. (2020)). Therefore, the relationship between employee benefits and firm performance remains controversial, and several questions remain unanswered. For example, to what extent do firms need to satisfy their employees? Furthermore, considering labor-induced operating leverage, does employee satisfaction impact a firm's credit risk, and if so, does it increase or decrease it? To address these questions, we examine the impact of employee satisfaction on credit spreads by focusing on which hypothesis—fair wage-effort or labor leverage hypothesis—is more plausible to explain the relationship between credit risk and employee satisfaction.

More specifically, the fair wage-effort hypothesis or efficiency wage model highlights the discrepancy between the actual wage and the fair wage. It assumes that a worker has a preconceived notion of what a fair wage should be. Then, if the worker's actual wage falls below the fair wage, they may adjust their effort to compensate for the discrepancy. Although we cannot observe the gap between the actual and fair wages at the worker level, the external evaluation of employee treatment at the firm level is observable as a social aspect ESG score (workforce score). In addition, the actual employee evaluation can be obtained from online employee reviews. Thus, we can calculate the firm-level GAP (hereafter GAP) between a worker's review score and the firm's

workforce score. We assume that if the GAP is positive (negative), workers are (dis)contented with what the firm is willing to pay.[1]

According to the fair wage-effort hypothesis, workers who think they are worth more than their salary reduce their effective labor power. Therefore, a positive GAP leads to more productive workers, and a firm's credit risk is lower, with less shirking, absenteeism, and strike risk. Meanwhile, the high labor compensation results in a rise in labor-induced operating leverage and increases the firm's credit risk according to the findings in Favilukis et al. (2020). This study tests the validity of the two opposing but not mutually exclusive views by comparing workers' perceived level and the firm's disclosed level of employee treatment. More concretely, as the actual online evaluation, we calculate the measure of employee satisfaction at the firm level based on the data from OpenWork[2], which provides online employee reviews for jobs, such as evaluation scores, salary information, and overtime hours. Among the available scores, we use employee Net Promoter Score (hereafter NPS), which is based on a question asking employees to rate the likelihood that they would recommend a company to a friend or family.[3]

By exploiting the detailed employee online reviews, we find that an increase in the firm-level GAP lowers credit spreads in high human capital-intensive sectors and increases credit spreads in low human capital-intensive sectors. No impact is observed in the middle human capital-intensive sectors. As for the mechanism of the effect, we provide evidence that an increase in the GAP of firms in high human capital-intensive sectors improves the labor productivity of the firms while that of firms in low-intensive sectors does not. These results suggest that in low-intensive sectors, the cost of generous employee treatments outweighs their benefits, thereby increasing credit risks. In Japan, where the labor market is characterized by an implicit contract of lifetime employment, unemployment remains consistently low—even during the COVID-19 pandemic period, with rates at 2.8% in 2020 and 2021, compared to 8.0% and 7.7% in the Euro area and 8.1% and 5.4% in the U.S. for 2020 and 2021, respectively.[4] Our finding from a country with such stable employment, where employee satisfaction seemingly does not matter, suggests that the importance of employee

[1] See section 3.2 for the detailed discussion on the plausibility of ESG workforce score as an external evaluation of employee treatments.

[2] https://www.openwork.co.jp/en

[3] Reichheld (2003) finds that the response to a question of whether users recommend service or goods to others captures useful information about the quality perceived by users. In fact, in Section 4, we show that NPS well summarizes different aspects of working environments.

[4] According to OECD Data.

satisfaction for credit spreads would be larger in other countries with higher labor mobility.

This study contributes to the recent literature on labor and asset prices, specifically credit risk. The macroeconomic literature explores the association between the labor market or labor friction and credit risk (Gilchrist et al. (2009), Gilchrist and Zakrajšek (2012), Faust et al. (2013), Bleaney et al. (2016), Gilchrist and Mojon (2018), and Okimoto and Takaoka (2022)). These studies focus on the predictive content of credit spreads for macroeconomic fluctuations. We extend this strand of literature by providing evidence that online employee reviews, a proxy for employee benefits and costs of labor, can affect credit spreads.

This paper is also related to another long strand of literature on the effect of employee treatment on firm performance. The positive effect of employee-friendly treatment on firm performance has been studied extensively (e.g., Akerlof and Yellen (1988), Akerlof and Yellen (1990), Clark and Oswald (1996), Gneezy and Rustichini (2000), Cohn et al. (2015), Chen et al. (2016) and Shan and Tang (2023)).[5] In particular, this literature focuses on the role of employee treatment as a tool for retaining skilled labor. As labor market frictions incur labor adjustment costs, including search, selection and hiring, and training costs, retaining skilled employees with generous benefits can be optimal for firms (e.g., Akerlof (1982) and Zingales (2000)). Few studies have investigated the relationship between employee treatment and credit risks. Among them, Chen et al. (2019) find that a higher ESG workplace score decreases the credit spread of corporate bonds. Although our paper is closely related to Chen et al. (2019), our paper utilizes the employees' review instead of ESG scores. ESG scores are calculated mainly based on external evaluation and might not reflect the actual employee treatment. This point recently becomes increasingly important as firms engage in ESG washing.[6] In our analysis, we control for ESG scores and uncover the effect of actual employee treatment.

On the other hand, previous studies also argue that generous employee benefits would be a result of agency problems between managers and stockholders, where, by providing employee-friendly treatment, managers enjoy private benefits, such as decreasing costs involving wage bargaining with employees (e.g., Cronqvist et al. (2009) and Bertrand and Mullainathan (2003)). If the overinvestment in labor is merely a result of deteriorated agency problems, a high internal

[5]For example, Clark and Oswald (1996) report that the peer workers' salary is an important determinant of the fair wage and Gneezy and Rustichini (2000) find that contract form would matter for the relationship between a sufficiently high payment and payees' efforts using experiments.

[6]See for example, Delmas and Burbano (2011).

reputation of the working environment by employees implies lower productivity and higher credit costs.

We add new insights to the literature by showing that the sign of the effect of employee treatment depends on the intensity of human capital in each sector, suggesting that these explanations do not contradict each other.

Additionally, this study provides a new perspective on the growing literature regarding utilizing information accumulated in online platform services to study the effect of the workforce environment on the economy. Among others, Dube and Zhu (2021) show that increasing pressure in workplace transparency through an online review platform affects firms' workforce practices, whereas the utilization of employees' satisfaction surveys is not a new approach (Edmans et al. (2014)). In particular, this study is closely related to a few studies that have investigated the impact of the workforce environment on firm performance using Japanese online workplace reviews (Openwork), including Nishie and Tsuda (2018) and Nishie and Nagao (2021). However, prior studies have mainly focused on the relationship between employee reviews and firm performance or stock returns. More specifically, these studies did not pay much attention to the interaction effect with external reputation or evaluation by third parties, such as ESG scores, which are extensively used in financial markets as an index for the progressiveness of firms' actions and systems taken in ESG fields (see, for example, Giese et al. (2019)). In this study, we provide evidence that the gap between employees' reviews and ESG workforce scores can serve as a proxy for the gap between actual employee treatment and what is expected externally as fair treatment for the firm. This finding aligns with the discussion on noise in ESG scores suggested by Berg et al. (2022) and sheds light on its relationship with firms' credit risks.

The remainder of this paper is organized as follows: Section 2 describes the empirical testing of the hypotheses. Section 3 describes the data and variable construction. Section 4 investigates the determinants of the two scores and GAP. Section 5 reports the main analysis of the effect on credit spreads. The final section offers concluding remarks.

2 Hypothesis

In the labor market, economic models suggest that job dissatisfaction causes damage to companies, such as output restrictions, defective products, shirking, sabotage, and labor strike risks.

Dissatisfied employees perform poorly as they reduce their efforts, resulting in poor firm performance. In this economic theory of the fair wage-effort hypothesis, the employee's perception of fairness in the workplace is critical as suggested by, for example, Akerlof and Yellen (1988) and Akerlof and Yellen (1990)). This hypothesis is supported by empirical studies, including a field experiment conducted by Cohn et al. (2015). In fact, Figure 1 indicates an upward slope relationship between the average review score per firm and the log of profits per capita based on our online review data. Hence, investors might be concerned about the drop in profitability or productivity of firms with dissatisfied workers.

[Figure 1 around here]

Online employee reviews provide more information on their perception of the workplace in addition to wages, such as motivation, teamwork, openness, chance to grow, and compliance. Even with more available information, it is natural to consider that firms with satisfied workers are less risky because they are free from the above-mentioned risks.

H1: Fair wage-effort hypothesis

As the dissatisfied employees perform less by reducing their efforts, the firm's performance deteriorates. The risk of sabotage, strikes, and product failure also increases the firm's credit risk. In addition, it will fail to minimize turnover and attract new talent, resulting in higher credit risk and credit spreads.

By contrast, we cannot ignore the fact that labor compensation is a major expense for firms as Favilukis et al. (2020) provide theoretical and empirical evidence that the labor leverage effect increases credit risk. An important factor in their underlying mechanism is precomitted wage payments, which make interest payments riskier. Their elaborate model, which incorporates labor market friction and wage rigidity, fits the Japanese labor market, even though their cross-country analysis does not include Japan. For instance, the Japanese labor market's implicit assumption of lifetime employment is a notable feature with both positive and negative effects on firms and the domestic economy (Ito and Hoshi (2020) and Lincoln (1999)). It results in very low unemployment rates and fewer strikes but also increases the burden of labor costs, especially during recessions, as firms can not swiftly fire extra labor forces. Therefore, generous employee treatment does not

necessarily yield a lower credit risk for the firm. Instead, high labor compensation can have an increasing effect on the firm's credit risk.

H2: Labor leverage hypothesis

The firms that spend more on employee treatment are regarded as having high precomitted compensation payments that make interest payments riskier. This leads to higher credit risk in the market and results in higher credit spreads for such firms.

To address this question, we carefully consider the factors of employee satisfaction to derive true employee satisfaction or dissatisfaction in the workplace across sectors. First, we should note that what we look for in a job differs across sectors and firms. For example, when we start to work in a high-tech company, we have different expectations about working treatments and environments from what we have for a job in a supermarket. In addition, we are informed or at least have an expectation of what the workplace would offer us before we decide to work there; thus, job dissatisfaction occurs when employees' expectations for their jobs are not met after they begin to work. It is natural for workers to review and confirm the terms offered by the firm, such as salary, working conditions, benefits, and training systems, which constitute the firm's pre-committed labor compensation.

The workplace environment is reviewed not only by its employees but also by ESG information providers who rate a firm's workforce score as a social issues category due to the increasing interest in ESG matters. This score is calculated from relevant themes, such as working conditions, career development, health and safety, and diversity and inclusion. We assume this workforce score at the firm level as what the firm's management regards their employees as deserving of and, in turn, for employees as what they are expected to be treated in the workplace. Therefore, we consider the gap between the employee's review score (NPS), and the firm's workforce score. This GAP reflects employees' true (dis)satisfaction compared with what they think they deserve, which has contrasting effects on firm credit risk. With a positive GAP, the firm is expected to avoid shirking, minimize turnover, and attract talent (lowering the effect on credit risk); however, the investor can regard that such a firm would have high labor leverage (increasing effect on credit risk). In the following sections, we examine this relationship by considering the industry characteristics.

3 Data and variable construction

3.1 Data

The dataset used in this study mainly consists of employee review site data, firms' ESG, financial data, and credit spreads on corporate bonds in Japan from 2016 to 2021. In addition, we included macroeconomic data.

3.1.1 Online review score

Crowdsourced employee review website data are from OpenWork launched in 2007 (formerly known as Vorkers), which is Japan's largest employee review platform. Similar to Glassdoor, OpenWork provides a platform through which employees can voluntarily and anonymously review their companies and share information. Reviews are manually examined to exclude invalid ones. OpenWork employee reviews contain employees' one-to-five ratings for eight topics such as salaries & benefits, employees motivation, openness and teamwork.[7] Last but not least, they asked employees to rate the likelihood that they would recommend a company as a next workplace to a friend or family on a scale of zero to ten. In this study, we use this answer, NPS, as a variable for the employee satisfaction review score, or simply the employee review score.

We categorized employee review scores into 17 industrial sectors defined by the Securities Identification Code Committee according to the employer firms. The upper panel of Figure 2 plots the average employee review scores by sector on a calendar year basis. There is time-series variation; however, differences in employee review scores across sectors persist. Electric power & Gas, Energy resources, and Automobiles & Transportation equipment are consistently among the top-scoring sectors. In contrast, the average scores for Retail trade and Real estate are the lowest. In labor economics, inter-industry differences are persistently observed in data such as wages, outputs, and productivity (Abowd et al. (2012), Abowd et al. (2018)). Our simple plot illustrates inter-industry differences in employee satisfaction, suggesting a sector-specific work environment. In the empirical analysis, we consider a sector-specific measure.

[Figure 2 around here]

[7] The other four topics are chance to grow for young employees, long-term development of employees, compliance, and employee evaluation system. In addition to these ratings, employees are able to enter nine textual responses: Structure & Culture, Reason for Joining, Work Fulfillment & Growth Opportunities, and Work-Life Balance.

3.1.2 ESG workforce score

For the firm's workforce commitments, we use workforce score provided by Refinitiv (Thomson Reuters)—one of the largest ESG information providers—including MSCI, Sustainalytics, Bloomberg, and RobecoSAM (Boffo and Patalano (2020)). They provide more than 450 different metrics. Among them, the workforce score, calculated from diversity and inclusion, career development and training, working conditions, and health and safety themes, is one of the categories that reformulates the social pillar score. We collect the workforce scores of listed Japanese firms from Datastream. According to the Refinitiv (Thomson Reuters) ESG scoring methodology, which produces a score between 0 and 100, the ESG score including the workforce score measures a company's ESG performance based on verifiable reported data in the public domain. The lower panel of Figure 2 plots the workforce score by sector at the fiscal year-end. Compared with the employee review scores in the upper panel, there is a noticeable difference in that the Electric power & Gas sector, which has one of the highest employee review scores, has one of the lowest workforce scores. As the evaluators of each score are different, it is not surprising that the two plots show different patterns. By contrast, Pharmaceutical, Energy resources, and Automobiles & Transportation equipment sectors received the highest scores. We examine the factors determining these scores in the following section.

3.1.3 Credit spreads

We use credit spreads on corporate bonds as a firm's credit risk variable. For the credit spread calculation, we retrieve individual corporate bond price data from the Japan Standard Bond Price database, including the interest rates, coupon rates, redemption dates, and issue dates of public and private offerings of domestic bonds, foreign bonds, and Eurobonds. This data source provides the most extensive coverage of secondary market prices of corporate bonds publicly issued in the Japanese market. To construct the individual firm's credit spreads, we limit our sample to only straight corporate bonds that are publicly issued in Japan by Japanese corporations. We exclude subordinated corporate bonds and Fiscal Investment and Loan Program agency bonds that the central government guarantees. To ensure that we measure firms' borrowing costs at the same point in their capital structures, our estimation sample of credit spreads is limited to corporate bonds with fixed coupon schedules and bullet bonds with no embedded options, following prior studies. We calculate the annual average of daily credit spreads for individual firms to match the

annual Workforce score.

More specifically, the JGB yield data are calculated by Eikon, which collects market data on JGBs from Tradeweb to calculate the curve. Eikon offers the JGB zero curve data with different maturities, ranging from one month to forty years. If a JGB zero coupon yield is missing for a particular maturity, it is estimated via cubic spline interpolation. Then, we employ the "bottom-up" approach proposed by Gilchrist et al. (2009) and Gilchrist and Zakrajšek (2012) to construct the firm-level credit spread index. With individual corporate and government bond data, credit spreads on corporate bonds are calculated as differences between corporate and government bond yields of the same maturity. Thus, we calculate credit spreads using corporate and government bond yields with exactly the same maturity. Specifically, the credit spread for corporate bond k with maturity m issued by firm i at time t is given by:

$$S_{imt}[k] = y_{imt}[k] - y^f_{mt}[k],$$

and $y_{imt}[k]$ is the yield of corporate bond k with maturity m at year t, while $y^f_{mt}[k]$ is the corresponding government bond yield of the thereafter same maturity at time t.

Given these credit spreads, we calculate the individual firm's credit spreads for bonds from the same firm as:

$$cs_{it} = \frac{1}{N_{it}} \sum_k S_{it}[k],$$

where N_{it} is the number of observations in year t of corporate bonds issued by firm i. That is, an individual firm i's credit spread in a given year is the arithmetic average of the firm's credit spreads for its outstanding bonds. We eliminate extreme observations including bond and month observations with credit spreads greater than 2,000 basis points following previous studies such as Gilchrist and Zakrajšek (2012). As a lower bound, we eliminate observations with credit spreads below zero basis points to avoid including negative credit spreads which are economically nonsensical.

3.1.4 Firm's financial data and macroeconomic variables

The firms' financial data, which include credit ratings and financial indicators to control the firm's financial health and credit quality, are retrieved from Eikon, Datastream, and Osiris databases. We retrieve various financial indicators including the firm's total assets, earnings before interest and taxes (EBIT) margin (EBIT/total revenue), R&D intensity (R&D expenditure/total revenue),

the compound annual growth rate of the number of employees over five years (CAGR employee). For credit risk analysis, we use one-period lagged firm's variables as control variables.

Finally, to analyze the determinants of scores, we incorporate three macroeconomic factors that Wu and Zhang (2008) identify three fundamental risk dimensions underlying an economy: inflation, real output growth, and financial market volatility. The year-on-year growth rate of the consumer price index (CPI) is used as the inflation factor. The data are obtained from the Statistics Bureau of Japan. As a real output growth variable, we use real gross domestic product (GDP) growth (year-on-year) published by the Cabinet Office of the Government of Japan. Finally, we include the percentage change in the Nikkei Volatility Index (year-on-year) as a measure of financial market volatility to capture the compound effect of business risk throughout the economy and financial leverage, following Wu and Zhang (2008).

3.2 Variable construction: GAP

We consider the difference between the employee review and workforce scores for each firm and each year as GAP at the firm level. It should be noted that while the workforce score is between 0 and 100, the employee review score is between 0 and 10. To obtain the employee review score comparable to the ESG workforce score based on the percentile rank, we convert the employee review score into a fractional rank within a year as follows:

Consider firm observations N on the employee review score in each year Y with the associated sampling weights, $(y_i, w_i)_{i=1}^N$. When we have K distinct values observed on Y, denoted as $y_1^* < y_2^* < ... < y_K^*$ and π_k^* the corresponding weighted sample proportions for any value of y_k^*,

$$\pi_k^* = \frac{\sum_{i=1}^N w_i \mathbf{1}(y_i = y_k^*)}{\sum_{i=1}^N w_i}$$

where $\mathbf{1}(condition)$ is unity if the condition is true; otherwise, 0. With no tied observations or sample weights, we have $\pi_k^* = 1/N$. The fractional rank of y_k^* is

$$F_k^* = \sum_{j=0}^{k-1} \pi_j^* + 0.5\pi_{j+1}^*$$

where $\pi_0^* = 0$. Then, the fractional rank is given as

$$F_i = \sum_{k=1}^{K} F_k^* \mathbf{1}(y_i = y_k^*).$$

The tied observations in this analysis do not depend on the order of the data, and the sample size does not affect the sample mean of the fractional ranks.

The advantages of using fractional rank are as follows. First, the range and scoring method are the same as the workforce score. Second, fractional rank retains the order among employee review scores in the cross-sectional data. Third, fractional rank is robust to outliers. It seems inappropriate to exclude outliers from the analysis because the workforce score is calculated for the worst or best company.

Then, we subtract the workforce score for firm i in year t from the employee review score for firm i in year t, yielding GAP for firm i in year t:

$$GAP_{it} = Employee\ review\ score_{it} - Workforce\ score_{it}. \tag{1}$$

In section 4, we conduct detailed analyses of what factors determine the review score, ESG workforce score, and GAP. However, checking correlations also gives us some evidence that the workforce ESG score can be a proxy of fair wage or treatment and that GAP captures the difference between actual and fair treatment. Figure 3 shows the scatter plot of the average salary in each sector and the workforce ESG score, which indicates that they have a strong positive correlation. The review score is also correlated with the average salary at the firm level, as shown in the left panel of Figure 4. Therefore, GAP has no correlation with the salary as observed in the right panel of Figure 4. The figures show suggestive evidence that the workforce ESG score can be used as a proxy for fair treatment to adjust the online review score.

[Figure. 3 around here]

[Figure. 4 around here]

Figure 5 presents a histogram representing the frequency distribution of GAP (employee review score - workforce score) variable with a kernel density curve. GAP data distribution is symmetric and bell-shaped without outliers, and they are dispersed too narrowly or too widely. Hence, we use this GAP variable without further modifications.

[Figure. 5 around here]

4 What factors influence employee satisfaction?

Before examining the effect of GAP on credit spreads, first, we explore the factors of employee satisfaction from the review question items and then analyze which factor affects the employee review score and workforce score. This analysis provides insights into the sources of employee satisfaction and the ways in which they differ across sectors.

4.1 Empirical methodology

Even though we use only NPS from online reviews for the analysis of credit spreads, eight employee's ratings of specific categories are useful for understanding the characteristics of NPS and ESG workforce score. More specifically, on a scale of 1 to 5, employees evaluate the following aspects of working environments: satisfaction toward salaries and benefits (*salaries benefits satisfaction*), motivation in the workplace (*employees motivation*), openness to argument regardless the position or department (*opennness*), culture of mutual respect and teamwork in the workplace (*teamwork*), chance to grow for employees in their 20s (*chance to grow for young employees*), long-term career development opportunities in the workplace for employees in their 30s to 50s (*long-term development of employees*), awareness of compliance with legislation, regulation, and business ethics (*compliance*), and fair evaluation system (*employee evaluation system*). Table 1 lists the correlation coefficients between the variables from online employee review question items. Each question item is equally important for reviewers and website visitors interested in that company; however, the variables in the data are highly correlated. Hence, we conduct principal component analysis (PCA) to summarize the information in the data without discarding any observations or variables.

[Tables 1 and 2 around here]

We extract the common factors of the eight rating scores using PCA. Top panel of Table 2 indicates that the first component explains about 47% of the variation in the data as the first component has the largest eigenvalue meaning that it explains most of the variation in the data. In addition, the first three components explain over 70% of the variation in the data. The bottom panel of Table 2 shows how each variable is loaded into each component.[8]

[8]Before explaining the PCA results, the validity of this analysis is tested using the Kaiser-Meyer-Olkin (KMO)

The bottom panel of Table 2 shows that the first component has a large positive association with *employee motivation*, *long-term employee development* , *opennness*, and *teamwork*, indicating that this component primarily measures motivation in the workplace. The second component has a large positive association with *compliance* and negative associations with *chance to grow for young employees* and the *employee evaluation system*, implying that this component primarily explains compliance and conservative workplaces. The third component has large negative associations with *teamwork* and *opennness* and positive associations with *employee evaluation system* and *salary benefits satisfaction*, suggesting that this component measures salaries.[9]

We use these three components to explain employee reviews and workforce scores.

$$Y_{i,t} = \beta_1 \times PC1_{i,t} + \beta_2 \times PC2_{i,t} + \beta_3 \times PC3_{i,t} + \alpha_i + \boldsymbol{\gamma}' \mathbf{Controls}_{i,t} + \upsilon_{i,t}, \tag{2}$$

where $Y_{i,t}$ denotes the employee review or workforce score of firm i in year t; PC1, PC2, and PC3 denote the scores of the first, second, and third components, respectively. To examine sectoral differences, interaction terms with manufacturing sector or non-manufacturing sector dummies are included.

We include firm fixed effects, represented by α_i, to account for unobserved firm heterogeneity. Additionally, we control for firm characteristics by including other firm covariates. The vector of variables **Controls** contains the following sets of variables: (i) firms' credit ratings, (ii) firms' financial indicators, and (iii) macroeconomic variables. Firms' credit rating variables are 0-1 dummy variables. For example, the *AA rating* takes the value of 1 if the firm's rating is AA+, AA, or AA- and 0 otherwise. To control for the effects of macroeconomic fluctuations on firm and employee perceptions, the model includes macroeconomic variables. In GAP model, where the dependent variable is GAP_{it} does not include PC1, PC2, and PC3, but the rest of the variables are the same as in Equation (2).

measure of sampling adequacy for the factor analysis, see Kaiser and Rice (1974). The KMO value, which ranged from 0 to 1, was 0.854. A value of 0 indicates that factor analysis is likely to be inappropriate. A KMO value close to 1 indicates that the factor analysis should yield distinct and reliable factors as the sum of partial correlations is not large relative to the sum of correlations. A KMO value between 0.80 to 0.89 is labeled as meritorious. Based on these results, we conclude that our data are appropriate for application to PCA.

[9] See Appendix for the detailed analysis of three factors.

4.2 Simple regression analysis of scores

The employee review score, workforce score, and GAP are distributed across firms' credit quality, as shown in Table 3. There seems to be a tendency for employee reviews and workforce scores to increase as the credit rating increases. Including firm fixed effects and control variables, we examine the factors that determine employee satisfaction, workforce scores, and GAP.

[Table 3 around here]

4.2.1 Employee review score

Column (1) of Table 4 reports the estimation results for the effects of the three components (PC1, PC2, and PC3) on the employee review score, NPS. The results indicate that an increase in the scores of the first and second components significantly increases the employee review score; however, that of the third component does not. Intuitively, the first component, which measures motivation in the workplace, and the second component, which measures compliance, positively affect employee review scores. The third component measures employees' perceptions of salaries. Although *salary benefits satisfaction* is incorporated to produce PC1 and PC2, the finding that the scores of the third component, mainly measuring salaries, do not affect employee satisfaction is interesting.

[Table 4 around here]

The results in Column (2), which include the interaction terms with the manufacturing and non-manufacturing sector dummies, indicate that the score of the first component significantly and evenly affects the employee review score regardless of the sector. The coefficients of both the interaction terms for PC1 are similar in size and sign. In the manufacturing sector, the score for the second component shows a positive association with the employee review score. However, the score of the first component, measuring motivation, is distinctly significant across sectors. What makes employees satisfied in the workplace seems common regardless of the sector.

Column (3) shows the estimation results for the effects of firm's credit quality and financial health. Table 3 indicates a positive association between a firm's credit quality and credit rating. The results indicate no significant relationship between credit quality and employee review scores, and firm size, as measured by revenue, is not significant. However, higher profitability (EBIT

margin) and growth in employment (compound annual growth rate of the number of employees over five years, CAGR employees) positively affect employee review scores. These variables may increase workplace motivation.

Column (4) includes the macroeconomic variables. The results indicate that CPI growth positively affects employee review scores, but the coefficients of Δ GDP and Δ NVIX are not significant. Although our sample period is not long enough to test the business cycle, we do not find evidence that macroeconomic fluctuations affect employee review scores.

4.2.2 ESG workforce score

Given that people who rate employee review and workforce scores are different, column (1) of Table 5 shows that the scores of the first and second components (PC1 and PC2) are positively significant in explaining the workforce score. The score for the third component is not significant, as shown in Table 4. Workforce scores by ESG information providers are calculated from themes on working conditions, career development, health and safety, and diversity and inclusion based on verifiable reported data in the public domain. Therefore, the ESG workforce score does not necessarily coincide with the ratings in online reviews. However, the significance of PC1 and PC2 implies that to some extent, both of them capture the working environments.

[Table 5 around here]

The results in column (2), which include the interaction terms with the manufacturing and non-manufacturing sector dummies, indicate that scores of the first and second components are significant only in the manufacturing sector.

The effects of a firm's credit quality and the financial indicators in Column (3) results differ from those in Table 4. While the credit quality variables are not significant in Table 4, the results indicate that an improvement in credit quality is positively associated with the workforce score. Firm size is positively significant, and EBIT margin is negatively associated in Column (3), but it is not significant when macroeconomic variables are included in Column (4).

The results in Column (4) indicate that business conditions are negatively associated with workforce score, negatively associated with GDP growth, and positively associated with NVIX. One interpretation is that, due to increased demand in a good economy, a firm can be short-staffed, resulting in worse working conditions, such as an increase in overtime hours.

4.2.3 GAP

Table 6 presents the estimation results of the GAP model. GAP is the difference between the employee review score and the ESG workforce score, which measures the gap between actual employee treatment and what is expected externally as fair treatment for the firm.

[Table 6 around here]

First, we test whether a firm's financial indicators are associated with the GAP. Column (1) shows that the AAA credit rating is significantly and negatively associated with the GAP, whereas the EBIT margin, which is an indicator of profitability, is positively significant. It can be interpreted that high profitability creates better workforce environments, while high-credit-risk firms are more prudent in providing extra generous benefits to employees.

Next, we examine whether macroeconomic fluctuations affect the GAP. Column (2) shows that GDP and CPI growth are positively associated with GAP, but financial market conditions do not influence GAP.

Column (3) includes both firms' financial indicators and macroeconomic variables. The results indicate that GAP remains positively related to GDP and CPI growth and is not related to financial market conditions. While macroeconomic fluctuations do not affect employee review scores, GAP variable appears to have cyclical properties.

5 Impacts on credit risk

This section investigates the impact of GAP on firm's credit spread and test which hypothesis, H1: Fair wage-effort hypothesis or H2: Labor leverage hypothesis, is supported.

5.1 Empirical model

We use the credit spread variable constructed in Section 3.1 as a firm's credit risk. The baseline model has the following specifications:

$$Credit\ spread_{i,t} = \alpha_i + \beta \times GAP_{i,t} + TimeFE_t + \boldsymbol{\gamma}'\mathbf{Controls}_{i,t} + \epsilon_{i,t}, \tag{3}$$

where $Credit\ spread_{it}$ denotes the annual average of the logarithm of credit spread (in basis point) in year t, and GAP of firm i in year t. We include firm fixed effects, represented by α_i, to

account for unobserved firm heterogeneity. $TimeFE_t$ indicates time fixed effects. Additionally, we control for firm characteristics by including other firm covariates. The vector of variables **Controls** contains the firm's credit rating variables. The firm's credit rating variables are 0-1 dummy variables that control for credit quality.

Our empirical strategy for determining the relationship between GAP and credit spreads begins with the panel estimation in Equation (3). One may be concerned about the reverse causality between GAP and credit spreads. However, employee benefits reflected in employee reviews can change only gradually compared to financial variables because employee benefits are determined based on explicit and implicit contracts after negotiations between employees and firms. In other words, a current change in credit spreads is less likely to immediately affect employee benefits. Therefore, reverse causality between credit spreads and GAP seems unlikely. However, to alleviate any possible endogeneity concerns about the causal impact of GAP on credit spreads, we employ an instrumental variable (IV) approach based on the 2SLS as a robustness check. In addition, we run a panel regression using a one-year lagged GAP variable, GAP_{t-1}, instead of GAP_t. Moreover, we estimate the panel regression by including the time-varying sectoral fixed effect to control for unobservable sectoral effects.

We then focus on the sectoral differences in the effects of GAP on credit spreads. Investors are expected to assess firms' credit risk according to their business operations sector, which means that the importance of human capital as the main asset differs across sectors. By grouping sectors into human-capital-intensive sectors, non-human-capital-intensive sectors, and the rest, we test which hypothesis, H1: Fair wage-effort hypothesis or H2: Labor leverage hypothesis, is supported in each sector group.

Table 7 reports the descriptive statistics of the variables used in the credit risk analysis. Firms in manufacturing sector account for 53.4% and those in the non-manufacturing sector account for 46.6% of this sample.

[Table 7 around here]

5.2 Main results

Table 8 presents the baseline results. Columns (1) and (2) show that GAP is significantly and negatively related to the credit spread without and with control variables, respectively. The results indicate that a higher GAP decreases the credit spread, which suggests that the fair wage-effort

hypothesis is dominant because investors positively evaluate firms with highly satisfied workers. This implies that, on average, more employee-friendly benefits contribute to decreasing credit risk, although they would incur some costs. The effect is also economically significant as one standard deviation increase in GAP is associated with about a 2 bps decrease in credit spread, which is substantial given that the median credit spread is 36 bps in the sample period. The estimated coefficient on the GAP in Column (2) with control variables has almost the same value as that in Column (1), suggesting that the GAP has distinct information related to credit risks. Higher credit ratings decrease credit spreads significantly.

[Table 8 around here]

Columns (3) and (4) show the results with the lagged GAP as an independent variable to mitigate the endogeneity problem without and with control variables, respectively. The coefficient on the GAP is estimated to be significantly negative in both specifications. These results support the fair wage-effort hypothesis.

5.2.1 Robustness check

To alleviate any possible endogeneity concerns about the causal impact of GAP on credit spreads, we employ an IV approach based on the 2SLS. We need variables that have a significant correlation with GAP but do not directly affect company credit spreads. The literature on firms' ESG performance and credit risk enables us to identify a possible instrument for GAP: the average GAP of all other companies in the same year (Jiraporn et al. (2014)). The idea is that credit spreads conditional on control variables may be related to firm-level GAP, but they are less likely to be related to other firms' GAP. Considering that there are many firms in a given year, changes in GAP for others are more likely to be exogenous. The results, although not reported to save space, show that the instrumental variable has significant explanatory power, as indicated by its positive and highly significant coefficient in the first-stage regression. Table 9 shows the second stage estimation result, indicating that the relationship between GAP and credit spreads is estimated to be qualitatively similar to the baseline estimation. The IV estimation mitigates the concern that our results are driven by endogeneity. In addition, the Kleibergen-Paap underidentification test statistics are enough large with a p-value of almost zero, which means the null hypothesis of the underidentification is rejected at the 1% significance level. In addition, the Kleibergen-Paap weak

identification test statistics show that the weak identification is not severe in the first stage regression. The results demonstrate that the endogeneity issue is not a serious concern as predicted. Therefore, we use the ordinary least squares (OLS) regression for the remainder of the analysis.

We also conduct a robustness check by including time-varying sectoral fixed effects to control for unobserved time-varying effects. The estimation result in Table 10 reports that the coefficient on the GAP is significantly negative and the magnitude of the impact is almost the same as that in the baseline model.

[Tables 9 and 10 around here]

5.3 Human capital intensity

In the previous sections, we investigated the average effect of GAP for all firms. However, as Cao and Rees (2020) points out, the role of employee treatments can vary across sectors as the labor input is not necessarily used in the same manner for all service and goods production. To further examine the two hypotheses focusing on this variation, we consider the degree of human-capital-intensiveness in each sector. Employee satisfaction can significantly affect a firm's performance when human capital is its main asset. On the other hand, for a firm in non-human-capital-intensive sectors, generous treatments increase labor costs whereas their contribution to an increase in labor productivity can be limited. Then, a negative economic shock leads to an increase in labor-induced operating leverage and an increase in credit spreads. Following Ghaly et al. (2015) and Cao and Rees (2020), we use R&D intensity, measured as the ratio of R&D expenses to sales, to measure human capital intensity.

We retrieve R&D intensity data of the firms in our sample from the Osiris database. As has already been widely indicated, there is a problem with missing data on firm-level R&D expenses. Instead of replacing the unreported missing value with zero, we identify the non-human-capital-intensive sectors by reporting individual firms' R&D intensity data and sectoral R&D expenses in Japan Industrial Productivity (JIP) data provided by the Research Institute of Economy, Trade, and Industry. We classified two sectors, the Real Estate sector and the Retail trade sector, as non-human-capital-intensive sectors based on zero R&D expenditure at the sector level in JIP data and the lowest sectoral average of firms in our retrieved R&D intensity data sample. Then, the Pharmaceutical, Electric appliances & Precision, Machinery sector, Raw materials & Chemicals,

and Automobiles & Transportation equipment sectors are classified as human-capital-intensive sectors based on their reported data. These five sectors have a distinctively high R&D intensity.

The first two columns of Table 11 show the estimation results for the full sample with the interaction effects between GAP and low, middle, or high R&D intensity sector dummies. The coefficient of the interaction effect with low R&D intensity sector dummy is significantly positive; however, no clear relationship is found in the interaction effect for the middle R&D intensity sectors. For high R&D intensity sectors, a higher GAP significantly lowers credit spreads. The estimation results indicate that H1: fair wage-effort hypothesis is supported in the high R&D intensity sector, that is, the human-capital-intensive sector, whereas H2: Labor leverage hypothesis is supported in the low R&D intensity sector, that is, the non-human-capital-intensive sector.

As all five high R&D intensity sectors are manufacturing sectors, one might be concerned that this result is driven by the difference between the manufacturing and non-manufacturing sectors. Hence, we limit our sample to non-manufacturing sectors and categorize the following as high R&D intensity sectors: Construction & Materials; IT & services, others, because they are the two highest R&D intensity non-manufacturing sectors. As in the case of the full sample estimation, the Real Estate sector and the Retail trade sector are classified as non-human-capital-intensive sectors. The last two columns in Table 11 indicate that the labor leverage hypothesis is supported in low R&D intensity sectors, i.e., the non-human-capital-intensive sector, even within non-manufacturing sectors while we do not find strong evidence for the effect of GAP in high human-capital-intensive sectors.

[Table 11 around here]

5.4 Why does GAP affect credit spreads?

In the previous sections, we show that in R&D intensive sectors, a higher GAP implies smaller credit spreads. In contrast, a higher GAP is associated with larger credit spreads in low-intensive sectors. In this subsection, we further investigate which channel GAP affects credit spreads. The fair wage-effort hypothesis suggests that GAP influences workers' productivity as the actual treatment changes employees' efforts. To examine the effect on productivity, we run a panel regression where the dependent variable is replaced with profits per employee in equation 3. Columns (1) and (2) of Table 12 indicate that in high R&D intensity sectors, a higher GAP is associated with higher labor productivity. This result suggests that higher GAP or more generous treatment of employees

leads to higher labor productivity for firms with higher human capital intensity, thereby decreasing credit spreads. On the other hand, for firms in low human capital intensity sectors, a high GAP is not associated with higher productivity. This result is consistent with the positive effect of GAP on credit spreads in low-intensity sectors shown in Table 11 because generous employee treatments increase labor costs but do not increase labor productivity.

However, we should note that this paper focuses on credit risks, which capture the downside risk of firms' value. Therefore, even though we find that generous employee treatment increases credit risks in low human capital intensity sectors, it is possible that such treatment increases the upside probability of a firm's growth in the sector.

6 Conclusion

The availability of workplace information has increased extensively as people voluntarily disclose information about their salaries and share reviews of workplaces on online platforms. Firms also publish workforce information voluntarily or non-voluntarily in recent global trends to improve the labor environment. In addition, research using online employee reviews or ESG data has rapidly expanded. Using crowdsourced online employee reviews and ESG data, this study provides new evidence of credit risk. One stream of research concludes that labor expense is an investment in human capital as the firm's main asset. At the same time, another theory indicates the labor leverage effect on credit spreads in a model with labor market frictions. We show that the sign of the effect of employee treatment, GAP in this study, on credit spreads depends on the sectoral intensity of human capital.

Our results do not contradict the findings of these previous studies. A positive GAP lowers the credit spreads of firms operating in human capital-intensive sectors and increases those of firms operating in non-human capital-intensive sectors. The credit spread is an indicator of default risk; hence, it is sensitive to downside risk rather than growth options. The finding that a positive GAP does not necessarily decrease credit spreads is plausible, given the characteristics of corporate bonds as the credit instrument. This study suggests that online employee reviews are a better proxy for the actual work environment, at least regarding a firm's credit risk.

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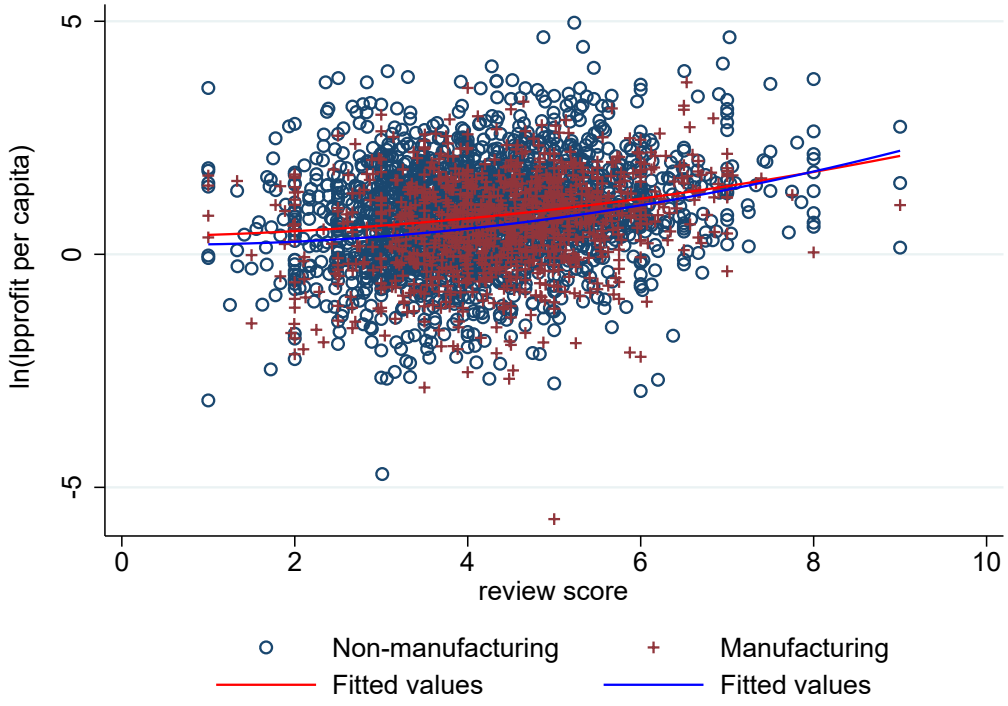

Figure 1: Online employee review score and profit per capita

Notes: Figure 1 plots the average online employee review score by company against the log of the corporate profit per capita.

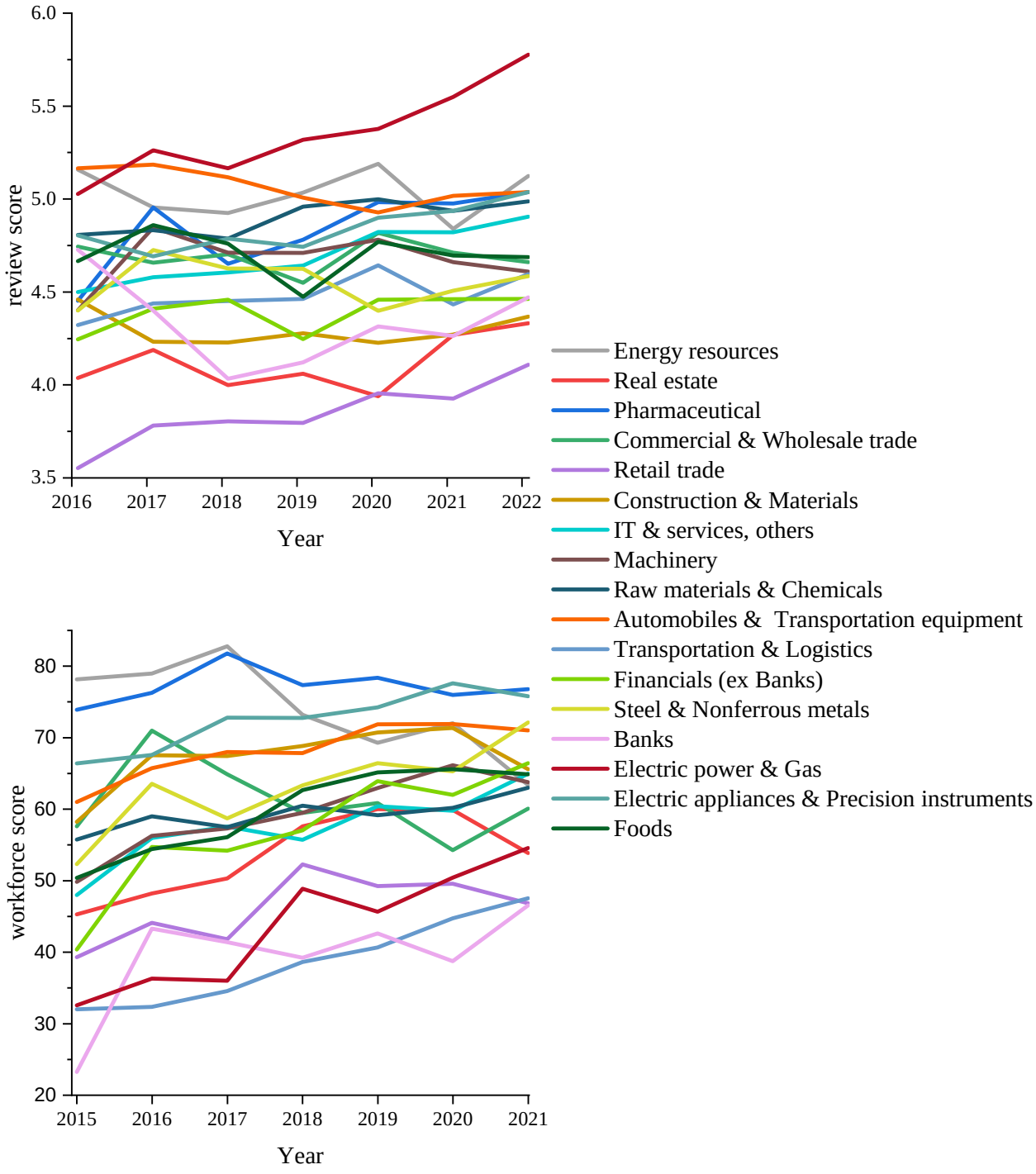

Figure 2: Online employee review score and workforce score by sector

Notes: Upper panel of Figure 2 plots the employee review score by sector on a calendar year basis, and lower panel plots the workforce score by sector as of fiscal year-end.

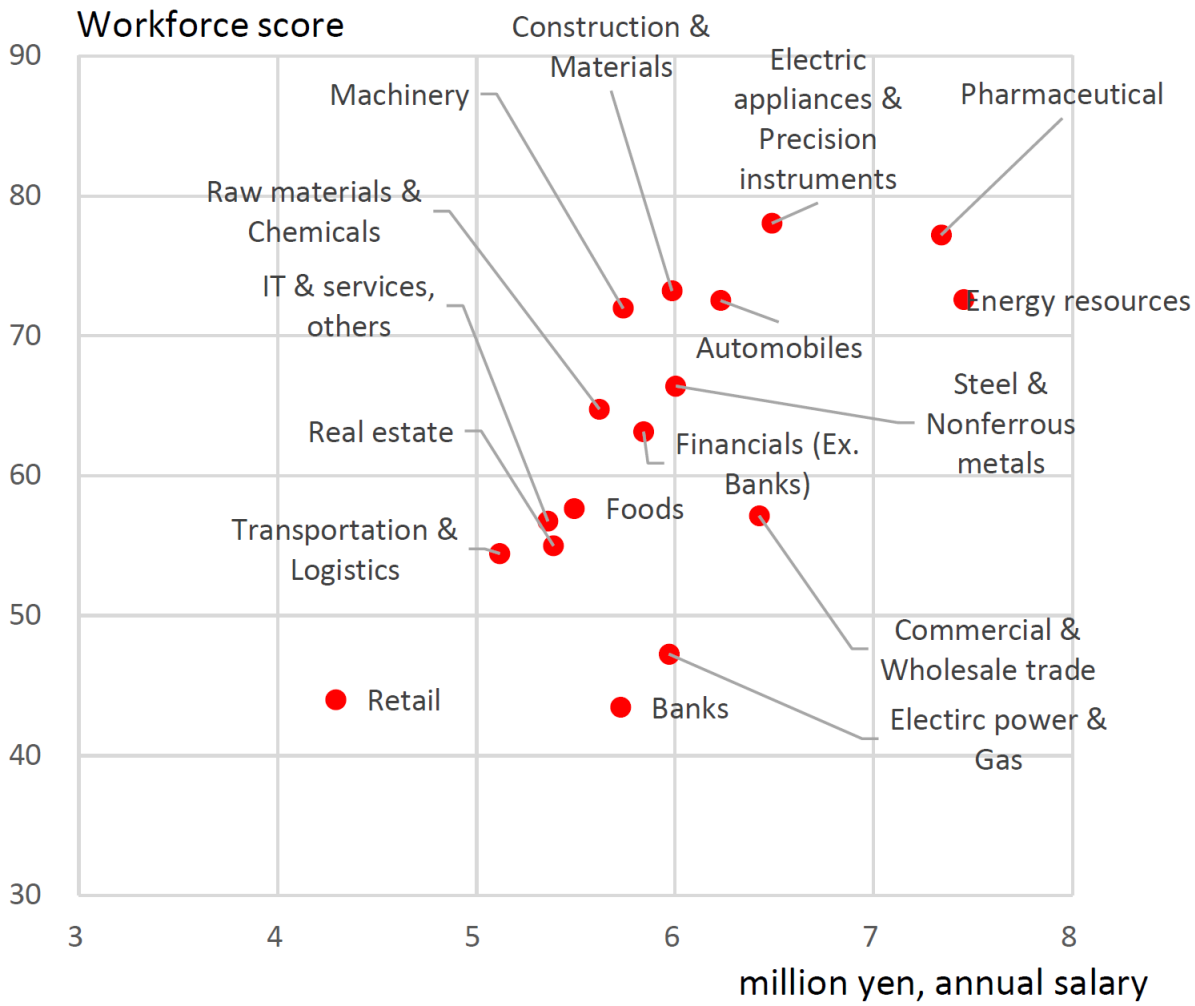

Figure 3: Workforce score as "fair" or "expected" treatment

Notes: Figure 3 plots average annual salaries by sector and workforce score by sector on a calendar year basis.

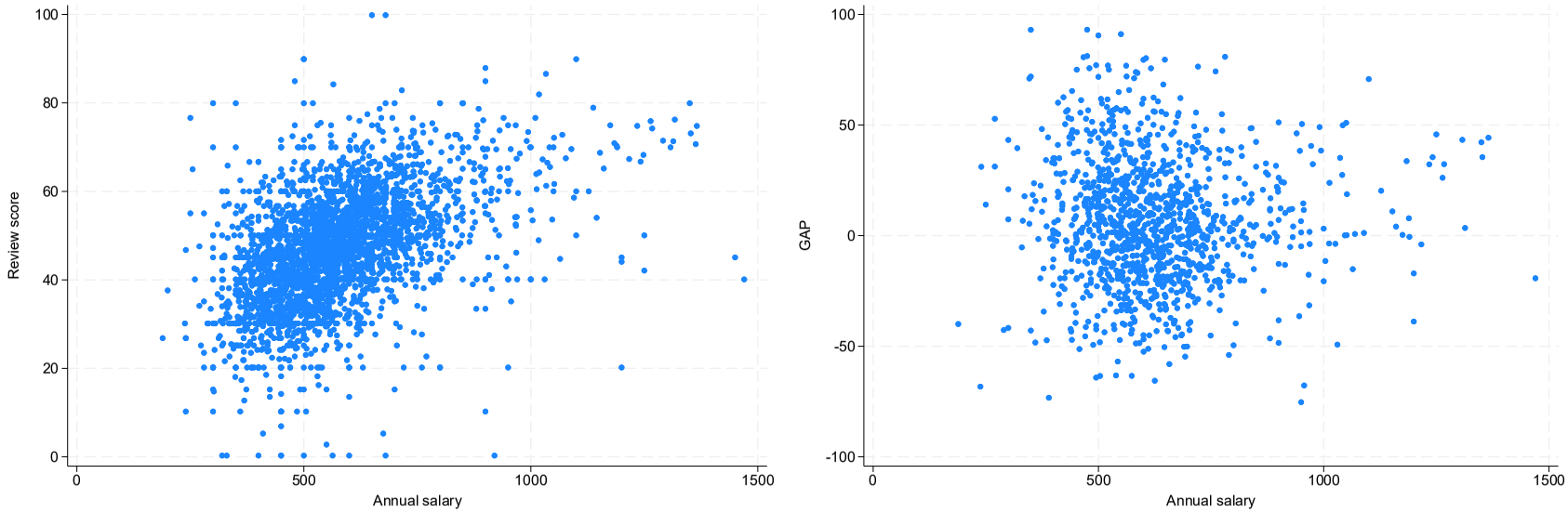

Figure 4: Adjustment of online review scores

Notes: Left panel of Figure 4 plots average annual salaries by firm and NPS score, while a right panel of Figure 4 plots average annual salaries by firm and GAP.

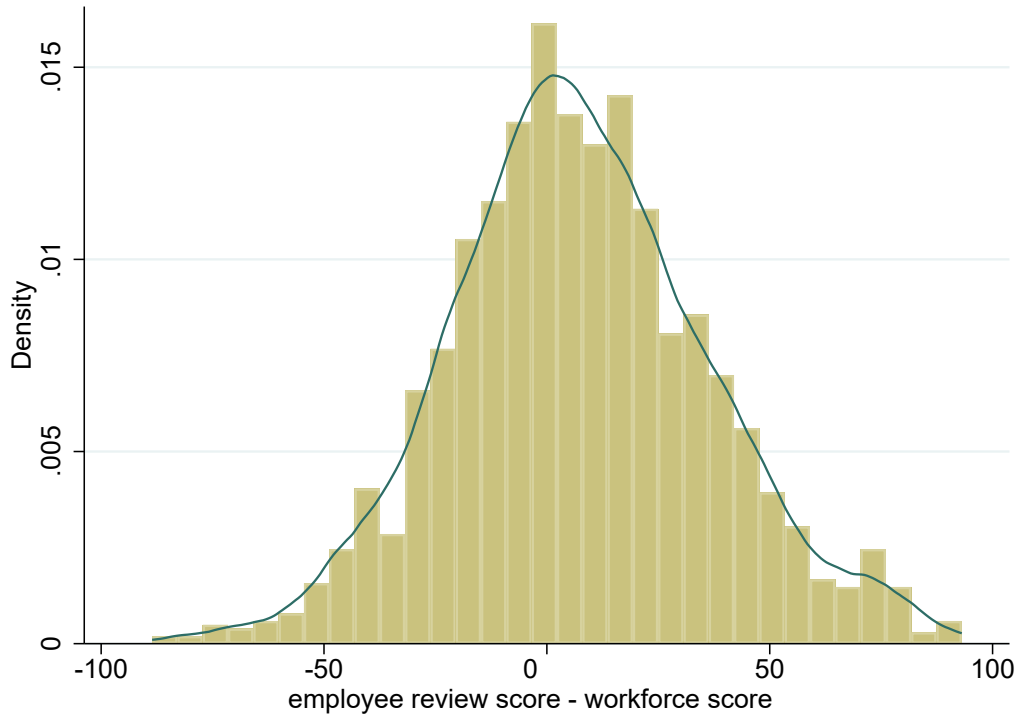

Figure 5: Histogram of GAP

Notes: Figure 5 displays a histogram to represent the frequency distribution of GAP (employee review score - workforce score) variable with a kernel density curve.

Table 1: Question items correlation

	salaries and benefits	employees motivation	openness	teamwork	chance to grow for young	long-term development	compliance	employee evaluation system
salaries and benefits	1							
employees motivation	0.427***	1						
openness	0.360***	0.479***	1					
teamwork	0.327***	0.504***	0.536***	1				
chance to grow for young	0.287***	0.551***	0.445***	0.344***	1			
long-term development	0.449***	0.502***	0.419***	0.474***	0.445***	1		
compliance	0.336***	0.259***	0.229***	0.312***	0.0470**	0.391***	1	
employee evaluation system	0.387***	0.528***	0.333***	0.296***	0.461***	0.419***	0.129***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The table presents correlation coefficients between variables from online employee review question items.

Table 2: Eigenvalue and estimated coefficients

Component	Eigenvalue	Cumulative
1	3.733	46.7%
2	1.087	60.3%
3	0.802	70.3%

Eigenvectors

	salaries and benefits	employees motivation	openness	teamwork	chance to grow for young	long-term development	compliance	employee evaluation system
Component1	0.335	0.415	0.367	0.365	0.350	0.394	0.231	0.342
Component2	0.223	-0.163	-0.042	0.148	-0.472	0.152	0.740	-0.325
Component3	0.464	0.027	-0.499	-0.539	-0.037	0.101	0.108	0.471

$Notes$: Top panel shows the eigenvalues for the first three components and the cumulative proportion of variation explained by each component. Bottom panel provides the eigenvectors for the first three components, indicating how each variable is loaded onto each component.

Table 3: Scores by credit rating

	Review score		Workforce score		GAP	
Credit rating	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
AAA	89.716	5.204	87.124	10.199	2.335	8.010
AA	72.047	21.578	67.158	24.743	3.931	26.146
A	60.661	24.844	57.862	27.931	7.692	30.133
BBB	51.064	26.688	49.930	27.411	12.792	28.112
BB	49.301	22.648	51.044	25.079	2.415	30.111
B	23.093	22.369	39.011	37.386	-2.969	43.710

$Notes$: The table reports the mean value and standard deviation of online employee review score, workforce score, and GAP by credit rating. Credit rating variables are 0-1 dummy variables. For example, the *AA rating* takes a value of 1 if the firm's rating is AA+, AA, or AA-, and a value of 0 otherwise.

Table 4: Determinants of review score

	(1)	(2)	(3)	(4)
PC1	3.962***			
	(0.191)			
PC2	0.785**			
	(0.368)			
PC3	0.107			
	(0.360)			
non-manufacturing× PC1		3.929***		
		(0.252)		
manufacturing× PC1		3.995***		
		(0.296)		
non-manufacturing× PC2		0.640		
		(0.499)		
manufacturing× PC2		0.963*		
		(0.535)		
non-manufacturing× PC3		0.514		
		(0.504)		
manufacturing× PC3		-0.360		
		(0.504)		
AAA rating			-3.759	-4.567
			(4.717)	(4.603)
AA rating			-3.052	-3.400
			(4.701)	(4.569)
A rating			-0.744	-0.912
			(4.442)	(4.297)
BBB rating			-1.419	-1.366
			(4.225)	(4.072)
ln(revenue)			1.287	0.536
			(1.765)	(1.825)
EBIT margin			8.819**	9.032**
			(3.822)	(3.729)
CAGR employee			0.115**	0.129**
			(0.050)	(0.051)
Δ GDP				-0.099
				(0.093)
Δ CPI				0.556*
				(0.293)
Δ NVIX				-0.004
				(0.004)
Observations	3657	3657	3605	3605
Adjusted R^2	0.23	0.23	0.01	0.01

Notes: The table presents the estimation results of Equation (2) where the dependent variable is the online employee review score. All specifications include firm fixed effects. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5: Determinants of workforce score

	(1)	(2)	(3)	(4)
PC1	0.745**			
	(0.351)			
PC2	1.976***			
	(0.661)			
PC3	0.531			
	(0.691)			
non-manufacturing× PC1		0.797		
		(0.561)		
manufacturing× PC1		0.678*		
		(0.411)		
non-manufacturing× PC2		1.407		
		(0.948)		
manufacturing× PC2		2.596***		
		(0.907)		
non-manufacturing× PC3		0.240		
		(0.968)		
manufacturing× PC3		0.910		
		(0.980)		
AAA rating			30.924***	27.664***
			(8.701)	(8.841)
AA rating			20.639**	19.774**
			(8.690)	(8.813)
A rating			19.751**	19.436**
			(8.265)	(8.379)
BBB rating			12.557	12.915
			(7.893)	(8.032)
ln(revenue)			7.876**	4.026
			(3.219)	(3.276)
EBIT margin			-13.691*	-10.700
			(7.267)	(7.008)
CAGR employee			-0.094	-0.047
			(0.093)	(0.088)
Δ GDP				-0.792***
				(0.178)
Δ CPI				-1.102
				(0.813)
Δ NVIX				0.009**
				(0.004)
Observations	2009	2009	1975	1975
Adjusted R^2	0.01	0.01	0.02	0.05

Notes: The table presents the estimation results of Equation (2) where the dependent variable is workforce score. All specifications include firm fixed effects. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 6: Determinants of GAP

	(1)	(2)	(3)
AAA rating	-23.131**		-20.508*
	(10.144)		(10.474)
AA rating	-11.787		-11.509
	(10.132)		(10.508)
A rating	-8.555		-8.590
	(9.375)		(9.780)
BBB rating	-1.033		-1.307
	(8.286)		(8.775)
ln(revenue)	-3.525		-0.435
	(4.554)		(4.729)
EBIT margin	30.964***		27.570***
	(10.298)		(10.052)
CAGR employee	0.216		0.169
	(0.141)		(0.140)
Δ GDP		0.520*	0.604**
		(0.265)	(0.293)
Δ CPI		4.263***	2.894*
		(1.592)	(1.733)
Δ NVIX		-0.006	-0.009
		(0.010)	(0.011)
Firm Fixed Effects	YES	YES	YES
Observations	1684	1790	1684
Adjusted R^2	0.02	0.02	0.03

Notes: The table presents the estimation results where the dependent variable is GAP, and explanatory variables are the manufacturing sector dummy in column (1), financial indicators in column (2), macroeconomic variables in column (3), and financial indicators and macroeconomic variables in column (4). Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 7: Descriptive statistics

Variable Name	Observations	25%	Median	Mean	75%	Std Dev
Review score	3883	3.857	4.727	4.695	5.583	1.410
Workforce score	2100	41.227	64.392	59.327	82.143	27.622
GAP	1790	-12.263	5.347	7.158	25.030	29.086
Credit spread (basis points)	2254	30	36	45	46	59
ln(Revenue)	4429	11.852	12.710	12.777	13.647	1.396
EBIT to Revenue	4372	0.041	0.072	0.093	0.120	0.105
Employees CAGR	4319	-0.041	1.941	3.008	4.5803	5.712
Rating (dummies)						
AAA rating	4508	0.000	0.000	0.003	0.000	0.054
AA rating	4508	0.000	0.000	0.134	0.000	0.341
A rating	4508	0.000	1.000	0.598	1.000	0.490
BBB rating	4508	0.000	0.000	0.254	1.000	0.435
BB rating	4508	0.000	0.000	0.009	0.000	0.094
B rating	4508	0.000	0.000	0.002	0.000	0.045
Manufacturing (dummy)	4508	0.000	1.000	0.534	1.000	0.499
Non-manufacturing (dummy)	4508	0.000	0.000	0.466	1.000	0.499
Macro Variables						
Δ GDP	4508	-0.400	0.800	0.305	1.700	2.024
Δ CPI	4508	0.300	0.500	0.690	1.000	0.775
Δ NVIX	4508	-24.280	8.731	8.633	37.824	40.417

$Notes$: The table presents the summary statistics for variables used in the analysis.

Table 8: Credit risk and GAP

	ln(spread)			
	(1) GAP_t	(2) GAP_t	(3) GAP_{t-1}	(4) GAP_{t-1}
GAP	-0.0008*	-0.0007*	-0.001**	-0.0009**
	(0.000)	(0.000)	(0.000)	(0.000)
AAA rating		-1.614***		-1.545***
		(0.473)		(0.508)
AA rating		-1.543***		-1.453***
		(0.469)		(0.503)
A rating		-1.444***		-1.351***
		(0.468)		(0.500)
BBB rating		-1.284***		-1.216**
		(0.459)		(0.491)
ln(revenue)		-0.204**		-0.163***
		(0.083)		(0.057)
EBIT margin		-0.134		0.034
		(0.144)		(0.119)
Year Fixed Effects	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES
Observations	1203	1202	1187	1186
Adjusted R^2	0.23	0.37	0.26	0.39

Notes: The table presents the estimation results of Equation (3) where the dependent variable is log of credit spread in basis point. Columns (1) and (2) include GAP while columns (3) and (4) include the lagged GAP variable. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 9: Instrumental variable analysis

	ln(spread)			
	(1) GAP_t	(2) GAP_t	(3) GAP_{t-1}	(4) GAP_{t-1}
GAP	-0.0008*	-0.0007*	-0.001**	-0.0009**
	(0.000)	(0.000)	(0.000)	(0.000)
AAA rating		-1.614***		-1.545***
		(0.473)		(0.508)
AA rating		-1.543***		-1.454***
		(0.469)		(0.503)
A rating		-1.444***		-1.352***
		(0.468)		(0.500)
BBB rating		-1.284***		-1.216**
		(0.459)		(0.491)
ln(revenue)		-0.204**		-0.163***
		(0.083)		(0.057)
EBIT margin		-0.134		0.034
		(0.144)		(0.119)
Year Fixed Effects	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES
Observations	1177	1177	1175	1173
Kleibergen-Paap underid.	101.52	100.73	104.39	103.41
p-val	0.00	0.00	0.00	0.00
Kleibergen-Paap weak id.	7138.91	7014.13	8968.77	8706.53

Notes: The table presents the estimation results of Equation (3) based on 2SLS. Reported coefficients and standard errors are from second-stage regressions from a 2SLS regression analysis of the influence of GAP on credit spreads which include the instrumented values of GAP as an independent variable. GAP is instrumented with its corresponding average GAP of all other companies in the same year. The baseline rating category is below the BB-rated categories. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 10: Credit risk and GAP: Year×sector fixed effects

	ln(spread)			
	(1)	(2)	(3)	(4)
	(1) GAP_t	(2) GAP_t	(3) GAP_{t-1}	(4) GAP_{t-1}
GAP	-0.0007*	-0.0007**	-0.0009**	-0.0009**
	(0.000)	(0.000)	(0.000)	(0.000)
AAA rating		-1.716***		-1.592***
		(0.409)		(0.421)
AA rating		-1.477***		-1.345***
		(0.392)		(0.415)
A rating		-1.423***		-1.308***
		(0.392)		(0.413)
BBB rating		-1.261***		-1.205***
		(0.386)		(0.408)
ln(revenue)		-0.152**		-0.106**
		(0.070)		(0.046)
EBIT margin		-0.160		-0.010
		(0.153)		(0.097)
Year*Sector Fixed Effects	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES
Observations	1175	1175	1172	1170
Adjusted R^2	0.86	0.88	0.89	0.91

Notes: The table presents the estimation results of Equation (3) where the dependent variable is log of credit spread in basis point. Columns (1) and (2) include GAP, while columns (3) and (4) include the lagged GAP variable. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 11: Credit risk and GAP: Human capital intensity

	All sectors		Non-manufacturing	
	(1) GAP_t	(2) GAP_{t-1}	(3) GAP_t	(4) GAP_{t-1}
Low R&D intensity × GAP	0.0028**	0.0033**	0.0026**	0.0028**
	(0.001)	(0.001)	(0.001)	(0.001)
Middle R&D intensity × GAP	-0.00003	-0.0003	-0.000	-0.0004
	(0.001)	(0.000)	(0.001)	(0.001)
High R&D intensity × GAP	-0.0021***	-0.0022***	0.0009	0.0006
	(0.001)	(0.001)	(0.001)	(0.001)
AAA rating	-1.628***	-1.542***		
	(0.472)	(0.502)		
AA rating	-1.539***	-1.443***	0.020	-0.280
	(0.467)	(0.497)	(0.112)	(0.320)
A rating	-1.427***	-1.331***	0.137	-0.154
	(0.466)	(0.494)	(0.098)	(0.316)
BBB rating	-1.270***	-1.199**	0.235***	-0.172
	(0.458)	(0.486)	(0.028)	(0.309)
ln(revenue)	-0.204**	-0.170***	-0.267***	-0.208***
	(0.081)	(0.057)	(0.093)	(0.060)
EBIT margin	-0.131	0.025	-0.074	-0.079
	(0.144)	(0.118)	(0.147)	(0.116)
Year Fixed Effects	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES
Observations	1202	1186	605	598
Adjusted R^2	0.39	0.40	0.41	0.50

Notes: The table presents the estimation results where the dependent variable is the log of credit spread in bp. Explanatory variables are interaction terms, low (middle, high) R&D intensity variable × GAP or its lagged variables, $t-1$, in addition to those in Equation (3). Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 12: Profits per capita and GAP

	ln(Profit/Empoloyee)	
	(1)	(2)
Low R&D intensity × GAP	-0.001	-0.001
	(0.001)	(0.001)
Middle R&D intensity × GAP	0.001	0.001
	(0.001)	(0.001)
High R&D intensity × GAP	0.003**	0.003**
	(0.001)	(0.001)
EBIT margin$_{t-1}$	0.724*	0.614
	(0.410)	(0.417)
ln(revenue)$_{t-1}$	-0.181	-0.168
	(0.233)	(0.230)
AAA rating		1.372***
		(0.490)
AA rating		1.015**
		(0.480)
A rating		0.930**
		(0.468)
BBB rating		0.744*
		(0.440)
Year Fixed Effects	YES	YES
Firm Fixed Effects	YES	YES
Observations	1440	1440
Adjusted R^2	0.06	0.07

$Notes$: The table presents the estimation results where the dependent variable is the log of profits per capita. Explanatory variables are interaction terms, low (middle, high) R&D intensity variable × GAP$_t$, lagged EBIT margin, log of revenue, and credit rating dummies. Standard errors (SE) clustered at the firm level in parenthesis. *** significant at 1%, ** significant at 5%, * significant at 10%.

Appendix

In section 4, we extracted the factors that explain the online review scores. In this appendix, we investigate the characteristics of factors and the variation across sectors in more detail. The left panel of Figure A1 illustrates the effects of each characteristic on the principal components. In this plot, *openness* strongly and positively influences the first component, but has little influence on the second component. Invertly, *compliance* has a strong influence on the second component, but the least influence on the first component. Notably, all eight variables positively influence the first component, whereas their influence on the second principal component differs in direction and magnitude. This difference contrasts with the first two components in which information is contained.

The right panel in Figure A1 shows the scatter plots of the scores for the first component against the scores for the second component using sectoral averages. Electric power & Gas sector and Pharmaceutical sector are shown at the upper right of the graph. As Figure A1 indicates, these two sectors have consistently high employee review scores. It is reasonable that firms whose employees evaluate the workplace highly from the viewpoint of compliance (second component) receive a high review score, as they operate in industries that are subject to more government regulations.

Although online employee review scores are not calculated directly from the ratings of these question items, it seems plausible to reflect these components in the workplace. On the y-axis, sectors such as Electric power & Gas, Transportation & Logistics, and Banks have the highest scores for the second component. As these are regulated sectors, it is intuitive to embed compliance in their corporate culture. On the lower left is the Retail trade sector in which the employee review score is consistently the lowest. In certain sectors, the first component yields lower scores than in the Retail trade sector, which suggests that the second or third component may be more important and that a low score in either of those components may contribute to low employee satisfaction. These results suggest sector-related differences in workplace mismatches occur when workers derive (less) satisfaction from the workplace.

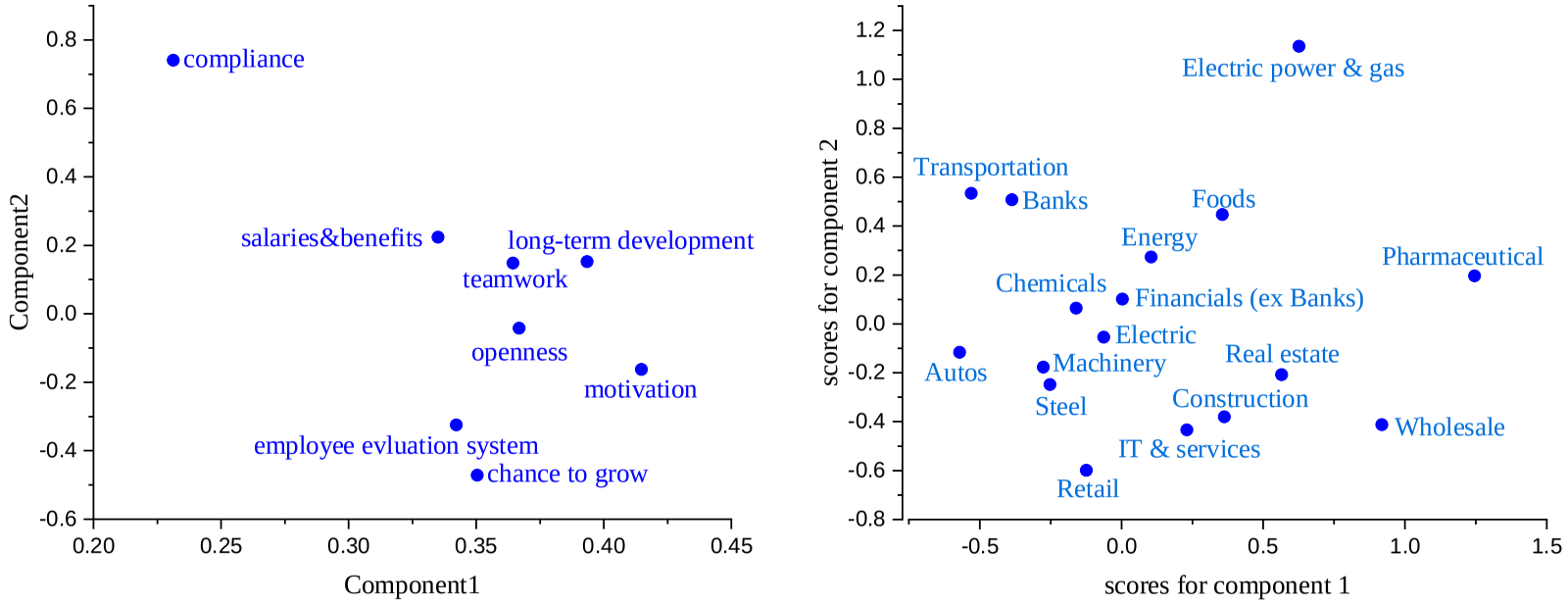

Figure A1: Factor analysis of online reviews

Notes: The left panel of Figure A1 plots the coefficients for the first component and the second component. The right panel displays the loading of each sector on the first component and the second component, where the label for each sector corresponds to the following: Energy, Energy resources; Real estate, Real estate; Pharmaceutical, Pharmaceutical; Wholesale, Commercial & Wholesale trade; Retail, Retail trade; Construction, Construction & Materials; IT & services, IT & services, others; Machinery, Machinery; Chemicals, Raw materials & Chemicals; Autos, Automobiles & Transportation equipment; Transportation, Transportation & Logistics; Financials (ex Banks), Financials (ex Banks); Steel, Steel & Nonferrous metals; Banks, Banks; Electric power & gas, Electric power & Gas; Electric, Electric appliances & Precision instruments; Foods, Foods.

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