Federal Reserve Bank of Chicago

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March 2022

WP 2022-09

https://doi.org/10.21033/wp-2022-09

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Abstract

An employee's annual earnings fall by 13% the year her firm files for bankruptcy, and the present value of lost earnings from bankruptcy to six years following bankruptcy is 87% of pre-bankruptcy annual earnings. More worker earnings are lost in thin labor markets and among small firms. Ex ante compensating wage differentials for this "bankruptcy risk" are approximately 2% of firm value for a firm whose credit rating falls from AA to BBB, comparable to the magnitude of debt tax benefits. Thus, wage premia for expected costs of bankruptcy are of sufficient magnitude to be an important consideration in corporate capital structure decisions.
JEL Codes: G32, G33, J21, J31, J61.

* We thank the Editors (Stefan Nagel and Ken Singleton), an anonymous associate editor, and two anonymous referees for valuable comments and support, and John Abowd, Ashwini Agrawal, Jonathan Berk, Rob Fairlie, Todd Gormley, Michael Hertzel, Joseph Hotz, Po-Hsuan Hsu, Robert Jarrow, Yawen Jiao, Pab Jotikasthira, Andrew Karolyi, Bryant Kim, Pauline Leung, Chen Lin, David Matsa, Roni Michaely, William Mullins, Justin Murfin, Paige Ouimet, Wendy Rotenberg, Daniel Sullivan, Yongjun Tang, Karin Thorburn, Michael Waldman, Wei Wang, Liu Yang, Hayong Yun, and seminar and conference participants at AFA, Census Bureau RDC Conference, Chicago Fed, Chinese University of Hong Kong, CICF, City University of Hong Kong, Cornell University (Finance and Labor Economics), CSEF-EIEF-SITE Conference on Finance and Labor, EFA, FIRS Conference, FMA Asia, IDC, Maryland Junior Corporate Finance Conference, NFA, SFS Finance Cavalcade, SOLE/EALE, University of Calgary, University of Hong Kong, and U.S. Census Bureau (CES) for helpful feedback. We also thank Bert Grider at the TFSRDC for help with data and clearance requests, Nichole Szembrot at the NYFSRDC (Cornell) for administrative support, and Tanya Bakshi, Vitor Costa, Daniel Gallego, Dawoon Kim, Eric Kim, Cindy Lu, and Katya Potemkina for research assistance. Any views expressed are those of the authors and not those of the U.S. Census Bureau. The Census Bureau's Disclosure Review Board and Disclosure Avoidance Officers have reviewed this information product for unauthorized disclosure of confidential information and have approved the disclosure avoidance practices applied to this release. This research was performed at a Federal Statistical Research Data Center under FSRDC Project Number 808 (CBDRB-FY21-P808-R8890, FY22-P808-R9448). This research uses data from the Census Bureau's Longitudinal Employer Household Dynamics Program, which was partially supported by the following National Science Foundation Grants SES-9978093, SES-0339191 and ITR-0427889; National Institute on Aging Grant AG018854; and grants from the Alfred P. Sloan Foundation. We are grateful to Edward Altman at NYU for sharing his dataset of default events, Antonio Falato for sharing DealScan-Compustat merged data and related programs, Lynn LoPucki at UCLA for sharing his Bankruptcy Research Database, and David Matsa for sharing data on state-level UI generosity. Kim acknowledges generous financial support from the Kwanjeong Educational Foundation. Li and Qiu acknowledge financial support from the Social Sciences and Humanities Research Council of Canada. This paper was previously circulated under the title "Human Capital Loss in Corporate Bankruptcy."

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1. Introduction

When a firm experiences a substantial negative shock, its employees bear personal costs resulting from labor market adjustments. An extensive literature documents such costs to workers caused by plant closures, international trade, and environmental regulation, among other shocks (Jacobson, LaLonde, and Sullivan, 1993; Walker, 2013; Autor et al., 2014; Hummels et al., 2014). In this paper, we focus on costs to the workforce resulting from corporate bankruptcy and the implications for the firm's risk-sharing role and capital structure decisions.

According to the theory of the firm as an insurance provider, it is optimal for a risk-neutral firm to provide insurance to risk-averse workers (e.g., Baily, 1974; Azariadis, 1975). Workers are willing to accept lower wages, implicitly paying for this insurance (Guiso, Pistaferri, and Schivardi, 2005). When firms choose to use more debt financing (perhaps to achieve tax benefits), they increase bankruptcy risk, thereby reducing the risk-sharing benefit provided to employees (Berk, Stanton, and Zechner, 2010). Employees in response demand higher promised wages (Abowd and Ashenfelter, 1981). We estimate these compensating wage differentials, which can be thought of as an implicit bankruptcy-related cost of debt (Agrawal and Matsa, 2013). Most empirical estimates of the bankruptcy costs of debt seem small relative to the benefits (the "debt conservatism" puzzle; Graham, 2000).[1] In this vein, our estimates help quantify a hard-to-measure indirect cost of bankruptcy, namely increased wages due to reduced risk sharing. Our analysis can thus be viewed as a step towards the goal of understanding the role of financial distress-induced employee costs in capital structure decisions.

To estimate the impact of an employer's bankruptcy filing on its workers' earnings, we rely on worker-firm matched data from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program, combined with a comprehensive database of public firm bankruptcy filings. The LEHD data allow us to follow individual workers across firms over time and observe their earnings and other characteristics of employment, such as industry and

[1] Traditional costs of financial distress or bankruptcy include those due to the bankruptcy process, such as lawyer's fees, loss of market share, and asset fire sales.

geographical location. As a result, we are able to estimate the effect of corporate bankruptcy on employees, even when they change employers post-bankruptcy.

We construct a sample of 130 bankruptcy filings by U.S. public firms from 1992 to 2005 and follow for up to six years approximately 234,000 workers who were employed by the bankrupt firms one year before bankruptcy. We estimate the effect of a bankruptcy filing on worker outcomes by comparing affected employees to workers in control firms matched using key firm characteristics before bankruptcy (except for financial leverage), such as the firm's industry, economic performance, and changes in the market value of assets. In addition, we control for unobserved heterogeneity in earnings across industries and geographies over time, and workers, using detailed fixed effects such as industry × county × year and worker fixed effects. Hence, our empirical approach compares within-worker earnings dynamics of employees of bankrupt and control firms with similar observables in the same industry, county, and year. Although it may not be possible to completely control for all unobservables that affect selection into bankruptcy filing, the comparison conditional on matched firm characteristics and detailed fixed effects helps mitigate many potentially confounding factors.

We find that on average employee earnings begin to deteriorate in the year of bankruptcy, relative to those of the control group. One year after bankruptcy, annual earnings are 13% (adjusting for unemployment insurance (UI)) to 14% (without UI adjustment) lower than pre-bankruptcy annual earnings (see Figure 1). The present value (PV) of cumulative earnings losses from the year of bankruptcy to six years afterward is 87% (with UI adjustment) to 89% (without UI adjustment) of pre-bankruptcy annual earnings. Importantly, earnings losses are larger for workers who leave the industry post-bankruptcy (suggestive that loss of human capital plays a role in worker earnings loss following corporate bankruptcy), and who worked in thinner local labor markets before bankruptcy (suggestive that labor mobility in thick labor markets helps attenuate earnings losses following corporate bankruptcy).

In competitive labor markets, employees would consider expected losses in their personal earnings that follow corporate bankruptcy and demand a wage differential ex ante. From the firm's perspective, such a wage premium is a cost associated with financial distress risk. Estimating the magnitude of wage premium thus may shed light on the debt conservatism puzzle. We estimate this compensating wage differential using two approaches that, despite different assumptions and estimates, produce quantitatively similar magnitudes of wage premia for bankruptcy risk. First, using the information on employees who move between firms, we regress movers' highest quarterly earnings in the last four quarters right before and in the first four quarters right after the movement on the leverages of their old and new firms, respectively. We find that workers' wages increase when they move from firms with low leverage to those with high leverage, controlling for unobserved and observed firm and worker characteristics, and time-varying industry and local labor market conditions. The regression coefficient on market leverage allows us to estimate the wage premium due to an increase in financial distress risk. One caveat of this approach is that these wage premium estimates may be biased due to omitted variables.

Therefore, we use a second, alternative approach based on a valuation model with plausible assumptions (e.g., risk-neutral valuation given risk averse workers); we find that the expected additional present value cost to compensate for bankruptcy-driven earnings loss risk is about 1.0% (3.0%) of firm value for a typical AA-rated (BBB-rated) firm, relative to a risk-free firm. These indirect distress costs are substantial in that they amount to 42% (59%) of the tax benefits of corporate debt for an AA-rated (BBB-rated) firm estimated in previous research (e.g., Graham, 2000). Overall, our estimated employee-related bankruptcy costs are of sufficient magnitude to potentially help explain the debt conservatism puzzle.

Our paper is related to two strands of literature. The first literature examines the earnings losses of displaced workers. A central finding of this line of research is that job displacement (i.e., job loss resulting from mass layoffs) leads to large and persistent earnings losses (e.g., Jacobson, Lalonde, and Sullivan, 1993; von Wachter, Handwerker, and Hildreth, 2009; Couch and Placzek, 2010; von Wachter, Song, and Manchester, 2011). This literature also shows that the effect of job displacement on earnings is especially large when labor market conditions are weaker, such as in recessions (Schoeni and Dardia, 2003; Kodrzycki, 2007; Davis and von Wachter, 2011).

Our paper differs from the existing work on displaced workers in several important ways. First, we focus on one specific financial shock on workers, namely corporate bankruptcy, as opposed to pure job displacements. As we show later, the workers in our sample of bankrupt firms are not necessarily displaced, with a substantial fraction of them staying with the bankrupt employer. Thus, our estimates of earnings losses are based on bankrupt firm employees, whether they separate from or remain with the firm after bankruptcy. Second, crucially, it is not possible to directly infer the employee cost of bankruptcy from estimates in the displacement literature, which often uses employees who stay with the firm (i.e., firm stayers) as the counterfactual group. Moreover, relative to workers who leave the firm, firm stayers may have different earnings loss patterns associated with bankruptcy, which a displaced worker analysis would not capture. Third, our estimates account for state-level unemployment insurance benefits, which offset part of earnings losses due to bankruptcy. Fourth, in a step beyond most of the job displacement literature, we attempt to identify the effect of financial distress on employee earnings using a regression discontinuity design for loan covenant violations.

The second strand related to our paper is the finance literature on the impact of financial distress on employees. Our paper is among the first to use worker-firm matched micro data to examine labor market outcomes for individuals after financial distress of their employer.[2] While previous research has examined the effects of bankruptcy filings on firm-level outcomes such as accounting performance and management turnover (Gilson, 1989; LoPucki and Whitford, 1992), relatively little is known about the consequences of bankruptcy and financial distress for employees, other than firm-level employment.[3] Our paper estimates detailed changes in employee earnings following bankruptcy relative to a control group using worker-level data. Importantly, our estimates have important implications for capital structure theory (see, e.g., Matsa (2018)).

We derive wage premia for bankruptcy risk as labor-related indirect bankruptcy costs. Capital structure theories model that employee wage loss due to financial distress discourages

[2] A contemporaneous paper by Baghai, Silva, Thell, and Vig (2021) uses Swedish worker-firm matched data to document that financially distressed firms lose their most skilled employees. However, they do not examine changes in employee earnings around financial distress nor wage premia for financial distress risk, which are our focus.

[3] For instance, using Compustat data on firm-level employment, Falato and Liang (2016) show that firms cut employment substantially after loan covenant violations, and Agrawal and Matsa (2013) show that firms reduce employment by about 30% during the years surrounding bond defaults. Similarly, Hotchkiss (1995) shows that firms suffer employment reductions around Chapter 11 bankruptcy filings.

firms from using debt (e.g., Titman, 1984; Butt-Jaggia and Thakor, 1994; Berk, Stanton, and Zechner, 2010). Agrawal and Matsa (2013) and Kim (2020) provide evidence of the importance of this mechanism by showing that changes in the cost of job loss affect corporate capital structure decisions. In our paper, we not only provide evidence for the importance of this mechanism, but also quantify the magnitude of these wage premia for employees' earnings loss risk due to bankruptcy. Differing from existing estimates of wage premia based on firm-level wage data (Chemmanur, Cheng, and Zhang, 2013) or implied by compensating differentials for unemployment risk (Agrawal and Matsa, 2013), we use worker-level wage data from LEHD to directly estimate the wage premia. Our analysis suggests that the resulting additional compensation cost is comparable in magnitude to the tax benefit of debt and thus could play a first-order role in corporate capital structure decisions.

2. Data and Descriptive Statistics

2.1. Data Sources and Sample Selection

2.1.1. Bankruptcy Event Data and LEHD Datasets

We begin by identifying corporate bankruptcy cases from the UCLA-LoPucki Bankruptcy Research Database (BRD).[4] The BRD contains public companies with more than $100 million of assets (measured in 1980 dollars) that filed bankruptcy cases from October 1, 1979 to present.[5] We focus on public firms' bankruptcy filings because we examine capital structure implications later in the paper.[6]

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[4] We thank Lynn M. LoPucki at UCLA for sharing this database, which is also used by Jiang, Li, and Wang (2012), Eckbo, Thorburn, and Wang (2016), and Goyal and Wang (2017).

[5] The majority of bankruptcy cases in the database are filed under Chapter 11 (reorganization) of the U.S. Bankruptcy Code, while only a handful are filed under Chapter 7 (liquidation).

[6] Using a 235 private firm sample selected by BankruptcyData.com that have public debt or that BankruptcyData deemed important, we find that employees of these private bankrupt firms experience about three times larger earnings losses after a bankruptcy filing than their public firm counterparts (see Online Appendix Table A5, column (1)). Possible explanations include that public firms, which tend to be larger, offer better opportunities for employees to develop general skills or to switch jobs. The results are consistent with our findings that there is significant heterogeneity in employee costs of bankruptcy depending on firm size and search frictions in the labor market. See Bernstein, Colonnelli, and Iverson (2019) for a study of asset reallocation effects of bankruptcy using a large sample

We merge these bankruptcy events to worker-firm matched information from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program, establishment-level databases, and the Compustat database. The LEHD data we have access to cover 30 participating U.S. states largely from 1990 (coverage in Maryland begins in 1985) to 2008 (see Table 1 for the list of covered states and years available) and provide detailed information on employment relationships such as employee earnings, industries, and geographical locations, and worker characteristics such as age, imputed education, and gender.[7] The annual earnings records in LEHD are non-missing as long as an individual reports positive earnings in any of the four quarters in a given year. However, if the individual earns nothing in all four quarters of the year, the annual record is missing (as opposed to showing zero earnings). Thus, missing annual observations are due to two potential reasons. First, an individual may move to any of the 20 non-LEHD states or become self-employed (in which case no earnings are reported in the LEHD data). Second, the individual may become unemployed and earn no wages in a given year. We empirically address how these sample attrition issues might affect our estimates in Section 3.1.2.

[Table 1 about here]

We link datasets from the LEHD infrastructure with other Census Bureau establishment-level datasets and subsequently with Compustat and BRD. Specifically, among the databases available from the LEHD infrastructure, we use the Individual Characteristics Files (ICF), which provides worker-level characteristic variables; the Employment History Files (EHF), which contains annual and quarterly earnings records, locations (state and county) and industries for each worker-firm pair; and the Unit-to-Worker Imputation File (U2W), which is used for job-location imputation at the SIC (or NAICS) industry and county level. We use the Business Register Bridge (BRB) and the Compustat-SSEL Bridge (CSB) in conjunction with the Standard Statistical

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of bankruptcy filings by both public and private firms. They focus on the difference between reorganization and liquidation but do not study employee costs or capital structure implications of the bankruptcy processes.

[7] The Census Bureau imputes the education variable as follows. For each state, a logit model is used to estimate the probability of belonging to one of 13 education categories (e.g., high school, college) using the characteristics such as age categories, earnings categories, and industry indicators. The education category is then imputed based on the predicted probability.

Establishment List (SSEL) to link the LEHD files with the Census Bureau's Longitudinal Business Database (LBD), Compustat and the BRD. To avoid complications associated with legal ages for employment and early retirement, we require that worker ages be between 22 and 55 in the year before a bankruptcy filing. To exclude earnings changes due to unstable employment relations with the firm (e.g., temporary workers), we focus on workers with at least two years of tenure with the bankrupt firm one year before its bankruptcy filing.[8]

Because earnings are a key variable in our analysis, we provide details on LEHD earnings records below. As discussed in Abowd et al. (2009), the LEHD earnings are extracted from the state unemployment insurance (UI) records and correspond to the report of an individual's UI-covered earnings, which is retained in the database as long as the worker earns at least one dollar of UI-covered earnings during a given quarter. According to the Bureau of Labor Statistics (BLS), UI coverage is comprehensive and comparable across states. For example, UI covered 96% of total jobs and 92.5% of the wage component of national income in 1994. The UI earnings include gross wages and salaries, bonuses, stock options, tips and other gratuities, and the value of meals and lodging, where supplied. In some states, employer contributions to certain deferred compensation plans, such as 401(k)s, are included in total earnings.[9]

2.1.2. Census Establishment-Level Data

We use the Longitudinal Business Database (LBD) to obtain comprehensive data on employment and payroll at business establishments. The LBD tracks more than five million establishments each year from 1977 to 2011 covering all U.S. states. The variables available in the database include employment, annual payroll, industry classifications, location identifiers (e.g., states, counties), and parent firm identifiers. Given the comprehensive nature, we use the LBD to measure firm-level employment, payroll, and the size of local labor markets. However, the LBD does not contain data on worker-level earnings, industries, or location of employment, which are contained in the LEHD.

2.1.3. Sample Selection: Bankrupt and Matched Firms

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[8] Requiring at least six years of tenure gives a qualitatively similar result (see Online Appendix Table A5, column (2)).
[9] See https://www.bls.gov/opub/hom/cew/pdf/cew.pdf at the BLS.

We begin with 510 bankruptcy cases from the BRD from 1990 to 2005 (excluding financials and utilities). We match these firms with the SSEL, LBD, and Compustat and require that they have non-missing employment information from the LBD and financial information from Compustat. This step produces 360 bankruptcy cases. We then match these bankrupt firms with LEHD and keep firms with at least ten employees in LEHD one year before filing. Because the LEHD earnings data we have access to are only available up to 2008, we include only the bankrupt firms that file for bankruptcy in or before 2005. This restriction allows employees of bankrupt firms in 2005 to have up to three years of earnings data post-bankruptcy. After matching with LEHD, we have 190 bankruptcy cases.

To construct a matched sample from non-bankrupt firms, we first require that the non-bankrupt firms have non-missing matching information and have at least ten workers from LEHD one year before matching from 1990 to 2005. Then for each year and three-digit SIC industry, we use a propensity-score matching approach in which we use market value of assets (MVA), the log change in MVA over the previous year, return on assets (ROA), market-to-book, and total number of employees (from the LBD) to match bankrupt to non-bankrupt firms. More specifically, we obtain the financial information in the latest fiscal year within two years prior to bankruptcy filings for bankrupt firms and the information for potential matches in the same industry and year.[10] The propensity score matching is performed within each industry-year cell to control for the influences of unobserved time-varying aggregate and industry conditions. Note that we use ROA, market-to-book, and (changes in) MVA but not leverage in matching, which enables us to control for the impact of (forward-looking) firm performance but also allows bankrupt firms to have different debt usage than matched firms.

For each bankrupt firm in the sample, we choose one non-bankrupt firm that has the closest linearized propensity score (LPS or log odds ratio) as a matched firm. We require that the absolute difference in the LPS be less than or equal to 0.25 (see e.g., Imbens and Rubin, 2015). If we do not find a matched firm within a given three-digit SIC-year cell based on the cut-off, we repeat the

[10] When we conduct the matching based on data from four years prior to bankruptcy filings (which is our benchmark year in earnings regressions), we obtain similar results (see Online Appendix Table A1).

matching process to find a matched firm within a given two-digit SIC-year cell, and then within a one-digit SIC-year cell. This one-to-one matching procedure gives us a final event sample consisting of 130 bankrupt and 130 matched firms from 1992 to 2005 that employ at least ten workers in LEHD one year before bankruptcy.

2.2. Descriptive Statistics

2.2.1. Firm Characteristics of Bankrupt and Control Firms

Table 2 presents descriptive statistics on bankruptcy events, firms and matched firms. Panel A shows that the distribution of bankrupt firms with employees in the LEHD data is similar to that of the full sample of bankrupt firms from the BRD, in terms of bankruptcy outcomes. Bankruptcy events that lead to merger, acquisition, or continuation of the firm represent about 30-40% of the events in both samples, and those leading to liquidation, firm closure, or refiling represent about 20%. The first four columns of Panel B further investigate the representativeness of the bankrupt firms that have workers in LEHD based on firm characteristics measured in the latest fiscal year within two years before bankruptcy. The means show that bankrupt firms from BRD (that have information from Compustat and LBD; column (1)) and the bankrupt firms with employees in LEHD (column (3)) are similar in most firm characteristics including firm size (measured using sales, assets, and number of employees), book and market leverage, total wage bills scaled by assets, and R&D expense scaled by assets (see column (7) for *t*-statistics for the differences). The exceptions are that bankrupt firms in LEHD are significantly more profitable, have lower market-to-book, and have lower capital expenditures relative to net property, plant, and equipment.

Importantly, to verify that the bankrupt firms in our final sample are similar to the matched firms, Panel B compares the mean and standard deviation characteristics of bankrupt firms with employees in LEHD (columns (3) and (4)) to propensity-score matched firms (columns (5) and (6)).[11] The *t*-statistics reported in column (8) on the differences between the means show that the bankrupt LEHD firms and matched firms do not differ significantly in any of the matching variables, including the level and log change in market value of assets, the number of employees,

[11] The Census Bureau does not permit researchers to disclose percentiles such as the median.

ROA, and market-to-book. The two groups also have similar sales, book assets, wages-to-assets ratios, capital expenditures, and R&D intensity, despite these variables not being explicitly employed in matching. Notably, the bankrupt firms have significantly higher book and market leverage than matched firms (60% vs. 35% for book leverage and 57% vs. 32% for market leverage), which is consistent with leverage playing a role in "treated" firms ending up in bankruptcy. (Recall that the matching process intentionally does not match on leverage.)

[Table 2 about here]

To check the similarity of the pre-event trends between the bankrupt and matched samples, Table 2, Panel C examines the dynamics of firm characteristics for the two samples starting three years before bankruptcy filings (see Online Appendix Figure A1 for a visual presentation of the results). To facilitate a balanced comparison of statistics across the years, we focus on a subset of bankrupt firms that have complete financial information from Compustat and LBD (on employment and payroll) during all the three years t-3, t-2, and t-1. This requirement leaves us with 90 bankrupt firms and their corresponding control firms.[12] The panel shows that each year during the pre-event window, all variables but leverage and log market value of assets in t-2 have similar values for treated and matched firms, indicating parallel trends. Importantly, though the (log) market value of assets for bankrupt firms declines over the years, the difference in cumulative changes in log from t-3 between the treatment and control groups is not statistically significant. Notably, both groups of firms experience an upward trend in leverage prior to bankruptcy, with bankrupt firms exhibiting substantially higher leverage than matched firms in each year before bankruptcy.

Overall, the results in Table 2 confirm that bankrupt and matched firms are similar in important firm characteristics including market value, growth opportunities, profitability, and their trends prior to the event year, except for leverage, suggesting that the matched firms are a valid control sample for our analysis.[13]

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[12] We find similar magnitudes of PV losses for this subset of events (see Online Appendix Table A5, column (4)).

[13] Of course, we cannot perfectly ensure that leverage is the only difference between the bankrupt and control firms. Thus, we interpret our results with caution (see also Section 3.1).

2.2.2. Employee Characteristics of Bankrupt and Control Firms

Table 3 presents employee characteristics from LEHD for the bankrupt and control firms. We examine employees of these firms one year prior to the bankruptcy filing. The worker characteristics, including imputed education, age, experience, gender, and earnings, are similar between the employees of bankrupt and the matched firms. All of the differences are insignificant at a conventional level (column (7)). In addition to comparing with the propensity-score matched sample, we follow the literature on labor market adjustments to job displacements (e.g., Couch and Placzek, 2010; Davis and von Wachter, 2011) and construct an alternative, less strict control sample of employees. To circumvent computational constraints, we randomly select 0.5% of workers in the LEHD universe (which contains more than 2.8 billion quarterly earnings records) who are employed by non-bankrupt public firms. We impose the same requirements on the control group for industry (i.e., exclude financial and utilities sectors), tenure, and age as we impose on the sample of bankrupt firms (see Section 2.1.1). Column (8) shows that all characteristics are similar between the bankruptcy and the randomly selected workers. Overall, the comparisons of employee characteristics suggest that both the propensity-score matched and randomly selected groups of workers are comparable to the treatment group in terms of observable characteristics.

The bottom half of Table 3 documents the rate at which employees move across firms, industries, and counties around bankruptcy filings. We first report the percentage of workers who are employed by the firm in year t-4 and stay in the same firm, industry, or county through t-1, separately for treated and matched firms. The results show that before bankruptcy, the treated and matched control groups are comparable in terms of employee staying. In particular, the rates of staying in the same firm, industry, and county and remaining in LEHD from t-4 to t-1 are 54.6% vs. 51.4%, 63.7% vs. 63.1%, 66.8% vs. 66.6%, and 66.9% vs. 63.9%, respectively, for bankrupt versus matched firms, with no pair having a statistically significant difference (column (7)).

In contrast, when tracking the employees from one year before until three years after bankruptcy, we find that the rates that bankrupt firm employees remain in the original firm, industry, and county are significantly lower than those of matched firm employees. Only 32.4% of employees stay in their bankrupt firm (vs. 43.2% in the control firm), 52.9% stay in their industry of employment (vs. 61.1%), and 53.4% stay in the county in which they work pre-bankruptcy (vs. 63.7%). At the bottom of the table, we examine the difference-in-differences of the attrition rates, and find that three years post-bankruptcy, employees of bankrupt firms are 14.0 (= -22.1 – (-8.2)) percentage-points less likely to stay in the firm (SE = 7.70), 8.8 percentage-points (SE = 4.73) in the industry, and 10.5 percentage-points (SE = 4.07) in the local area, relative to the propensity-of-staying pattern for employees of non-bankrupt firms, and to the staying rates pre-bankruptcy. We find qualitatively similar difference-in-differences results by comparing changes in mobility between employees of the bankrupt firm and randomly selected workers. We also find that employees of bankrupt firms are 7.2 percentage-points less likely (= -9.6 – (-2.4)) to remain in LEHD relative to those of matched non-bankrupt firms, compared with their difference before bankruptcy, although this difference-in-differences is statistically insignificant.

In summary, Table 3 shows that the employees of the bankrupt firms are comparable to those of the matched firms along key individual characteristics observed before bankruptcy. In contrast, the table shows that employees of bankrupt firms are significantly more likely to leave the firm, industry, and county than those of matched firms post-bankruptcy.

[Table 3 about here]

3. Empirical Results

3.1. Effect of Corporate Bankruptcy on Employee Earnings

We employ a difference-in-differences approach to estimate earnings changes for employees of bankrupt firms relative to earnings changes that would have occurred in the absence of bankruptcy. Specifically, we estimate the following regression equation:

$$y_{it} = \alpha_i + \gamma_{jct} + \beta x_{it} + \sum_{k=-3}^{6} \lambda_k d[k]_{it} + \sum_{k=-3}^{6} \delta_k d[k]_{it} \times BR_i + \varepsilon_{it}, \quad (1)$$

where i, j, c, and t index workers, industries, counties, and years, and y_{it} is worker i's logarithm of real annual earnings (adjusted using the CPI in 2001 constant dollars) in year t. For a worker who holds multiple jobs in a given year, we use the worker's total earnings aggregated across all her jobs in that year.[14] α_i and γ_{jct} represent worker and industry × county × year fixed effects. x_{it} includes the following time-varying worker characteristics: years of experience (defined as age – imputed education – 6) × imputed years of education and years of experience × female indicator. We do not include imputed education or a female indicator as stand-alone variables because they are constant at the individual level and thus are collinear with worker fixed effects. Likewise, years of experience is implicitly controlled for as it is collinear with worker and year fixed effects. We do not include age because it is collinear with experience and imputed education. $d[k]_{it}$ is an indicator variable equal to one if year t is |k| years before or after a bankruptcy filing, and zero otherwise ($-3 \leq k \leq 6$). BR_i is an indicator variable equal to one if worker i was an employee of a bankrupt firm (in any of the worker's jobs) one year prior to bankruptcy, and zero if the worker was an employee of a control firm. ε_{it} is the random error. Standard errors are double clustered at the firm and worker level.

We use equation (1) to study employees that work at the bankrupt (or control) firms one year prior to the bankruptcy filing (or year of matching) and analyze these employees from t-4 to t+6. As the event indicator variables begin in t-3, the implicit benchmark is earnings in year t-4 for both groups. The estimates of δ_k capture the change (from the benchmark year t-4) in earnings of bankrupt firms' employees in each event year relative to that of the control group. We include worker fixed effects to control for unobserved individual-level heterogeneity. We include original two-digit SIC industry × county × year fixed effects to control for unobserved time-varying economic shocks specific to industry by county of the worker's pre-bankruptcy job. Thus, our identification of the effect of corporate bankruptcy on employee earnings is based on the variation in earnings between employees of bankrupt and non-bankrupt firms in the same original industry-county cell in the same year.

Although we match non-bankrupt firms on observables and include them as a counterfactual group, and employ detailed fixed effects to control for unobserved heterogeneities across industries and local labor markets over time, we note that our empirical approach might not

[14] In the case of multiple jobs, industry and county fixed effects are based on the industry and location for her job with highest earnings.

provide perfect counterfactuals. For example, a negative technology (or general economic) shock might hit the bankrupt firm and its employees but not the matched firm and employees, even within the same industry and local labor market. If such a shock leads to both a bankruptcy filing and a reduction in the value of employee skills, the future earnings of the bankrupt firm's employees could decline even in the absence of bankruptcy filing itself. However, if economic shocks are largely common within industries and local labor markets, our approach is likely to provide a valid counterfactual.

3.1.1. Baseline Results

Table 4 presents the regression results, with column (5) reporting the result from the main specification in equation (1) and other columns controlling for various layers of fixed effects. The control group includes employees of the propensity-score matched firms in Panel A, and randomly selected employees of non-bankrupt public firms in Panel B. The interaction terms *d[k]* × *BR* ($0 \leq k \leq 6$) are the variables of interest and the coefficient estimates show that relative to the control group, employees of bankrupt firms experience significant reductions in earnings over the years after a bankruptcy filing. Across all specifications, most of the coefficients on the interaction terms are significantly negative at conventional levels from year t to t+2 or t+3.

[Table 4 about here]

We examine the economic magnitude of the employee earnings losses associated with bankruptcy filings using estimates in column (5) of Panel A, which includes worker and industry × county × year fixed effects. We use column (5) as the preferred specification to ensure that our estimates do not simply reflect time-varying industry-by-local labor market conditions. For example, bankrupt firm employees may be in industries and geographic areas that experience different economic shocks than those of control firm employees, which would affect their subsequent earnings even in the absence of bankruptcy filings.

In column (5), the -0.128 coefficient on *d[0]* × *BR*, which is the difference between log earnings in year t and log earnings in benchmark year t-4 for bankrupt firms, relative to the same difference for matched control firms, implies a 12.0% decline (= exp(-0.128) – 1) in earnings in year t relative to the counterfactual earnings. Similarly, the coefficients on *d[k]* × *BR* ($1 \leq k \leq 6$)

indicate an average annual earnings loss of around 10% relative to the pre-bankruptcy earnings and to the non-bankrupt firm employees. The last few rows in the panel show that the present value (PV) of earnings losses during the seven years since bankruptcy filing, computed using a real discount rate of -7.4%, is 89.5% of the pre-bankruptcy annual earnings (measured in benchmark year t-4).[15] As explained in the preceding footnote, the discount rate is negative because it accounts for workers' uninsurable idiosyncratic risk. Alternatively, the PV of earnings losses calculated using a real risk-free rate of 3.34% is 66.0% of the pre-bankruptcy earnings.

Figure 1 visually presents the earnings dynamics based on the coefficient estimates in column (5) of Panel A. The figure shows that earnings of bankrupt firm employees (relative to those of matched control firm employees) are flat during the pre-bankruptcy period from t-3 to t-1. Earnings are significantly lower in the year of the bankruptcy filing and remain low from that year onward. From t to t+6, Panel A shows that employees lose about 10% of the pre-bankruptcy (t-4) annual earnings on average, relative to the earnings of the matched firm employees in the respective year. Panel B presents the cumulative employee earnings losses through t+6.

[Figure 1 about here]

The other columns in Table 4 explore whether our results are robust with respect to econometric specifications with different fixed effects. All specifications control for worker fixed effects. In general, when we use less refined layers of fixed effects (e.g., county × year or industry × year rather than industry × county × year), heterogeneity that we do not control for (such as industry-by-region-specific shocks) likely biases estimates of earnings losses for bankrupt firm employees. In column (1), which includes year fixed effects, we find that the PV of earnings losses is 58.9% of pre-bankruptcy earnings. Columns (2) through (4) include industry × year, county × year, and both industry × year and county × year fixed effects, respectively. The PV's of earnings

[15] To calculate the PV of earnings losses, we use an inflation- and risk-adjusted discount rate that is appropriate given workers' exposure to uninsurable idiosyncratic risk. To this end, we first simulate the distribution of wealth for a representative worker who earns average earnings in our sample and holds average financial assets in the Survey of Consumer Finance. We then use a certainty equivalence approach to find the discount rate for this representative worker. See Online Appendix C for details of the approach. To bookend our estimate, we also perform the PV calculation using a real risk-free rate of 3.34%. The PV of earnings losses calculated using the real risk-free rate ignores the worker's (idiosyncratic) risk exposure.

losses in these specifications are generally smaller than that in column (5) with the PV in column (4) closest in magnitude (68.7%).

3.1.2. Additional Results

This section examines the robustness of the baseline results using an alternative control group, by accounting for unemployment insurance benefits in the earnings loss estimates, and by imputing missing earnings in LEHD.

Random Sample of Workers as Control Group: Panel B of Table 4 reports the regression results based on the randomly selected control group of workers. Comparing to the results in Table 4 Panel A, the magnitudes of earnings loss estimates are generally larger when these randomly selected workers are used as the control group and industry × county × year fixed effects are not employed. For example, column (2) in Panels A and B shows present value earnings losses are 40% and 121% of the benchmark annual earnings, respectively. This result suggests that the latter estimates may be biased upward in absolute value, likely due to lack of controls for firm-level characteristics, particularly economic performance proxies that we use as matching variables (such as the change in market value of assets, ROA, and market-to-book). However, we find similar magnitudes of PV losses in column (5) in both panels, indicating that industry × county × year fixed effects control for important unobserved heterogeneity between the bankruptcy and control groups that may be captured by firm characteristics employed in matching. The similar column (5) magnitudes between the two panels provide confidence in our estimates of the PV earnings loss due to bankruptcy of about 79-89%.

Unemployment Insurance Benefits: We incorporate unemployment insurance (UI) into our estimates because UI benefits would partially offset workers' lost earnings after bankruptcy (see, e.g., Hsu, Matsa, and Melzer, 2018). We collect information on regular and extended UI benefits and estimate each eligible unemployed worker's quarterly UI benefits, which are added to their quarterly earnings from LEHD to get total, UI-adjusted earnings (Online Appendix D provides details on the UI benefits calculations).[16] In the baseline analysis, we define unemployment spells

[16] We thank David Matsa for generously providing data on state UI benefits for this analysis.

as lasting a maximum of two quarters of consecutive zero or missing quarterly earnings, and consider three or more quarters of consecutive zero or missing earnings as missing values. We re-estimate equation (1) with the dependent variable being the logarithm of UI-adjusted real annual earnings.

Panel C of Table 4 shows that the estimates for the PV of earnings losses with the UI adjustments are generally somewhat smaller than the PV estimates without the UI adjustments. For example, using the preferred specification in column (5), the PV's with and without the UI adjustments are 89.5% and 87.1% of the pre-bankruptcy earnings, respectively. Overall, the results suggest that even after accounting for UI benefits, employees of bankrupt firms experience significant reductions in earnings in the years following a corporate bankruptcy filing. UI has quantitatively small effects on earnings losses in the baseline sample because the sample excludes many potential unemployment spells that last longer than two quarters in situations in which the worker disappears from the LEHD data.

Imputation of Missing Earnings and UI Benefits: As mentioned in Section 2.1.1, missing earnings in the LEHD data could be due to an individual moving to a non-LEHD state, becoming self-employed, or unemployed. To examine the implications of missing earnings for earnings loss estimates, we provide additional estimates using two imputation approaches.[17] First, for both treatment and control groups, we replace missing earnings with the first percentile value of the earnings distribution in our sample.[18] This approach essentially assumes that individuals who disappear from the LEHD data are unemployed. Alternatively, we replace missing quarterly earnings with the maximum quarterly earnings in the last year the individual appeared in the LEHD data; this approach effectively assumes that those who disappear move to work in non-LEHD

[17] See e.g., Walker (2013), who uses similar imputation approaches to address limitations of the LEHD data. Our approach differs from Walker's in that he uses the average dollar earnings for cohorts as the dependent variable and replaces missing earnings with zeros. Our dependent variable is log(earnings), and thus we use the 1st percentile value in lieu of earnings when workers with missing earnings records are assumed to be unemployed.

[18] Specifically, when the entire annual earnings records are missing, we replace them with the first percentile value of the annual earnings distribution. When earnings are missing for less than four quarters, we impute the missing quarterly earnings records with the first percentile value of the annual earnings divided by four. We also impute missing earnings with the 0.5% and 5% values of the earnings distribution and obtain similar results (see Online Appendix Table A2).

states or become self-employed and earn the same wages as before.[19, 20] Using the preferred specification as in column (5) in Panel A, we find in Online Appendix Table A2 that when we replace missing earnings with the first percentile, the present value of earnings losses is 158% (114% with UI adjustments), whereas when we replace missing quarterly earnings with the maximum quarterly earnings in the last observed annual record, the PV is 64% (62% with UI adjustments). This considerable effect of UI on PV earnings losses in the first percentile-imputed sample appears reasonable given that many more missing quarterly earnings are assumed to be unemployment in this sample (where workers who disappear from the LEHD are assumed to be unemployed until the end of the event window or sample period) relative to the baseline. In addition, the average unemployment spell length is about eight quarters in this sample. Therefore, the unemployed typically collect UI income for about 25% (= two /eight quarters) of the length of unemployment spells.

3.2. Worker Reallocation as a Mechanism of Earnings Losses after Bankruptcy

Our main analysis documents a significant decline in earnings for average employees of bankrupt firms. While informative, the baseline estimates could mask rich heterogeneity in labor market adjustments post-bankruptcy. In this section, we condition our estimation of earnings dynamics on whether workers reallocate across firms, industries, and geographical areas post-bankruptcy, as well as on labor market characteristics and bankruptcy outcomes. The analysis sheds light on two mechanisms through which workers may suffer earnings losses: costs associated

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[19] If a worker leaves an employer in an LEHD state for a non-LEHD state or becomes unemployed in the middle of a year (e.g., June) or a quarter (e.g., February for first quarter), last annual or last quarterly earnings in her previous job may underestimate her "true" wages in that job. To mitigate this potential bias, we impute missing quarterly earnings using the maximum of the quarterly earnings in her last observed year. This approach is of little economic consequence because if we were to instead impute using the last observed annual earnings divided by four, the PV earnings losses are of similar magnitude (see Online Appendix Table A2).

[20] By analyzing real earnings throughout the paper, we avoid the effects of inflationary earnings growth. Nonetheless, real earnings may grow and the growth rate may differ conditional on the worker's characteristics. We calculate the average growth rate of real annual earnings by gender, education, and experience groups using the LEHD data (we use a 10% random sample to reduce computational burden). We then apply these growth rates of real earnings to imputed earnings in columns (5) and (6) in Online Appendix Table A2, where missing quarterly earnings are imputed at the maximum quarterly earnings in the last observed annual record or the last observed annual earnings divided by four.

with worker mobility and loss of firm- or industry-specific human capital. We consider the results in this section suggestive and thus interpret them with caution, given that worker selection on observable and unobservable characteristics (e.g., ability) is likely to affect both the conditioning variable (e.g., whether switching firms or employed in smaller local labor markets) and post-bankruptcy earnings. We partly mitigate this concern by including worker fixed effects in the empirical specification. In this and other sections throughout the rest of this paper, we use the specification that includes worker and two-digit SIC industry × county × year fixed effects and use the matched control group (see column (5) of Table 4, Panel A, and related discussion in Section 3.1).

3.2.1. Worker Movement and Post-Bankruptcy Earnings

If an important part of earnings losses during labor market adjustments is due to the loss of human capital specific to firms (Becker, 1962) or industries (Neal, 1995), then the costs of bankruptcy might be largely borne by workers who leave their firms or industries. To test these predictions, in the following regression specification we employ an indicator variable *Stay*, which is equal to one if a worker who was in a given firm, two-digit SIC industry, or county in year t-1 stays in the same firm, industry, or county through year t+3:

$$y_{it} = \alpha_i + \gamma_{jct} + \beta x_{it} + \sum_{k=-3}^{6} \lambda_k d[k]_{it} + \sum_{k=-3}^{6} d[k]_{it} \times BR_i \times (\delta_k Stay_i + \theta_k (1 - Stay_i)) + \varepsilon_{it}, \quad (2)$$

where the coefficients δ_k represent the effect of bankruptcy on earnings of the bankrupt firm employees who stay in the firm (or industry, or county), and the coefficients θ_k represent the effect on earnings of the bankrupt firm employees who do not stay.[21] We stratify the treatment (i.e., bankruptcy) group based on whether workers stay with their firms (or industries, or counties) until year t+3. We do not stratify the control group, so our analysis decomposes earnings losses of the treated group relative to the *average* worker in the control group (see e.g., Walker (2013) for a similar stratification).

[Table 5 about here]

[21] Note that the specification in equation (2) does not include the stand-alone *Stay* indicator because it is collinear with worker fixed effects. Also, we find similar results if we alternatively define the *Stay* indicator equal to one if a worker stays in the same firm, two-digit SIC industry, or county through year t+5 (see Online Appendix Table A3).

We first examine whether the magnitudes of earnings losses are different between the employees who stay with the bankrupt firm and those who leave the firm (Table 5, Panel A). Comparing the estimates indicates that "firm leavers" (column (2)) fare significantly worse than "firm stayers" (column (1)) during the years after the bankruptcy filing. Using the present-value approach described in Section 3.1, workers who leave the firm lose on average 120% of their annual earnings for the seven years from t to t+6 (significant at the 1% level), while those who stay with the firm experience a statistically insignificant gain of 38%.[22]

We next unpack the earnings loss of the workers who leave the bankrupt firm along another dimension: whether they leave the industry and/or county. If an employee's human capital (e.g., skill set) is specific to her original industry, the earnings loss would be more pronounced for "industry leavers," all else equal. Consistent with this prediction, columns (5) and (6) show that among county leavers, earnings losses for industry leavers are substantially greater than for those for industry stayers, with the difference significant at the 1% level. Similarly, columns (3) and (4) examine county stayers and also find that the industry leaver effect (= 19.0% – 79.1%) is negative and significant at the 5% level. These results imply that the cost of corporate bankruptcy is borne by workers who leave their industries (and not by those who stay in the same industries even though leaving their original firms), consistent with industry-specific human capital playing an important role in labor market adjustments after bankruptcy.[23] As noted above, however, the

[22] Note that the above results show the earnings losses of stayers and leavers in the treated group relative to the *average* worker in the control group. Instead of using the average worker in the control group as the benchmark, in a separate specification we examine whether stayers (leavers) of the bankrupt firm fare worse than the stayers (leavers) of the control firm by including the *Stay* indicator (and 1 – *Stay* indicator) uninteracted with a *BR* indicator but interacted with the event time indicators in equation (2). That is, we replace $\sum_{k=-3}^{6} \lambda_k d[k]_{it}$ in equation (2) with $\sum_{k=-3}^{6} d[k]_{it} \times (\mu_k Stay_i + \pi_k(1 - Stay_i))$. The results for this conditional analysis that stratifies both the bankruptcy and non-bankruptcy groups (in Online Appendix Table A4) show that both stayers and leavers of bankrupt firms lose significant earnings relative to their counterparts in non-bankrupt firms. In particular, the finding that stayers of bankrupt firms also lose considerable earnings relative to stayers of non-bankrupt firms suggests that earnings losses associated with corporate bankruptcy may be beyond the losses due to just job displacement. However, we interpret this implication with caution given the different selection for stayers (or leavers) of bankrupt and non-bankrupt firms.

[23] Kambourov and Manovskii (2009) show that once controlling for occupation-specific tenure (based on the Standard Occupational Classification), tenure in an industry (based on SIC) has a limited effect on wages, suggesting that the effect of industry switches on earnings that we find may be (in part) due to occupation switches (which are likely correlated with industry switches). Unfortunately, we are unable to empirically examine this issue because the LEHD data do not contain information on the occupation of employment.

association between switching industry and earnings losses could be due to selection. For example, it is possible that more able workers stay in the industry while worse workers leave, leading to the differential earnings patterns across the groups.

In terms of county stayer status, the comparison of columns (3) and (5) and columns (4) and (6) shows that whether workers remain in the same industry or not, switching counties is associated with significantly lower post-bankruptcy earnings at the 1% level. This considerable difference appears to reflect a more onerous transition period for those who relocate across geographical areas, or due to selection (on ability, for example) in which less able workers "have to" move outside the original county post-bankruptcy.

In sum, while the analysis in this subsection does not allow us to make a statement about causality of earnings losses post-bankruptcy, it sheds light on potential drivers of the losses, such as industry-specific skills and costly worker movements across industries and geographies.

3.2.2. Heterogeneity Conditional on Firm and Labor Market Size and Bankruptcy Outcomes

The analysis in the previous section suggests that costs to worker mobility and loss of specific human capital are potential mechanisms through which workers suffer earnings losses. To explore these mechanisms further, in this section we examine employees' post-bankruptcy earnings conditional on labor market characteristics and bankruptcy outcomes using a modified version of equation (2). Specifically, for this analysis we stratify both the treatment (bankruptcy) and control groups of employees based on the conditioning variables, which include firm size, local labor market size, and bankruptcy liquidation outcome. Then we compare the present value of earnings losses across the groups in Table 5, Panel B.

We first explore the effect of bankruptcy on earnings conditional on the size of firms measured by book assets. Workers in larger firms may fare better after bankruptcy than those in smaller firms because of better opportunities to reallocate within (e.g., to another division in the internal labor market) or across firms (Lazear and Oyer, 2004; Tate and Yang, 2015) or because of better opportunities to develop general skills that improve their job mobility. Moreover, Graham (2022) shows that concerns about leverage-induced financial distress are greater in small firms. Consistent with these notions, the estimates in columns (1) and (2) in Panel B show that the present value of earning losses for employees of smaller firms is 99% of pre-bankruptcy annual earnings and statistically significant, whereas it is 62% for employees of larger firms (defined as book assets larger than the 75th percentile) though this difference is not significant.

Second, we explore whether the impact of bankruptcy on earnings is related to the size of labor markets. The analysis is motivated by the extant literature arguing that large labor markets reduce search frictions and thus make it easier for workers to find jobs requiring similar skills (Diamond, 1982; Moretti, 2011). Following the labor market search literature (e.g., Petrongolo and Pissaride, 2006; Manning and Petrongolo, 2017; Kim, 2020), we measure the size of the labor market at the local level. In particular, we sort industry-county cells at the 75th percentile of the distribution of total employment (from the LBD) into "large" vs. "small" (or "thick" vs. "thin") labor markets.[24] The results, reported in columns (3) and (4) in Table 5, Panel B, show that earnings decline less in larger labor markets after bankruptcy, plausibly because workers in these markets can more easily find jobs that match their skill set. Specifically, the present value of earning losses for employees facing a smaller labor market is 116% and statistically significant, while it is 24% for employees of firms facing a larger labor market and statistically insignificant. Combined with the results in Panel A, these results highlight the importance of employment opportunities in the same industry (that presumably require similar human capital) and local area (that reduce search costs) in mitigating the adverse effects of bankruptcy on earnings. We note that the relation between employer and labor market characteristics and earnings losses post-bankruptcy could be due to selection, and thus we interpret these results as an association instead of a causal relation.

Lastly, in columns (5) and (6) we estimate the earnings patterns of employees for ultimately liquidated versus non-liquidated bankrupt firms. To the extent that workers are more likely to leave the firm after a bankruptcy that eventually ends in liquidation, earnings losses could be greater in liquidation. In addition, liquidation may indicate poor economic or labor market conditions, under which worker reallocation is costlier, leading to greater earnings losses. We find that the PV

[24] We sort the sample at the 75th percentile, given that the distribution of these variables is right-skewed.

earnings losses may be slightly larger in absolute magnitude for liquidated firms than for non-liquidated firms. Columns (5) and (6) show that the PV of earnings losses amounts to 97% (of pre-bankruptcy annual earnings) for liquidated firms and 84% for non-liquidated firms. The insignificant difference between liquidating and non-liquidating bankrupt firms appears to be due to different timing of earnings losses across the groups – employees of liquidated firms experience larger losses right after bankruptcy (when many workers likely leave the firms) but smaller losses in later years, when their transition to next jobs is likely complete; in comparison, employees of non-liquidating firms experience considerable losses throughout the seven years post-bankruptcy (see Online Appendix Figure A2). The finding suggests that while liquidation may accelerate earnings losses, employees ultimately experience significant earnings losses whether the bankrupt firm liquidates or not.

3.3. Regression Discontinuity Analysis of Loan Covenant Violations

Our main analysis thus far examines earnings dynamics for employees of bankrupt and matched firms and provides evidence consistent with ex ante comparable workers experiencing substantial earnings losses due to corporate financial distress. However, the analysis based on matching on observables and detailed fixed effects may not completely rule out alternative explanations concerning unobserved economic shocks affecting the different earnings trajectories of the treated and control groups. In this section, we provide complementary evidence for a causal effect of financial distress on employee earnings by using a regression discontinuity design (RDD) around loan covenant violations. Specifically, we follow Falato and Liang (2016) to construct a sample of firms in the DealScan and Compustat databases, match them with employees in LEHD from 1995 through 2008, and estimate the following equation:[25, 26]

$$\Delta y_{ift-1\rightarrow t} = \alpha_f + \gamma_{jct} + Bind_{ift} + \delta z_{ift} + \beta x_{it-1} + \varepsilon_{ift}, \quad (3)$$

where $\Delta y_{ift-1\rightarrow t}$ is the first difference in worker i's (who is employed by firm f in year t-1) logarithm of real annual earnings in year t relative to year t-1, α_f and γ_{jct} represent firm and two-digit SIC

[25] We thank Antonio Falato for sharing DealScan-Compustat merged data and related programs.
[26] See also Chava and Roberts (2008) for an RDD analysis of loan covenant violations on corporate investment.

industry × county × year fixed effects; $Bind_{ift}$ is an indicator variable equal to one if worker i is an employee of firm f that violates a loan covenant concerning the current ratio or net worth in year t, and zero otherwise; z_{ift} includes the relative distances from covenant violation thresholds for the current ratio (CR) and net worth (NW) and their second-order polynomial terms; and x_{it-1} includes the following worker characteristics: imputed education, female indicator, imputed education × female indicator, years of experience, imputed education × years of experience, and female indicator × years of experience. ε_{ift} is the random error. Standard errors are double clustered at the firm and worker level. Following Falato and Liang (2016), we use a sample of firms within +/- 20% of the relative distance to covenant violation thresholds ("discontinuity sample"). The sample excludes financials, firms with employment less than 10, and those incorporated outside the U.S. In addition, we include up to second-order (i.e., square) terms of the relative distances (see e.g., Gelman and Imbens, 2019).

First, we verify that there is no "jump" in worker characteristics (e.g., annual real earnings, imputed education) around the violation threshold before potential violation, consistent with employees of firms "just above" and "just below" the threshold being comparable ex ante (see Online Appendix Table A6). In addition, Figure A3 in the Online Appendix shows that there is a sharp break in the average earnings growth rate of employees of firms that fall just below the covenant violation threshold relative to firms that fall just above the threshold. Second, we present the results of estimating equation (3) in Table 6. The coefficients on *Bind* show that a loan covenant violation leads to a 3.6-5.5 percentage-point (e.g., exp(-0.037) – 1 = -0.036 from column (1)) decline in the worker's earnings growth rate, which is significant at the 5% level across the specifications. We obtain similar results when we also include second-order terms of relative NW and CR in column (2). The results are robust when we include firm fixed effects (columns (3) and (4)), which control for unobserved firm-level heterogeneity in earnings growth due, e.g., to differences in productivity growth.

[Table 6 about here]

To the extent that a covenant violation represents a form of financial distress, potentially a "first step" towards bankruptcy, the results for declining earnings growth due to covenant violations are qualitatively consistent with the existence of a causal effect of financial distress on employee earnings losses, which we analyze in the main analysis using corporate bankruptcy events. In this sense, the analysis of loan covenant violations complements the main analysis and supports the interpretation that the employee costs of financial distress could affect firms' capital structure decisions ex ante. This is the topic we examine in the next section.

4. Wage Premia for Bankruptcy Risk and Capital Structure Implications

In competitive labor markets, employees exposed to higher risk of earnings loss (due to, for example, unemployment or moving to lower-paying jobs) would plausibly demand an ex ante wage premium to compensate for the risk (Abowd and Ashenfelter, 1981; Topel, 1984).[27] In the context of bankruptcy risk, such a wage premium represents an ex ante cost of bankruptcy for the firm, creating a disincentive to use debt. This section gauges whether this indirect cost of bankruptcy is of sufficient magnitude to affect corporate debt choices. In Section 4.1 we estimate the effect of leverage on wage premia by regressing wages on leverage using the LEHD data. Given that regression estimates may be affected by omitted variables, in Section 4.2 we alternatively derive wage premia using a binomial valuation model. In Section 4.3, we show that implied wage premia from the wage regression and from the valuation model have similar orders of economic magnitude. Finally, in Section 4.4 we compare our implied wage premium to the tax benefit of debt to explore capital structure implications.[28]

4.1. Estimating Wage Premia Using Wage Regressions

[27] See e.g., Rosen (1986) for theoretical underpinnings of compensating (or equalizing) differences. Agrawal and Matsa (2013) point out that even if workers do not gauge their employment stability by observing direct signals of the firm's financial conditions such as financial leverage and credit ratings, they can rely on indirect signals from management, the media, and other aspects of economic conditions. Consistent with workers' ability to understand the financial status of firms, Brown and Matsa (2016) find that job seekers accurately perceive firms' financial health and act upon it by reducing labor supply to distressed firms.

[28] Our approach uses compensating wage differentials to directly estimate the cost of financial distress resulting from the employee earnings losses due to bankruptcy. See Brown and Matsa (2016) and Baghai, Silva, Thell, and Vig (2021) for evidence that highly levered firms lose high-quality job candidates and employees due to poor job stability. Brown and Matsa (2016) also provide an empirical approach to estimate the indirect cost of financial distress due to deterioration of worker quality in financial distress.

We first estimate wage premia for the risk of bankruptcy using a wage regression approach on a sample of workers with ages between 22 and 55 who move across jobs at public firms in LEHD. In particular, we regress movers' highest quarterly earnings in the last four quarters right before and in the first the four quarters right after the movement on the leverages of their old and new employers, respectively. This choice of highest quarterly earnings as a measure of wages is in recognition that quarterly earnings immediately before or after a move likely under-estimate the "true" full-quarter wage rates for the worker because of the "move-within-the-quarter" issue.

We focus on earnings of "new hires" given that firms are hesitant to adjust wages for incumbent workers (e.g., Dickens et al., 2007), likely due to concerns about fairness, adverse selection, and turnover (Blinder and Choi, 1990; Campbell and Kamlani, 1997). In addition, Brown and Matsa (2016) find evidence that job changers accurately perceive firms' financial health and firms in distress indeed offer higher posted wages, suggesting that wages of job changers are likely sensitive to the company's leverage. Sample firms are in Compustat from 1986 to 2008, and have S&P credit ratings between AA+ and B- or unrated.[29] We apply the same criteria for book assets as in the bankrupt firm sample used in Section 2.[30] We drop spurious moves such as changes in firm identifiers due to apparent mergers and acquisitions from the sample. This procedure yields about 9.1 million quarterly earnings observations of job movers before and after their movements.

Using this sample, we estimate a standard earnings equation augmented by market leverage of the employer, a proxy for the risk of bankruptcy, as follows:

$$y_{ifjct} = \alpha_i + \alpha_f + \alpha_{jct} + \beta Market\ leverage_{ift} + \gamma x_{it} + \delta z_{ift} + \varepsilon_{ift}, \quad (4)$$

[29] We exclude firms with AAA ratings given that they are rare in practice. We also exclude firms with ratings below B- in an attempt to focus on the ex-ante wage premium outside of ex-post financial distress. For example, Benmelech, Bergman, and Enriquez (2012) show that employees of financially distressed firms (especially those with weak bargaining power) experience wage cuts, which would induce a negative bias into our estimate of the wage-leverage relation. Similarly, Almeida and Philippon (2007) stop at a B rating in their analysis. We present the results when all these firms are included in the sample (in Online Appendix Table A7, Panel A). The table shows very similar results for the effect of leverage on wages.

[30] That is, we require that book assets be greater than \$100 million in 1980 constant dollars and less than or equal to the assets of the largest firm in our bankrupt and matched firm sample.

where y_{ifjct} is the logarithm of quarterly real earnings (in 2001 constant dollars) for worker i employed in firm f, industry j, county c, and year t; α_i, α_f, and α_{jct} represent worker, firm, and two-digit SIC industry × county × year fixed effects; and $Market\ leverage_{ift}$ is the market leverage ratio of firm f (where worker i is employed) in year t. x_{it} is a set of worker-level control variables including a female indicator × years of experience and imputed education × years of experience. z_{ift} includes the following firm-level control variables: log book assets, market-to-book, ROA, and asset tangibility for firm f that employs worker i in year t. ε_{ift} is the random error. Standard errors are double clustered at the firm and worker level. Controlling for employee ability is important for identifying the effect of financial distress risk on wages (Berk, Stanton, and Zechner, 2010) and compensating differentials in general (Brown, 1980). Therefore, we control for both worker and firm fixed effects (e.g., Abowd, Kramarz, and Margolis, 1999; He and Maire, 2020) as well as the observed worker and firm characteristics.

[Table 7 about here]

Consistent with the existence of compensating differentials for corporate bankruptcy risk, Table 7 shows evidence that employees of firms with higher leverage are paid higher wages, all else equal. The coefficient on market leverage in column (1) suggests that a ten-percentage-point increase in leverage is associated with a 0.59% (= 10% × (exp(0.057) – 1)) increase in wages (significant at the 1% level). Importantly, this result is based on a sample of public firm employees from the LEHD data. Thus, our estimates refine those in Chemmanur, Cheng, and Zhang (2013), which are based on firm-level aggregate wage bills and executive compensation data. Also, our results complement Brown and Matsa (2016), who show that firms with higher risk of financial distress (proxied by CDS prices) offer higher wages to job applicants.

We next examine the heterogeneity in wage premia for employees facing different risks of earnings loss. We split the full sample at the 75th percentiles of firm size (measured by book assets) and local labor market size (measured by employment in a given two-digit SIC industry and county cell) distributions.[31] Columns (2) through (5) show that significant wage premia exist only for

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[31] As in Section 3.2.2, we sort the sample at the 75th percentile, given that the distribution of these variables is right-skewed.

workers employed by smaller firms and in smaller local labor markets. The difference in wage premium estimates between workers in smaller versus larger firms (larger labor markets) is significant at the 10% (5%) level. A concurrent paper by Dore and Zarutskie (2018) also estimates earnings equations using LEHD data and finds that an increase in book leverage is associated with higher wage growth, particularly in smaller (relative to larger) local labor markets. Combined with our finding in Table 5, Panel B that bankruptcy is associated with greater earnings losses for workers employed by smaller firms and in smaller local labor markets, the results in this section suggest that workers are paid a significant wage premium for bankruptcy risk, especially for job movers.[32]

We further sort the sample of bankrupt and matched firm employees at the 75th percentile of ages in year t-1. We find that older workers (age > 75th percentile) lose 108% of their pre-bankruptcy annual earnings over the seven years after bankruptcy, whereas younger workers lose 79%. However, we find that older workers do not receive a larger magnitude of financial leverage wage premium than do younger workers – a ten-percentage-point increase in market leverage is associated with 0.48% and 0.64% increases in wages for older and younger workers, respectively. That is, unlike our tests on firm size and labor market size above, the PV (earnings losses) and

[32] We report additional results for the sample including (a 30% random sample of) all workers (movers and non-movers) in Online Appendix Table A7, Panel B. The results show that leverage is significantly positively associated with wages in regressions without firm fixed effects, while the relation becomes insignificant when controlling for firm fixed effects. The results are consistent with our earlier discussion of the wage rigidity of incumbent workers, which implies that it may be difficult to detect the relation between leverage and wages using within-firm variation. It would be particularly difficult for the firm to reduce incumbent workers' wages when it decreases leverage due to downward wage rigidity. Even when a firm increases its leverage, it might not increase wages immediately because labor market frictions (such as specific human capital and search costs) may prevent incumbent workers from moving quickly to other firms with a lower leverage and/or higher wages. Intuitively, the firm would only need to increase wages for higher leverage when the worker is willing to switch jobs given the associated mobility costs (See Manning (2003, chapter 8.2) for a general discussion of how worker mobility costs, i.e., imperfect competition in labor markets, render workers not fully compensated for job disamenities like risk of earnings losses). Therefore, for a 'modest' increase in leverage, we might not observe an immediate adjustment in the wages of incumbent workers. In contrast, for job movers, who by revealed preference make job-to-job moves reflecting their preferences, wages are more likely to promptly reflect a premium (discount) for higher (lower) leverage. As such, there could be a difference in the promptness between changes in the wages of incumbent workers and job movers, and the process for wages of all employees to fully incorporate a premium or discount for leverage changes could be slow. Under these conditions, the leverage-wage relationship may be easier to detect as a cross-sectional phenomenon that shows up in regressions without firm fixed effects and/or through the mover sample.

wage premium results do not align for worker age. A possible explanation for why older workers appear not to receive a larger wage premium conditional on leverage is that, while older workers face greater earnings losses upon bankruptcy, they also have less labor market mobility, which could imply that the labor market they face is "less competitive." As labor markets become less competitive, firms are less likely to pay compensating differentials.

Although we control for firm, worker, and industry × county × year fixed effects, as well as firm and worker characteristics in our wage equation, one caveat of the analysis is that the wage premium estimates may be biased due to omitted variables. One such potential omitted variable is the quality of corporate governance. For example, Cronqvist et al. (2009) find that entrenched CEOs tend to pay higher wages to workers, whereas Berger, Ofek and Yermack (1997) find evidence that entrenched CEOs seek to avoid debt usage, which implies that the quality of corporate governance might be negatively (positively) correlated with wages (leverage). Thus, omitting variables capturing the quality of corporate governance, which likely varies over time even within firms, could lead to under-estimating the effect of leverage on wages.

Similarly, managerial characteristics such as overconfidence could bias our estimated relation. CEO overconfidence is positively associated with the firm's leverage (Malmendier et al., 2011; Ben-David et al., 2013). In addition, it is conceivable that overconfident managers may overpay workers because they believe their firms are more valuable than the market value. Therefore, omitting a control for CEO overconfidence (which varies within firms over time) could lead to over-estimating the relationship between leverage and employee wages. We thus employ an alternative approach to quantify wage premia in the next section.

4.2. Implied Wage Premia Using a Binomial Valuation Model

Our alternative approach to derive wage premia builds on the notion of compensating differentials. In a competitive labor market, firms with different risks of bankruptcy pay risk-averse employees the same risk-adjusted present value of expected wages (or provide the same level of expected utility), all else equal. In particular, the contracted wages for a firm with a higher probability of bankruptcy should be higher due to greater expected personal costs of bankruptcy for the firm's employees. This argument implies that the wage premium that a worker demands should equal the expected PV of the earnings losses due to the likelihood of her employer filling bankruptcy in that year.

Online Appendix A develops a framework to estimate the wage premia demanded by an employee working for a risky firm. The appendix shows that a firm's wage premium relative to wages at a risk-free firm is equal to $\frac{q(\frac{NL}{W})}{1+r_f}$, where r_f is the risk-free rate, q is the annual risk-adjusted (i.e., risk-neutral) bankruptcy probability, and $\frac{NL}{W}$ is the present value of employee net earnings losses (with UI adjustments) given bankruptcy as a fraction of pre-bankruptcy wages. Intuitively, at the beginning of a year, a worker employed by a risky firm with an annual bankruptcy probability q will face an expected earnings loss of $q\times(NL/W)$ by the end of the year, for which the worker demands a risk premium equal to its present value $\frac{q(\frac{NL}{W})}{1+r_f}$. We focus on "net" earnings losses given that part of the present value of earnings losses might be due to the loss of a compensation differential that existed pre-bankruptcy between a riskier bankrupt firm and a less risky matched firm. The net earnings losses are equal to earnings loss estimates in Section 3.1 times an adjustment factor.[33]

Because no direct estimate of the risk-neutral probability of bankruptcy, q, is available, we begin our estimation of q from the risk-adjusted probability of default that Almeida and Philippon (2007) derive from bond risk premia times the conditional probability of bankruptcy given default (Prob(Bankruptcy|Default)). Using Moody's Default and Recovery Database (DRD) from 1981 to 2013, we find that 66.4% of public default firms ultimately file for bankruptcy. Similarly, the Altman-Kuehne/NYU Salomon Center Bond Master Default Database shows that 58.7% of firms in default end up filing for bankruptcy protection from 1981 to 2014.[34] Thus, we use 60% as our estimate of Prob(Bankruptcy|Default). Given that bankruptcy is likely to occur in bad states, the

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[33] In Online Appendix A.3, we show that the adjustment factor is equal to $\frac{1}{1+\frac{fq}{1+r_f}}$, where f is the annuity factor from years t to t+6.

[34] We thank Edward Altman for sharing his dataset of default events.

conditional risk-neutral probability may be higher than the conditional natural probability. We thus check the sensitivity of our results by increasing the conditional probability from 0.6 to 0.9 and find that this results in the wage premium between BBB and AA-rated firms increasing by 0.33% of firm value (from 1.99% to 2.32%; see column (2) in Table 10, Panel A), suggesting little sensitivity of our results to the conditional probability.[35]

Since Almeida and Philippon (2007) provide ten-year cumulative risk-adjusted default probabilities, we convert the ten-year probability into a one-year probability. Specifically, in column (2) in Table 8, for each credit rating group, we compute the annual risk-adjusted probability of bankruptcy as $q = 1 - (1-0.6 \times q_{10})^{1/10}$, where 0.6 is the probability of bankruptcy conditional on default discussed above, and q_{10} is the ten-year risk-adjusted default probability from Almeida and Philippon (2007) shown in column (1).

[Table 8 about here]

Importantly, the risk-adjusted probability of default for bondholders is likely different from that for workers who likely hold less diversified portfolios and thus are exposed to more idiosyncratic risk. To account for the difference, we use a certainty equivalence approach to estimate the ratio of annual risk-adjusted default probability for workers to that for bondholders, using the portfolio holdings information of average bondholders and workers in the Survey of Consumer Finance. We then use the ratio to adjust q to obtain q^w, the annual risk-adjusted bankruptcy probability for workers. Column (3) in Table 8 shows q^w, which we use to calculate the implied wage premium as a fraction of wages paid by the firm to the worker: $\frac{q^w(\frac{NL}{W})}{1+r_f}$. Online Appendix B provides details of the estimation approach for q^w.

Column (4) in Table 8 shows that the implied wage premium accounts for a notable portion of wages, particularly for firms with low credit ratings. The implied wage premium accounts for 0.29% of wages for AA-rated firms and 0.94% for BBB-rated firms.

4.3. Comparing Regression-Based and Implied Wage Premia

[35] Given that default is also likely to happen in bad states, the "true" conditional probability might be smaller than 0.9.

In this section, we compare the implied wage premium derived from the binomial valuation model in Section 4.2 to the wage premium estimated from the wage regression in Section 4.1. Given that our wage regression does not benchmark with risk-free firms, we use AA-rated firms as a benchmark for our regression-based wage premia estimates. As such, Table 9 compares the wage premia that BBB-rated firms pay relative to AA-rated firms between these two approaches. Full sample comparisons are in column (1), while columns (2) and (3) show comparisons for subsamples based on firm assets size and columns (5) and (6) based on labor market size.

Panel A shows that using the binomial valuation model, the additional implied wage premium due to moving from AA to BBB rating is 0.66% of wages for the full sample. We derive the implied wage premia for subsamples in columns (2) through (7) similarly following the process explained in Section 4.2, except that we use the UI-adjusted PV earnings loss estimates for those subsamples from Online Appendix Table A8, Panel B, columns (1) through (4) (e.g., -97.7% of pre-bankruptcy earnings for employees of smaller firms). As shown in Table 9, the implied wage premia are larger in subsamples for which the post-bankruptcy earnings losses are greater (i.e., for smaller firms and smaller labor markets). The difference between the two groups is significant for labor market size (at the 5% level) but not for firm size.

[Table 9 about here]

Next, in Panel B we report the estimates for the differential wage premium between BBB and AA-rated firms using the wage regression results. We begin with the coefficient on market leverage in column (1) of Table 7 (0.057), which implies that a one-percentage-point increase in leverage is associated with a 0.059% (= exp(0.057) – 1) increase in wages. We then calculate the difference in market leverage between BBB and AA-rated firms in our sample, controlling for aggregate changes in leverage using year fixed effects. This leverage difference is equal to 11.3%. Lastly, the differential wage premium between BBB and AA-rated firms is equal to the leverage difference (11.3%) times the coefficient on leverage in the wage regression in percentage terms (0.059), which is 0.64%. The wage premia for subsamples are calculated similarly except that we use coefficients on leverage for different subsamples in Table 7, columns (2) to (5). Panel B of Table 9 reinforces the conclusion obtained from Panel A that wage premia are larger when employees face potentially larger earnings losses from bankruptcy (i.e., for smaller firms and for firms operating in smaller local labor markets).

Comparing Panels A and B of Table 9 shows that the differences in wage premia between BBB and AA-rated firms are of similar magnitudes in the two different approaches we employ.

4.4. Implied Wage Premia and Capital Structure Implications

In this section, we build upon the implied wage premia for risky firms (relative to risk-free firms) based on the binomial valuation model (Section 4.2) and compute the capitalized value of implied wage premia for firms with different credit ratings. The capitalized wage premia, interpreted as indirect costs of financial distress, are then compared with tax benefits of debt for firms with different credit ratings. We are not able to compute the capitalized wage premia over risk-free firms using the wage regression approach (Section 4.1) because the wage regression is conducted on firms with credit risk.[36]

4.4.1. Capitalized Value of Implied Wage Premia as Indirect Costs of Financial Distress

Given that tax benefits of debt are often measured as a fraction of firm value (e.g., Graham, 2000), we compute the capitalized value of implied wage premia as a fraction of firm value. First, we convert the wage premium as a fraction of wages (Section 4.2), $\frac{q^w(\frac{NL}{W})}{1+r_f}$, into the annual premium as a fraction of market value of the firm as $\frac{q^w(\frac{NL}{MV})}{1+r_f} = \frac{q^w(\frac{NL}{W})}{1+r_f} \times \frac{W}{MV}$, where $\frac{W}{MV}$ is the ratio of total wage bill and market value of the average sample bankrupt firm in year t-4. Second, we compute the present value of the wage premium for a firm with an infinite horizon, and derive that the firm's capitalized value of wage premia relative to a risk-free firm as a fraction of firm value is equal to $\frac{q^w(\frac{NL}{MV})}{r_f+q}$ (see Section A.2 of the Online Appendix for details).[37]

[Table 10 about here]

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[36] We benchmark against risk-free firms in calculating the PV of wage premia because the existing estimates on expected costs of financial distress and tax benefits are relative to risk-free firms.

[37] Almeida and Philippon (2007) use similar valuation models and risk-adjusted default probabilities to compute the expected costs of financial distress (but they do not address employee costs or the wage premia that we compute).

Column (1) in Panel A of Table 10 shows the annual wage premium as a fraction of firm value for firms with different credit ratings. Column (2) shows that the capitalized value of the wage premium is a nontrivial fraction of firm value, particularly for firms with low credit ratings. The present value of the wage premium is 1.05% of firm value for AA-rated firms, and increases to 3.04% for BBB-rated firms. The increase in wage premia for firms with lower credit ratings (and thus higher leverage) may potentially offset the increased tax benefits of debt for these more highly-levered firms. In the next subsection, we explore the implications of bankruptcy-induced wage premia for capital structure decisions.

4.4.2. Comparing Implied Wage Premia to Tax Benefits of Debt and Expected Costs of Financial Distress

Comparing columns (2) and (3) in Panel A of Table 10 indicates that the present value of implied wage premia is a significant fraction of the tax benefits of debt. For AA and BBB-rated firms, tax benefits of debt equal 2.51% and 5.18% of firm value, respectively, while wage premia are 1.05% and 3.04% of firm value. Thus, wage premia offset 42% and 59% of the tax benefits of debt for AA and BBB-rated firms, which appears to be of large enough magnitude to affect capital structure choices.

To further assess the importance of wage premia, we explicitly factor in non-wage costs of financial distress by benchmarking implied wage premia with the tax benefits, net of the expected financial distress costs estimated by Almeida and Philippon (2007) and Elkamhi, Ericsson, and Parsons (2012). Both papers use risk-neutral probabilities to estimate expected costs of financial distress. However, as Elkamhi et al. (2012) point out, Almeida and Philippon (2007) may overstate the expected costs of financial distress by applying Andrade and Kaplan's (1998) 10-23% proportional losses to the firm's current (i.e., potentially far outside default) value. In contrast, Elkamhi et al. (2012) use the firm's value near default, on which Andrade and Kaplan (1998) derive their 10-23% estimates. As a result, the expected distress cost estimates from Elkamhi et al. (2012) are considerably smaller than those from Almeida and Philippon (2007). For example, Elkamhi et al. (2012) find that a BBB-rated firm's expected costs of financial distress are only 0.5% of firm value, which is significantly smaller than 4.53% in Almeida and Philippon (2007).

Based on the estimates from Elkamhi et al. (2012), when a firm's credit rating decreases from AA to BBB, the tax benefits of debt net of expected cost of financial distress increase by 2.17% (= 2.67% – 0.5%, last row of columns (3) and (5) in Table 10, Panel A). This is close to our estimate of the difference in the wage premium of 1.99% between BBB and AA-rated firms (column (2)). Therefore, our estimated wage premium appears to account for a substantial portion of the gap between tax benefits of debt and the expected cost of financial distress documented in the literature.

The capitalized value of implied wage premia in Panel A of Table 10 implicitly assumes that all employees receive the premium irrespective of when they are hired, which could be interpreted as a "frictionless" wage premium in which all employees are fully compensated for the earnings loss risk due to financial leverage. For example, the capitalized value of implied wage premium of a BBB-rated firm reflects the wage premium when all workers in a BBB-rated firm are compensated for the wage premium due to the difference in bankruptcy risk between BBB and risk-free firms. As we discussed earlier, in practice, the dynamics of a firm's wage adjustments depend on its wage rigidity or workers' mobility costs. Thus, at a given point in time, a firm's wage premium could deviate from the "frictionless" value, with only a portion of the workers receiving the wage premium. In Panel B of Table 10, we illustrate this point quantitatively by presenting the implied wage premia relative to firm value assuming that only recently hired employees are compensated for the risk of bankruptcy. The panel shows that the implied wage premia for the newly hired employees still represent a considerable fraction of firm value, given that the wage bill of workers with one, two, and three years of job tenure are 25%, 19%, and 14% of the average sample bankrupt firm's total wage bills, respectively.

We note that our estimates of wage premia are larger than those in Agrawal and Matsa (2013, AM). AM find that, assuming no wage replacement by unemployment insurance benefits, firms with AA and BBB ratings respectively pay 0.16% and 1.54% wage premiums. Matsa (2018) argues that the differences between AM's (2013) estimates and ours are understandable for several reasons. For example, AM's estimates account for unemployment risk only, while our estimates also include earnings losses for employees who stay with a bankrupt firm (see Online Appendix

Table A4). Also, our estimates include earnings losses following an unemployment spell. These differences help explain the somewhat larger magnitude of our wage premium estimates relative to AM's.

Overall, our estimates for wage premia associated with bankruptcy risk are large enough to be an important component of financial distress costs (Titman, 1984; Berk, Stanton, and Zechner, 2010), which may help to explain the debt conservatism puzzle.

5. Conclusion

We examine how corporate bankruptcy leads to employee earnings losses due to adjustments in labor markets. We use worker-firm matched data from the U.S. Census Bureau to show that employee earnings deteriorate significantly post-bankruptcy. The present value of earnings losses accumulated over seven years averages 87% of pre-bankruptcy annual earnings. Earnings losses are larger for individuals who leave the industry, and who work for smaller firms or in thinner local labor markets. These results highlight the role of industry-specific human capital and costs of moving across geographical areas as important forces behind the post-bankruptcy earnings loss.

Given that a firm's debt choice affects the probability of bankruptcy, we argue that these ex-post lost wages circle back to high-leverage companies in the form of employees demanding higher ex ante wages (wage premia). We show that the ex-ante wage premium that firms must pay to compensate for the expected earnings loss due to bankruptcy is a considerable fraction of the magnitude of the tax benefits of debt. Thus, our results suggest that these indirect bankruptcy costs are significant enough to be a first-order consideration when firms make capital structure choices. An important future research direction is to provide direct evidence of the causal impact of wage premia on actual capital structure choices.

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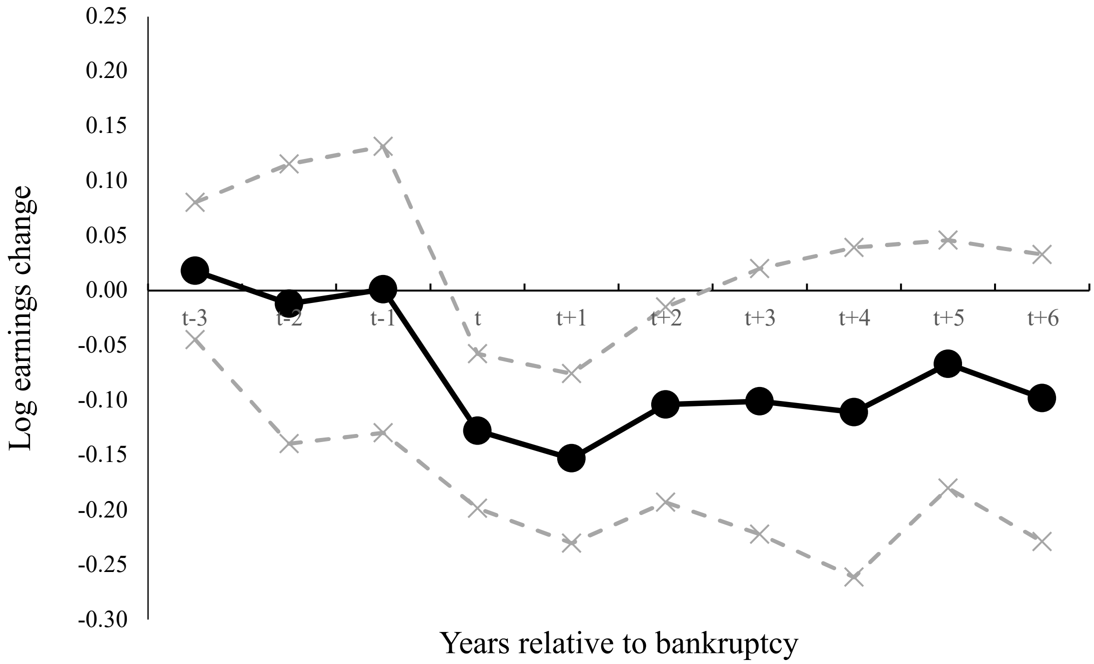
Appendix - Definition of Variables

Variable Name	**Variable Definition**
Firm characteristics	
Sales	Total sales of the firm in $millions
Book assets	Total book value of assets in $millions
Market value of assets	Total debt + market equity, where total debt = long term plus short-term debt, in $millions
Book (Market) leverage	Total debt/book assets (book assets – book equity + market equity)
ROA	Operating income before depreciation and amortizations/lagged book assets
Market-to-book	(Total debt + market equity)/(total debt + book equity)
Number of employees	Number of employees obtained from Longitudinal Business Database (LBD)
Credit rating	S&P credit rating from Compustat
Asset tangibility	Net PP&E/book assets
Capex/Net PP&E	Capital expenditures/lagged net PP&E
R&D/Assets	R&D expense/lagged book assets
Wages/Assets	Wage bills (LBD)/book assets
Worker characteristics	From LEHD-ICF
Female	An indicator variable equal to one if the worker is female, and zero otherwise
Experience	Years of potential work experience = age – (imputed years of education + 6)
Imputed education	Years of education imputed by the Census Bureau
Dependent and main independent variables	
Log (earnings)	Natural logarithm of annual (or quarterly) earnings from LEHD-EHF adjusted for inflation using the CPI (in 2001 constant dollars)
BR	An indicator variable equal to one for employees of bankrupt firms, and zero for employees of control firms
d[k], where k = -3 to +6	Event year indicator variables from three years before to six years after bankruptcy
Earnings growth	Change in natural logarithm of annual earnings (relative to the previous year) from LEHD-EHF adjusted for inflation using the CPI (in 2001 constant dollars)
Bind	An indicator variable equal to one if the worker is an employee of a firm that violates a loan covenant concerning the current ratio or net worth
Distance (NW or CR)	Relative distance of the firm's net worth (or current ratio) from the covenant threshold
2nd order distance NW & CR	Squared relative distances of the firm's net worth and current ratio

Figure 1: Effect of Corporate Bankruptcy on Employee Earnings

Panel A of the figure uses the difference-in-differences estimates in Table 4, Panel A, column (5) and plots the log change in real earnings without unemployment insurance (UI) adjustments (solid line) for employees of bankrupt firms from the benchmark (i.e., t-4) earnings, relative to the earnings change for employees of matched firms. Panel B plots the cumulative change in real earnings without UI adjustment. The dashed lines represent 95% confidence intervals. "Year t" represents the year of bankruptcy filing.

Panel A: Change in Log Earnings



Panel B: Cumulative Change in Log Earnings

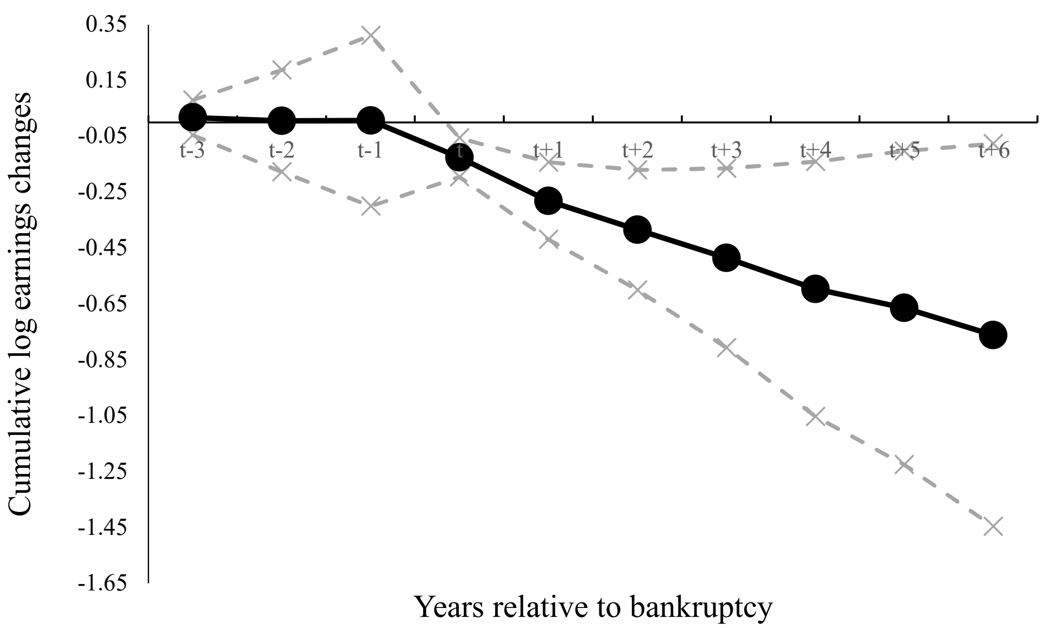


Table 1: Coverage of LEHD States and Years

This table presents the coverage of states and years by the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD)-Employment History File (EHF). See Vilhuber and McKinney (2014) for details of the LEHD infrastructure.

State	State abbreviation	First year	Last year
Arkansas	AR	2002	2008
California	CA	1991	2008
Colorado	CO	1990	2008
Florida	FL	1992	2008
Georgia	GA	1994	2008
Hawaii	HI	1995	2008
Iowa	IA	1998	2008
Idaho	ID	1990	2008
Illinois	IL	1990	2008
Indiana	IN	1990	2008
Louisiana	LA	1990	2008
Maryland	MD	1985	2008
Maine	ME	1996	2008
Montana	MT	1993	2008
North Carolina	NC	1991	2008
Nevada	NV	1998	2008
New Jersey	NJ	1996	2008
New Mexico	NM	1995	2008
Oklahoma	OK	2000	2008
Oregon	OR	1991	2008
Rhode Island	RI	1995	2008
South Carolina	SC	1998	2008
Texas	TX	1995	2008
Tennessee	TN	1998	2008
Utah	UT	1999	2008
Virginia	VA	1998	2008
Vermont	VT	2000	2008
Washington	WA	1990	2008
Wisconsin	WI	1990	2008
West Virginia	WV	1997	2008

Table 2: Descriptive Statistics on Characteristics of Bankrupt and Matched Firms

This table presents descriptive statistics on characteristics of bankruptcy events, firms and their matched firms. Panel A presents bankruptcy outcomes for the full sample of the bankrupt firms in the LoPucki Bankruptcy Research Database (BRD) from 1990 to 2005 and the matched bankrupt firms with at least ten employees in the Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) database. Panel B compares firm characteristics of bankrupt and propensity-score matched firms, with the statistics based on the values in the latest fiscal year before bankruptcy (in year t-1 or t-2, where "year t" is the year of bankruptcy filing). Panel C presents the descriptive statistics on dynamics of firm characteristics for bankrupt and matched firms from years t-3 to t-1. See the Appendix for variable definitions. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. "n.a." indicates cases in which statistics are not available.

Panel A: Bankruptcy Outcomes

	All bankrupt firms from BRD		Matched bankrupt firms with employees in LEHD	
	N. events	% of sample	N. events	% of sample
Merged, acquired, or continue	224	43.9%	40	30.8%
Liquidated, closed, or refile Chapter 11	106	20.8%	30	23.1%
Unknown	180	35.3%	60	46.2%
Total	510	100%	130	100%

Panel B: Firm Characteristics of Bankrupt and Matched Firms

Sample	Bankrupt firms with information from Compustat/LBD		Bankrupt firms with employees in LEHD		Propensity-score matched firms		*t*-statistic for difference	
Variable	(1) Mean	(2) STD	(3) Mean	(4) STD	(5) Mean	(6) STD	(7) (3)–(1)	(8) (3)–(5)
Sales ($m)	1,537	6,113	1,710	3,693	1,460	3,384	0.51	0.56
Book assets ($m)	1,390	4,244	1,278	1,781	1,224	2,381	-0.46	0.19
Market value of assets ($m)	1,185	4,333	954	1,277	1,168	3,814	-0.95	-0.58
Log market value of assets	6.26	1.05	6.32	1.00	6.08	1.16	0.89	1.63
Δ log market value of assets	-0.19	0.48	-0.16	0.41	-0.14	0.41	0.70	-0.44
Number of employees	8,672	20,920	9,497	22,940	6,067	10,270	0.53	1.52
Book leverage	0.63	0.37	0.60	0.35	0.35	0.28	-1.13	6.57***
Market leverage	0.57	0.26	0.57	0.23	0.32	0.23	-0.30	8.38***
ROA	0.00	0.31	0.05	0.09	0.06	0.08	3.05***	-0.82
Market-to-book	1.18	0.87	1.09	0.66	1.12	0.46	-1.75*	-0.47
Wages/Assets	0.22	0.25	0.25	0.24	0.22	0.15	1.62	1.20
Capex/Net PP&E	0.32	0.47	0.25	0.32	0.24	0.26	-2.49**	0.18
R&D/Assets	0.01	0.03	0.01	0.02	0.01	0.03	-0.60	-0.92
N. events	360	-	130	-	130	-	-	-

Panel C: Dynamics of Firm Characteristics for Bankrupt and Matched Firms Prior to Bankruptcy

	(1) Bankrupt firms (N = 90)			(2) Matched firms (N = 90)			*t*-statistic for (1)–(2)		
Year	t-3	t-2	t-1	t-3	t-2	t-1	t-3	t-2	t-1
Sales ($m)	1762	1871	1799	1,375	1,524	1,512	0.80	0.65	0.52
Book assets ($m)	1437	1497	1380	1,246	1,389	1,196	0.56	0.26	0.58
Market value of assets ($m)	1402	1175	952	1,623	1,232	902	-0.30	-0.13	0.21
Log market value of assets ($m)	6.61	6.54	6.36	6.31	6.23	6.10	1.59	1.70*	1.58
Δ log market value of assets ($m, from t-3)	n.a.	-0.08	-0.26	n.a.	-0.08	-0.22	n.a.	0.07	-0.48
Number of employees	12,860	12,430	10,980	7,771	7,270	6,741	1.46	1.60	1.40
Book leverage	0.43	0.51	0.62	0.31	0.33	0.36	3.22***	4.73***	5.86***
Market leverage	0.37	0.46	0.58	0.26	0.30	0.33	3.12***	5.00***	7.10***
ROA	0.11	0.09	0.05	0.12	0.09	0.06	-0.40	-0.40	-1.02
Market-to-book	1.57	1.25	1.04	1.49	1.19	1.09	0.49	0.71	-0.94
Wages/Assets	0.27	0.26	0.26	0.23	0.22	0.22	1.41	1.32	1.19
Capex/Net PP&E	0.35	0.28	0.18	0.40	0.31	0.21	-0.63	-0.59	-1.10
R&D/Assets	0.01	0.01	0.01	0.01	0.01	0.01	-0.41	-0.30	0.13

Table 3: Descriptive Statistics on Characteristics of Workers Employed by Bankrupt and Control Firms

This table presents descriptive statistics of the workers employed by bankrupt and control firms. All variables are measured at t-1 (where "year t" is the year of bankruptcy filing). The earnings data for individual employees are from the LEHD-EHF (Employment History Files), and other individual characteristics are from the LEHD-ICF (Individual Characteristics Files). We require that workers have at least two years of tenure and ages between 22 and 55 years in year t-1. Columns (5) and (6) show statistics for a 0.5% random sample of workers from the LEHD-EHF who are employed by non-bankrupt public firms, and satisfy the same requirements for industry (i.e., excluding financials and utilities), tenure, and age as the workers in the bankruptcy sample. Earnings are CPI-adjusted (in 2001 constant dollars). "% stay in firm (before)" (industry, county, or LEHD) is the percent of employees who stay in the firm (the employee's industry, county, or LEHD) from t-4 to t-1. Similarly, "% stay in firm (after)" (industry, county, or LEHD) is the percent of employees who stay in the firm (the employee's industry, county, or LEHD) from t-1 to t+3. "Δ % stay in firm (before → after)" (industry, county, or LEHD) is the change in the percent of employees who stay in the firm (the employee's industry, county, or LEHD) between t-4 to t-1 and t-1 to t+3. In columns (5) and (6), we report "% stay in firm/industry/county (before)" from t-1 to t-4 (instead of from t-4 to t-1) because the randomly selected worker sample does not condition on firms but on individuals. As a result, a sample of workers who were employees of the "same firm/industry/county" several years before t-1 is not well defined. For a similar reason, we are not able to report "% stay in LEHD (before)." Definitions of variables are in the Appendix. Columns (7) and (8) report heteroskedasticity robust *t*-statistics adjusted for within-firm clustering. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of employees is rounded to the nearest thousand to follow the Census Bureau's disclosure rules. "n.a." indicates cases in which statistics are not available.

	Employees of bankrupt firms		Employees of matched firms		Randomly selected workers		*t*-statistic for (1)–(3)	*t*-statistic for (1)–(5)
	(1) Mean	(2) STD	(3) Mean	(4) STD	(5) Mean	(6) STD	(7)	(8)
Years of education (imputed)	13.34	2.44	13.29	2.36	13.46	2.41	0.42	-1.04
Age	37.64	9.35	36.88	9.50	37.17	9.37	1.40	1.03
Years of experience	18.30	9.21	17.59	9.34	17.71	9.21	1.39	1.45
Female	0.51	0.50	0.46	0.50	0.45	0.50	0.84	0.93
Annual real earnings at t-1 (2001$)	31,460	33,430	28,710	94,210	35,100	83,960	0.55	-0.75
Number of employees	234,000		154,000		267,000		-	-
% stay in firm (before)	54.6	49.8	51.4	50.0	68.5	46.5	0.51	-3.03***
% stay in industry (before)	63.7	48.1	63.1	48.3	76.9	42.2	0.12	-2.86***
% stay in county (before)	66.8	47.1	66.6	47.2	77.2	41.9	0.03	-2.60**
% stay in LEHD (before)	66.9	47.1	63.9	48.0	n.a.	n.a.	0.53	n.a.
% stay in firm (after)	32.4	49.5	43.2	46.8	58.0	49.4	-1.66*	-4.75***
% stay in industry (after)	52.9	48.8	61.1	49.9	70.2	45.7	-2.10**	-5.69***
% stay in county (after)	53.4	48.1	63.7	49.9	70.9	45.4	-2.61***	-5.73***

% stay in LEHD (after)	57.3	48.6	61.6	49.5	66.3	47.3	-1.56	-3.80***
Δ % stay in firm (before → after)	-22.1	n.a.	-8.2	n.a.	-10.5	n.a.	-1.82*	-2.02**
Δ % stay in industry (before → after)	-10.8	n.a.	-2.0	n.a.	-6.7	n.a.	-1.86*	-1.17
Δ % stay in county (before → after)	-13.4	n.a.	-2.9	n.a.	-6.3	n.a.	-2.57**	-2.91***
Δ % stay in LEHD (before → after)	-9.6	n.a.	-2.4	n.a.	n.a.	n.a.	-1.20	n.a.

Table 4: Effect of Corporate Bankruptcy on Employee Earnings

This table presents difference-in-differences estimates of earnings changes for workers employed by bankrupt firms around bankruptcy filings relative to a control group of workers. The control group in Panel A includes employees of the matched firms, and in Panel B a 0.5% random sample of workers from the LEHD universe employed by public non-bankrupt firms. Panel C reports the present value of earnings losses after estimated unemployment insurance (UI) income is incorporated. The dependent variable is log(annual earnings) in 2001 constant dollars. "BR" is an indicator variable equal to one for employees of bankrupt firms. The event year indicator variables are "d[k]," where $-3 \leq k \leq 6$. The regressions use the observations from event years t-4 to t+6, with the benchmark earnings being the earnings in year t-4. Standalone event year indicators d[k] ($-3 \leq k \leq 6$) are included in all regressions but suppressed for expositional convenience. "PV (Earnings losses)" ("PV (Earnings losses, R_f)") is the present value of earnings losses from years t to t+6 computed using a real risk-adjusted discount rate (real risk-free rate) as a percent of the pre-bankruptcy annual earnings in t-4. To illustrate the process to compute the PV, take Panel A, column (5) as an example. We first convert the coefficient on "d[1] × BR," -0.153, into $\exp(-0.153) - 1 = -14.2\%$, which is the percentage change in earnings when "d[1] × BR" changes from zero to one. We then discount the percentage change by a year using a real discount rate of -7.40% or the risk-free rate of 3.34%. The real discount rate is inflation- and risk-adjusted that is appropriate given workers' exposure to uninsurable idiosyncratic risk. The risk-free rate ignores the worker's (idiosyncratic) risk exposure. We repeat the calculation for all coefficients on "d[k] × BR" for $0 \leq k \leq 6$, and then sum up the present values across the seven years. For regression coefficients, heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses. Definitions of variables are in the Appendix. For present values of earnings losses, *t*-statistics for the PV significantly differing from zero are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousand to follow the Census Bureau's disclosure rules.

Panel A: Earnings Losses Using Matched Firms' Employees as Control Group

Dep. Var. = Log (Earnings)	(1)	(2)	(3)	(4)	(5)
d[-3] × BR	-0.004	0.033	0.024	0.001	0.018
	(-0.17)	(1.31)	(1.29)	(0.05)	(0.56)
d[-2] × BR	-0.034	0.043	-0.004	-0.017	-0.012
	(-0.83)	(1.00)	(-0.11)	(-0.39)	(-0.19)
d[-1] × BR	-0.034	0.038	0.006	0.007	0.001
	(-0.81)	(0.83)	(0.16)	(0.14)	(0.01)
d[0] × BR	-0.086**	-0.045	-0.083***	-0.106***	-0.128***
	(-2.43)	(-1.36)	(-2.93)	(-3.78)	(-3.55)
d[1] × BR	-0.159***	-0.105***	-0.126***	-0.161***	-0.153***
	(-3.39)	(-2.66)	(-3.69)	(-5.15)	(-3.89)
d[2] × BR	-0.126**	-0.144***	-0.055	-0.104***	-0.104**
	(-2.20)	(-3.26)	(-1.63)	(-3.03)	(-2.29)
d[3] × BR	-0.037	-0.079**	-0.013	-0.097***	-0.101
	(-0.51)	(-2.08)	(-0.30)	(-2.61)	(-1.63)
d[4] × BR	-0.056	-0.044	-0.030	-0.074*	-0.111
	(-0.87)	(-1.10)	(-0.75)	(-1.76)	(-1.45)
d[5] × BR	-0.014	0.026	0.017	-0.031	-0.067
	(-0.18)	(0.71)	(0.32)	(-0.89)	(-1.16)
d[6] × BR	-0.046	0.012	0.017	-0.033	-0.098
	(-0.61)	(0.28)	(0.43)	(-0.76)	(-1.46)
Female × Experience	0.010***	-0.001	0.005**	-0.002*	-0.002
	(2.83)	(-1.02)	(2.65)	(-1.68)	(-1.56)
Education × Experience	-0.005***	-0.004***	-0.004***	-0.004***	-0.004***
	(-11.69)	(-19.70)	(-19.22)	(-22.19)	(-22.41)
Standalone event year indicators d[k] ($-3 \leq k \leq 6$)	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				
SIC2 × Year FE		Yes		Yes	
County × Year FE			Yes	Yes	
SIC2 × County × Year FE					Yes
Observations	2,967,000	2,967,000	2,967,000	2,967,000	2,967,000
R^2	57.1%	58.3%	59.3%	59.9%	61.4%
PV (Earnings losses)	-58.9%	-40.2%	-27.7%	-68.7%**	-89.5%**
	(-1.24)	(-1.41)	(-0.89)	(-2.51)	(-2.14)
PV (Earnings losses, R_f)	-46.4%	-33.9%*	-25.6%	-53.6%***	-66.0%**
	(-1.45)	(-1.71)	(-1.21)	(-2.88)	(-2.35)

Panel B: Earnings Losses Using Randomly Selected Workers as Control Group

Dep. Var. = Log (Earnings)	(1)	(2)	(3)	(4)	(5)
d[-3] × BR	0.008	-0.001	0.007	-0.015	0.006
	(0.42)	(-0.08)	(0.64)	(-1.17)	(0.32)
d[-2] × BR	0.004	-0.005	0.017	-0.017	0.003
	(0.12)	(-0.18)	(0.55)	(-0.58)	(0.08)
d[-1] × BR	-0.036	-0.029	-0.001	-0.035	-0.027
	(-1.05)	(-0.91)	(-0.04)	(-1.13)	(-0.67)
d[0] × BR	-0.125***	-0.138***	-0.120***	-0.182***	-0.187***
	(-3.70)	(-6.00)	(-4.62)	(-9.59)	(-8.08)
d[1] × BR	-0.184***	-0.204***	-0.157***	-0.240***	-0.210***
	(-4.00)	(-6.80)	(-5.16)	(-9.93)	(-7.80)
d[2] × BR	-0.200***	-0.241***	-0.122***	-0.199***	-0.180***
	(-4.70)	(-8.16)	(-5.17)	(-8.45)	(-5.74)
d[3] × BR	-0.120***	-0.169***	-0.050**	-0.144***	-0.094***
	(-2.74)	(-6.85)	(-1.97)	(-5.97)	(-2.99)
d[4] × BR	-0.131***	-0.167***	-0.039	-0.133***	-0.076**
	(-2.80)	(-5.59)	(-1.44)	(-4.63)	(-2.04)
d[5] × BR	-0.050	-0.052	0.019	-0.050	0.022
	(-1.28)	(-1.26)	(0.65)	(-1.15)	(0.38)
d[6] × BR	-0.053	-0.102***	0.042	-0.067**	-0.027
	(-0.77)	(-2.59)	(1.37)	(-2.12)	(-0.66)
Female × Experience	0.011***	-0.003**	0.007***	-0.004***	-0.004***
	(4.85)	(-2.50)	(5.25)	(-2.98)	(-3.08)
Education × Experience	-0.005***	-0.004***	-0.004***	-0.004***	-0.004***
	(-14.71)	(-19.22)	(-22.56)	(-20.86)	(-20.66)
Standalone event year indicators d[k] ($-3 \leq k \leq 6$)	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				
SIC2 × Year FE		Yes		Yes	
County × Year FE			Yes	Yes	
SIC2 × County × Year FE					Yes
Observations	3,855,000	3,855,000	3,855,000	3,855,000	3,855,000
R^2	59.3%	60.0%	60.9%	61.2%	63.9%
PV (Earnings losses)	-97.3%***	-121.3%***	-42.2%**	-112.1%***	-78.9%***
	(-2.81)	(-5.88)	(-2.07)	(-5.68)	(-2.96)
PV (Earnings losses, R_f)	-74.4%***	-90.7%***	-38.8%***	-86.8%***	-65.7%***
	(-3.16)	(-6.6)	(-2.77)	(-6.62)	(-3.71)

Panel C: Earnings Losses Adjusted for Unemployment Insurance Income

Dep. Var. = Log (Earnings)	(1)	(2)	(3)	(4)	(5)
Worker-level controls	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				
SIC2 × Year FE		Yes		Yes	
County × Year FE			Yes	Yes	
SIC2 × County × Year FE					Yes
	Using Matched Firms' Employees as Control Group				
PV (Earnings losses)	-54.5%	-33.9%	-26.3%	-64.4%**	-87.1%**
	(-1.15)	(-1.17)	(-0.84)	(-2.31)	(-2.07)
PV (Earnings losses, R_f)	-42.9%	-28.7%	-24.2%	-50.2%**	-63.8%**
	(-1.35)	(-1.43)	(-1.14)	(-2.62)	(-2.23)
	Using Randomly Selected Workers as Control Group				
PV (Earnings losses)	-94.6%***	-118.0%***	-40.2%**	-110.0%***	-80.2%***
	(-2.82)	(-5.81)	(-1.99)	(-5.65)	(-3.02)
PV (Earnings losses, R_f)	-71.6%***	-87.4%***	-36.5%**	-84.2%***	-65.1%***
	(-3.15)	(-6.39)	(-2.66)	(-6.44)	(-3.66)

Table 5: Effect of Corporate Bankruptcy on Employee Earnings - Conditional Analysis on Worker Mobility, Labor Market Characteristics, and Bankruptcy Liquidation Outcomes

This table presents the present value of earnings losses conditional on worker mobility, labor market characteristics, and bankruptcy liquidation outcomes. "PV (Earnings losses)" is the present value of earnings losses from years t to t+6 (computed using a real risk-adjusted discount rate of -7.40%) as a percent of the pre-bankruptcy annual earnings in t-4. Panel A reports the present values of earnings losses conditional on worker mobility. We define a worker as a stayer if she stays in the same firm, industry, or county through year t+3 as her t-1 firm, industry, or county. This panel stratifies the treated (i.e., bankrupt) firm employees based on whether they stay with their firms, industries, or counties, but not the matched control firm employees. Thus, the panel decomposes earnings losses of the treated group workers relative to the average worker in the control group. Panel B reports the present values of earnings losses conditional on firm size (as measured by book assets from Compustat), local labor market size (total employment in a given two-digit SIC industry and county cell), and bankruptcy outcomes (liquidation vs. non-liquidation). We split the sample at the 75th percentile of the firm size and labor market size distributions. This panel stratifies both the treated and control firm employees. *t*-statistics for the (difference in) present value significantly differing from zero are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***.

Panel A: Present Value of Earnings Losses Conditional on Worker Mobility

	(1)	(2)	(3)	(4)	(5)	(6)
Group:	Firm stayers	Firm leavers	Leavers: same industry same county	Leavers: diff. industry same county	Leavers: same industry diff. county	Leavers: diff. industry diff. county
PV (Earnings losses)	37.9%	-119.9%***	79.1%	19.0%	8.5%	-211.1%***
	(0.62)	(-3.11)	(1.42)	(0.39)	(0.16)	(-6.02)
Diff. between columns	-	(2)–(1)***	(6)–(4)***	(4)–(3)**	(5)–(3)***	(6)–(5)***
(*t*-statistic)	-	(-3.62)	(-8.83)	(-2.45)	(-3.25)	(-12.29)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Present Value of Earnings Losses Conditional on Firm Size, Labor Market Size, and Bankruptcy Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Conditioning variable:	Firm size		Labor market size		Bankruptcy liquidation outcome	
Sample:	Large	Small	Large	Small	Liquidation	Non-liquidation
PV (Earnings losses)	-61.5%	-99.1%**	-24.2%	-116.0%**	-97.4%*	-83.6%**
	(-1.00)	(-2.32)	(-0.55)	(-2.46)	(-1.75)	(-1.99)
Diff. between two groups	37.6%		91.8%**		-13.8%	
(*t*-statistic)	(0.66)		(2.11)		(-0.33)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Covenant Violations and Employee Earnings Changes - An RDD Analysis

This table presents the effect of loan covenant violations on employee earnings growth using a regression discontinuity design based on DealScan-Compustat-LEHD matched data from 1995 to 2008. The dependent variable is the change in a worker's log(annual earnings) in 2001 constant dollars from the previous year. "Bind" is an indicator variable equal to one if the worker is an employee of a firm that violates a loan covenant concerning the current ratio or net worth, and zero otherwise. Worker-level controls include imputed education, female indicator, imputed education × female indicator, years of experience, imputed education × years of experience, and female indicator × years of experience. Distance (NW) is the relative distance of the firm's net worth from the covenant threshold. Distance (CR) is the relative distance of the firm's current ratio from the covenant threshold. "2nd order distance (NW & CR)" is the squared relative distances of net worth and current ratio. Definitions of variables are in the Appendix. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

Dep. Var. = Earnings growth	(1)	(2)	(3)	(4)
Bind	-0.037**	-0.037**	-0.052**	-0.056**
	(-2.13)	(-2.33)	(-2.15)	(-2.21)
Distance (NW)	0.050***	0.045	-0.015	-0.020
	(8.05)	(1.47)	(-0.91)	(-1.35)
Distance (CR)	0.003	0.028	0.026*	-0.001
	(0.31)	(0.78)	(1.77)	(-0.04)
2nd order distance (NW & CR)		Yes		Yes
Worker-level controls	Yes	Yes	Yes	Yes
SIC2 × county × year FE	Yes	Yes	Yes	Yes
Firm FE			Yes	Yes
Observations	1,673,000	1,673,000	1,673,000	1,673,000
R^2	8.3%	8.3%	8.8%	8.8%

Table 7: Leverage and Employee Wages - A Wage Regression Approach

This table presents the relationship between corporate leverage and employee earnings. The dependent variable is log(quarterly earnings) in 2001 constant dollars. The control variables include log(book assets), market-to-book, ROA, asset tangibility of firms, female indicator × years of experience, imputed education × years of experience of individual workers, firm, worker, and two-digit SIC industry × county × year fixed effects. To select the sample for the regression, we begin with Compustat firms with S&P credit ratings between AA+ and B- or unrated, and book assets greater than $100 million in 1980 constant dollars and less than or equal to the assets of the largest firm in our bankrupt and matched firm sample from 1986 to 2008. Then we select all workers in LEHD with ages between 22 and 55 and at least two years of tenure who move between these firms. For earnings before moving, we use the highest quarterly earnings in the last four quarters at the old firm; for earnings after moving, we use the highest quarterly earnings in the first four quarters at the new firm. Column (1) presents estimates for the full sample. Columns (2) and (3) present estimates conditional on firm size, measured by book assets of a given firm. Columns (4) and (5) present estimates conditional on local labor market size, measured by total employment in a given two-digit SIC industry and county cell. "Large" ("Small") represents a subsample in which firm assets or local labor market size is greater than (less than or equal to) the 75^{th} percentile in the sample distribution. Definitions of variables are in the Appendix. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

Dep. Var. = Log (earnings)	(1)	(2)	(3)	(4)	(5)
Conditioning variable:	-	Firm size		Labor market size	
Sample:	Full	Large	Small	Large	Small
Market leverage	0.057***	-0.110	0.066***	0.014	0.070***
	(3.17)	(-1.25)	(2.94)	(0.53)	(3.82)
Worker-level controls	Yes	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes
Observations	9,094,000	2,282,000	6,812,000	2,276,000	6,819,000
R^2	70.7%	91.5%	76.7%	84.6%	76.0%
Market leverage × (Small – Large)	-	0.176*		0.056**	
(*t*-statistic)	-	(1.94)		(2.05)	

Table 8: Implied Wage Premia from Binomial Valuation Model

This table develops implied wage premia for firms with different credit ratings. We use the present value of earnings losses with unemployment insurance (UI) adjustments as a fraction of pre-bankruptcy annual wages in a binomial valuation model (see Section A.1 of Online Appendix) to derive the implied wage premia. We first calculate a one-year risk-adjusted bankruptcy probability q in column (2) as $1-(1-0.6\times q_{10})^{1/10}$, where 0.6 is the estimated probability of bankruptcy conditional on default (based on Moody's Default and Recovery Database and the Altman-Kuehne/NYU Salomon Center Bond Master Default Database), and q_{10} (in column (1)) is the ten-year risk-adjusted default probability provided in Almeida and Philippon (2007, Table III). We then use a certainty equivalence approach (described in Online Appendix B) to estimate the one-year risk-adjusted bankruptcy probability for under-diversified workers, q^w, in column (3). In column (4), we use this annual q^w to calculate the discounted wage premium a firm would pay workers as $[q^w \times (NL/W)/(1+r_f)]$, where "NL" represents the present value of earnings losses given bankruptcy with UI adjustments, net of compensating differentials lost post-bankruptcy and "W" represents pre-bankruptcy annual wages. The nominal risk-free rate (r_f) is assumed to be 6.33%, the average 10-year Treasury rate from 1985-2008, our sample period. All numbers in the table are in %.

Credit rating	q_{10} = Ten-year risk-adjusted default probability from Almeida and Philippon (2007) (1)	q = one-year risk-adjusted bankruptcy probability based on q_{10} (2)	q^w = One-year risk-adjusted bankruptcy probability (workers) (3)	Implied wage premium as fraction of wages (Binomial valuation model) (4)
AAA	1.65	0.10	0.11	0.07
AA	6.75	0.41	0.46	0.29
A	12.72	0.79	0.89	0.55
BBB	20.88	1.33	1.51	0.94
BB	39.16	2.64	3.02	1.89
B	62.48	4.59	5.24	3.27
BBB minus AA	14.13	0.92	1.05	0.66

Table 9: Comparison of Wage Premia - Binomial Valuation Model versus Wage Regression

This table compares the implied premia derived from the binomial valuation model in Table 8 with those estimated from the wage regression in Table 7. In particular, it presents the additional wage premium due to moving from AA to BBB ratings. Column (1) presents the results for the full sample, and columns (2) through (7) for subsamples by firm size and labor market size. Firm size is measured by book assets of a given firm, and local labor market size by total employment in a given two-digit SIC industry and county cell. "Large" ("Small") represents a subsample in which firm assets or local labor market size is greater than (less than or equal to) the 75th percentile in the sample distribution. Panel A (B) presents the change in implied wage premia (in percent) estimated from the binomial valuation model (wage regressions in Table 7). Statistical significance, based on estimates from Tables 4 and Online Appendix A8 (for the valuation model) and from Table 7 (for wage regressions), at the 10%, 5%, and 1% levels is indicated by *, **, and ***. Heteroskedasticity robust standard errors adjusted for within-firm and worker clustering are in parentheses.

Conditioning variable:		Firm size			Labor market size		
Sample:	Full	Large	Small	Diff.	Large	Small	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Binomial Valuation Model							
PV (wage premia)							
BBB minus AA	0.66%**	0.35%	0.74%**	0.39%	0.16%	0.86%**	0.70%**
(Std. Err.)	(0.32%)	(0.46%)	(0.32%)	(0.40%)	(0.33%)	(0.36%)	(0.32%)
Panel B: Wage Regression							
PV (wage premia)							
BBB minus AA	0.64%***	-1.24%	0.74%***	1.98%*	0.15%	0.79%***	0.64%**
(Std. Err.)	(0.20%)	(0.99%)	(0.25%)	(1.02%)	(0.29%)	(0.21%)	(0.31%)

Table 10: Capitalized Value of Implied Wage Premia, Tax Benefits of Financial Leverage, and Expected Costs of Financial Distress

This table develops the capitalized value of implied wage premia as a fraction of firm value for firms with different credit ratings, and compares them with the tax benefits of debt and expected costs of financial distress. Panel A assumes that all employees are fully compensated for bankruptcy risk. Column (1) presents the annual wage premium as a fraction of firm value. Column (2) calculates the present value of implied wage premia as a fraction of firm value that the firm would pay workers in an infinite horizon (i.e., capitalized value) as $[q^w/(q+r_f)] \times NL/MV$, where "NL" represents the present value of net earnings losses with unemployment insurance adjustments given bankruptcy and "MV" represents firm value. The nominal risk-free rate (r_f) is assumed to be 6.33%, the average 10-year Treasury rate from 1985-2008, our sample period. Online Appendix A provides detailed models underlying these wage premia calculations. Columns (3)-(5) show the tax benefits of debt and expected costs of financial distress estimated from Almeida and Philippon (2007, Table VI) and Elkamhi, Ericsson, and Parsons (2012, Tables 2 and 3). Wage premia, tax benefits, and expected costs of financial distress in the table are present values as percentages of pre-bankruptcy firm value. Panel B presents alternative capitalized values of implied wage premia as a fraction of firm value, assuming that only newly hired employees are compensated for bankruptcy risk.

Panel A: Assuming All Employees Are Fully Compensated for Bankruptcy Risk

Credit rating	Implied annual wage premium as fraction of firm value	Capitalized value of implied wage premium as fraction of firm value	Tax benefits of debt from Almeida and Philippon (2007)	E(costs of financial distress) from Almeida and Philippon (2007)	E(costs of financial distress) from Elkamhi, Ericsson, Parsons (2012)
	(1)	(2)	(3)	(4)	(5)
AAA	0.02	0.27	0.47	0.32	0.0
AA	0.07	1.05	2.51	1.84	0.0
A	0.13	1.91	4.40	3.84	0.2
BBB	0.22	3.04	5.18	4.53	0.5
BB	0.44	5.18	7.22	6.81	0.9
B	0.76	7.38	8.95	9.54	2.1
BBB minus AA	0.15	1.99	2.67	2.69	0.5

Panel B: Capitalized Wage Premium Assuming Newly Hired Employees Are Compensated for Bankruptcy Risk

BBB minus AA	Capitalized value of implied wage premium as fraction of firm value
New hires in t	0.50
New hires in t and t-1	0.88
New hires in t, t-1, and t-2	1.17

Employee Costs of Corporate Bankruptcy
Online Appendix (Not for Publication)*

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March 2022

Abstract

This online appendix presents a detailed model to compute wage premia (Appendix A), approaches to account for workers' exposure to idiosyncratic risk (Appendices B-C), the approach to adjust earnings losses for unemployment insurance benefits (Appendix D), and supplementary tables and figures.

* Any views expressed are those of the authors and not those of the U.S. Census Bureau. The Census Bureau's Disclosure Review Board and Disclosure Avoidance Officers have reviewed this information product for unauthorized disclosure of confidential information and have approved the disclosure avoidance practices applied to this release. This research was performed at a Federal Statistical Research Data Center under FSRDC Project Number 808 (CBDRB-FY21-P808-R8890, FY22-P808-R9448). This research uses data from the Census Bureau's Longitudinal Employer Household Dynamics Program, which was partially supported by the following National Science Foundation Grants SES-9978093, SES-0339191 and ITR-0427889; National Institute on Aging Grant AG018854; and grants from the Alfred P. Sloan Foundation.

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Online Appendix A

Binomial Valuation Model to Compute Implied Wage Premia Due to Bankruptcy Risk

In a competitive labor market, when an employee expects earnings reductions following a bankruptcy filing of her employer, she will require higher wages ex ante to compensate for such a potential loss. In this appendix, we first derive the wage premium demanded by an employee in Section A.1 and then the capitalized value of wage premia paid by a firm with an infinite life (going concern) in Section A.2.

A.1. Wage Premium a Worker Demands

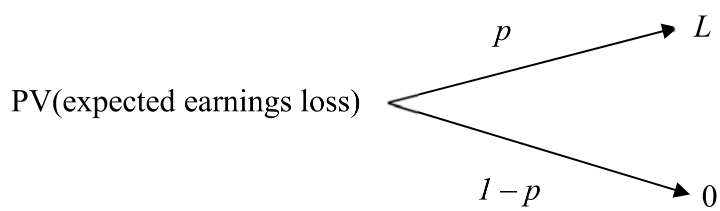


Figure A.1

Let L be the employee's earnings loss given bankruptcy of her employer, p the historical annual probability of bankruptcy, and r_D^w the appropriate discount rate for the worker. Note that L could be normalized by wage or firm value as in the paper. Then, the present value (PV) of expected earnings loss in a given year is equal to:

$$PV(expected\ earnings\ loss) = \frac{pL}{1+r_D^w}. \quad \text{(A-1)}$$

Assuming that the employee is risk averse and the firm is more likely to file for bankruptcy in bad times, the discount rate $r_D^w < r_f$, the risk-free rate. Because we do not observe r_D^w, we adopt a risk-neutral approach proposed in Almeida and Philippon (2007) to estimate the PV expected earnings loss. Specifically,

$$PV(expected\ earnings\ loss) = \frac{q^w L}{1+r_f}, \quad \text{(A-2)}$$

where q^w is the annual risk-adjusted probability of bankruptcy for the worker and r_f is the risk-free rate.

If we use a risk-free firm (i.e., $q^w = 0$) as the benchmark case, in a competitive labor market the risky firm has to offer the same expected annual wages, *W_1 – PV(expected earnings loss),* to the employee, the same as the wages offered by a risk-free firm W_0, all else equal. This implies that the annual wage premium demanded by the employee relative to a risk-free firm is:

$$annual\ wage\ premium = W_1 - W_0$$

$$= PV(expected\ earnings\ loss) = \frac{q^w L}{1+r_f}. \quad \text{(A-3)}$$

This result is intuitive; the annual wage premium is equal to the marginal increase in the PV expected earnings loss resulting from a marginal increase in annual bankruptcy probability.

A.2. Capitalized Value of Wage Premia the Firm Pays a Worker

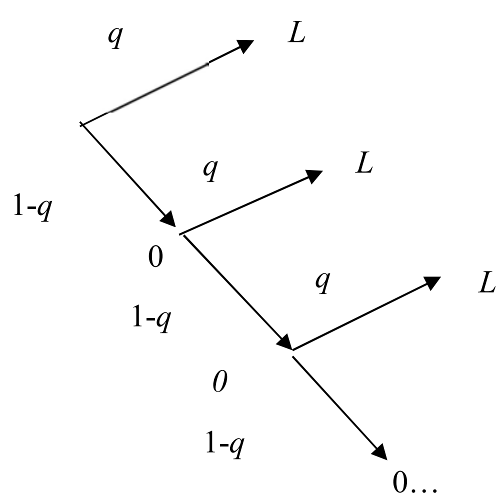


Figure A.2

In an infinite-period model, the firm will have an employee indefinitely. If we use a risk-free firm as the benchmark, in year 0, the firm faces a risk-adjusted bankruptcy probability q and will need to offer an annual wage premium of $\frac{q^w L}{1+r_f}$ over a risk-free firm as shown in equation (A-3).[3] Note that the risk-neutral probability of bankruptcy for the firm q and the worker q^w are different as they have different risk preferences (e.g., portfolios). If the firm survives to the next year (with probability $1 - q$), the employee again will face a risk-adjusted bankruptcy probability q^w in that year, and the firm will again pay an annual wage premium of $\frac{q^w L}{1+r_f}$ over a risk-free firm.

Continuing this process indefinitely, the PV of wage premia that the firm has to offer over a risk-free firm over its life is:

$$PV\ of\ wage\ premia = \sum_{t=0}^{\infty} annual\ wage\ premium \times \left(\frac{1-q}{1+r_f}\right)^t. \qquad \text{(A-4)}$$

Using a perpetuity formula, equation (A-4) can be re-written as:

$$PV\ of\ wage\ premia$$

$$= Annual\ wage\ premium + annual\ wage\ premium \times \frac{1-q}{r_f+q}$$

$$= \frac{q^w L}{1+r_f} \times \left(1 + \frac{1-q}{r_f+q}\right) = \frac{q^w L}{r_f+q}. \qquad \text{(A-5)}$$

In general, the difference in the capitalized value of wage premia between any two firms with risk-adjusted bankruptcy probabilities q_2 and q_1 ($q_2 > q_1$) is equal to:

$$Difference\ in\ PV\ of\ wage\ premia = \frac{q_2^w L}{r_f+q_2} - \frac{q_1^w L}{r_f+q_1}. \qquad \text{(A-6)}$$

[3] Note that this model does not require that the same employee work for the firm indefinitely. Workers receive a risk premium to compensate them for the risk that the firm might go bankrupt in the current period. If the firm survives the next period, it will compensate its workers for the risk of bankruptcy in that period, whether they are the same employees that worked in the previous period or not.

For example, if a firm's credit rating changes from AA to BBB, the capitalized value of wage premia of AA over BBB ratings is equal to $\frac{q_{BBB}^{w}L}{r_f+q_{BBB}} - \frac{q_{AA}^{w}L}{r_f+q_{AA}}$.

A.3. Capitalized Value of Wage Premia, Adjusting for Pre-bankruptcy Wage Premium

Part of the present value of earnings loss L above might be due to the loss of a compensating differential that existed pre-bankruptcy, which we attempt to tease out as follows. Suppose that the average credit rating for the ultimately bankrupt firms is 'B,' while the average credit rating for the control firms is 'BBB,' four years before bankruptcy. This assumption is based on the average book leverage of the ultimately bankrupt and non-bankrupt firms (i.e., 41% and 27%), which very closely map to 'B' and 'BBB' ratings in Table V of AP (2007) (i.e., 42% and 28%). Suppose that the annual wage premium due to the difference in bankruptcy probability between BBB and B-rated firms is W. This implies that the loss of the pre-bankruptcy wage premium contributes a decline in earnings of W in each post-bankruptcy year from t to t+6. The present value of the loss of this pre-bankruptcy wage premium from year t to t+6 is equal to W times the annuity factor for seven years (f), which is fW. Therefore, the PV of "net" bankruptcy earnings losses is:

$$NL = L - fW. \tag{A-7}$$

Given NL, the worker will demand an annual wage premium (over a risk-free firm) that is equal to $\frac{q^{w}NL}{(1+r_f)}$. Thus, the difference in annual wage premium between BBB and B-rated firms is:

$$W = \frac{q_{B}^{w}NL}{1+r_f} - \frac{q_{BBB}^{w}NL}{1+r_f}. \tag{A-8}$$

Substituting (A-8) into (A-7), we get: $NL = L - f\left(\frac{q_{B}^{w}NL}{1+r_f} - \frac{q_{BBB}^{w}NL}{1+r_f}\right)$. Solving the equation for *NL*, we get:

$$NL = \frac{L}{1+\frac{f(q_B^W - q_{BBB}^W)}{1+r_f}}. \quad \text{(A-9)}$$

Given $r_f = 3.34\%$, $f = \sum_{t=0}^{6} \frac{1}{(1-7.4\%)^t} = 8.92$,[4] $q_B^W = 1.51\%$ and $q_{BBB}^W = 5.24\%$ (from Table 8, column (3)), the resulting value for *NL* relative to *L* suggests that the worker's net earning loss due to bankruptcy is about 76.2% of the "gross" loss.

[4] -7.4% is the annual, risk-adjusted discount rate for the earnings loss conditional on a bankruptcy state, i.e., the discount rate of earning losses from t to t+6. Online Appendix C provides details of how to derive this discount rate.

Online Appendix B

Certainty Equivalence Approach to Estimate Workers' Risk-Neutral Probability of Bankruptcy[5]

To estimate the difference in risk-neutral probabilities of the bankruptcy state between the worker and bondholder, we use a certainty equivalence approach similar to that used by Hall and Murphy (2002) who calculate the risk-adjusted value of option grants for under-diversified executives. We first calculate the certainty equivalent values of labor income loss in the bankruptcy state for the worker and bondholder. The worker and bondholder's asset holdings are calibrated to match the holdings of the average workers and bondholders in the Survey of Consumer Finance in 1998, which is approximately in the middle of our sample period. We then calculate the relative magnitudes of the worker and bondholder's risk-neutral probabilities of bankruptcy using their certainty equivalent values of labor income loss in the state. Details of the theoretical framework, parameter calibration, and simulation results are described below.

B.1. Theoretical Framework

a) Worker

At Time 0, the worker has financial wealth W_0^w allocated to directly held individual stocks, indirectly held stocks through well diversified portfolios (such as equity mutual funds), the own company's stock, and the risk-free asset. We denote w_{direct}^w, $w_{indirect}^w$, and $w_{company}^w$ as the proportions of the worker's direct stock holdings, indirect stock holdings, and own company stock in her financial assets, respectively. The proportion of the risk-free asset is equals to $w_{riskfree}^w =$

[5] The simulation code for the certainty equivalence approach is available upon request.

$1 - w^w_{direct} - w^w_{indirect} - w^w_{company}$. N^w is the number of directly held stocks. We assume that the allocation to each individual stock in the direct holdings is equally weighted. In the normal (i.e., non-bankruptcy) state, the worker will earn labor income I^w_0. In the bankruptcy state, the worker will lose a ϕ fraction of the labor income. The bankruptcy state is characterized by the worker's own company stock return going below a threshold level $\bar{r}$, i.e., $r_c < \bar{r}$.

The worker's wealth at time 1 is given by:

$$W^w_1 = W^w_0 \Big[\sum_{i=1}^{N^w} \frac{1}{N^w} w^w_{direct}\big(1 + r_{direct,i}\big) + w^w_{indirect}(1 + r_m) + w^w_{company}(1 + r_C) + \big(1 - w^w_{direct} - w^w_{indirect} - w^w_{company}\big)\big(1 + r_f\big)\Big] + I^w_0 - \phi I^w_0 \cdot 1(r_c < \bar{r}), \tag{A-10}$$

where $r_{direct,i}$ is the return on directly held stocks i; r_m is the return on indirectly held stocks; and r_C is the return on the own company stock. r_f is the risk-free rate. $1(r_c < \bar{r})$ is equal to one if $r_c < \bar{r}$, and zero otherwise. To find the worker's certainty equivalent for her uncertain labor income loss $\phi I^w_0 \cdot 1(r_c < \bar{r})$, suppose that the worker is willing to give up C^w_0 in cash at Time 0 (which she would have invested in the risk-free asset) in exchange for the uncertain labor income loss. Her wealth at Time 1 would be:

$$W^{w,CE}_1 = W^w_0 \Big[\sum_{i=1}^{N^w} \frac{1}{N^w} w^w_{direct}\big(1 + r_{direct,i}\big) + w^w_{indirect}(1 + r_m) + w^w_{company}(1 + r_C) + \big(1 - w^w_{direct} - w^w_{indirect} - w^w_{company}\big)\big(1 + r_f\big)\Big] + I^w_0 - C^w_0\big(1 + r_f\big). \tag{A-11}$$

Certainty equivalence requires that the worker achieves the same level of expected utility with these two distributions of wealth at Time 1, i.e.,

$$EU(W^w_1) = EU\big(W^{w,CE}_1\big)$$

$$\int U(W^w_1) f\big(r_{direct,1}, .., r_{direct,N^w}, r_m, r_c\big) d\big(r_{direct,1}, .., r_{direct,N^w}, r_m, r_c\big) = \int U(W^{w,CE}_1)\big(r_{direct,1}, .., r_{direct,N^w}, r_m, r_c\big) d\big(r_{direct,1}, .., r_{direct,N^w}, r_m, r_c\big). \tag{A-12}$$

b) Bondholder

With a similar set-up, the bondholder's wealth at Time 1 is given by:

$$W_1^b = W_0^b \left[\sum_{i=1}^{N^b} \frac{1}{N^b} w_{direct}^b \left(1 + r_{direct,i}\right) + w_{indirect}^b (1 + r_m) + w_{company}^b (1 + r_c) + \left(1 - w_{direct}^b - w_{indirect}^b - w_{company}^b\right)\left(1 + r_f\right)\right] + I_0^b - \phi I_0^b \cdot 1(r_c < \bar{r}). \quad \text{(A-13)}$$

The definitions of these variables are analogous to those for the worker except that the superscript "*b*" indicates the variables are for the bondholder.

Similarly, to find the bondholder's certainty equivalent for her uncertain labor income loss $\phi I_0^b \cdot 1(r_c < \bar{r})$, suppose that the bondholder's is willing to give up C_0^b in cash at Time 0 (which she would have invested in the risk-free asset) in exchange for the uncertain labor income loss. Her wealth at Time 1 would be:

$$W_1^{b,CE} = W_0^b \left[\sum_{i=1}^{N^b} \frac{1}{N^b} w_{direct}^b \left(1 + r_{direct,i}\right) + w_{indirect}^b (1 + r_m) + w_{company}^b (1 + r_c) + \left(1 - w_{direct}^b - w_{indirect}^b - w_{company}^b\right)\left(1 + r_f\right)\right] + I_0^b - C_0^b\left(1 + r_f\right). \quad \text{(A-14)}$$

Certainty equivalence requires that the bondholder achieves the same level of expected utility with these two distributions of wealth at Time 1, i.e.,

$$EU(W_1^b) = EU\left(W_1^{b,CE}\right)$$

$$\int U\left(W_1^b\right) f\left(r_{direct,1}, \ldots, r_{direct,N^b}, r_m, r_c\right) d\left(r_{direct,1}, \ldots, r_{direct,N^b}, r_m, r_c\right) = \int U\left(W_1^{b,CE}\right)\left(r_{direct,1}, \ldots, r_{direct,N^b}, r_m, r_c\right) d\left(r_{direct,1}, \ldots, r_{direct,N^b}, r_m, r_c\right). \quad \text{(A-15)}$$

We solve equations (A-12) and (A-15) numerically to find a certainty equivalent loss for the worker, C_0^w and for the bondholder, C_0^b. The implementation details are described in Sections B.2 and B.3.

c) Converting Certainty Equivalent to Risk-Neutral Probability

The certainty equivalent of the labor income loss equals the risk-adjusted present value of the loss, which implies:

$$C_0^w = \frac{q^w \phi I_0^w}{1+r_f} \text{ or } q^w = \frac{C_0^w (1+r_f)}{\phi I_0^w}. \tag{A-16}$$

Similarly,

$$C_0^b = \frac{q^b \phi I_0^b}{1+r_f} \text{ or } q^b = \frac{C_0^b (1+r_f)}{\phi I_0^b}. \tag{A-17}$$

Therefore, $\frac{q^w}{q^b} = \frac{C_0^w / I_0^w}{C_0^b / I_0^b}$. This result shows that if the fractional certainty equivalent of the labor income loss is greater for the worker than for the bondholder ($C_0^w / I_0^w > C_0^b / I_0^b$), the risk-neutral probability of bankruptcy is also greater for the worker than for the bondholder ($\frac{q^w}{q^b} > 1$). The connection between the certainty equivalent and risk-neutral probability is intuitive; if the bankruptcy state is more "painful" for the worker, she is willing to offer a greater certain loss in exchange for the expected risky loss (i.e., certainty equivalent of the labor income loss in the bankruptcy state is bigger). The more "painful" is the bankruptcy state, the higher the marginal utility of consumption in (and thus the risk-neutral probability of) the bankruptcy state.

B.2. Parameters

To solve equations (A-12) and (A-15) numerically, we calibrate parameters of asset allocations, the utility function, and the bankruptcy state.

a) Parameters of Asset Allocation and Labor Income

We collect detailed and realistic information on portfolio holdings of average workers with financial assets and bondholders from the 1998 Survey of Consumer Finance (SCF). As the table below shows, the average worker holds a considerably less diversified portfolio than the average bondholder. For instance, the worker on average has four stocks in her directly owned stock portfolio, whereas the bondholder has 11 stocks. Moreover, the worker holds more of her own employer's stock, which further increases her exposure to idiosyncratic risk.

Summary Statistics of Asset Allocations for Workers and Bondholders in 1998 SCF

	Workers	Bondholders
Total financial assets (FA)	\$83,570	\$747,552
Age	37.3	57.0
Percentage own stocks	62.3%	84.3%
Indirectly held stocks/FA	25.1%	28.7%
Directly held stocks/FA	4.4%	10.9%
Number of directly held stocks, conditional on having directly held stocks	4	11
Own company stocks/FA	4.1%	2.0%

Given the information from the 1998 SCF, the parameters of financial asset allocations are set as follows:

Worker: W_0^w = \$83,570; $N^w = 4$; w_{direct}^w = 4.4%; $w_{indirect}^w$ = 25.1%; $w_{company}^w$ = 4.1%.

Bondholder: W_0^b = \$747,552; $N^b = 11$; w_{direct}^b=10.9%; $w_{indirect}^b$ = 28.7%; $w_{company}^b = 2\%$.

The worker's labor income is set to the average labor income in our sample, i.e., $L_0^w =$ \$31,460; The bondholder's labor income is set to the average employment earnings of bondholders in the SCF, i.e., L_0^b = \$67,901.

b) Parameters of Risk-free Rate and Market Return

- Nominal risk-free rate $r_f = 6.33\%$ (the average 10-year Treasury yield during our sample period of 1985-2008).
- Expected market return $r_m = 11.35\%$ (the average CRSP value-weighted annual return (including dividends) from 1985 to 2008).
- Standard deviation of market returns $\sigma_m = 0.18$ (the standard deviation of annual CRSP value-weighted return (including dividends) from 1985 to 2008).

c) Parameters of Directly Held Individual Stocks

- Expected return of directly held individual stocks is the same as the expected market return: $r_{direct,i} = r_m$.
- Standard deviation of individual stock returns: $\sigma_{direct,i} = 0.58$ (Fu, 2009).

d) Parameters of Indirectly Held Stocks

Indirectly held stocks are through mutual funds or pension funds which are well diversified, so their expected return and variance are assumed to be the same as those of the market: $r_{indirect} = r_m$; $\sigma_{indirect} = \sigma_m$.

e) Parameters of Own Company Stock Return

- Expected return of the own company stock is the same as the expected market return: $r_{direct,i} = r_m$.
- Standard deviation of the own company stock returns is the same as that of the directly held stocks: $\sigma_{company} = \sigma_{direct,i}$.

f) Covariance between Stock Returns

The distribution of stock returns in Time 1 is lognormal with covariances between all stock returns assumed to be the same and equal to the variance of the market return ($0.18^2 = 1.32\%$). Polkovnichenko (2003, 2005) note that this assumption is based on the fact that portfolio variance converges to the weighted average covariance of stocks in the portfolio as the number of stocks increases.[6] It allows for imputation being internally consistent because the total variance of the

[6] The variance of a portfolio $\sigma^2(R_P) = Diversifiable\ risk + Nondiversifiable\ risk$, where $Diversifiable\ risk = \sum_{i=1}^{n} w_i^2 \sigma^2(r_i)$, $Nondiversifiable\ risk = \sum_i^n \sum_{j=1, i \neq j}^{n} w_i w_j Cov(r_i, r_j)$; w_i and r_i are the weight and return of individual stock i, respectively. As the number of securities increases, $Diversifiable\ risk$ converges to 0, while $Nondiversifiable\ risk$ converges to σ_m^2 when $Cov(r_i, r_j) = \sigma_m^2$.

stock portfolio of a household who owns a large number of different stocks would converge to the market return variance.

g) Utility Function

The worker and bondholder are assumed to have a constant relative risk aversion utility function $U(W) = \frac{W^{1-\gamma}}{1-\gamma}$ with relative risk aversion $\gamma = 2$ (Hall and Murphy, 2002).

h) Bankruptcy State

The worker's (or bondholder's) employer files for bankruptcy once the stock return falls below a threshold that matches the historical bankruptcy probability by credit rating. Therefore, for AAA-rated firms, the threshold $\bar{r}_{AAA}$ for the own company stock return is determined by $Prob(r_c < \bar{r}_{AAA}) = 0.0005$, which is the historical bankruptcy probability for AAA-rated firms. Similarly, thresholds for AA, A, BBB, BB and B-rated firms are determined by their historical bankruptcy probabilities, which are equal to 0.0006, 0.0010, 0.0032, 0.0137, and 0.0322, respectively.

B.3. Simulation

Given the above parameters, we first calculate the expected utility based on a simulation of 1,000,000 sample stock returns. We then solve for the certainty equivalence relations in (A-12) and (A-15) to find the risk-neutral probabilities for the worker and bondholder using (A-16) and (A-17).

The table below shows the simulation results by credit rating (from 'AAA' to 'B'). Consistent with the worker's greater exposure to idiosyncratic risk, which would make her require a greater compensation for earnings loss risk in bankruptcy, the table shows that the worker's risk-adjusted bankruptcy probability (q^w) is approximately 1.13 times (ranging between 1.11 and 1.14) of the bondholder's risk-adjusted probability (q^b) across the ratings.

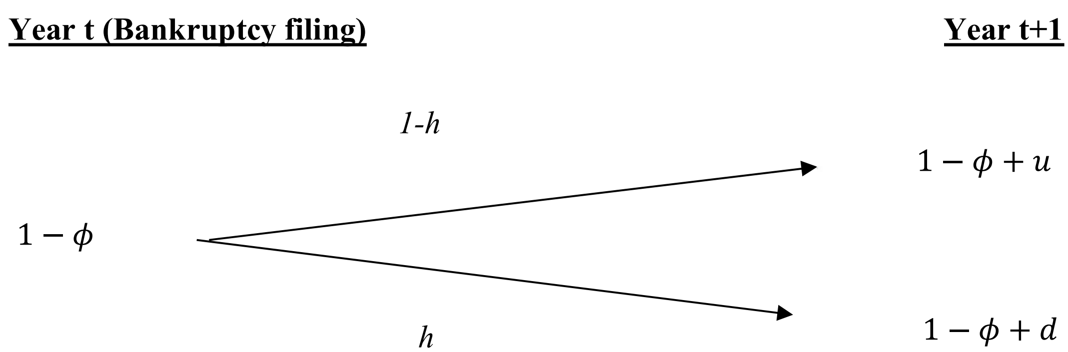
Table: Ratio between Risk-adjusted Bankruptcy Probabilities for Average Worker and Bondholder

Credit Rating	Ratio (q^w/ q^b)
AAA	1.11
AA	1.11
A	1.12
BBB	1.14
BB	1.14
B	1.14

Online Appendix C

Estimating Workers' Risk-Adjusted Discount Rate for Earnings Losses Given Bankruptcy

This appendix illustrates the approach to estimate the risk-adjusted discount rate for earnings losses given corporate bankruptcy for workers who are exposed to considerable idiosyncratic risk. We begin by building a simple model of the worker's earnings process between year t (when the firm files for bankruptcy) and year t+1. When the firm files for bankruptcy in year t, the worker's annual earnings become $(1-\phi)I_0^w$, where ϕ is the average fractional earnings loss in bankruptcy and I_0^w is the pre-bankruptcy annual earnings. In the following year t+1, there are two potential states: (1) in a "good" state (with a probability 1-*h*), the worker's earnings change by u, and (2) in a "bad" state (with a probability h), the worker's earnings change by d (< *u*), both relative to earnings in year t. Normalizing the pre-bankruptcy earnings (I_0^w) to one, the situation between years t and t+1 is depicted by the following binomial tree.



For given ϕ, h, and the variance of earnings growth between years t and t+1 (σ^2), u and d should satisfy the following two conditions:

$$E(earnings\ growth) = (1-h)(\frac{u}{1-\phi}) + h(\frac{d}{1-\phi}) = 0, \qquad \text{(A-18)}$$

$$Var(earnings\ grwoth) = (1-h)\left(\frac{u}{1-\phi}\right)^2 + h(\frac{d}{1-\phi})^2 = \sigma^2. \qquad \text{(A-19)}$$

Solving these two equations, we get:

$$u = \frac{\sigma \cdot (1-\phi)}{\sqrt{\frac{1-h}{h}}}$$

$$d = -u \cdot (\frac{1-h}{h}).$$

Therefore, conditional on bankruptcy filing in year t, the present value (PV) of earnings loss in year t+1 using risk-neutral probabilities equals:

$$PV(loss_1)_0 = \frac{(1-\pi^w)(-\phi+u)+\pi^w(-\phi+d)}{1+r_f}$$

$$= \frac{-\phi}{1+r_f} + \frac{(1-\pi^w)u+\pi^w d}{1+r_f},$$

where π^w is the risk-neutral probability of state *d* for the worker and r_f is the risk-free rate. The first term represents the PV in case the loss is risk-free, and the second term is an adjustment for the riskiness of the earnings loss in year t+1.

Using a risk-adjusted discount rate, the same present value of earnings loss in year t+1 is equal to:

$$PV(loss_1)_0 = \frac{(1-h)(-\phi+u)+h(-\phi+d)}{1+r_D^w} = \frac{-\phi}{1+r_D^w} = \frac{E(loss_1)}{1+r_D^w},$$

where r_D^w is the risk-adjusted discount rate for the worker.

For the two approaches to produce the same risk-adjusted PV,

$$PV(loss_1)_0 = \frac{-\phi+(1-\pi^w)u+\pi^w d}{1+r_f} = \frac{-\phi}{1+r_D^w},$$

or

$$r_D^W = \frac{(1+r_f)\phi}{\phi-[(1-\pi^w)u+\pi^w d]} - 1.$$

The intuition of the above equation is the following:

a) If there is no correlation between a post-bankruptcy earnings loss and the marginal utility, π^W is equal to *h*, the historical probability, so that $r_D^W = r_f$ and we can discount the expected earnings loss using the risk-free rate. (This is because if $\pi^W = h$, then $(1-\pi^w)u + \pi^w d = (1-h)u + hd = 0$ by equation (A-18)).

b) If the post-bankruptcy earnings loss is positively correlated with the marginal utility, π^W should be larger than h, which implies $r_D^W < r_f$. (This is because if $\pi^W > h$, then $(1-\pi^w)u + \pi^w d < (1-h)u + hd = 0$ by equation (A-18)).
c) If the post-bankruptcy earnings loss is negatively correlated with the marginal utility, π^W should be smaller than h, which implies $r_D^W > r_f$. (This is because if $\pi^W < h$, then $(1-\pi^w)u + \pi^w d > (1-h)u + hd = 0$ by equation (A-18)).

To implement this approach, we make the following assumptions. First, the mean earnings loss in year t (ϕ) is equal to 9.61% of pre-bankruptcy annual earnings, the average earnings loss for each year from t through t+6 after UI payment adjustments (Table 4, Panel C). Second, without loss of generality, we assume h (probability of the "bad" state in year t+1, conditional on bankruptcy filing in t) is equal to 0.5. Third, we follow Cocco, Gomes, and Maenhout (2005) and Brown, Fang, and Gomes (2012), and assume σ (the standard deviation of annual earnings growth) is equal to 0.10.[7] These assumptions, combined with conditions in equations (A-18) and (A-19), lead to u = 0.0904 and d = -0.0904. Lastly, we assume a real risk-free rate of 3.34%.

With these assumptions on the worker's earnings risk between years t and t+1 conditional on bankruptcy, we employ a certainty equivalence approach similar to that in Online Appendix B (which is used to quantify the risk-adjusted probability of bankruptcy). While most of the assumptions are the same (such as CRRA utility with a relative risk aversion of two), the key differences include the definition of the two states and that labor income is assumed to be lower by 9.61% for this simulation in year t (since we condition on bankruptcy). We find that π^w, the risk-adjusted probability of the "bad" state, is equal to 0.5614 > 0.5 = h, which in turn implies

[7] Cocco, Gomes, and Meanhout (2005) use the PSID data and estimate the variance of permanent labor income shocks to be 0.0106 (or an SD of 0.1030) and Brown, Fang, and Gomes (2012) estimate the variances of permanent labor income shocks to be 0.0097 (or an SD of 0.0985) and 0.0100 (or an SD of 0.1000) for high school and college graduates, respectively.

$r_D^w = -7.4\% < r_f = 3.34\%$. This discount rate is smaller than the risk-free rate, consistent with the worker's relative lack of diversification, making her earnings losses in the bad state "more painful." We use this risk-adjusted discount rate to calculate the (risk-adjusted) PV of earnings losses from years t through t+6.

Online Appendix D

Adjusting Earnings Losses for Unemployment Insurance Benefits

This appendix describes approaches to adjust the estimates of earnings losses after bankruptcy for unemployment insurance (UI). For unemployed workers who satisfy the UI eligibility conditions (see Section D.4), we calculate quarterly UI benefits using the following equation:

quarterly UI benefits = min(13 weeks × maximum weekly benefits, replacement rate × average high-quarter(s) earnings during the base period before unemployment) × estimated UI take-up rate. (A-20)

Below we provide the details on each variable in the equation. Table 4, Panel C and Online Appendix Table A8 present the earnings loss estimates that account for all UI adjustments we describe below.

D.1. Replacement Rate

The UI replacement rate is defined as the ratio of the UI claimants' weekly benefit amount to the claimants' average weekly wage. We collect the state-year-level unemployment insurance benefits schedule from the "Significant Provisions of State Unemployment Insurance Laws" (the "Provisions" hereafter) issued by the U.S. Department of Labor (DOL) over our sample period and estimate the replacement rate for each state and year.[8] The Provisions contain information on the calculation of the weekly benefit amount in each state and each year. The weekly benefit amount is generally specified as a percentage of employees' representative wages before unemployment. For example, the weekly benefit amount is 1/26 of high-quarter wages for Florida in 2000, where the "high quarter" is the quarter with the highest wages among the base period,

[8] The Provisions are obtained from https://oui.doleta.gov/unemploy/laws.asp.

defined as the first four of the last five completed calendar quarters. We record the UI replacement rate as 50% (= 1/26 × 13 weeks) for this case. When the Provisions give a range of the weekly benefit amount, we use a mid-point value. For example, the weekly benefit is 1/23 to 1/33 of the high-quarter wage in California in 2000, so we use 46.43% (= 1/28 × 13 weeks) as the (estimated) replacement rate.

D.2. High-quarter Wages

By following the Provisions for each state and year, we separately code the earnings that UI benefits are based on ("high-quarter wages"). We find that for about two-thirds of our sample state-years, the specified weekly benefits are based on the highest-quarter wages during the base period. For the rest of the approximately one-third sample state-years, UI benefits are based on the average of highest two through four quarters in the base period. For these state-years, we revise our formula accordingly.

D.3. Maximum Benefit Amount

The Provisions also provide information on the maximum weekly benefit amount. For example, the Provisions state that the maximum weekly benefit is $435 in Colorado in 2007. We use this information to cap the amount of UI benefits received by each unemployed worker.

D.4. Take-up Rate

We note that not every unemployed worker applies for and receives the UI even if he or she is eligible. We thus need to calculate a UI take-up rate, defined as the proportion of the unemployed receiving UI out of all UI-eligible unemployed. Because UI take-up rates are not directly available from public sources such as US DOL publications (e.g., Auray et al., 2019), we estimate the state-year-level take-up rates by combining data from the US DOL and LEHD and following the procedures provided in Auray et al. (2019). First, we write the UI take-up rate as follows:

Take up rate = recipiency rate/fraction eligible, (A-21)

where the recipiency rate is the number of unemployed individuals that have collected or are collecting UI benefits divided by the total number of unemployed individuals, and the fraction eligible is the number of unemployed individuals who are eligible to collect UI benefits divided by the total number of unemployed individuals.

We obtain the UI recipiency rate by state and year from the US DOL website.[9] The data show that UI recipiency rates vary across states. This suggests that incorporating variation in UI recipiency rates across states is important for accurately calculating UI benefits.

We then use the worker-level LEHD data to estimate the fraction eligible for UI (second term in equation (A-21)). Eligibility depends primarily on three factors: (1) monetary requirements; (2) the duration of unemployment; and (3) the nature of separation, which should not be voluntary (see e.g., Blank and Card (1991)). (1) Monetary requirements are obtained from the Provisions. For each state and year, the Provisions provide information on the employment earnings needed in the base period for workers to qualify for UI. For example, the Provision for Florida in January 2002 specifies that the base-period earnings required to qualify for UI is the maximum of $3,400 and 1.5 times the worker's highest-quarter wage. (2) The maximum number of UI benefit weeks is 26 weeks for all sample states (except for Montana which has 28 weeks). If an individual has

[9] https://oui.doleta.gov/unemploy/data_summary/DataSum.asp, then choose "Labor Force Data."

collected benefits for 26 (or 28) total weeks but remained unemployed, they are no longer eligible to collect, unless extended benefits have been triggered (see Section D.5).

For (3), we follow Anderson and Meyer (1997) to exclude spurious transitions and voluntary quits. We assume that separation cases in which an individual has no reported earnings in one or two quarters, but earnings before and after this gap are nearly identical (i.e., within 5% of each other) are not actually unemployed and thus not eligible for UI, since these cases are likely due to a firm neglecting to report wages, as they argue. As a robustness test, we impute these missing quarterly earnings that firms appear to neglect to report using the average of quarterly earnings right before and right after the gap. The PV earnings loss estimate (Online Appendix Table A5, column (7)) shows that the magnitude (87.9%) is similar to our baseline estimate (89.5%). Anderson and Meyer (1997) also exclude separations that result in only a slight drop in usual earnings (i.e., less than 2/13 of quarterly earnings, equivalent to under two weeks' unemployment) because such separations are likely to be quits related to a quick job move rather than unemployment. This type of separation is not captured as unemployment in our definitions, since we define unemployment as either having zero quarterly earnings or more than a half drop in quarterly earnings.

We note that UI take-up may be higher among individuals in longer unemployment spells, and thus adjust the state-year level take-up rate (recipiency rate in particular) for unemployment durations as follows. We follow Vroman (2009) and use the 2005 Current Population Survey - Unemployment Insurance Supplemental Survey (2005 UI survey) to estimate the UI recipiency rate by group of unemployment spell length.[10] The groups include: a) less than a quarter of

[10] According to Vroman (2009), Current Population Survey – Unemployment Insurance Supplemental Surveys were conducted in 1976, 1989, and 1993, and 2005. Since 2006, the survey was only conducted in 2018. We contacted Vroman and Research Director of Department of Labor, and were advised that the 1976, 1989, and 1993 survey data

unemployment (which is captured by reduced yet positive quarterly earnings); b) a quarter of unemployment (captured by a full quarter of zero or missing earnings); c) between a quarter and two quarters of unemployment; d) two quarters of unemployment; and e) more than two quarters of unemployment.

We then apply a "premium" or "discount" to the state-year-level average recipiency rate, conditional on the length of unemployment spells. For example, the UI survey data show that the recipiency rate for those with 14-26 weeks of unemployment is 41% higher than the average recipiency rate. Then, for Florida in 2005-Q3, in which the UI recipiency rate is 27.9%, we estimate the recipiency rate for those with 14-26 weeks of unemployment duration to be 27.9% × 1.41 = 39.3%.

Finally, combing the duration-dependent recipiency rate and the average fraction of UI eligible workers, we obtain the UI take-up rates using equation (A-21) for different unemployment durations. We use the resulting UI take-up rate by state-year-duration group in our UI benefits calculations. The average take-up rate across all unemployed workers in our sample is 72.6% and is in line with existing estimates (e.g., 70.7% over 1977-1987 from Blank and Card (1991)).

D.5. Extended UI Benefits

UI benefits include not only the regular benefits as specified in the Provisions, but also extended benefits, which consist of the permanent federal-state extended benefits (EB) and temporary emergency unemployment compensation (EUC) programs. The permanent EB program provides an additional 13 weeks of benefits to workers who have exhausted regular UI benefits

are currently not available for researchers to use. Therefore, we use the 2005 survey data, which is within our sample period, to estimate the recipiency rate by duration of unemployment. We do not use the 2018 data because our sample ends well before 2018.

when a state meets a high unemployment rate threshold. For states with extremely high unemployment rates, the benefits are extended for 20 weeks (see e.g., Hsu, Matsa, and Melzer, 2018). We use the “Extended Benefit Trigger Notice Reports” to obtain the information on the start and end dates for the EB program by state and whether it is for 13 or 20 additional weeks. [11]

In addition to the EB program, we collect information on the three temporary EUC programs that are applicable to our sample period from 1990 to 2008: EUC (Emergency Unemployment Compensation) 1991-94, TEUC (Temporary Extended Unemployment Compensation) 2002-04, and EUC (Emergency Unemployment Compensation) 2008. EUC 1991-94, effective from November 1991 to April 1994 and applicable to all states, covers individuals who exhausted their regular and extended benefits. Additionally, the benefits received under the EUC program are reduced by any EB received (Lake, 2002). The maximum number of benefit weeks under EUC 1991-94 is based on unemployment rates of states. The maximum number of benefit weeks also varies over periods, ranging from 13 to 33 weeks. For example, the maximum number of benefit weeks across all states was 26 from June 14, 1992 to March 6, 1993 and 15 for the period from March 7, 1993 to October 2, 1993. We obtain the EUC 1991-94 benefit duration in weeks by state from Table B of Lake (2002).

The second emergency unemployment insurance program, TEUC 2002-04, was effective from March 2002 to March 2004. This program includes two tiers; the first tier provides up to 13 weeks of benefits for all states, and the second tier, TEUC-X, provides up to 26 weeks in the high-

[11] The trigger notice reports starting in October 2002 are available on the website https://oui.doleta.gov/unemploy/claims_arch.asp. Based on the laws on EB, trigger notices should be provided to the public via the Federal Register. For the period between 1995 and 2002, we collect the “Notice of Changes in Status of Extended Benefit (EB) Periods” on www.federalregister.gov by searching for “extended benefit” as keywords. For years before 1995, a digitized federal register in scanned newspaper format is obtained from www.gpo.gov and the information on EB is obtained through searching using keywords including “federal-state unemployment compensation program” and “extended benefit.”

unemployment states (Whittaker and Isaacs (2014b)).[12] In contrast to EUC 1991-94, TEUC 2002-04 supplements the EB program. When a state has the EB program triggered during the same period, the benefit weeks from the TEUC program are added to regular UI and EB weeks.

The third program, EUC 2008, was in effect from July 2008 till December 2013. Since our sample ends in 2008, EUC 2008 is applicable only up to December 2008. EUC 2008 provides up to 13 weeks of benefits for all states from July 6, 2008 till November 22, 2008. From November 23, 2008 to March 28, 2009, there are two tiers under EUC 2008. Tier 1 provides up to 20 benefit weeks for all states, and tier 2 provides 13 additional weeks (33 weeks in total) if the state unemployment rate is higher than a pre-specified threshold (i.e., state total unemployment rate (TUR) is 6% or higher, or insured unemployed rate (IUR) is 4% or higher) (Table A-4 of Whittaker and Isaacs (2014b)).[13] According to Whittaker and Isaacs (2014a), EUC 2008 benefits are in addition to regular UI and EB. However, states pay EUC 2008 benefits after regular UI exhaustion, but before EB benefits prior to EUC 2008 expiration.

To summarize, we include the permanent EB and three different temporary EUC programs, in addition to regular UI benefits in our analysis. The regular UI provides up to 26 weeks of benefits (28 weeks for Montana), the EB program up to 20 weeks, EUC 1991-94 up to 33 weeks, TEUC 2002-04 a maximum of 26 weeks, and EUC 2008 up to 33 weeks until March 2009. In general, when the EUC programs are not in effect, a worker could have a maximum of 46 (= 26 + 20) weeks of benefits. When EUC 1991-94 was in effect, a worker's maximum number of benefit

[12] The high-unemployment states that trigger TEUC-X are obtained from the trigger notices at https://oui.doleta.gov/unemploy/teuc/2002/teuc_101302.html.
[13] We use the trigger notices on the DOL website (https://oui.doleta.gov/unemploy/claims_arch.asp) to find the tiers of benefits each state qualifies for within the EUC 2008 program.

weeks was 59 (= 26 + 33). The maximum number of weeks was 72 (= 26 + 20 + 26) when TEUC 2002-04 was in effect, and 79 (= 26 + 20 + 33) when EUC 2008 was in effect.

Finally, to include these extended benefits in our calculation of UI benefits, we first infer a worker's duration of unemployment from her quarterly earnings. If the duration is greater than 26 weeks (the maximum number of weeks one is typically entitled to regular UI), then we check whether there is any active EB or EUC program during the unemployment spell. If there are, then we add the additional benefit weeks to the regular (typically) 26 weeks. It is possible that the maximum available EB and EUC benefit weeks change during a worker's unemployment spell. For example, the EB duration could increase from 13 to 20 weeks in a very high unemployment period. In this case, we choose the maximum (i.e., 20 weeks of EB in the example above). Of course we require that the total number of benefit weeks not exceed the worker's unemployment duration.

D.6. Accounting for Short Unemployment Spells

When a worker is laid off at the beginning of one quarter and reemployed during the same quarter, the unemployment spell for the worker spans less than an entire quarter and the worker may still have positive earnings during this quarter. Our main analysis may thus underestimate the amount of UI received by the worker because we attribute this quarter with positive earnings as employed and ignore UI received during this "employed" quarter. Similarly, even some unemployment spells lasting more than a quarter (e.g., 5.5 months) can be missed if the worker is laid off at the beginning of one quarter and reemployed at the end of the subsequent quarter.

To account for these missing spells, we assume that a temporary drop in wages following bankruptcy (or matching) is attributable to unemployment. Specifically, we assume that an unemployment spell begins when quarterly earnings drop by at least half of the previous quarterly earnings or becomes zero, the latter being our definition in the main analysis. In addition, we assume that an unemployment spell may end with positive quarterly earnings that are lower than the pre-unemployment quarterly earnings, in which case the worker can receive UI payments. These adjustments would fully capture UI benefits during a 5.5-month unemployment spell across two calendar quarters, for example.

The results for this bounding exercise show that in our preferred specification, the present value (PV) of earnings losses with this alternative UI adjustment (84.2%) is slightly smaller in magnitude than the PV with our main UI adjustment (87.1%). Therefore, this alternative definition of unemployment allows workers to be unemployed and eligible for UI benefits more frequently and potentially longer. Given that the threshold to define unemployment with positive quarterly earnings is arbitrary and that the economic magnitudes in both UI adjustments are similar, we present the PV with the alternative UI adjustment as a robustness check in Online Appendix Table A5, column (3).

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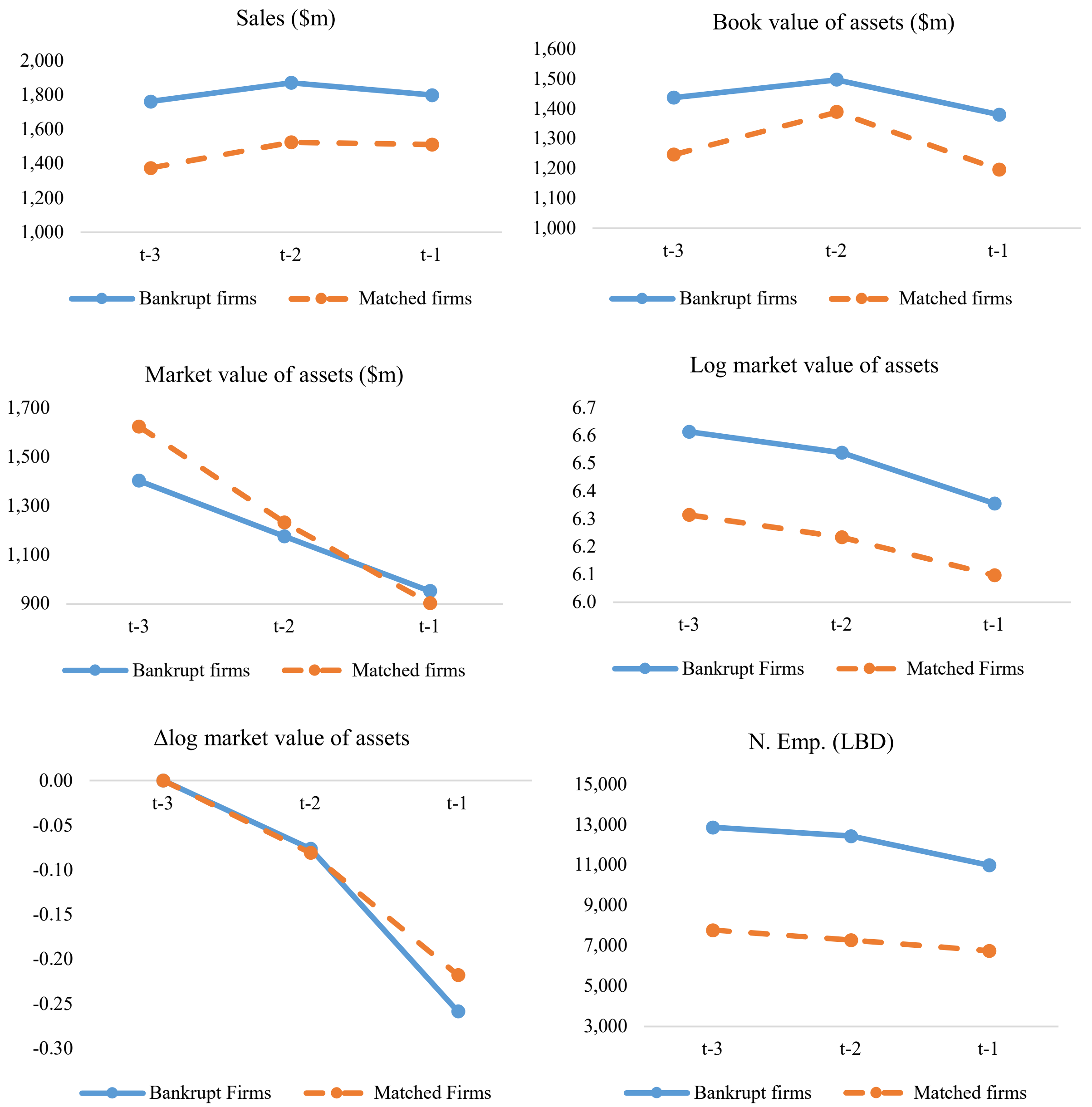
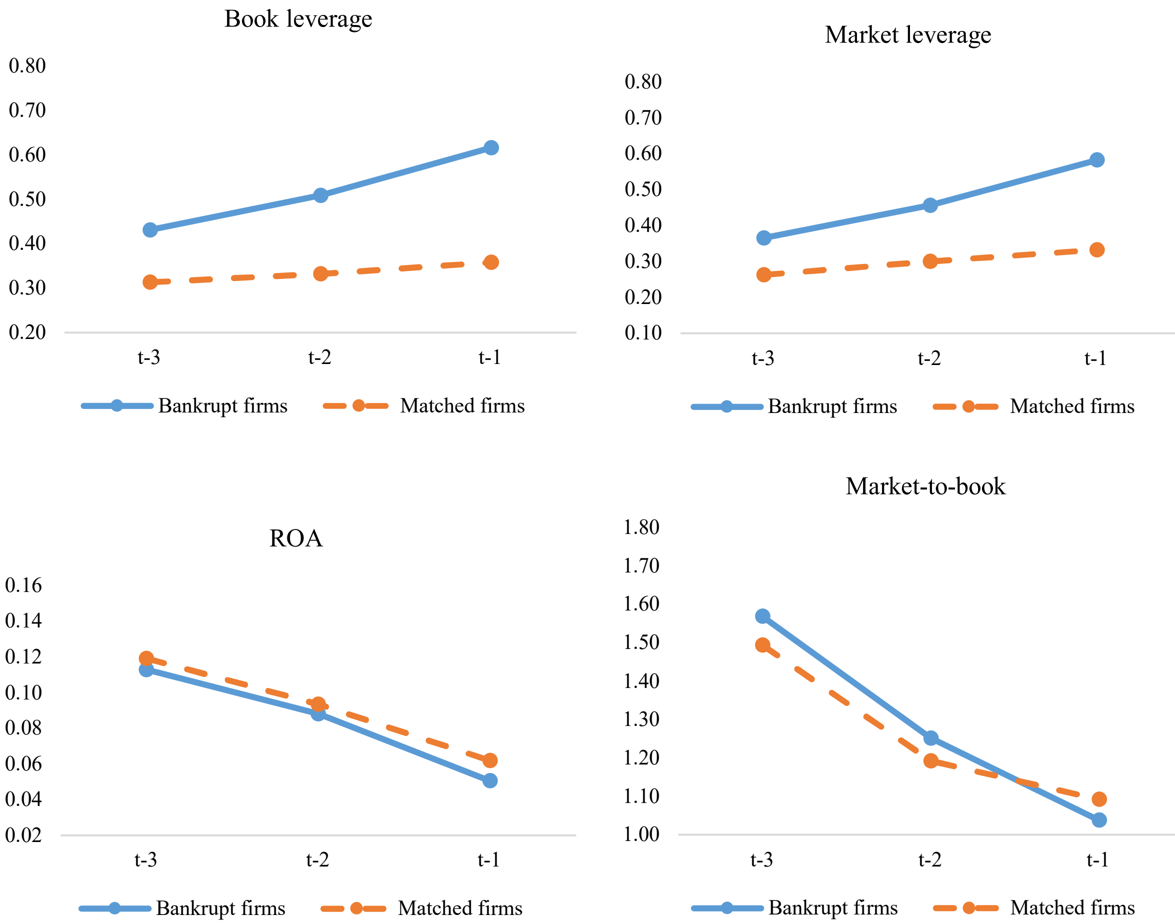
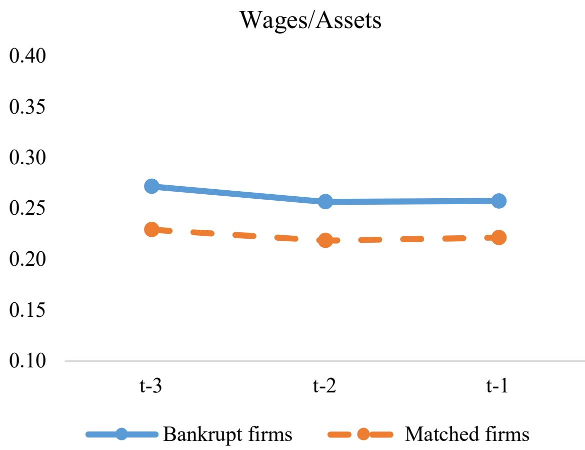
Online Appendix Figure A1: Dynamics of Firm Characteristics for Bankrupt and Matched Firms Prior to Bankruptcy

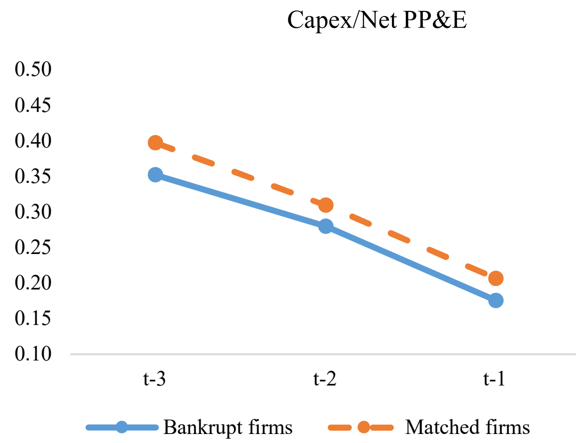
This figure plots the descriptive statistics on dynamics of firm characteristics for bankrupt and matched firms from years t-3 to t-1, which are reported in Table 2, Panel C in the paper.



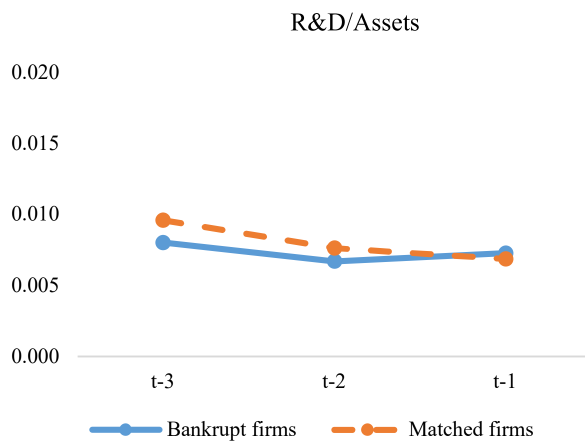

Book leverage
0.80
0.70
0.60
0.50
0.40
0.30
0.20
t-3
t-2
t-1
Bankrupt firms
Matched firms
Market leverage
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
t-3
t-2
t-1
Bankrupt firms
Matched firms
ROA
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
t-3
t-2
t-1
Bankrupt firms
Matched firms
Market-to-book
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
t-3
t-2
t-1
Bankrupt firms
Matched firms



Wages/Assets
0.40
0.35
0.30
0.25
0.20
0.15
0.10
t-3
t-2
t-1
Bankrupt firms
Matched firms



Capex/Net PP&E
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
t-3
t-2
t-1
Bankrupt firms
Matched firms

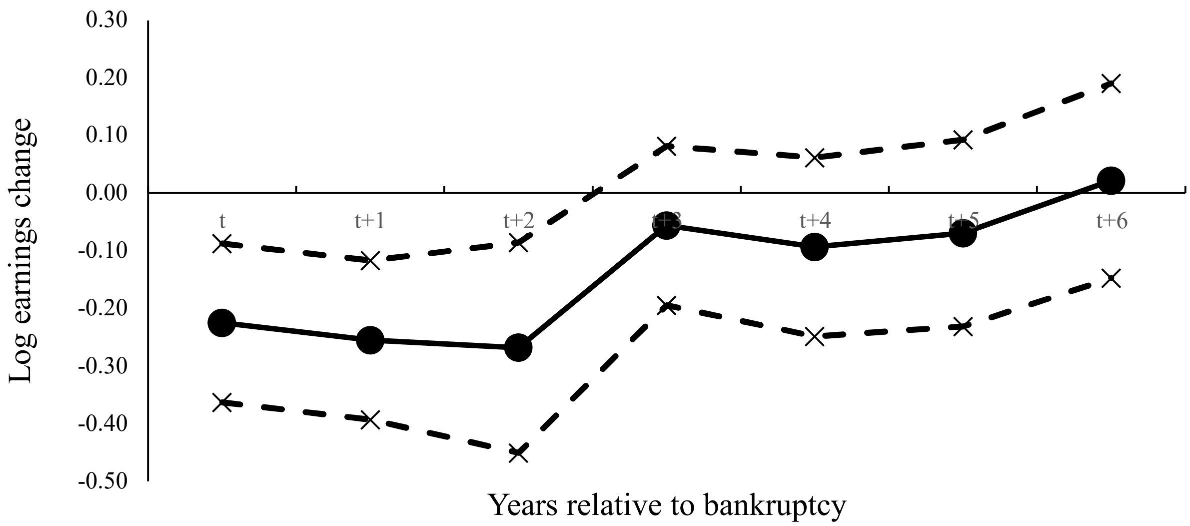


R&D/Assets
0.020
0.015
0.010
0.005
0.000
t-3
t-2
t-1
Bankrupt firms
Matched firms

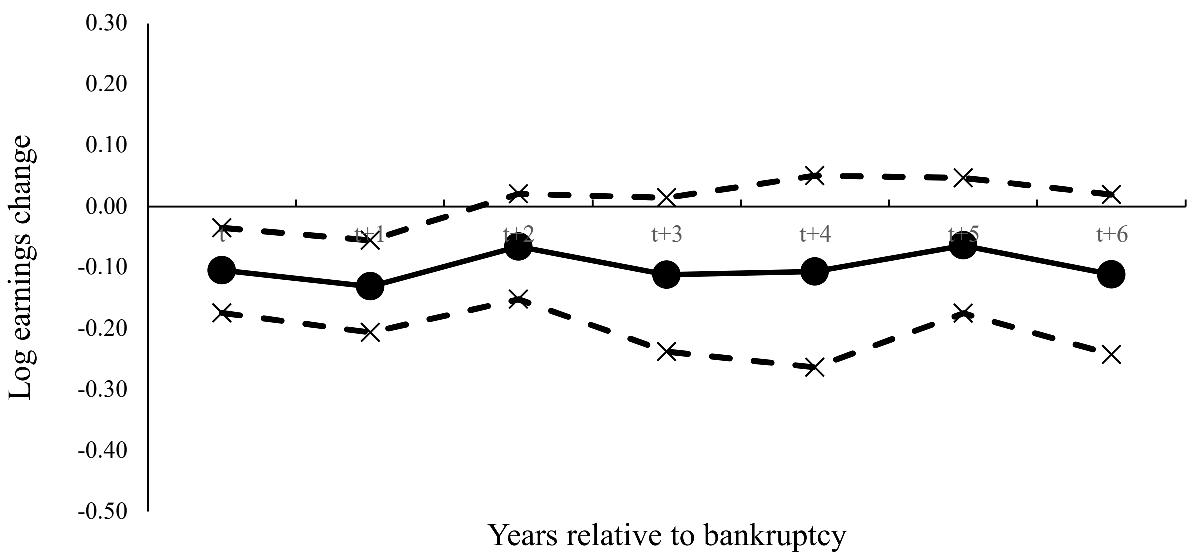
Online Appendix Figure A2: Dynamics of Employee Earnings after Corporate Bankruptcy - Conditional Analysis on Bankruptcy Liquidation Outcomes

This figure plots difference-in-differences estimates of earnings changes for workers employed by bankrupt firms around bankruptcy filings relative to the matched control group of workers, conditional on bankruptcy liquidation outcomes. Panel A (Panel B) shows the estimates for bankruptcy events that ultimately lead to liquidation (non-liquidation). The present values of the earnings loss estimates are reported in Table 5, Panel B in the paper.

Panel A: Liquidation

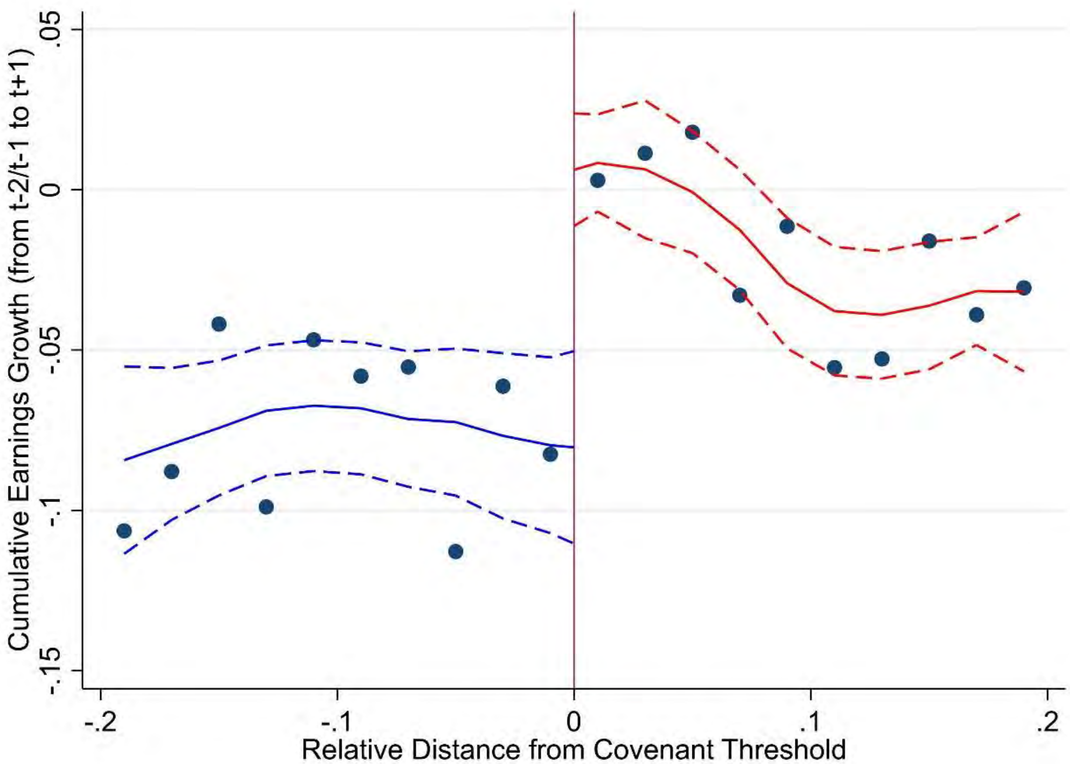


Panel B: Non-liquidation



Online Appendix Figure A3: Covenant Violations and Employee Earnings Changes - An RDD Graphical Analysis

This figure plots the average cumulative growth in a worker's log(annual earnings) in 2001 constant dollars over years t and t+1 relative to the average real log(annual earnings) in years t-1 and t-2 (y-axis) against the relative average distance from the net worth and current ratio covenant thresholds (x-axis). We employ the cumulative earnings growth and average distance given the relatively small firm-year sample using the DealScan-Compustat-LEHD matched data from 1995 to 2007. Each circle represents the average cumulative earnings growth within the bin, with each bin containing multiple underlying worker observations. Solid lines are fitted values from kernel-weighted polynomial regressions and the dashed lines represent the 95% confidence intervals.



Online Appendix Table A1: Effect of Bankruptcy on Employee Earnings When Control Group is Matched Using Observations from the Baseline Year, t-4

This table presents the present value of earnings losses by constructing matched firms based on the information in the baseline year, t-4. "PV (Earnings losses)" is the present value of earnings losses from years t to t+6 as a percent of the pre-bankruptcy annual earnings in t-4. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

	(1)	(2)	(3)	(4)	(5)
PV (Earnings losses)	-153.5%***	-163.1%***	-66.4%*	-128.8%***	-148.3%**
	(-4.24)	(-4.44)	(-1.68)	(-3.82)	(-2.43)
Controls	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				
SIC2 × Year FE		Yes		Yes	
County × Year FE			Yes	Yes	
SIC2 × County × Year FE					Yes
Observations	2,151,000	2,151,000	2,151,000	2,151,000	2,151,000

Online Appendix Table A2: Effect of Corporate Bankruptcy on Employee Earnings After Imputing Missing Earnings

This table presents the present value of earnings losses using the matched firms' employees as the control group and after imputing missing earnings in LEHD. "PV (Earnings losses)" ("PV (Earnings losses, UI)") is the present value of earnings losses without (with) unemployment insurance adjustments from years t to t+6 as a percent of the pre-bankruptcy annual earnings in t-4. Column (1) shows the baseline PV estimates from Table 4, Panels A and C, column (5). Columns (2) through (4) impute missing earnings in LEHD with the 0.5%, 1%, and 5% values of the earnings distribution in our sample. Columns (5) and (6) impute missing earnings in LEHD with the last observed quarterly and annual earnings for a given worker. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	Impute with 0.5% earnings	Impute with 1% earnings	Impute with 5% earnings	Impute with last observed quarterly earnings	Impute with last observed annual earnings
PV (Earnings losses)	-89.5%**	-169.3%**	-157.5%**	-121.4%**	-63.6%**	-83.5%***
	(-2.14)	(-2.22)	(-2.29)	(-2.55)	(-2.44)	(-3.17)
PV (Earnings losses, UI)	-87.1%**	-115.6%***	-113.9%***	-107.5%***	-62.2%**	-82.2%***
	(-2.07)	(-2.70)	(-2.88)	(-3.36)	(-2.35)	(-3.10)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Online Appendix Table A3: Alternative Definition of Firm, Industry, and County Stayers in Year t+3 vs. t+5

This table presents the present value of earnings losses conditional on mobility of employees of the bankrupt firms. “PV (Earnings losses)” is the present value of earnings losses from years t to t+6 as a percent of the pre-bankruptcy annual earnings in t-4. Panel A (Panel B) defines a worker as a “stayer” if she stays in the same firm, industry, or county through year t+3 (t+5) as her t-1 firm, industry, or county. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Group:	Firm stayers	Firm leavers	Leavers: same industry same county	Leavers: diff. industry same county	Leavers: same industry diff. county	Leavers: diff. industry diff. county
Panel A: Stayers Defined in t+3						
PV (Earnings losses)	37.9%	-119.9%***	79.1%	19.0%	8.5%	-211.1%***
	(0.62)	(-3.11)	(1.42)	(0.39)	(0.16)	(-6.02)
Panel B: Stayers Defined in t+5						
PV (Earnings losses)	107.0%	-110.7%***	130.7%**	28.9%	22.2%	-187.6%***
	(1.45)	(-2.77)	(2.17)	(0.57)	(0.41)	(-5.07)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Online Appendix Table A4: Present Value of Earnings Losses Conditional on Firm, Industry, and County Stayer Status of both Treated and Control Groups

This table presents the present value of earnings losses conditional on mobility of employees of both bankrupt and matched control firms. The main difference between this table and Table 5, Panel A in the main text is as follows. This table stratifies both the treated (i.e., bankrupt) and control firm employees. Thus, this table examines how stayers (leavers) of the bankrupt firm fare relative to the stayers (leavers) of the control firm. In contrast, Table 5, Panel A stratifies the treated firm employees based on whether they stay with their firms, industries, or counties, but not the control firm employees. Thus, the panel decomposes earnings losses of the treated group relative to the average worker in the control group. "PV (Earnings losses)" is the present value of earnings losses from years t to t+6 as a percent of the pre-bankruptcy annual earnings in t-4. We define a worker as a stayer if she stays in the same firm, industry, or county through year t+3 as her t-1 firm, industry, or county. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Group:	Firm stayers	Firm leavers	Leavers: same industry same county	Leavers: diff. industry same county	Leavers: same industry diff. county	Leavers: diff. industry diff. county
PV (Earnings losses)	-116.2%** (-2.00)	-86.8%** (-2.59)	-97.0%** (-2.23)	-94.9%** (-2.41)	-143.7%*** (-3.56)	-106.5%*** (-3.14)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Online Appendix Table A5: Present Value of Earnings Losses Estimates Using Alternative Samples and Specifications

This table presents the present value of earnings losses using various alternative samples and specifications to the baseline results. Column (1) examines the earnings losses of employees of private bankrupt firms relative to matched private non-bankrupt firms; Column (2) focuses on a subsample of employees in the treated and control groups of the main sample with at least six years of tenure in year t-1; Column (3) estimates equation (1) using the unemployment insurance adjusted earnings, in which unemployment spells are defined to begin when quarterly earnings either drop by at least half of the previous quarterly earnings or become zero; Column (4) focuses on a subsample of firms that have existed in years t-3 through t-1, corresponding to the subsample used in Table 2, Panel C; Column (5) controls for worker education by using five categories of education level, instead of the number of schooling years in the main specification; Column (6) uses employees of bankrupt and matched firms with at least two years of tenure in year t-4 as a sample; Column (7) imputes one or two quarters of zero earnings that are preceded and followed by nearly identical positive quarterly earnings (i.e., within 5% of each other) with the average of the positive earnings. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Description:	Private firms	Tenure ≥ 6	Unemp. w/ pos. earnings	Firms existed in t-3 to t-1	Discrete education	Workers in year t-4	Spurious zeros imputed
PV (Earnings losses)	-289.3%***	-84.8%	-84.2%**	-133.9%***	-89.1%**	-62.0%***	-87.9%**
	(-6.08)	(-1.34)	(-2.04)	(-2.81)	(-2.13)	(-2.70)	(-2.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	332,000	781,000	2,967,000	2,588,000	2,967,000	1,770,000	2,967,000

Online Appendix Table A6: Covariate Balance Before Potential Loan Covenant Violations

This table employ a regression discontinuity design to show the balance of worker characteristics around covenant violation thresholds using DealScan-Compustat-LEHD matched data from 1995 to 2008. The dependent variable is the worker's annual earnings in 2001 constant dollars in the year before potential violations (column (1)), an indicator for female (column (2)), years of experience (column (3)), imputed education (column (4)), and age (column (5)). "Bind" is an indicator variable equal to one if the worker is an employee of a firm that violates a loan covenant concerning the current ratio or net worth, and zero otherwise. "1st order distance" is the relative distance of the firm's net worth and current ratio from the covenant thresholds. Definitions of these variables are available in the Appendix. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

	(1)	(2)	(3)	(4)	(5)
Dep. Var.:	Earnings ($)	Female	Experience	Education	Age
Bind	-162.3	-0.002	-0.040	-0.026	-0.066
	(-0.22)	(-0.49)	(-0.42)	(-1.21)	(-0.64)
1st order distance	Yes	Yes	Yes	Yes	Yes
Worker-level controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,673,000	1,673,000	1,673,000	1,673,000	1,673,000
R^2	8.04%	21.46%	15.89%	7.03%	17.42%

Online Appendix Table A7: Leverage and Employee Wages - A Wage Regression Approach Using Alternative Samples

This table presents the relationship between corporate leverage and employee earnings using alternative samples to those used in Table 7. In Panel A, the dependent variable is log(quarterly earnings) in 2001 constant dollars. The control variables include log(book assets), market-to-book, ROA, asset tangibility of firms, female indicator × years of experience, imputed education × years of experience of individual workers, firm, worker, and two-digit SIC industry × county × year fixed effects. To select the sample for the regression, we begin with all Compustat firms, except for those with S&P credit ratings D (default), with book assets greater than $100 million in 1980 constant dollars and less than or equal to the assets of the largest firm in our bankrupt and matched firm sample from 1986 to 2008. Then, we select all workers in LEHD with ages between 22 and 55 with at least two years of tenure who move between these firms. For earnings before moving, we use the highest quarterly earnings in the last four quarters at the old firm; for earnings after moving, we use the highest quarterly earnings in the first four quarters at the new firm. Column (1) presents estimates for the full sample. Columns (2) and (3) present estimates conditional on firm size, as measured by book assets of a given firm. Columns (4) and (5) present estimates conditional on local labor market size, as measured by total employment in a given two-digit SIC industry and county cell. "Large" ("Small") represents a subsample in which firm assets or local labor market size is greater than (less than or equal to) the 75th percentile in the sample distribution. In Panel B, the dependent variable is log(annual earnings) in 2001 constant dollars. To select the sample for the regression, we begin with Compustat firms with S&P credit ratings between AA+ and B- or unrated, and book assets greater than $100 million in 1980 constant dollars and less than or equal to the assets of the largest firm in our bankrupt and matched firm sample from 1986 to 2008. Then we draw a 30% random sample of all employees of these firms in LEHD (to reduce computational burden) with ages between 22 and 55 and at least two years of tenure. The same sets of worker- and firm-level controls as those in Panel A are employed. Definitions of these variables are in the Appendix. Heteroskedasticity robust *t*-statistics adjusted for within-firm and worker clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***. The number of observations is rounded to the nearest thousands to follow the Census Bureau's disclosure rules.

Panel A: Mover Sample Including All Rated and Unrated Firms

Dep. Var. = Log (earnings)	(1)	(2)	(3)	(4)	(5)
Conditioning variable:	-	Firm size		Labor market size	
Sample:	Full - Movers	Large	Small	Large	Small
Market leverage	0.050***	-0.113	0.063***	0.013	0.061***
	(2.96)	(-1.27)	(3.01)	(0.51)	(3.59)
Worker-level controls	Yes	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes
Observations	9,292,000	2,336,000	6,956,000	2,324,000	6,969,000
R^2	70.7%	91.5%	76.7%	84.6%	76.0%
Market leverage × (Small – Large)	-	0.175*		0.049*	
(*t*-statistic)	-	(1.87)		(1.92)	

Panel B: 30% Representative Sample of All Workers (Including Movers and Non-movers, and Including Firms with Ratings Between AA+ and B- or Unrated)

Dep. Var. = Log (earnings)	(1)	(2)
Sample:	All workers	
Market leverage	0.075**	-0.006
	(2.47)	(-0.33)
Worker-level controls	Yes	Yes
Firm-level controls	Yes	Yes
Worker FE	Yes	Yes
Firm FE	No	Yes
SIC2 × County × Year FE	Yes	Yes
Observations	20,910,000	20,910,000
R^2	92.4%	92.5%

Online Appendix Table A8: Effect of Corporate Bankruptcy on Employee Earnings - Conditional Analysis on Worker Mobility, Labor Market Characteristics, and Bankruptcy Liquidation Outcomes, with UI Benefits Adjustments

This table presents the present value of earnings losses conditional on worker mobility, labor market characteristics, and bankruptcy liquidation outcomes after estimated unemployment insurance (UI) benefits are adjusted for. "PV (Earnings losses)" is the present value of earnings losses from years t to t+6 as a percent of the pre-bankruptcy annual earnings in t-4. Panel A reports the present values of earnings losses conditional on worker mobility. We define a worker as a stayer if she stays in the same firm, industry, or county through year t+3 as her t-1 firm, industry, or county. This panel stratifies the treated (i.e., bankrupt) firm employees based on whether they stay with their firms, industries, or counties, but not the matched control firm employees. Thus, the panel decomposes earnings losses of the treated group workers relative to the average worker in the control group. Panel B reports the present values of earnings losses conditional on firm size (as measured by book assets from Compustat), local labor market size (total employment in a given two-digit SIC industry and county cell), and bankruptcy outcomes (liquidation vs. non-liquidation). We split the sample at the 75th percentile of the firm size and labor market size distributions. This panel stratifies both the treated and control firm employees. *t*-statistics for the (difference in) present value significantly differing from zero are in parentheses (standard errors are computed using the delta method). Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***.

Panel A: Present Value of Earnings Losses Conditional on Worker Mobility

	(1)	(2)	(3)	(4)	(5)	(6)
Group:	Firm stayers	Firm leavers	Leavers: same industry same county	Leavers: diff. industry same county	Leavers: same industry diff. county	Leavers: diff. industry diff. county
PV (Earnings losses)	19.4% (0.32)	-114.4%*** (-2.90)	79.4% (1.42)	26.2% (0.53)	9.3% (0.18)	-205.0%*** (-5.71)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Present Value of Earnings Losses Conditional on Firm Size, Local Market Size and Bankruptcy Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Conditioning variable:	Firm size		Labor market size		Bankruptcy liquidation outcome	
Sample:	Large	Small	Large	Small	Liquidation	Non-liquidation
PV (Earnings losses)	-46.3% (-0.76)	-97.7** (-2.30)	-20.9% (-0.48)	-113.6%** (-2.39)	-95.7%* (-1.72)	-82.6%* (-1.95)
Diff. between two groups (*t*-statistic)	51.4% (0.96)		92.7%** (2.21)		-13.0% (-0.31)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes	Yes	Yes	Yes	Yes	Yes
SIC2 × County × Year FE	Yes	Yes	Yes	Yes	Yes	Yes