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Firm Leverage, Labor Market Size, and Employee Pay*

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Abstract

We provide estimates of the wage costs of firms' debt exploiting within-firm variation in workers' expected unemployment costs due to variation in local labor market size. We find that, following an increase in firm leverage, workers with higher unemployment costs experience higher wage growth relative to workers at the same firm with lower unemployment costs. Our estimates suggest wage costs are an important component in the cost of debt; a 10 percentage point increase in firm leverage increases wages for the median worker by 1.9% and increases total firm wage costs by 17 basis points of firm value.

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A large literature is dedicated to estimating the benefits and costs of corporate debt, including tax benefits, bankruptcy costs, agency benefits and costs, and other costs of financial distress. More recently, this research has focused on estimating the costs of debt, or leverage, arising from changes in rank-and-file employee behavior in response to changes in firms' capital structures. For example, Chang (1992), Jaggia and Thakor (1994) and Berk, Stanton and Zechner (2010) show theoretically that, in the presence of costs to employees when firms enter financial distress, employees may demand ex ante higher wages to compensate for such risk as firms increase their leverage. This, in turn, may limit the amount of debt that firms issue.

Estimating the effect of firm leverage on employee wages is challenging for several reasons. First, firms may endogenously choose their capital structures in response to wage costs. In particular, if firms need to compensate individuals for unemployment risk, then optimal leverage ratios could be lower than if workers do not demand compensation. Second, omitted variables such as the marginal product of labor could lead to biased estimates. For instance, firms may issue equity to finance new investment in labor-augmenting technology. As a result, leverage ratios decrease and, because the marginal product of labor increases, wages will likely increase. Third, in many datasets one cannot observe individual employee's wages or other characteristics, but rather only a total wage bill of the firm which could also be influenced by changes in worker composition. For example, if skilled workers earning higher wages leave and are then replaced with lower-skill, and lower-paid, workers given an increase in firm leverage, then the estimated relationship between changes in leverage and employee pay could be biased.

In our paper, we use an approach that addresses the above concerns by using matched firm-worker-level data from the Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program to exploit within-firm variation in employees' expected costs of unemployment to provide estimates of the wage costs of firm debt in a broad sample of publicly traded U.S. firms over the period 1991 to 2008. In particular, our empirical design relies on within-firm variation in expected unemployment costs due to geographical differences in local labor markets faced by workers in the same firm. Expected unemployment costs may vary across workers within the same firm if the firm operates in multiple locations due to geographical differences in labor search and matching frictions. Therefore, when a firm increases its leverage, workers with higher expected unemployment costs should demand a higher wage premium than other workers. By focusing on within-firm variation in expected unemployment costs, we are able to account for firm-level shocks that determine firm leverage. Likewise, we are also able to control for individual worker characteristics that could influence their wages and the possible confounding effects of shifts in worker composition over time. Additionally, our analysis of a broad sample of U.S. firms also allows us to obtain estimates of the wage costs of debt that are more generalizable than those that are focused on particular subsamples of firms, such as those in financial distress (e.g., Graham, Kim, Li, and Qiu (2016)) or those engaged in bargaining with unions (e.g., Matsa (2010)) and provide large-scale estimates of the ex ante, rather than ex post, wage costs associated with an increase in firm leverage.

Our primary measure of a worker's expected unemployment costs is the relative size of the individual worker's labor market, a measure of the relative size of the worker's possible outside employment options, which we calculate as the industry share of MSA employment relative to the industry share of national employment. This measurement choice is informed by the literature on job search which finds evidence of economies of scale in labor markets. For example, Petrongolo and Pissarides (2006) find that individuals in larger labor markets have significantly higher reservation wages during unemployment and earn significantly higher wages following unemployment than those in smaller labor markets. Helsley and Strange (1990) and Bleakley and Lin (2012) also document a negative relationship between labor market size and unemployment.

We provide empirical justification of our formulation of labor market size as a measure of expected unemployment costs; in particular, we find that, following a firm bankruptcy, individuals in larger labor markets are significantly more likely to be employed and, conditional on employment, earn significantly more than individuals at the same firm that are in smaller labor markets. In addition to capturing meaningful variation in unemployment costs, this measure of labor market size permits the inclusion of MSA-year fixed effects to control for local economic shocks, unlike MSA-level measures of labor market size. We also find that our results are robust to alternative measures of labor market size and to alternative measures of unemployment costs.

Using our empirical approach, we find that, within a firm, wages for employees in smaller labor markets grow faster than other employees at the firm in response to an increase in firm leverage. The estimates imply that, in response to a 10 percentage point increase in leverage, employees in small labor markets (those at the 25th percentile) earn a wage premium of 0.2% relative to employees who work at the same firm but in large labor markets (those at the 75th percentile). We then use this cross-sectional result to estimate the effect of firm leverage on employee pay. This calculation suggests that a 10 percentage point increase in leverage increases compensation for the median worker by about 1.9% and total employee compensation at the firm by approximately 17 basis points of firm value, implying that labor costs are an important consideration for firms when choosing their capital structure.

We then examine whether certain types of employees demand greater compensation for increases in firm leverage vis-à-vis other employees. For employees to be compensated for greater unemployment risk due to higher leverage, these employees need to understand the effect of firm leverage on unemployment risk and they need sufficient bargaining power. We find evidence that both factors are important determinants of wage changes in response to changes in firms' leverage. First, the wage response is stronger for those workers more likely to understand the relationship between leverage and unemployment; employees with higher wages, a measure of skilled labor, and employees with exposure to previous bankruptcies experience higher wage increases in response to increases in firm leverage. Second, we find the wage response to changes in firm leverage is stronger in more competitive labor markets and in markets with low unemployment, environments in which employees likely have greater bargaining power with their employers. We also find that the effect of leverage on wages is stronger amongst new employees, who are also more likely to negotiate wage increases vis-à-vis continuing employees. We find that, among new employees at a given firm, a 10 percentage point increase in leverage leads new employees in small labor markets to earn approximately 0.5% more than new employees in larger labor markets, double the effect estimated across all workers at firms.

Finally, we consider explanations for our empirical results that may bias our main estimates of the wage costs of leverage. We first examine the possibility of reverse causality, where increasing employee wages lead firms to increase leverage, and we argue that it is unlikely to hold. We find no evidence that this is the case; our main result is unaffected when we include leads and lags of firm leverage changes interacted with labor market size. We also find no evidence that the results are due to an unobserved productivity shock. To rule out this explanation, we study within-firm variation in growth rates across MSAs. If our results are due to a localized productivity shock, we would expect the establishments benefitting from positive shocks to grow faster than the firm's other establishments. We find no evidence of differential effect on growth rates in employment, establishment counts, sales, valued added, or capital expenditures.

Our paper contributes to the growing literature on the relationship between firms' financial and labor market decisions and provides new estimates of the ex ante wage costs associated with financial leverage based on a large sample of public U.S. firms. The most closely related paper to ours is Chemmanur, Cheng, and Zhang (2013). These authors study the relationship between leverage and employee compensation and find that workers are paid higher wages when leverage ratios are higher. Their measure of employee compensation is based on Compustat data on labor and related expenses, and is an aggregate measure of employee pay sparely populated at the firm level that cannot account for the changing composition of workers over time. The approach employed in our paper allows us to more precisely measure the effects of changes in firm leverage on employee wages, holding firm and employee characteristics constant and to more effectively overcome some of the empirical challenges facing the identification of the wage costs of firm debt.

Other related papers are Graham, Kim, Li, and Qiu (2016), Agrawal and Matsa (2013), and Kim (2015). Graham, Kim, Li, and Qiu (2016) study the long term effects on employee earnings following bankruptcy and uses the ex post wage loss to calculate an ex ante premium required to offset the realized losses. Agrawal and Matsa (2013) study the effects of changes in state unemployment benefits on firm leverage and use the observed relationship to calculate the labor costs of financial distress.[1] Kim (2015) finds that the opening of new manufacturing plants leads to an increase in leverage for other manufacturing firms in the same county and interprets these findings as when employees are more costly, firms take on less debt. In contrast, our approach calculates the ex ante wage premium that employees do receive as compensation for the increased unemployment risk using a broad sample of public firms.

Our paper also relates to the labor economics literature on compensating differentials. For example, Topel (1984) uses variation in unemployment insurance coverage to estimate a compensating differential of 2.5% for a one point increase in the probability of unemployment.[2] While papers in this literature typically exploit variation in aggregate risk, we incorporate firm-specific variation in unemployment risk into the analysis, which may better capture the risk of employment of individual workers.

[1]Conversely, Matsa (2010) shows that leverage may be used as a bargaining tool in negotiations with organized labor and, in some cases, may be used to reduce the employment costs of the firm. Other papers, such Peters and Wagner (2014), examine the relationship between risk and CEO compensation.

[2]Abowd and Ashenfelter (1981), Li (1986), Rosen (1986), and Moretti (2000) also estimate compensating differentials for bearing unemployment risk and find broadly similar effects.

1 Theoretical and Empirical Framework

Financial distress imposes significant costs on employees. Following periods of financial distress, firms significantly reduce employment (Hotchkiss (1995), Agrawal and Matsa (2013), Falato and Liang (2016)). This imposes costs on employees through two channels. First, search and matching frictions give rise to periods of unemployment (Mortensen and Pissarides (1994)), leading to lost wages and a deterioration in skills. Second, an unemployment spell can lead to lower wages in the long run due to the elimination of firm-specific capital (Becker (1962)) or due to a lower quality match between employee and employer (Jovanovic (1979)). Consistent with this theoretical evidence, Graham, Kim, Li, and Qiu (2016) find empirically that workers experience significantly lower wages for at least five years following a bankruptcy of their employer.

The ex post reduction in lifetime earnings suggests that employees of highly levered firms should be compensated for the increased distress risk. In other words, higher firm leverage should lead to higher employee compensation (Berk, Stanton, and Zechner (2010)).

Firm financial distress leads to a significant decline in employment, imposing large costs on its employees. These costs arise due to the fact that unemployment leads to lower lifetime earnings. The reduction in earnings is due both to long unemployment spells (Katz and Meyer (1990), Meyer (1990), and Krueger and Mueller (2010)) and lower wages in subsequent employment (Gibbons and Katz (1991), Farber (2005), Couch and Placzek (2010)).

Theoretical and empirical evidence suggests that firms compensate individuals for bearing unemployment risk. For instance, in Abowd and Ashenfelter (1981), workers require a wage premium, also known as a compensating differential, to work for a sector with higher unemployment risk. Exploiting variation in unemployment risk across industries, they estimate individuals earn compensating differentials of up to 14%. Berk, Stanton, and Zechner (2010) provide theoretical support for a positive relationship between leverage and employee compensation.

1.1 Labor Market Size as a Measure of Unemployment Costs

While theory predicts that increased firm leverage will lead to higher compensation for workers, unemployment risks are not constant across workers at a firm. For example, the individual's labor market plays an important role in the magnitude of lost earnings, and individual workers in a firm may face different expected costs to unemployment based on their local labor markets (e.g., Moretti (2011)).

Our primary measure of expected unemployment costs for a given worker is the size of his local labor market, which we measure as the industry share of MSA employment relative to the industry share of national employment. Our choice of labor market size as a proxy for unemployment costs is informed by the literature on job search, such as Petrongolo and Pissarides (2006), who find evidence of economies of scale in labor markets. In particular, in such job search models, individuals in larger labor markets have significantly higher reservation wages during unemployment and earn significantly higher wages following unemployment than those in smaller labor markets. In particular, unemployment is less harmful for individuals in larger labor markets as they earn higher wages upon returning to employment (Helsley and Strange (1990) and Petrongolo and Pissarides (2006)). Most related to our analysis, Graham, Kim, Li, and Qiu (2016) show that workers in larger labor market experience smaller wage losses following their employer's bankruptcy than workers in smaller labor markets.

To further support our primary measure of unemployment costs at the local labor market level, we present evidence that our measure of labor market size captures meaningful variation in unemployment costs. We identify firm bankruptcies in our sample, firms whose workers experience a shock to their employment status that is plausibly exogenous to their individual-specific path of expected earnings. We then track the earnings of these workers for the five years following the bankruptcy and relate these earnings to the size of the individual's labor market. In particular, we estimate

$$
\begin{aligned}
Y_{ikl,t+z} &= \alpha + \sum_{z=0}^{5} \beta_z LMS_{klt} * YearRelBankruptcy_{j,t+z} + \beta_6 LMS_{klt} \\
&+ \sum_{z=0}^{5} \psi_z YearRelBankruptcy_{j,t+z} + \beta_7 Y_{it} \\
&+ \gamma_{jt} + \eta_{kt} + \sigma_{kl} + \nu_{ijkl,t+z} \qquad (1)
\end{aligned}
$$

where $Y_{ijkl,t+y}$ is the outcome variable of interest for employee i at bankrupt firm j in MSA k and industry l in the year $t+z$ following the bankruptcy of firm j in year t, LMS_{klt} is the size of the labor market in MSA k and industry l in year t, $YearRelBankruptcy_{j,t+z}$ is an indicator variable identifying the number of years since the bankruptcy of firm j, and Y_{it} represents controls for employee i in year t. There are four outcome variables of interest: (1) $PosEarn_{i,t+z}$, which is an indicator variable equal to one if employee i has positive earnings in year $t+z$, (2) $LnEarn_{i,t+z}$, which is the natural log of total annual earnings of employee i in year $t+z$, (3) $PosEarn_{i,t+z,-j}$, which is an indicator variable equal to one if employee i has positive earnings in year $t+z$, excluding earnings at firm j, and (4) $LnEarn_{i,t+z,-j}$, which is the natural log of total annual earnings of employee i in year $t+z$, excluding earnings at firm j. In addition, firm-year fixed effects γ_{jt}, MSA-year fixed effects η_{kt}, and MSA-industry fixed effects σ_{kl} are included.

The coefficients of interest are β_1-β_6, which estimate the effect of labor market size on the four outcomes of interest for each of the six years t to $t+5$ following the firm bankruptcy. The results are presented in Table 1.

[Insert Table 1 here]

As the results in Table 1 show, among workers at the same bankrupt firm, labor market size is positively correlated with worker earnings following a firm bankruptcy. In column 1, we examine the relationship between labor market size and whether or not the individual has any earnings during the year. The estimates show that, in the year of the bankruptcy, workers in large labor markets have a higher probability of having positive earnings, although the estimate is only marginally significant. The estimate of 0.157 implies that moving from the 25th percentile of labor market size to the 75th percentile is associated with a 26 percent increase in the probability of positive earnings. The estimated effect is larger and more significant in the year after the bankruptcy; the estimate implies that moving from the 25th to 75th percentile of labor market size increases the probability of positive earnings by approximately 42 percent. Over time, the magnitude and statistical significance of the effect declines over time and, within 5 years of the bankruptcy, the relationship between labor market size and the likelihood of having positive earnings is small and insignificant.

Next, in column 2, we examine the relationship between labor market size and log earnings. Again, we find evidence that workers in larger labor markets earn more following a bankruptcy than those in smaller labor markets. In the year of the bankruptcy, the estimate of 0.384 implies that moving from the 25th percentile of labor market size to the 75th percentile is associated with an increase in annual earnings of approximately $11,600. Similarly, in the second year following bankruptcy, workers at the 75th percentile of labor market size earn approximately $22,800 more than workers at the 25th percentile. While the estimated effects in other years are noisy and insignificant, aggregating the estimates implies that workers in the larger labor market earn approximately $40,000 more than workers in the smaller labor market.

These results provide evidence that workers in larger labor markets are less affected by a firm bankruptcy than workers in smaller labor markets. This differential effect could be because, when a firm cuts costs following a bankruptcy, they do so by reducing employment and wages more aggressively in their small labor markets, which may represent non-core parts of the firm. Alternatively, it could be the case that larger labor markets enable workers to more easily leave the bankrupt firm for alternative employment.

In columns 3 and 4, we provide evidence for the latter explanation by looking at earnings only at other firms.[3] In particular, the dependent variable in column 3 is an indicator variable equal to one if the worker had positive earnings during the year at a firm other than the bankrupt firm and zero otherwise. In column 4, the dependent variable is the log of yearly earnings, excluding earnings at the bankrupt firm. As the estimates in column 3 show, workers in larger labor markets are significantly more likely to be employed at new firms than workers in smaller labor markets. The effect is particularly strong in the year following the bankruptcy, where the estimate of 0.651 implies that moving from the 25th to the 75th percentile of labor market size increases the probability of working for a new firm by about 89 percent. The estimated effect declines to 70 percent in the second year after the bankruptcy and 55 percent in the third year. It is smaller in magnitude and statistically insignificant in later years.

Furthermore, the estimates in column 4 show that, conditional on positive earnings from another firm, those earnings are greater for workers in larger labor markets. The estimates are positive in all years except for the fourth year after the bankruptcy and statistically significant in years two and three. The estimates imply that moving from the 25th to the 75th percentile in labor market size is associated with an increase in earnings of approximately $30,000 in the second year after the bankruptcy and $5,000 in the third year post-bankruptcy. Aggregating the estimates across the six years implies a total increase of approximately $50,000 at other firms.

While we interpret these results as evidence that labor market size is an important determinant in earnings losses due to bankruptcy, we are implicitly making the assumption that earnings growth would have been similar in large and small labor markets in the absence of the bankruptcy. We do control for each worker's earnings in the each of the two years prior to the bankruptcy to strengthen this assumption but larger labor markets could still lead to higher wage growth due to, for example, higher churn and improved matching between workers and firms. To alleviate this concern, we next match each worker in the bankrupt firm

[3] In unreported results, we find no evidence that, in the year after a bankruptcy, changes in local employment by the firm are correlated with labor market size.

sample to up to ten individuals at non-bankrupt firms in our public firm sample in the same MSA, industry, and year with similar demographic characteristics (age, race, gender, and education) and similar earnings in each of the prior two years. By comparing the earnings of workers at bankrupt firms to other workers in the same labor market with similar characteristics, we are able to control for differential earnings trends in different labor markets. Specifically, we estimate

$$\begin{aligned} Y_{ikl,t+z} &= \alpha + \sum_{z=0}^{5} \beta_z BankruptSample_{ijt} * LMS_{klt} * YearRelBankruptcy_{j,t+z} \\ &+ \beta_6 LMS_{klt} + \sum_{z=0}^{5} \psi_z YearRelBankruptcy_{j,t+z} + \beta_7 Y_{it} \\ &+ \gamma_{jt} + \eta_{kt} + \sigma_{kl} + \nu_{ijkl,t+z} \end{aligned} \tag{2}$$

where the variables are the same as in equation 1. The variable $BankruptSample_{ijt}$ is an indicator variable equal to one if employee i was employed at bankrupt firm j in the year of its bankruptcy t. The coefficients of interest are β_0-β_5, which estimate the effect of labor market size for employees at bankrupt firms relative to the matched sample on the four outcomes of interest for each of the six years t to $t+6$ following the firm bankruptcy. The results are presented in Table 2.

[Insert Table 2 here]

First, as in Table 1, the dependent variable in column 1 is an indicator variable measuring whether or not the worker has any earnings during the year. The results suggest that, among workers at a bankrupt firm, those in larger labor markets are more likely to have positive earnings relative to similar workers in their labor market. The estimates on the interactions between the bankrupt sample indicator, labor market size, and the year relative to the bankruptcy are consistently positive and qualitatively similar to the corresponding estimates in Table 1, although only significant for the year following the bankruptcy.

Next, in column 2, we find that, conditional on working, workers in larger labor markets have significantly higher earnings relative to similar workers in the same market following a bankruptcy. The coefficients on the triple interactions are consistently positive and are statistically significant for four of the six interactions. Moreover, they are slightly larger than the corresponding estimates in Table 1.

As in Table 1, we next examine in column 3 whether workers in larger labor markets are more likely be switch employers following a bankruptcy. In this specification, the use of the matched sample means that we control for differences in job churning across large and small labor markets. Nevertheless, we continue to find that employees at bankrupt firms are more likely to move to new firms when they are in larger labor markets. Again, the estimates on the triple interaction terms are typically positive and are significant in three of the six specifications.

In column 4, we again find evidence that, among workers at bankrupt firms that move to new employers, those in larger labor markets earn significantly more than those in smaller labor markets, when compared to other, similar workers in the same labor market. The coefficients on the triple interaction term is positive in four of the six cases and significant in two cases.

In additional tests, we use the matched sample to calculate mean for the outcome of interest for similar workers for the bankrupt sample and re-estimate equation 1, including this mean as a control. The results, presented in Appendix Table A2, are qualitatively similar to the results of Table 1. In an additional test of the effect of labor market size on unemployment costs, we track workers of single establishment firms that cease operations entirely as a shock to the employment status of individual workers. Such firms by definition operate in a single MSA. We then track the earnings of these workers over five years and relate these earnings to the size of the individual's labor market. The results, presented in Appendix Table A3, also demonstrate a robust positive relationship between labor market size and workers' subsequent earnings.

The results of Tables 1 and 2, as well as Appendix Table A2, show that, following a firm bankruptcy, workers at the firm who are in larger labor markets are significantly more likely to be employed, earn significantly more, and are significantly more likely to switch employers than workers at the firm in smaller labor markets. Furthermore, in Appendix Table A3, we show that, following a firm closure, labor market size is positively correlated with subsequent earnings. Thus, our measure of labor market size does appear to capture important variation in the expected costs of unemployment.

1.2 Empirical Framework

The compensation that workers receive in return for bearing unemployment risk should vary, even within a single firm. Our empirical framework examines large firms which operate in multiple local labor markets in which employees may face different costs of unemployment. Workers with relatively lower unemployment costs should receive a lower wage premium for unemployment risk than workers with relatively higher unemployment cots. In other words, when a firm increases its leverage, workers in large labor markets (those whom we argue face lower unemployment costs) should experience lower pay growth than workers with small labor markets (those with higher unemployment costs).

To test this implication, we run panel regressions using worker-firm level data relating changes in worker pay to labor market size and its interaction with changes in firm leverage.

Specifically, we estimate:

$$
\begin{aligned}
\Delta Pay_{ijkl,t\to t+1} &= \alpha + \beta_1 \Delta Leverage_{j,t-1\to t} * LMS_{klt} \\
&+ \beta_2 \Delta X_{j,t-1\to t} * LMS_{klt} \\
&+ \beta_3 LMS_{klt} + \beta_4 Y_{it} \\
&+ \gamma_{jt} + \eta_{kt} + \sigma_{km} + \nu_{ijkl,t\to t+1} \qquad (3)
\end{aligned}
$$

where $\Delta Pay_{ijkl,t\to t+1}$ is the growth in pay for employee i at firm j in MSA k and industry l from year t to $t+1$, $\Delta Leverage_{j,t-1\to t}$ is the change in book leverage for firm j from year $t-1$ to t, $LMS_{kl,t-1}$ is the size of the labor market in MSA k and industry l, $\Delta X_{j,t-1\to t}$ represents a vector of controls for firm j from year $t-1$ to t, and $Y_{i,t-1}$ represents controls for employee i in year $t-1$. In addition, firm-year fixed effects γ_{jt}, MSA-year fixed effects η_{kt}, and MSA-industry fixed effects σ_{km} are included.[4] Therefore, estimates of β_1 measure the differential effect on wages that changes in firm leverage have on workers at the same firm residing in labor markets of different size. Note that we do not control for changes in firm characteristics in addition to their interactions with labor market size since we include firm-year fixed effects in our specification.

2 Data Sources and Variable Construction

2.1 Data Sources

We construct a unique worker-firm-level dataset that combines data on individual workers with data on the firms for which they work. Worker-level data are from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program. The LEHD data

[4] We include worker fixed effects in some specifications but doing so is computationally intensive as there are approximately 14 million workers in our sample. Therefore, for many tests, we omit worker fixed effects.

cover 25 states[5] and provides detailed data on worker earnings and other characteristics. The Employment History File (EHF) provides data on quarterly earnings for each worker-firm pair. The Individual Characteristics File (ICF) provides data on worker age, place of birth, gender, education, and race.

We match the worker data to firm data from other Census datasets as well as Compustat and CRSP. We use the Census Bureau's Longitudinal Business Database (LBD) to construct measures of employment and the number of establishments at the level of the firm and the firm-MSA. We also use the Census Bureau's Census of Manufactures (CMF) and Annual Survey of Manufactures (ASM) to calculate measures of the value of shipments and value added at the level of the firm and the firm-MSA. The Census data are matched with Compustat and CRSP using the Compustat-SSEL bridge.[6]

Firms are classified to three digit SIC industries using industry codes from Compustat. In cases where the industry code is missing in Compustat, we use the industry code from CRSP. We exclude financial firms (SIC codes 6000-6999), utilities (SIC codes 4900-4999), and public administration firms (SIC codes 9000-9999) and restrict the sample to workers between the ages of 25 and 64. This yields a sample of 51,293,300 worker-level observations and 27,500 firm-year observations, covering approximately 14,000,000 workers at 4,200 firms between the years 1991 and 2008.[7,8]

[5]The states in our sample are Arkansas, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Montana, Nevada, New Jersey, New Mexico, North Carolina, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Utah, Vermont, Virginia, Washington, and Wisconsin. There is considerable variation across states in terms of the time period covered with some states having coverage from 1991 to 2008 with data for other states not beginning until 2000. The majority of states begin coverage on or before 1995.

[6]The current version of the Compustat-SSEL bridge is only available through 2005. We extend the bridge through 2008 using employer name and EIN following the procedure described in McCue (2003).

[7]Counts have been rounded to the nearest hundred following disclosure guidelines by the U.S. Census Bureau.

[8]Due to the limited geographical coverage of the LEHD, our final dataset includes 40% of the approximately 70,000 firm-year observations of the CRSP-Compustat universe with non-missing data for our key variables. See next section for a discussion of the representativeness of our final sample.

2.2 Variable Construction and Summary Statistics

Our main dependent variable is the change in log average quarterly earnings at the firm. We calculate book leverage as debt in current liabilities plus long-term debt relative to assets.[9] We follow Leary and Roberts (2014) to construct firm-level controls for profitability, size, market-to-book ratio, and asset tangibility. Marginal tax rates are from John Graham's website.[10] Finally, our measure of labor market size is based on data from the LBD. This measure is calculated as the industry share of employment in an MSA relative to the industry share of employment for the nation, where industry is defined using three-digit SIC codes. For more detail on variable construction, see Appendix Table A1.

Table 3 provides summary statistics of key variables for our sample.[11] Panel A presents statistics for worker data. Average pay growth is high at 8.7% per year. Median pay growth, in contrast, is 1.4% per year. Average quarterly earnings are approximately $11,000 with a median of approximately $9,000. High average pay growth is the result of high turnover rates at firms and the asymmetric nature of growth rates. Employees who join a firm in the middle of a period will have a very high rate of pay growth for their second period of employment that is theoretically unbounded. Employees who leave a firm in the middle of a period will have low rate of pay growth that is bounded at -1. As a result, turnover will increase average rates of pay growth. To reduce this effect, we calculate average pay growth as the average quarterly pay in year $t+1$ relative to t rather than using annual pay.

Finally, the average labor market size is approximately 3.8, suggesting a high degree of industry agglomeration; the local industry share of employment is almost four times greater on average than the national industry share of employment. However, given that the median is only 1.08 and the standard deviation is approximately 10, there is significant variation across workers in the size of their labor market.

[9] In unreported tests, using market leverage and net leverage as alternative measures of firm leverage yields qualitatively similar results.

[10] `https://faculty.fuqua.duke.edu/~jgraham/taxform.html`

[11] All variables are winsorized at the 1st and 99th percentiles.

[Insert Table 3 here]

Panel B presents statistics for data consolidated to firm-year observations. Average (median) firm book leverage is approximately 23% (21%). Consistent with the literature on the stability of firm leverage,[12] the average (median) change in leverage is only 0.3% (-0.1%). However, the standard deviation is approximately 8%, suggesting that a substantial set of firms do exhibit large changes in leverage.[13]

As discussed above, due to the geographical coverage of LEHD, we match approximately 40% of firm-year observations from the intersection of CRSP and Compustat data. Comparing the summary statistics of our final sample with those for the CRSP-Compustat data, we find that, while firms in our sample are larger and more profitable than in the broader sample, leverage ratios are similar across the two samples. In particular, the mean firm sales in our sample is $2.27 billion and the mean profitability is 12.6%, the mean firm sales in the full sample is $1.22 billion and mean profitability is 4.4%. However, mean book leverage is very similar, at 23.1 for our sample and 22.2 for the full sample. Similarly, differences in mean market-to-book ratio (1.49 versus 1.75) and asset tangibility (0.291 versus 0.269) are small across the two samples.

3 Main Estimates of the Relation between Firm Leverage and Employee Wages

In this section, we examine the effect that firm leverage has on employee wages. Before we present the estimates of equation 3, which was laid out in Section 1.2, we first analyze the

[12]See, for example, Lemmon, Roberts and Zender (2008) and Graham and Leary (2011)

[13]This is consistent with the literature on adjustment costs such as in Leary and Roberts (2005).

correlation between leverage and wages. To do so, we estimate the regression

$$Pay_{ijklt} = \alpha + \beta_1 Leverage_{j,t-1} + \beta_2 X_{i,t-1} + \beta_3 Y_{j,t-1} + \gamma_j + \eta_k + \sigma_t + \eta_{it} \quad (4)$$

where Pay_{ijklt} is the natural log of pay for employee i at firm j in MSA k and industry l in year t, $Leverage_{j,t-1}$ is the book leverage for firm j in year $t-1$ to t, $X_{j,t-1}$ represents a vector of controls for firm j in year $t-1$, and $Y_{i,t-1}$ represents controls for employee i in year $t-1$. In addition, firm fixed effects γ_j, MSA fixed effects η_k, and year fixed effects σ_t are included in certain specifications. The results are presented in Table 4.

[Insert Table 4 here]

We find no evidence that higher leverage is associated with higher employee pay. The estimated effect of leverage is negative in four of the six specifications and even negative and marginally significant in one specification. The negative estimates in columns 1 and 2 are in contrast to the positive and significant estimates from similar specifications in Table 6 of Chemmanur, Cheng, and Zhang (2013). However, there are key differences between the two sets of analysis, including differences in the set of firms included in each sample, differences in the unit of observation, and differences in control variables, that may account for the difference in the direction and magnitude of our estimates. Graham, Kim, Li, and Qiu (2016) estimate the relationship between wages and book leverage in their LEHD-based sample and also find an insignificant estimate on book leverage across their full sample of firms.

However, as discussed above, this analysis fails to account for potential selection bias, where we may not observe firms increasing leverage if doing so would lead to large increases in employee wages, and omitted variable bias, where unobservable factors such as productivity shocks affect both firm leverage and employee compensation. In other words, the estimates in Table 4 may be downwardly biased. For instance, if firms tend to raise equity to invest in labor-augmenting technology, which increases labor productivity and therefore wages, we would expect to find a negative correlation between leverage and wages. To account for these sources of bias, we then estimate equation 3, which estimates changes in wages within firms on the interaction of changes in firm leverage and labor market size, and present the results in Table 5.[14]

[Insert Table 5 here]

In contrast to the previous results, we find that leverage has an important effect on employee wages. In column 1, we find that the estimate of the interaction between the change in firm leverage and labor market size is negative and highly significant. In other words, the pay of employees in relatively small labor markets, in which workers have higher expected unemployment costs, increases in response to increased firm leverage, relative to employees at the same firm in larger labor markets.

In column 2, we include interactions between labor market size and several firm level controls – the change in EBITDA relative to assets, the change in market to book ratio, the change in log sales, the change in asset tangibility, and the change in the firm's marginal tax rate. The coefficient on the interaction term between LMS and change in leverage remains negative and significant and is largely unchanged in magnitude. Next, in column 3, we include worker fixed effects to control for worker-level unobservable characteristics. While slightly smaller in magnitude, the coefficient on the interaction term between LMS and change in leverage remains negative and significant.

In column 4, rather than use a continuous measure for the firm controls, we use indicator variables for each quartile across the distribution of changes. We find that wages only

[14] As discussed above, the average of pay growth is high due to employees who join the firm in the middle of the quarter. Due to this concern, in Appendix Table A4, we replicate Table 5 with pay growth calculated using only full quarter earnings. Full quarter earnings are identified as earnings in quarters where the individual has earnings at the firm in the preceding and following quarters as well.

respond to large increases in firm leverage; only the interaction between labor market size and the indicator variable for the top quartile of the change in firm leverage is negative and significant. This result is reasonable for several reasons. In particular, large increases in firm leverage likely have the largest effect on unemployment risk. Moreover, employees are more likely to be aware of large increases in firm leverage than small changes in leverage as these changes are more likely to result in tangible changes at the firm and are more likely to attract media attention. As a result, it is these changes in firm leverage for which employees would plausibly demand compensation for increased risk.

In column 5, we interact labor market size with the log change in total firm debt, rather than the change in leverage. One potential concern is whether firm leverage is changing due to changes in the denominator of the leverage ratio, firm assets, rather than the numerator, firm debt. However, the estimates in column 5 show that the effect is due to changes in debt levels. The interaction of labor market size and the change in firm debt also enters negatively and significantly.

To understand the economic magnitudes of the estimate, consider two employees at a firm. The labor market of Employee A is in the 25th percentile of size while the labor market of Employee B is at the 75th percentile of size. If the firm increases its leverage by 10 percentage points, the estimates in column 2 imply that Employee A earn approximately 0.2% more than Employee B due to the change in leverage.

3.1 Baseline Estimates of the Wage Costs of Firm Leverage

We next use these cross-sectional estimates to calculate the effect of firm leverage on employee compensation. To do so, we first need to identify a control group, a group of workers for whom increased leverage has no effect on their compensation as compensation for increased unemployment risk. We choose as our control group the set of workers in the top decile of labor market size. Because their labor market is so large, their unemployment risk is likely to be very low and, as a result, they likely receive little to no addition compensation due to higher firm leverage. To the extent to which workers in the top decile are compensated as a result of increased leverage, the estimates below will understate the true wage costs of leverage.

We then split all workers into subsamples based on their decile of labor market size and then calculate the average labor market size for each of the deciles. Under the assumption that workers in the top decile require no wage premium for increased firm leverage, we can then calculate the effect of firm leverage on compensation for workers in each decile of the labor market size distribution. To do so, we calculate the difference between the average labor market size for that decile and the average for the top decile and then multiply that by the estimate on the interaction between labor market size and the change in firm leverage. This yields an estimate for the effect of a one-unit change of firm leverage on a given worker's compensation.

To be more concrete, consider a worker in the fifth decile of labor market size. To calculate the effect of firm leverage on that worker's compensation, we calculate the difference between the average labor market size for workers in that decile and the average size for workers in the top decile, which is approximately 23.8. We then multiply 23.8 by the estimate on the interaction between labor market size and the change in firm leverage. Using the estimate from column 2 of Table 5 of -0.008, this yields approximately 0.2. Since the dependent variable is the natural log of the average quarterly earnings in year $t+1$ minus the natural log of the average quarterly earnings in year t, we then raise e to the power of 0.2 and substract 1 to calculate the effect of a one unit change on the level of worker's compensation. We then multiply that effect by 0.1 to estimate that, for an individual in the fifth decile of labor market size, a 10 percentage point increase in firm leverages increases pay by approximately 1.9%. Repeating this procedure for each of the other nine deciles yields an estimated effect for any worker as a function of their labor market size.[15]

[15]Importantly, while our estimation sample is restricted to employees in states with LEHD data, we only need the labor market size for each employee to calculate the estimated effect. As a result, we use the LBD to estimate the effects for all U.S.-based employees at firms in our estimation sample, rather than only employees in LEHD states.

Next, based on data from the LBD, we calculate the distribution of payroll across the ten deciles of labor market size for each firm in our estimation sample. We then multiply the fraction of payroll in each decile by the estimated effect of changes in firm leverage on wages. This yields an estimated effect of changes in firm leverage on total firm wages. So, for example, assume that a firm has half of its payroll in the fifth decile of labor market size and half in the tenth decile. As discussed above, wages for employees in the fifth decile of labor market size would increase by 1.9% in response to a 10 percentage point increase in firm leverage while wages for employees in the tenth decile would be unchanged. Therefore, for a firm with that distribution of payroll, total firm payroll would increase by approximately 0.95% in response to a 10 percentage point increase in leverage. We repeat this process for every firm in our sample and then calculate the average effect across all firms and years.

Assuming again that the top decile is a legitimate control group, the estimate in column 2 of Table 5 implies that, for a 10 percentage point increase in the leverage of the average firm in CRSP and Compustat that is matched to the LBD, total firm payroll increases by approximately 0.5%.[16] Calculated relative to the market value of firm assets, as in Almeida and Philippon (2007), this estimate implies that payroll increases by approximately 17 basis points of firm market value. Almeida and Philippon (2007) calculate that the difference between the tax benefits and costs of financial distress are at most 65 basis points of firm value for BBB-rated firms. Our estimates therefore imply that the added labor costs can account for a meaningful fraction of this difference.

3.2 Estimates on Subsamples of Workers

While we document a significant wage effect across all workers on average, certain workers may be more aware of the unemployment risks associated with an increase in firm leverage or have greater bargaining power and may therefore negotiate greater wage increases relative

[16] The effect of leverage on the average worker and the average firm differ because of the distribution of workers and wages across firms.

to other employees who may be less informed or have lower relative bargaining power.

3.2.1 New Employees

One set of workers that may be more likely to be compensated for higher leverage is new employees; Barattieri, Basu and Gottschalk (2014) find that workers that switch jobs are much more likely to have a change in wage than workers that remain at the same firm.[17] Therefore, we re-estimate equation 3 where the dependent variable is the log average quarterly wage in year $t+1$ for all workers who joined the firm at any point in year t. The results are presented in Table 6.

[Insert Table 6 here]

As expected, the effects on new employee wages are stronger than the effects on existing employees. In columns 1 and 2, the estimate on the interaction term is positive and statistically significant. Moreover, the estimate in column 2 implies that a new employee whose labor market size is equal to the 25th percentile will earn approximately 0.5% more than a new employee at the 75th percentile of labor market size due to a 10 percentage point increase in leverage.

Exploiting the cross-sectional results to estimate the effect of leverage on pay as described above, the estimate implies that the 10 percentage point increase in leverage increases pay for the average new worker by 8.5%. Similar to the results in Table 5, we find in column 3 that the effect on pay arises due to large increases in leverage. Finally, in column 4, we use the change in log debt in place of the change in leverage and again find that interaction term enters negatively and significantly.

[17] See Topel and Ward (1992) for additional evidence on the relationship between the role of job changes on wage growth.

3.2.2 Other Measures of Employee Bargaining Power

Next, we show that the effects of change in leverage on wages are stronger for employees who are more likely to understand the relationship between firm leverage and unemployment risk and for employees with relatively more bargaining power.[18]

[Insert Table 7 here]

First, in Table 7, to show that employees who likely have a greater understanding of the relationship between firm leverage and the probability of unemployment, we employ two sample splits – one split based on employee compensation level and one split based on employee's experience with or knowledge of firm bankruptcy. In columns 1 through 4, we divide the sample in quartiles on the basis of wage income within the firm. Wage income is a proxy for human capital and so more highly paid individuals may be more likely to understand the downsides of higher firm leverage. In addition, more highly paid workers may be likely more involved in the decision making of the firm and thus are more aware of the tradeoffs of higher leverage.

We do, in fact, find some evidence that the effect of changes in firm leverage is increasing in the level of employee wage compensation. In columns 1 and 2, where the sample is employees in the lowest two quartiles of wage compensation at the firm, the coefficient on the interaction of the change in firm leverage and labor market size is insignificant. In other words, we find no evidence that the lowest paid employees at the firm are compensated as a result of higher firm leverage. Looking at the results in columns 3 and 4, for employees in the third and fourth quartiles of compensation of the firm, we find that the coefficient is negative and significant for both samples. Moreover, the magnitude of the coefficient is

[18]In addition to influencing the effect of leverage on employee wages, bargaining power also may affect capital structure decisions. Matsa (2010) finds evidence that stronger bargaining power, as measured by the degree of unionization, leads to lower firm leverage. In our analysis, given that we analyze within-firm variation across multiple labor markets, we treat bargaining power as exogenous to the capital structure decision.

largest for the top quartile of earners, suggesting that the more highly paid a worker is, the higher the premium he receives in response to higher firm leverage.

Exploiting the cross-sectional variation to estimate the effect of firm leverage on wages, as detailed above, the estimates imply relatively little difference at different levels of pay. In particular, for the highest quartile, the estimates imply that a 10 percentage point increase in firm leverage increases compensation for a worker in the median decile of labor market size by approximately 2.1%, only slightly higher than the effect for the total population.

In columns 5 and 6, we divide the sample of workers on the basis of exposure to the effects of bankruptcy on employment. Such workers will presumably be more cognizant of the effects of bankruptcy and unemployment on employee wages and therefore more aware of the unemployment risk associated with higher firm leverage. To do so, we identify bankruptcies of public firms from the UCLA-LoPucki Bankruptcy Research Database. After matching these firms to Census data, we identify MSA-industry markets where a public firm declared bankruptcy in the prior 5 years and classify individuals in those markets as being exposed to the effects of bankruptcy. We find evidence that, in fact, the compensation of individuals with exposure to bankrupt firms is more sensitive to changes in firm leverage. In particular, the estimate on the interaction of the change in book leverage and labor market size is negative and large in magnitude, albeit only marginally significant, for individuals with a public firm bankruptcy within their labor market in the prior 5 years. For individuals without a recent public firm bankruptcy, the estimate on the interaction term is positive, small in magnitude, and statistically insignificant. In terms of how leverage affects pay differentially for these two groups, the estimates in columns 5 and 6 imply workers in those labor markets earn approximately 7.1% more in response to a 10 percentage point increase in firm leverage.

Next, to show that the relationship between firm leverage and employee compensation is stronger when employees have greater bargaining power, we split the sample in two ways. In columns 1 and 2 of Table 8, we separate the sample on the basis of the local unemployment rate; in column 1, the sample is restricted to markets with an unemployment rate of 5 percent or less and, in column 2, the sample is restricted to markets with an unemployment rate of more than 5 percent. In times of low unemployment, employees have more attractive outside options and therefore have relatively more bargaining power than in times of high unemployment (Christofides and Oswald (1992)). As a result, workers should be more likely to receive compensation for higher firm leverage.

[Insert Table 8 here]

This is precisely what we find in columns 1 and 2. In labor markets with more slack, employees do not receive additional compensation for higher firm leverage, as the interaction term in column 1 is negative but insignificant. In column 2, the interaction term is negative and significant; in other words, in tighter labor markets with lower unemployment rates, employees are compensated for increases in firm leverage. It is important to note that the unemployment rate is not a clean measure of bargaining power, as it affects an individual's expected cost of unemployment as well. This relationship works against our analysis, since when the unemployment rate is low, the risk of extended unemployment spells is lower. However, the estimates in Table 8 show that, even in times with relatively low expected unemployment costs, workers with sufficient bargaining power earn higher wages in response to increased firm leverage.

In columns 3 and 4, we split the sample on the basis of the competitiveness of the local labor market. For each MSA-industry market, we calculate the Herfindahl-Hirschman index (HHI) across firms using employment shares. The sample in column 3 is restricted to less competitive labor markets, defined as markets with an HHI of 1500 or greater, and the sample in column 4 is restricted to more competitive markets, defined as markets with an HHI of less than 1500. As with the splits based on local unemployment rates, we find that the relationship is stronger for more competitive markets where workers likely have relatively more bargaining power. While the estimate in column 3 is positive and insignificant, the estimate of the interaction of the change in firm leverage and labor market size in column 4 is larger in magnitude than the full sample results.

Translating these estimates into an estimate of the impact of leverage on pay, the estimates imply that a 10 percentage point increase in leverage increases worker compensation by 4.2% for those in MSAs with an unemployment rate of less than 5% while it increases by 0.6% for workers in MSAs with an unemployment rate of 5% or higher. Employment concentration across firms in the market also dramatically influences the effect; in markets with low employment concentration, with an HHI of less than 1500, compensation increases by 2.5% for workers in the median size decile. In other words, workers in more competitive labor markets are compensated significantly for increased firm leverage while workers in less competitive markets are not.

4 Alternative Measures of Unemployment Costs

We have documented an important relationship between employee wages, firm leverage, and labor market size within firms. We argued previously in Section 1.1 that our choice of labor market size is a good proxy for employees' expected unemployment costs and one that allows us to examine a large sample of firms and workers while still holding fixed a number of important geographical, time, firm, and employee characteristics constant. In this section, we explore the robustness of our results to alternative measures of expected unemployment costs.

4.1 Subsamples of Firms by Employment Growth

If the relationship between changes in firm leverage and employee wages by labor market size arises as compensation for increased unemployment costs born by employees, we would expect that the effects are strongest for workers with an elevated probability of unemployment. Therefore, in Table 9 we re-estimate equation 3 separately for workers at firms that are expanding employment and for workers at firms that are not. Specifically, in column 1, the sample is restricted to employees at firms whose total employment in year $t+1$ was greater than year t employment and, in column 2, the sample is employees at firms whose year $t+1$ employment was no greater than year t. Similarly, in column 3, the sample is restricted to employees at firms whose MSA employment in year $t+1$ was greater than year t employment and, in column 4, the sample is employees at firms whose year $t+1$ MSA-specific employment was no greater than year t.

[Insert Table 9 here]

Regardless of how expanding firms are defined, we find that the relationship between firm leverage, labor market size, and wages is only significant at firms that are not expanding. In columns 1 and 3, the coefficient on the interaction term between change in leverage and wages is positive and insignificant. For the samples of workers at firms that are not expanding in columns 2 and 4, the estimate is negative and significant. We then replicate the process described above to translate these estimates into an estimate of the effect of leverage on employee pay. In terms of magnitudes, the estimates imply that leverage increases compensation by approximately 4.5% for workers in the median size decile at firms with declining total employment and by approximately 5.1% for workers at firms whose employment in the MSA is declining. Thus, it does appear that our results are driven by workers with an elevated risk of unemployment.

4.2 Other Measures of Labor Market Size

In the results discussed above, we have used a specific measure of labor market size as a proxy for expected unemployment costs. We now discuss alternative measures of labor market size as well as other possible proxies for expected unemployment costs.

[Insert Table 10 here]

In Table 10, we replicate our main results from Tables 5 and 6 using three alternative measures of labor market size. First, in columns 1 and 4, we measure the size of an individual's labor market as the industry share of employment in an MSA. In columns 2 and 5, we use the industry share of establishments in an MSA relative to the national average. In columns 3 and 6, we use the industry share of young firms — defined as firms that are ten years old or younger — in an MSA.[19] With all three measures, we find results that are qualitatively similar to our main results. For continuing workers, the same sample as in Table 5, we find that the estimate on the interaction of labor market size and the indicator for a large increase in firm leverage is negative and significant. Similarly, for new workers, the sample from Table 6, the estimate is consistently negative and significant. In other words, across these three measure of labor market size, workers in smaller labor markets earn more than workers at the same firm in larger labor markets due to an increase in firm leverage.

4.3 Measures Based on Unemployment Insurance

We have also explored the use of various measures of UI generosity to proxy for expected unemployment costs. These proxies include both aggregate measures such as the state-specific weekly maximum benefit and individual-specific measures of benefits that we can estimate using LEHD data.

For several subsamples, we have found evidence that, when a firm increases its leverage, workers at the firm with lower unemployment benefits experience larger wage increases. In particular, in unreported results, we find that, among employees in the top quartile of earnings at the firm, those with lower unemployment benefits do experience significantly

[19] The focus on young firms, rather than all firms, is motivated by Haltiwanger, Jarmin, and Miranda (2013), who find find that younger firms experience significantly higher employment growth than older firms, conditional on survival. This finding suggests that younger firms are likely to be the relevant outside option.

higher wage growth. This relationship is not significant for employees in the bottom three quartiles. As argued above, employees need to understand the effect of leverage on their employment risk and to have sufficient bargaining power in order to successfully bargain for higher wages and this is most likely the case for higher earners.

In addition, we find that the relationship between leverage, employee wages, and UI benefits is significant for employees at firms with higher probability of financial distress. Among these firms, we do find that, when a firm increases its leverage, employees with lower UI benefits experience significantly higher wage growth than workers with higher UI benefits at the firm. For firms with a low probability of financial distress, the relationship is not significant.

5 Exploring Alternative Explanations for the Observed Relationship between Changes in Firm Leverage and Employee Wages

While we find evidence that the associations between firm leverage, labor market size, and employee compensation arise due to firms compensating employees for bearing unemployment risk, there are alternative explanations for our results. In this section, we explore several of these explanations and find evidence that is inconsistent with these explanations, further lending support to our interpretation that higher wages are compensation for increased unemployment risk associated with increases in leverage.

The first alternative explanation for our results is reverse causality; that is, higher wages require that firms raise new debt and increase leverage. To rule out this explanation, we explore the timing of the relationship in Table 11, by including interactions between labor market size and changes in firm leverage (as well as changes in other firm variables) in additional years, namely changes between year $t-3$ to $t-2$, from year $t-2$ to $t-1$, from year

t to $t+1$, and from year $t+1$ to $t+2$.[20]

[Insert Table 11 here]

In all three specifications, we continue to find that a negative and significant relationship between wage growth and the interaction of labor market size and the change in firm leverage in the previous year. In addition, the magnitude of the estimates are similar to our estimates in Table 5. Thus, it does not appear that our results are driven by reverse causality. Interestingly, the interaction terms for changes in leverage from year t to $t+1$, and from year $t+1$ to $t+2$ are negative and significant, suggesting either that firms are slowly adjusting their leverage over time, possibly to match new optimal leverage ratios, or that higher wages are inducing firms to further increase their leverage.[21]

An alternative explanation for the effect of changes in leverage on wages is that it is due to higher labor productivity rather than compensation for unemployment risk. For instance, suppose that there is a positive productivity shock in a given MSA-industry. Firms respond by increasing employment, thereby increasing the size of the labor market. At the same time, public firms raise equity to increase more heavily in their establishments in that market. These investments increase labor productivity and therefore wages rise. While this provides an explanation for our previous results, we do not find evidence of a contemporaneous productivity shock.

First, we test directly for an effect on labor productivity. We use data on establishment-level output from the Census of Manufactures and Annual Survey of Manufactures to calculate measures of average labor productivity at the firm-MSA level. We then re-estimate equation 3 with measures of labor productivity as the dependent variable. The results are

[20] In Appendix Table A5, we further examine reverse causality by re-estimating our main specification but using log pay growth from year $t-2$ to $t-1$, log pay growth from year $t-1$ to t, log pay growth from year $t+1$ to $t+2$, and log pay growth from year $t+2$ to $t+3$ as dependent variables. We similarly find no evidence of reverse causality.

[21] See, for example, Fama and French (2002) for evidence that adjustment costs lead firms to adjust their capital structure slowly towards target leverage ratios.

presented in Table 12.

[Insert Table 12 here]

In column 1 and 2, we study the effect on the growth in average output per worker. We find that the estimate on the interaction of the change in firm leverage and labor market size is insignificant and small in magnitude. Similarly, in the estimates of the growth in average value added per worker in columns 3 and 4, the interaction term enters negatively but insignificantly. Thus, there is no evidence of a differential effect on labor productivity.[22]

[Insert Table 13 here]

Second, we test whether firm behavior is consistent with localized productivity shocks. In particular, if a particular set of a firm's establishments become more productive, we would expect those establishments to grow faster than the firm's other establishments. To test for difference in growth rates within a firm, we calculate firm-state measures of growth in employment and number of establishments from the LBD and growth in output per worker, value added per worker, and capital expenditures for manufacturing firms from the CMF and ASM and then re-estimate equation 3. The results are presented in Table 13. In all five tests, we find an insignificant effect of the interaction of the change in leverage and labor market size. Thus, there is no evidence that firms are reallocating resources towards their operations in smaller labor markets following an increase in leverage, which is inconsistent with those smaller labor markets receiving a positive productivity shock.

[22]In specifications for this subsample with wage growth as the dependent variable, the estimate on the interaction term is negative and larger in magnitude than the full sample estimate but is statistically insignificant.

6 Comparison with Prior Estimates of the Wage Costs of Debt

In this section, we discuss our estimates in relation to other estimates of the effects of changes of firm leverage on employee compensation. As discussed in Section 3 above, our estimates from Table 5 imply that a 10 percentage point in book leverage increases compensation for the median worker by approximately 1.9%. We also find that new employees earn approximately 8.5% more as a result of the increased leverage.

Despite being derived in a different manner to prior studies, this estimate is similar to other estimates of wage premium elasticities. For instance, Chemmanur, Cheng, and Zhang (2013) use Compustat data to examine the relationship between firm leverage and average employee pay. Using marginal corporate tax rates as an instrument for leverage, they find that an increase in market leverage of 10 percentage points increases average employee pay by approximately 2.4% for the average firm.

Graham, Kim, Li, and Qiu (2016) take a different approach to estimating the required premium by calculating the realized wage losses workers experience as a result of a corporate bankruptcy. They then estimate the implied ex ante wage premium that would be required to offset these ex post losses for employees at firms with a given credit rating, using the risk neutral probability of default following Almeida and Phillippon (2007). Using this procedure, they estimate that, for workers at the average firm, compensation needs to increase by 1.0% for a 10 percentage point increase in book leverage and 2.3% for a similar increase in market leverage to compensate for expected wage loss.

We also provide an estimate of the effect of leverage on aggregate labor costs at the firm. In our framework discussed in Section 3.1, we find increased leverage increases compensation for continuing workers by approximately 17 basis points for the average firm. Our estimates are likely a lower bound for the wage costs of leverage, given that we assume that the workers in the top decile of labor market size are not compensated for increased leverage. To the extent that those workers are compensated, that would increase the effect for workers across the distribution of labor market size.

Agrawal and Matsa (2013) use variation in the generosity of state unemployment insurance (UI) benefits to back out the cost of distress due to unemployment. In particular, they first estimate the effect that changes in UI benefits has on firm capital structures and find that increased UI benefits leads to increased leverage for firms headquartered in the state. Because they do not observe employee wages, to calculate the ex ante labor costs of leverage, they need to make several assumptions about the probability of firm default, the probability of being laid off conditional on a bond default, and the wage premium for the increase in unemployment risk. For these values, they use estimated default probabilities by credit rating from Altman (2007), the wage premium per unit of unemployment risk from Topel (1984), and the probability of being laid off conditional on a bond default, which they estimate using Compustat data. Combining these data, they are able to estimate the average value of the compensating wage premium, which they calculate to range from 1 basis point of firm value for a AAA-rated firm to 159 basis points of firm value for a B-rated firm. Our estimate of 17 basis points of firm value for the average firm falls between the premium for a A-rated firm and a BBB-rated firm, consistent with Compustat data on the distribution of credit ratings.

Graham, Kim, Li, and Qiu (2016) also back out the effects of the required wage premium at the firm level using their worker-level estimates. Using their preferred specification, they find required wage premia ranging from 6 basis points of firm value for a AAA-rated firm to 419 basis points of firm value for a B-rated firm. These estimates are noticeably higher than our estimate for the average firm. However, our estimates are likely more representative of the typical ex ante wage costs associated with debt compared to Graham, Kim, Li and Qiu (2016) since our approach does not rely on wage losses of employees at bankrupt firms to infer ex ante wage costs. Our estimates suggest that bargaining power of employees is an important determinant of their ex ante wage compensation for increased leverage, suggesting that the estimates in Graham, Kim, Li, and Qiu (2016) provide an upper bound estimate on the true wage costs of firm leverage.

7 Conclusion

Exploiting within-firm variation in labor market size as a proxy for expected unemployment costs, we find that employees in smaller labor markets experience higher wage growth than other employees in response to increased firm leverage. This effect is stronger for new employees and is robust to alternative specifications of labor market size.

Our results suggest that the higher wages are compensation for unemployment risk and not driven by reverse causality or an unobserved productivity shock. At the firm level, the added labor costs due to higher leverage are significant and represent a significant fraction of the difference between the tax benefits of debt and costs of financial distress. Thus, labor costs appear to be a significant factor in determining optimal debt levels. However, our estimates are lower than those in prior studies which examine ex post wage losses following financial distress.

Our findings add to previous work on the effect of firm debt on employee wages. In particular, our analysis has several key advantages relative to previous studies. We exploit worker-level data for a large sample of firms, not only those have experienced bankruptcy or other types of financial distress. Moreover, we use this worker-level data to estimate the realized wage premia employees earn for bearing the risks associated with higher firm leverage and to understand how the premia vary across workers. These features of our analysis allow us to provide more general estimates of the wage costs of debt across firms.

Higher wage costs are just one potential effect of debt on firm employees. Higher leverage may also have an effect on employee turnover or the ability of firms to hire employees. Indeed, Brown and Matsa (2016) show that increased firm financial distress leads to fewer employment applications, an effect that may also be present for firms increasing their leverage ratios. While we find that employees are compensated for higher leverage on average, variation in bargaining power, firm-specific capital, and risk aversion likely means that a substantial fraction of employees are not adequately compensated for bearing this risk. As a result, employees would likely benefit from moving to a new firm in response to an increase in firm leverage which raises the likelihood of financial distress. Higher debt levels may also reduce the incentive for development of firm-specific capital as the higher probability of distress reduces its long-term benefits. Therefore, labor considerations beyond total wage compensation likely factor into the costs of debt and may play a larger role in determining optimal debt levels than wage effects suggest. Such questions pose fruitful areas of future research.

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Table 1: Labor Market Size and Earnings: Evidence from Firm Bankruptcies

This table presents OLS regressions with four dependent variables based on a sample of workers at bankrupt firms. The dependent variable in column 1 is an indicator variable equal to one if the individual had positive earnings and zero otherwise, the dependent variable in column 2 is the natural log of earnings, the dependent variable in column 3 is an indicator variable equal to one if the individual had positive earnings at a firm other than the bankrupt firm and zero otherwise, and the dependent variable in column 4 is the natural log of earnings at firms other than the bankrupt firm. The key independent variables are labor market size (LMS) interacted with indicator variables identifying the time since firm bankruptcy. Labor market size is included as an additional control. Worker controls include log earnings in the each of the two years prior to the firm bankruptcy and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate and are included in all specifications. See Appendix Table A1 for variable definitions. The unit of observation is worker-year. Standard errors are adjusted for clustering by industry and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * (Year Rel. to Bank. = 0)	0.157*	0.384**	-0.165	0.342
	(0.093)	(0.178)	(0.144)	(0.248)
LMS * (Year Rel. to Bank. = 1)	0.295***	-0.274	0.651***	0.314
	(0.092)	(0.227)	(0.116)	(0.247)
LMS * (Year Rel. to Bank. = 2)	0.219	0.581***	0.352***	0.884***
	(0.161)	(0.191)	(0.133)	(0.164)
LMS * (Year Rel. to Bank. = 3)	0.206**	0.161	0.226**	0.319*
	(0.102)	(0.244)	(0.101)	(0.174)
LMS * (Year Rel. to Bank. = 4)	0.112	-0.072	0.122	-0.037
	(0.092)	(0.207)	(0.093)	(0.202)
LMS * (Year Rel. to Bank. = 5)	-0.039	0.260	-0.036	0.287
	(0.109)	(0.211)	(0.105)	(0.208)
Dep. Var.	$PosEarn_{i,t+z}$	$LnEarn_{i,t+z}$	$PosEarn_{i,t+z,-j}$	$LnEarn_{i,t+z,-j}$
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes
Observations	1,680,000	1,404,000	1,680,000	1,068,000
R-Squared	0.14	0.42	0.30	0.35

Table 2: Labor Market Size and Earnings: Evidence from Firm Bankruptcies with Matched Sample

This table presents OLS regressions with four dependent variables based on a sample of workers at bankrupt firms and a matched sample of workers at non-bankrupt firms. The dependent variable in column 1 is an indicator variable equal to one if the individual had positive earnings and zero otherwise, the dependent variable in column 2 is the natural log of earnings, the dependent variable in column 3 is an indicator variable equal to one if the individual had positive earnings at a firm other than the bankrupt firm and zero otherwise, and the dependent variable in column 4 is the natural log of earnings at firms other than the bankrupt firm. The key independent variables are an indicator variable equal to one if the worker is at a bankrupt firm interacted with labor market size (LMS) and indicator variables identifying the time since firm bankruptcy. Labor market size and the indicator variables identifying the time since firm bankruptcy and the appropriate interaction terms are also included as controls. Included in all specifications are controls controls for log earnings in the each of the two years prior to the firm bankruptcy. See Appendix Table A1 for variable definitions. The unit of observation is worker-year. Standard errors are adjusted for clustering by industry and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 0)	0.148	1.010***	0.232	1.878***
	(0.091)	(0.233)	(0.279)	(0.420)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 1)	0.261**	0.177	0.737*	-0.044
	(0.105)	(0.302)	(0.431)	(0.549)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 2)	0.208	0.689***	0.118	0.470
	(0.172)	(0.193)	(0.274)	(0.377)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 3)	0.141	0.505***	-0.040	0.367***
	(0.101)	(0.188)	(0.197)	(0.112)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 4)	0.102	0.378*	0.844**	0.305
	(0.098)	(0.210)	(0.336)	(0.196)
Bankrupt Firm * LMS * (Year Rel. to Bankruptcy = 5)	0.102	0.018	0.761**	-0.674
	(0.106)	(0.215)	(0.321)	(0.449)
Dep. Var.	$PosEarn_{i,t+z}$	$LnEarn_{i,t+z}$	$PosEarn_{i,t+z,-j}$	$LnEarn_{i,t+z,-j}$
Bankrupt Sample-Bankrupt Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes
Observations	11,100,000	9,428,000	11,100,000	6,589,000
R-Squared	0.13	0.43	0.18	0.30

Table 3: Summary Statistics

This table presents summary statistics for worker-level variables in Panel A and firm-level variables in Panel B. The sample consists of 51,293,300 worker-firm-year observations, covering approximately 14,000,000 unique workers and 4,200 unique firms, from 1991 through 2008. See Appendix Table A1 for variable definitions.

	N	Mean	Std. Dev.	Median
Panel A: Worker Level Variables				
ΔPay	51,293,300	0.087	0.652	0.014
Pay	51,293,300	11,029.25	8,870.277	9,101.673
LMS	51,293,300	3.809	10.004	1.077
Panel B: Firm Level Variables				
Leverage	27,500	0.231	0.191	0.210
ΔLeverage	27,500	0.003	0.078	-0.001
Market / Book	27,500	1.485	1.137	1.114
ΔMarket / Book	27,500	-0.045	0.636	-0.008
Sales	27,500	2,270.289	8,732.016	379.234
ΔSales	27,500	0.099	0.214	0.081
EBITDA / Assets	27,500	0.126	0.091	0.129
ΔEBITDA / Assets	27,500	-0.005	0.058	0.000
Asset Tangibility	27,500	0.291	0.207	0.242
ΔAsset Tangibility	27,500	-0.002	0.043	-0.002
Marginal Tax Rate	27,500	0.276	0.093	0.322
ΔMarginal Tax Rate	27,500	-0.002	0.049	0.000

Table 4: Employee Pay and Leverage

This table presents OLS regressions using one year ahead worker log average quarterly pay as the dependent variable. The key independent variable is firm leverage (*Leverage*). Worker controls include indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. In columns 1 through 3, the dependent variable and the independent variables are in levels, and in columns 4 through 6, they are first differenced. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.234	0.120	-0.028	-0.018	-0.001	-0.027*
	(0.240)	(0.140)	(0.038)	(0.017)	(0.021)	(0.016)
Market / Book		0.069***	0.003		0.019***	0.011***
		(0.024)	(0.007)		(0.005)	(0.002)
EBITDA / Assets		-0.821***	-0.035		-0.006	0.063**
		(0.278)	(0.082)		(0.042)	(0.032)
Log Sales		0.060***	0.008		0.041***	0.017**
		(0.017)	(0.012)		(0.012)	(0.008)
Asset Tangibility		-0.255*	-0.153**		-0.086**	-0.066*
		(0.143)	(0.064)		(0.040)	(0.037)
Marginal Tax Rate		-0.362**	-0.045		0.038	0.033
		(0.182)	(0.060)		(0.069)	(0.075)
Obs	51,293,300	51,293,300	51,293,300	51,293,300	51,293,300	51,293,300
R-squared	0.00	0.36	0.57	0.00	0.02	0.05
Levels/Diff	Levels	Levels	Levels	Diff	Diff	Diff
Worker Controls	no	yes	yes	no	yes	yes
Year FE	no	no	yes	no	no	yes
MSA FE	no	no	yes	no	no	yes
Firm FE	no	no	yes	no	no	yes

Table 5: Employee Pay, Labor Market Size, and Leverage

This table presents OLS regressions using change in worker log average quarterly pay as the dependent variable. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in columns 2-5. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate and are included in all specifications. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
LMS * ΔLeverage	-0.008**	-0.008**	-0.006*		
	(0.004)	(0.004)	(0.004)		
LMS * (2nd Quartile ΔLeverage)				-0.001	
				(0.001)	
LMS * (3rd Quartile ΔLeverage)				-0.001	
				(0.001)	
LMS * (4th Quartile ΔLeverage)				-0.001**	
				(0.001)	
LMS * ΔTotalDebt					-0.002**
					(0.001)
LMS	-0.001*	-0.001*	0.000	-0.001	-0.001***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Worker Controls	yes	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes	yes
Worker FE	no	no	yes	no	no
Obs	51,293,300	51,293,300	51,293,300	51,293,300	51,293,300
R-Squared	0.06	0.06	0.42	0.06	0.06

Table 6: Employee Pay, Labor Market Size, and Leverage — New Employees

This table presents OLS regressions using worker log average quarterly pay as the dependent variable. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in columns 2 through 4. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year and the sample is restricted to new employees at the firm. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	-0.093***	-0.077***		
	(0.028)	(0.024)		
LMS * (2nd Quartile ΔLeverage)			-0.009	
			(0.009)	
LMS * (3rd Quartile ΔLeverage)			-0.003	
			(0.007)	
LMS * (4th Quartile ΔLeverage)			-0.008**	
			(0.004)	
LMS * ΔTotalDebt				-0.008**
				(0.004)
LMS	0.003	0.002	0.004	0.000
	(0.002)	(0.003)	(0.003)	(0.003)
Worker Controls	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes
Obs	19,551,900	19,551,900	19,551,900	19,551,900
R-squared	0.79	0.80	0.85	0.80

Table 7: Estimates using Subsamples Based on Employee Background

This table presents OLS regressions using the change in worker log average quarterly pay as the dependent variable. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in columns 2 and 3. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Column 1 restricts the sample to workers in the bottom quartile of earnings at the firm, column 2 restricts the sample to workers in the second quartile of earnings at the firm, column 3 restricts the sample to workers in the third quartile of earnings at the firm, column 4 restricts the sample to workers in the top quartile of earnings at the firm, column 5 restricts the sample to workers in an MSA-SIC3 pair that had a public firm bankruptcy in the previous five years, and column 6 restricts the sample to workers in an MSA-SIC3 that had a public firm bankruptcy in the previous five years. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
LMS * ΔLeverage	-0.008	-0.005	-0.008**	-0.009**	-0.030*	0.003
	(0.009)	(0.004)	(0.004)	(0.004)	(0.015)	(0.004)
LMS	-0.002*	-0.001	-0.001	0.000	-0.001	-0.001**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)
Sample	Bottom Quartile Earner	2nd Quartile Earner	3rd Quartile Earner	Top Quartile Earner	Bankruptcy Exp	No Bankruptcy Exp
Worker Controls	yes	yes	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes	yes	yes
Obs	12,890,500	12,796,700	12,840,100	12,766,000	23,946,900	27,346,400
R-squared	0.19	0.06	0.07	0.10	0.07	0.07

Table 8: Estimates using Subsamples Based on Competitiveness of the Labor Market

This table presents OLS regressions using the change in worker log average quarterly pay as the dependent variable. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). The change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in column 1. Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in columns 2 and 3. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Column 1 restricts the sample to workers in MSAs with an unemployment rate greater than 5 percent, column 2 restricts the sample to workers in MSAs with an unemployment rate less than or equal to 5 percent, column 3 restricts the sample to workers in MSA-industries with an employment HHI greater than 1500, and column 4 restricts the sample to workers in MSA-industries with an employment HHI less than or equal to 1500. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	-0.002	-0.018**	0.004	-0.011**
	(0.007)	(0.007)	(0.009)	(0.005)
LMS	-0.001*	0.001	-0.004***	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Sample	Unemp Rate $\geq$ 5	Unemp Rate < 5	HHI $\geq$ 1500	HHI < 1500
Worker Controls	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes
Obs	20,873,900	30,419,400	29,313,500	21,979,800
R-squared	0.07	0.07	0.10	0.06

Table 9: Estimates using Subsamples Based on Firm Growth

This table presents OLS regressions using the change in worker log average quarterly pay as the dependent variable. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in all specifications. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Column 1 restricts the sample to workers at firms whose year $t+1$ employment was greater than year t employment. Column 2 restricts the sample to workers at firms whose year $t+1$ employment was less than or equal than year t employment. Column 3 restricts the sample to workers at firms whose year $t+1$ employment in the MSA was greater than year t employment in the state. Column 4 restricts the sample to workers at firms whose year $t+1$ employment in the MSA was less than or equal than year t employment in the state. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	0.002	-0.012***	0.004	-0.021***
	(0.006)	(0.007)	(0.007)	(0.005)
LMS	-0.001	0.000	-0.003***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Sample	ΔFirm Emp > 0	ΔFirm Emp ≤ 0	ΔFirm-MSA Emp > 0	ΔFirm-MSA Emp ≤ 0
Worker Controls	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes
Obs	25,453,200	25,840,100	23,795,600	27,497,700
R-squared	0.07	0.07	0.07	0.07

Table 10: Employee Pay, Labor Market Size, and Leverage — Alternate Labor Market Size Measures

This table presents OLS regressions using measures of worker pay as the dependent variable. In columns 1 through 3, the dependent variable is change in worker log average quarterly pay and the sample is restricted to continuing employees. In columns 4 through 6, the dependent variable is worker log average quarterly pay and the sample is restricted to new employees at the firm. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). In columns 1 and 3, labor market size is measured as the share of MSA employment in the industry. In columns 2 and 4, labor market size is measured as the share of MSA establishments in the industry relative to the national share of establishments in the industry. In columns 3 and 6, labor market size is measured as the share of young firms in the industry relative to the national share of young firms in the industry. Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in all specifications. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
LMS * (2nd Quartile ΔLeverage)	0.001	0.002	0.006	-0.008	-0.003	-0.010
	(0.002)	(0.001)	(0.005)	(0.015)	(0.020)	(0.016)
LMS * (3rd Quartile ΔLeverage)	-0.001	-0.001	-0.002	-0.008	-0.001	-0.007
	(0.002)	(0.002)	(0.004)	(0.011)	(0.018)	(0.015)
LMS * (4th Quartile ΔLeverage)	-0.003**	-0.003*	-0.011***	-0.019**	-0.025*	-0.021**
	(0.002)	(0.001)	(0.003)	(0.009)	(0.015)	(0.010)
LMS	-0.006	0.003	0.005	0.016	0.030	0.017
	(0.005)	(0.002)	(0.011)	(0.011)	(0.021)	(0.013)
Sample	Continuing Employees			New Employees		
LMS Measure	$\frac{Emp_{klt}}{Emp_{kt}}$	$\frac{\left(\frac{Estab_{klt}}{Estab_{kt}}\right)}{\left(\frac{Estab_{lt}}{Estab_{t}}\right)}$	$\frac{\left(\frac{YoungFirms_{klt}}{YoungFirms_{kt}}\right)}{\left(\frac{YoungFirms_{lt}}{YoungFirms_{t}}\right)}$	$\frac{Emp_{klt}}{Emp_{kt}}$	$\frac{\left(\frac{Estab_{klt}}{Estab_{kt}}\right)}{\left(\frac{Estab_{lt}}{Estab_{t}}\right)}$	$\frac{\left(\frac{YoungFirms_{klt}}{YoungFirms_{kt}}\right)}{\left(\frac{YoungFirms_{lt}}{YoungFirms_{t}}\right)}$
Worker Controls	yes	yes	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes	yes	yes
Obs	51,293,300	51,293,300	51,293,300	19,551,900	19,551,900	19,551,900
R-squared	0.06	0.06	0.07	0.61	0.61	0.61

Table 11: Robustness: Timing Regressions

This table presents OLS regressions using the change in worker log average quarterly pay as the dependent variable. The key independent variables are the interaction of labor market size (LMS) with the change in firm leverage for a given year ($\Delta Leverage$, $\Delta\text{Leverage}_{t-2 \Rightarrow t-1}$, etc.). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate for the same years as the change in firm leverage are included in each specification. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
LMS * ΔLeverage	-0.008*	-0.012**	-0.012**
	(0.005)	(0.005)	(0.005)
LMS * $\Delta\text{Leverage}_{t-2 \Rightarrow t-1}$	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)
LMS * $\Delta\text{Leverage}_{t-3 \Rightarrow t-2}$		-0.003	-0.003
		(0.002)	(0.002)
LMS * $\Delta\text{Leverage}_{t \Rightarrow t+1}$			-0.005**
			(0.002)
LMS * $\Delta\text{Leverage}_{t+1 \Rightarrow t+2}$			-0.006***
			(0.002)
LMS	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)
Firm-Year FE	yes	yes	yes
MSA-Year FE	yes	yes	yes
MSA-Industry FE	yes	yes	yes
Obs	46,220,000	43,690,000	39,810,000
R-squared	0.06	0.06	0.06

Table 12: Robustness: Labor Productivity, Labor Market Size, and Leverage

This table presents OLS regressions with three dependent variables. The dependent variable in columns 1 and 2 is the change in the firm-MSA value of shipments per worker, and the dependent variable in columns 3 and 4 is the change in the firm-MSA value added per worker. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in all specifications. Worker controls include indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. Columns 1 and 2 also include log firm-MSA value of shipments per worker, and column 3 and 4 also include log firm-MSA value added per worker. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. The sample is restricted to workers at firms with data in the CMF and ASM. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	-0.003	-0.008	-0.030	-0.030
	(0.018)	(0.020)	(0.030)	(0.033)
LMS	-0.002	-0.003	-0.008*	-0.008
	(0.003)	(0.004)	(0.005)	(0.006)
Dep. Var.	ΔLabor Prod		ΔValue Add per Emp	
Worker Controls	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes
Worker FE	no	yes	no	yes
Obs	18,791,000	18,791,000	18,791,000	18,791,000
R-squared	0.89	0.91	0.90	0.92

Table 13: Robustness: Firm-MSA Growth Rates, Labor Market Size, and Leverage

This table presents OLS regressions using firm-MSA growth rates as the dependent variable. The dependent variable in column 1 is employment growth, the dependent variable in column 2 is growth in the number of establishments, the dependent variable in column 3 is sales growth, the dependent variable in column 4 is growth in value added, and the dependent variable in column 5 is growth in capital expenditures. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in all specifications. The initial level of the dependent variable, in logs, is included in each specification. See Appendix Table A1 for variable definitions. The unit of observation is firm-MSA-year. The samples in columns 3 through 5 are restricted to firms with data in the CMF and ASM. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
LMS * ΔLeverage	0.012	-0.009	-0.002	-0.027	-0.012
	(0.011)	(0.007)	(-0.223)	(-0.801)	(-0.287)
LMS	-0.013***	-0.001	-0.002	-0.010	-0.007
	(0.002)	(0.001)	(-0.697)	(-1.274)	(-0.733)
Dep. Var.	ΔMSA Emp	ΔMSA Estab	ΔMSA Sales	ΔMSA Value Add	ΔMSA CapEx
Firm-Year FE	yes	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes	yes
Obs	372,300	372,300	29,300	29,300	29,300
R-squared	0.36	0.52	0.54	0.57	0.62

Appendix

Table A1: Variable Definitions

This table presents definitions for the key variables used in the analysis. Workers, firms, establishments, MSA, industries, years and quarters are indexed by i, j, e, k, l, t, and q, respectively. Data sources are the Census Bureau's Longitudinal Employer-Household Database (LEHD), the Census Bureau's Longitudinal Business Database (LBD), Compustat, the Census Bureau's Census of Manufactures (CMF), and the Census Bureau's Annual Survey of Manufactures (ASM).

Variable Name	Description	Source	Definition
Pay	Sum of quarterly earnings (in 2007 dollars) at firm relative to number of quarters with positive earnings	LEHD	$\sum_{q=1}^{4} Earn_{ijtq} / \sum_{q=1}^{4} \mathbb{1}_{Earn_{ijtq}>0}$
ΔPay	Change in log *Pay*	LEHD	$Ln(Pay_{t+1}) - Ln(Pay_t)$
LMS	Industry share of MSA employment relative to industry share of national employment	LBD	$\frac{(Emp_{klt}/Emp_{kt})}{(Emp_{lt}/Emp_t)}$
Total Debt	Book value of firm debt	Compustat	$dltt_{jt} + dlc_{jt}$
ΔTotal Debt	Change in log *Debt*	Compustat	$Book\ Total\ Debt_t - Total\ Debt_{t-1}$
Leverage	Firm book leverage	Compustat	$\frac{dltt_{jt}+dlc_{jt}}{at_{jt}}$
ΔLeverage	Change in *Leverage*	Compustat	$Book\ Leverage_t - Book\ Leverage_{t-1}$
Market Value	Firm market value of assets (in millions of 2007 dollars)	Compustat	$prcc_{f,jt} * cshpri_{jt} + dlc_{jt} + dltt_{jt} + pstkl_{jt} - txditc_{jt}$
Market / Book	Firm market-book ratio	Compustat	$\frac{Market\ Value}{at_{jt}}$
ΔMarket / Book	Change in *Market / Book*	Compustat	$Market\ /\ Book_t - Market\ /\ Book_{t-1}$

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Variable Name	Description	Source	Definition
Sales	Firm sales (in millions of 2007 dollars)	Compustat	$sale_{jt}$
ΔSales	Change in log *Sales*	Compustat	$Ln(Sales_t) - Ln(Sales_{t-1})$
EBITDA / Assets	Firm return on assets	Compustat	$\frac{oibdp_{jt}}{at_{jt}}$
ΔEBITDA / Assets	Change in *EBITDA / Assets*	Compustat	$EBITDA\ /\ Assets_t - EBITDA\ /\ Assets_{t-1}$
Asset Tangibility	Firm asset tangibility	Compustat	$\frac{ppent_{jt}}{at_{jt}}$
ΔAsset Tangibility	Change in *Asset Tangibility*	Compustat	$Asset\ Tangibility_t -$
Marginal Tax Rate	Firm marginal tax rate	John Graham	$bcgmtrint_{jt}$
ΔMarginal Tax Rate	Change in *Marginal Tax Rate*	Compustat	$Marginal\ Tax\ Rate_t - Marginal\ Tax\ Rate_{t-1}$
MSA Emp	Firm-MSA employment	LBD	$\sum_e emp_{jkt}$
ΔMSA Emp	*MSA Emp* growth rate	LBD	$\frac{MSA\ Emp_{t+1} - MSA\ Emp_t}{MSA\ Emp_t}$
MSA Estab	Firm-MSA establishment count	LBD	$\sum_e \mathbb{1}_{emp_{jkt}>0}$
ΔMSA Estab	*MSA Estab* growth rate	CMF, ASM	$\frac{MSA\ Estab_{t+1} - MSA\ Estab_t}{MSA\ Estab_t}$
MSA Sales	Firm-MSA sales (in 2007 dollars)	CMF, ASM	$\sum_e tvs_{jkt}$
ΔMSA Sales	*MSA Sales* growth rate	CMF, ASM	$\frac{MSA\ Sales_{t+1} - MSA\ Sales_t}{MSA\ Sales_t}$
MSA Value Add	Firm-MSA value added (in 2007 dollars)	CMF, ASM	$\sum_e va_{jkt}$
ΔMSA Value Add	*MSA ValueAdd* growth rate	CMF, ASM	$\frac{MSA\ ValueAdd_{t+1} - MSA\ ValueAdd_t}{MSA\ ValueAdd_t}$

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Variable Name	Description	Source	Definition
MSA CapEx	Firm-MSA capital expenditures (in 2007 dollars)	CMF, ASM	$\sum_{e} capex_{jkt}$
ΔMSA CapEx	*MSA CapEx* growth rate	CMF, ASM	$\frac{MSA\,CapEx_{t+1} - MSA\,CapEx_{t}}{MSA\,CapEx_{t}}$
Labor Prod	Firm-MSA sales per employee	CMF, ASM	$\frac{MSA\,Sales}{MSA\,Emp}$
ΔLabor Prod	Change in log *Labor Prod*	CMF, ASM	$Ln(Labor\,Prod_{t+1}) - Ln(Labor\,Prod_{t})$
Value Add per Emp	Firm-MSA value added per employee	CMF, ASM	$\frac{MSA\,Value\,Add}{MSA\,Emp}$
ΔValue Add per Emp	Change in log *Value Add per Emp*	CMF, ASM	$Ln(Value\,Add\,per\,Emp_{t+1}) - Ln(Value\,Add\,per\,Emp_{t})$

Table A2: Labor Market Size and Earnings: Evidence from Firm Bankruptcies with Matched Sample Controls

This table presents OLS regressions with four dependent variables based on a sample of workers at bankrupt firms. The dependent variable in column 1 is an indicator variable equal to one if the individual had positive earnings and zero otherwise, the dependent variable in column 2 is the natural log of earnings, the dependent variable in column 3 is an indicator variable equal to one if the individual had positive earnings at a firm other than the bankrupt firm and zero otherwise, and the dependent variable in column 4 is the natural log of earnings at firms other than the bankrupt firm. The key independent variables are labor market size (LMS) interacted with indicator variables identifying the time since firm bankruptcy. Labor market size is included as an additional control. Worker controls include log earnings in the each of the two years prior to the firm bankruptcy and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate and are included in all specifications. The mean of the outcome variable for the matched sample is also included as a control. See Appendix Table A1 for variable definitions. The unit of observation is worker-year. Standard errors are adjusted for clustering by industry and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * (Year Rel. to Bank. = 0)	0.168*	0.474**	-0.162	0.394*
	(0.092)	(0.200)	(0.142)	(0.236)
LMS * (Year Rel. to Bank. = 1)	0.307***	-0.205	0.645***	0.312
	(0.094)	(0.249)	(0.129)	(0.262)
LMS * (Year Rel. to Bank. = 2)	0.235	0.618***	0.348***	0.869***
	(0.163)	(0.208)	(0.131)	(0.168)
LMS * (Year Rel. to Bank. = 3)	0.218**	0.213	0.227**	0.320*
	(0.105)	(0.263)	(0.103)	(0.185)
LMS * (Year Rel. to Bank. = 4)	0.124	-0.008	0.128	-0.001
	(0.096)	(0.230)	(0.096)	(0.214)
LMS * (Year Rel. to Bank. = 5)	-0.026	0.298	-0.043	0.272
	(0.111)	(0.217)	(0.103)	(0.208)
Mean Dep. Var. for Matched Sample	0.053***	0.081***	0.043***	0.060***
	(0.020)	(0.018)	(0.009)	(0.009)
Dep. Var.	$PosEarn_{i,t+z}$	$LnEarn_{i,t+z}$	$PosEarn_{i,t+z,-j}$	$LnEarn_{i,t+z,-j}$
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes
Observations	1,680,000	1,404,000	1,680,000	1,068,000
R-Squared	0.15	0.42	0.30	0.35

Table A3: Labor Market Size and Earnings: Evidence from Single-MSA Firm Exits

This table presents OLS regressions using log annual earnings as the dependent variable. The key independent variable is labor market size (LMS). Worker controls include log average quarterly pay in the year prior to firm exit and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate and are included in all specifications. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by industry and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
LMS	0.016***	0.005***	0.007***	0.006***	0.002
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Year from Exit	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$
MSA-Year FE	yes	yes	yes	yes	yes
SIC3-Year FE	yes	yes	yes	yes	yes
MSA-SIC3 FE	yes	yes	yes	yes	yes
Obs	28,660,000	24,680,000	21,710,000	19,240,000	16,920,000
R-squared	0.28	0.25	0.21	0.19	0.17

Table A4: Employee Pay, Labor Market Size, and Leverage – Full Quarter Earnings Only

This table presents OLS regressions using change in worker log average quarterly pay as the dependent variable, where average quarterly based is calculated using full quarter earnings only. Full quarter earnings are earnings in which the worker has positive earnings at the firm in the previous quarter, the current quarter, and the subsequent quarter, The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate and are included in all specifications. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	-0.012***	-0.012**		
	(0.005)	(0.005)		
LMS * (2nd Quartile ΔLeverage)			-0.001	
			(0.000)	
LMS * (3rd Quartile ΔLeverage)			-0.001*	
			(0.001)	
LMS * (4th Quartile ΔLeverage)			-0.001**	
			(0.001)	
LMS * ΔTotalDebt				-0.002***
				(0.001)
LMS	0.000	0.000	-0.001*	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Worker Controls	yes	yes	yes	yes
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes
Worker FE	no	yes	no	no
Obs	45,620,000	45,620,000	45,620,000	45,620,000
R-Squared	0.05	0.36	0.05	0.05

Table A5: Robustness: Timing Regressions – Alternative Approach

This table presents OLS regressions using the change in worker log average quarterly pay as the dependent variable. In column 1, the change is calculated for year $t-2$ to year $t-1$, in column 2, it is calculated for year $t-1$ to t, in column 3, it is calculated for year $t+1$ to year $t+2$, and in column 4, it is calculated for year $t+2$ to year $t+3$. The key independent variable is the interaction of labor market size (LMS) and the change in firm leverage ($\Delta Leverage$). Labor market size interacted with the change in firm profitability, market-to-book ratio, log sales, asset tangibility, and marginal tax rate are included as controls in all specifications. Worker controls include log average quarterly pay and indicator variables for worker age = 25-34, worker age = 35-44, worker age = 45-54, race, male, high school graduate, and college graduate. See Appendix Table A1 for variable definitions. The unit of observation is worker-firm-year. Standard errors are adjusted for clustering by firm and are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
LMS * ΔLeverage	0.002	-0.007	0.002	-0.002
	(0.005)	(0.006)	(0.006)	(0.006)
Year	$t-2$	$t-1$	$t+1$	$t+2$
Firm-Year FE	yes	yes	yes	yes
MSA-Year FE	yes	yes	yes	yes
MSA-Industry FE	yes	yes	yes	yes
Obs	40,419,900	45,590,800	45,028,300	39,601,400
R-squared	0.04	0.07	0.04	0.03