The Elephant in the Room: the Impact of Labor Obligations on Credit Markets[*]

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Abstract We show that labor market frictions are first-order for understanding credit markets. Wage growth and labor share forecast aggregate credit spreads and debt growth as well as or better than alternative predictors. They also predict credit risk and debt growth in a cross-section of international firms. Finally, high labor share firms choose lower financial leverage. A model with labor market frictions and risky long-term debt can explain these findings, and produce large credit spreads despite realistically low default probabilities. This is because pre-committed payments to labor make other committed payments (i.e. interest) riskier.

1 Introduction

We study the impact of labor market frictions on credit markets. Our central finding is that labor market variables (wage growth or labor share) are first-order in accounting for variations in credit risk, debt growth, and financial leverage. This is true both in aggregate U.S. data, and in large, cross-country firm-level data. These findings are consistent with an equilibrium model featuring a risky credit market with long-term debt, and sticky wages. Intuitively, when wages are rigid, a negative economic shock leads to a rise in labor induced operating leverage, as wages fall too slowly and labor share rises. This labor leverage effect increases firms' credit risk because pre-committed wage payments make interest payments riskier. Adjustment happens both in prices and quantities: in response to a negative shock, bond prices fall (yields rise) and firms issue less debt. Firms with

higher labor leverage tend to have higher credit risk and lower financial leverage. A model without wage rigidity implies counterfactually constant labor share and is unable to capture the relations between labor markets and credit markets observed in the data.

Empirically, we show that low wage growth and high labor share significantly forecast a high aggregate U.S. Baa-Aaa credit spread. A 1% decrease in wage growth (increase in labor share) is associated with a 15bp (11bp) increase in the credit spread, and the univariate R^2 of wage growth (labor share) is 0.28 (0.09). These findings are robust to inclusion of standard controls used in the literature, including financial leverage and market volatility. The same two labor market variables also forecast corporate debt growth, but with opposite signs. A 1% decrease in wage growth (increase in labor share) is associated with a 1.3% (0.4%) reduction in the aggregate quantity of U.S. corporate debt.

In the cross section, we show that firm-level labor market variables are important predictors of credit risk, as measured by the Moody-KMV expected default frequency (EDF),[1] or by the CDS spread, across a wide range of countries, including U.S., Canada, and major European and Asian Pacific countries. Again, these findings are robust to standard controls. More specifically, firms with lower labor expense growth rates and higher labor share have higher future EDFs and CDS spreads. As in aggregate data, these variables also forecast corporate debt growth, but with opposite signs. All of the aforementioned results are stronger for firms whose wages are more sticky, consistent with the interpretation that labor leverage affects credit risk. Additionally, firms with higher labor leverage tend to have lower financial leverage – the strikingly strong negative relationship between labor share and financial leverage is shown in Figure 1. Lastly, we show that credit market conditions affect real outcomes. Specifically, financial leverage and credit spreads negatively forecast firms' employment growth, investment and wage growth. Taken together, our results suggest that labor markets play a major role in driving both aggregate and cross-sectional variation in credit risk, corporate debt growth, and capital structure.

To understand this relationship, we solve a dynamic stochastic general equilibrium (DSGE) model with heterogeneous firms. In our model, the labor market is not frictionless – wage contracts are staggered, which prevents firms from immediately adjusting their labor expenses in response to new shocks. This causes wages to be sticky; as in the data, the wage process in our model is smoother than output, and is imperfectly correlated with output. This also causes labor leverage to matter for asset prices. On the financing side, firms issue long-term debt to pay for investment and labor expenses, and to reduce tax liability through interest deductions. Firms in the model trade off financial leverage, and the labor leverage induced by sticky wages.

In the model, the predictability of labor market variables for the credit spread and debt growth arises endogenously due to the interaction between operating leverage and financial leverage. In economic downturns, productivity, output, and wages fall. However, because of labor market frictions, wages fall by less, causing an increase in labor share and in labor leverage. High expected payments to labor make firms more likely to default in bad times, especially when the wage bill is

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[1]EDF is a widely used measure of the probability that a firm will default over a specified period of time.

relatively high. Thus, the model implies that labor share (positively) and wage growth (negatively) are natural predictors of credit risk. Similarly, at the firm level, firms which experience negative (positive) economic shocks endogenously have lower (higher) wage growth, and higher (lower) labor share, which then results in more (less) risky debt. Firms with high labor leverage then choose to issue less debt because credit risk caused by rigid wages is high.

Notably, the model with wage rigidity and corporate debt provides a coherent accounting of several major financial puzzles - the credit spread puzzle, the under-leverage puzzle, and the equity premium puzzle - in a unified framework. Specifically, the model produces a realistically large credit spread despite of low default probabilities, which is often referred as the credit spread puzzle (Huang and Huang (2012)). In our model, shocks to the growth rate of productivity are persistent, and households have Epstein and Zin (1989) utility, thus standard long run risk forces are present, as in Bansal and Yaron (2004), Kaltenbrunner and Lochstoer (2010), and Croce (2014). Because shocks are persistent, a negative shock today implies that consumption growth is likely to be low for many periods into the future. Such a shock is especially unpleasant because the intertemporal elasticity of substitution (IES) is above one, implying that households prefer early resolution of uncertainty. In this world, safe long-term debt is an especially good hedge, because it promises a long-term, stable interest payment. On the other hand, long-term corporate debt is especially risky, because firms are likely to default exactly when a long sequence of negative shocks leaves their revenues low relative to promised interest payments. This effect is magnified by wage rigidity, since after such a long sequence of low growth, not only are interest payments high relative to revenues, but payments to labor are relatively high too.

The model also produces a quantitatively realistic leverage ratio, despite zero explicit bankruptcy costs. This happens because long-term debt exacerbates the problem of debt overhang and under-investment. Firms with high financial leverage under-invest ex-post, and to avoid this, firms issue less debt ex-ante.[2] The interactions of long-term debt, sticky wages, and long-run risk all strengthen the effect.

In addition to successfully replicating the observed predictability in credit spread, the model also produces a sizable equity premium and equity volatility. The equity premium and volatility are high in a model with wage rigidity, because without labor frictions, profits are too smooth and dividends may be countercyclical, which is counterfactual. Wage rigidity, through operating leverage, makes profits and dividends behave more like in the data. Thus, the residual claimants, such as debt and equity, are particularly risky in our model.

In addition to the specific economic question, we believe that our solution of a general equilibrium, heterogenous firm model with long-term wage and long-term debt contracts is, in itself, an important methodological contribution. Models with defaultable long-term debt have only recently appeared in the sovereign default literature (Arellano and Ramanarayanan (2012), Chatterjee and Burcu (2012)), though doing this with heterogenous firms requires additional complexity.

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[2]This problem was first studied by Myers (1977). Hennessy (2004) and Moyen (2007) have pointed out that debt overhang may be more severe in the presence of long-term debt. Admati, DeMarzo, Hellwig, and Pfleiderer (2017) argue that similar intuition causes firms to avoid reducing leverage.

Literature review The macroeconomic literature on wages and labor is quite large,[3] although only more recently has this literature begun to relate to financial economics.[4] On the other hand, financial economists have also recently begun exploring links between labor and asset prices both in structural models,[5] and empirical analysis.[6] However, much of the work linking labor frictions to asset prices has focused on equity and there has been relatively little work relating it to credit risk. A notable exception is Gilchrist and Zakrajsek (2012), who show that credit spreads predict future movements of aggregate quantities, including the unemployment rate. We differ because we focus on the impact of labor market frictions on credit risk. Our paper provides both a large set of empirical results, as well as a calibrated structural model.

Our paper is also related to the literature using structural models to study credit risk, which highlights the roles of financial leverage, asset volatility, and macroeconomic risk as the key determinants of credit spread.[7] Closer to what we do, Collin-Dufresne and Goldstein (2001) consider firms who change leverage in response to changes in their value, which leads to mean reversion in leverage; Chen (2010) studies the effect of macro-economic uncertainty and risk premia on firms' capital structure and default policies; Gomes and Schmid (2010) and Gomes and Schmid (2012) explore the propagation mechanism of movements in bond markets into the real economy; Gourio (2013) studies the impact of disaster risk on credit risk in a DSGE model; Gilchrist, Sim, and Zakrajsek (2014) study the relationship between uncertainty, investment, and credit risk in a DSGE model; Khan, Senga, and Thomas (2014) study default risk in a DSGE model with credit shocks; and Gomes, Jermann, and Schmid (2016) study the relation between nominal long-term debt, inflation, and movements in real quantities. However, labor is not the focus of any of these papers. As we show in this paper, wage rigidity is crucial to match cash flow dynamics in DSGE models. We complement the previous literature by incorporating realistic labor markets into the analysis.

Our first set of empirical findings, on labor markets and credit risk, relates to the empirical literature on the determinants of credit spreads. Collin-Dufresne, Goldstein, and Martin (2001) show that standard credit spread forecasters have rather limited explanatory power. Elton, Gruber, Agrawal, and Mann (2001) find that expected default losses account for a small fraction of the credit

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[3]Examples include Pissarides (1979), Calvo (1982), Taylor (1983), Taylor (1999), Shimer (2005), Hall (2005), Gertler and Trigari (2009).

[4]See Hall (2016) who reviews the recent literature and shows that a higher discount rate is associated with higher unemployment.

[5]Examples include Danthine and Donaldson (2002), Berk, Stanton, and Zechner (2010), Berk and Walden (2013), Petrosky-Nadeau, Zhang, and Kuehn (2013), Belo, Lin, and Bazdresch (2014), Donangelo (2014), Li and Palomino (2014), Palacios (2015), Favilukis and Lin (2016b), Zhang (2015), Bai (2016), Blanco and Navarro (2016) and Donangelo, Eiling, and Palacios (2016).

[6]Tuzel and Zhang (2015), Favilukis and Lin (2016a), Donangelo, Gourio, and Palacios (2016), Donangelo (2016), and Qiu and Shen (2016) find links between operating leverage due to labor, and asset returns. Non-labor related rigidities matter too: Weber (2015), and Gorodnichenko and Weber (2016) show that rigidity in price setting affects firms' equity risk. There is also a more mature literature that explores the relationship between unions (which are one cause of labor market frictions) and asset prices. Ruback and Zimmerman (1984), Abowd (1989), Hirsch (1991), Lee and Mas (2009) find a negative relation between unions and firm values, while Chen, Kacperczyk, and Ortiz-Molina (2011) find that unionization is related to higher costs of equity and Campello, Gao, Qiu, and Zhang (2016) show that unions lead to losses for bond holders.

[7]Examples include Hackbarth, Miao, and Morellec (2006), Chen, Collin-Dufresne, and Goldstein (2009), Bhamra, Kuehn, and Strebulaev (2010a), Elenev, Landvoigt, and Van Nieuwerburgh (2018).

risk premium. We show that labor market variables have as strong explanatory power as financial leverage and stock market volatility in predicting the Baa-Aaa spread, and the cross-sectional variation in firms' EDFs.

Since we solve a general equilibrium model with endogenous debt, our work relates not only to the price of debt, but also to the quantity of debt, and more broadly the literature integrating financing frictions, capital structure, q-theory and asset pricing.[8] As with the literature on credit risk, we complement previous work by considering how labor market frictions affect the firm's financing decision. A closely related paper is Michaels, Page, and Whited (2016), which, through a structural model, asks how financing frictions affect the firm's labor decision.

Our second set of empirical findings, that labor leverage leads to lower debt issuance, complements that of Simintzi, Vig, and Volpin (2015), who show that firms tend to reduce financial leverage when employment protection rises and stress the importance of fixed costs of labor. The channel proposed in that paper works in a similar way to the wage rigidity we consider. Similarly, Schmalz (2015) shows that small or constrained firms are likely to reduce financial leverage after unionization and Bartram (2015) shows that firms with higher pension and health obligations tend to have lower financial leverage. Our finding that high labor share firms hold less debt mirrors that of D'Acunto, Liu, Pflueger, and Weber (2016), who find that firms with inflexible prices are more exposed to aggregate risk and hold less debt. Several papers have explored the strategic role of debt, where firms use debt to attain a better bargaining position vis-a-vis labor.[9] This channel would lead to an opposite prediction: debt should increase when labor leverage is stronger.

It is useful at this stage, to contrast this paper with our previous work in Favilukis and Lin (2016b). Both papers build models in which wages are less volatile than the marginal product of labor, the mechanism for this combines a CES production function where capital and labor are complementary, and infrequent labor contract renegotiation. Favilukis and Lin (2016b) show that this mechanism creates operating leverage due to wage rigidity. This makes dividends more procyclical, and equity more volatile, bringing the model closer to the data. Our current work departs from Favilukis and Lin (2016b) in three major ways. First, we introduce risky long-term debt, which is endogenously chosen by firms. Although computationally, this is a major challenge, it allows us to study the impact of labor market frictions for both credit risk and capital structure decisions. Second, Favilukis and Lin (2016b) assume that the Modigliani and Miller (1958) propositions hold, and exogenously impose a separation of total cash flows into equity and short-term debt. In our model, long-term debt induces a debt overhang problem, therefore financial decisions affect real decisions. Third, while Favilukis and Lin (2016b) is a calibration exercise, the current paper presents an extensive empirical analysis of the relationships between labor markets and credit markets, providing support for the model's mechanism.

The rest of the paper is laid out as follows. Section 2 presents both the aggregate and cross-

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[8]Dynamic models which focus on capital structure include Hennessy (2004), Hennessy and Whited (2005), Hennessy and Whited (2007), Bhamra, Kuehn, and Strebulaev (2010b), and Bolton, Chen, and Wang (2011).

[9]These include Baldwin (1983), Bronars and Deere (1991), Perotti and Spier (1989), Dasgupta and Sengupta (1993), Hennessy and Livdan (2009), and Matsa (2010).

sectional empirical results. Section 3 describes the model and calibration. Section 4 presents the model's results. Section 5 concludes.

2   Empirical evidence

In this section we explore the empirical relationship between labor markets and credit markets. We do so first, using aggregate, time series analysis of U.S. data, and second, using a cross-sectional analysis of firm-level data across a wide range of countries.

We document that labor share is positively, and that wage growth is negatively associated with stress in the credit markets. In particular, labor share is positively associated with credit spread, and negatively with debt growth; wage growth is negatively associated with credit spread, and positively with debt growth. The intuition is as follows. If the wage bill moves one for one with GDP, then the labor share is constant. Otherwise, times of high labor share are times when a larger fraction of the firm's output is committed to labor payments, leaving less for other payments, such as interest. Similarly when wages do not move one for one with GDP, negative shocks are associated with falling output, and falling wages, however, since wages fall by less, falling wages indicate an increase in operating leverage and more risk for residual cash flows.[10] The same time series intuition holds in the cross-section, where firms with higher labor share or lower wage growth are riskier. This intuition is laid out formally in Section 3.

2.1   Time series analysis

This section performs time series analysis using aggregate data. We first describe the data, then the empirical specifications and the results.

2.1.1   Data and variable definitions. Our key dependent variables are the credit spread and debt growth, while our key independent variables are labor share and wage growth. We briefly describe them here. Section A.5 in the online appendix contains more detailed definitions of these variables, the control variables, as well as summary statistics.

The credit spread is the Moody's Baa corporate bond yield in excess of Aaa corporate bond yield from the Federal Reserve. Aggregate debt growth is the growth rate of credit market instrument liabilities for non-financial business sector from the Flow of Funds Table L102. Wage growth is the growth rate in the real wages and salaries per full-time equivalent employee from NIPA Table 6.6, deflated by the price index of personal consumption expenditures from NIPA Table 2.2.4. Labor share is the ratio of aggregate compensation of employees to GDP. Aggregate compensation is from NIPA and includes noncash benefits.

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[10]Note that if wages fell for an exogenous reason, without a fall in output, then labor leverage would fall. Our intuition relies on wages and output both responding to the same shock, but at different rates. The empirical evidence is consistent with the latter.

Figure 1: Labor share and financial leverage

This figure compares labor share and financial leverage. The three panels on the left contain book leverage, and the three on the right contain market leverage. The top two panels contain the median labor share in each country and the median leverage in each country. For the middle two panels, we define the relative labor share as a firm's labor share minus the country's labor share and we define relative leverage analogously. We then sort all firms into 50 portfolios based on relative labor share and plot the median relative labor share of each portfolio against the median relative leverage of each portfolio. In the bottom two panels, for each firm, we use baseline model-simulated data and compute its average labor share and financial leverage over every non-overlapping 25 year period. We then sort all of these into 50 portfolios based on labor share and plot the median labor share of each portfolio against its median financial leverage. Firm level labor share is labor expenses scaled by the sum of labor expenses and earnings before interest. Book (market) leverage is the book debt scaled by the sum of the book (market) value of equity and book debt.
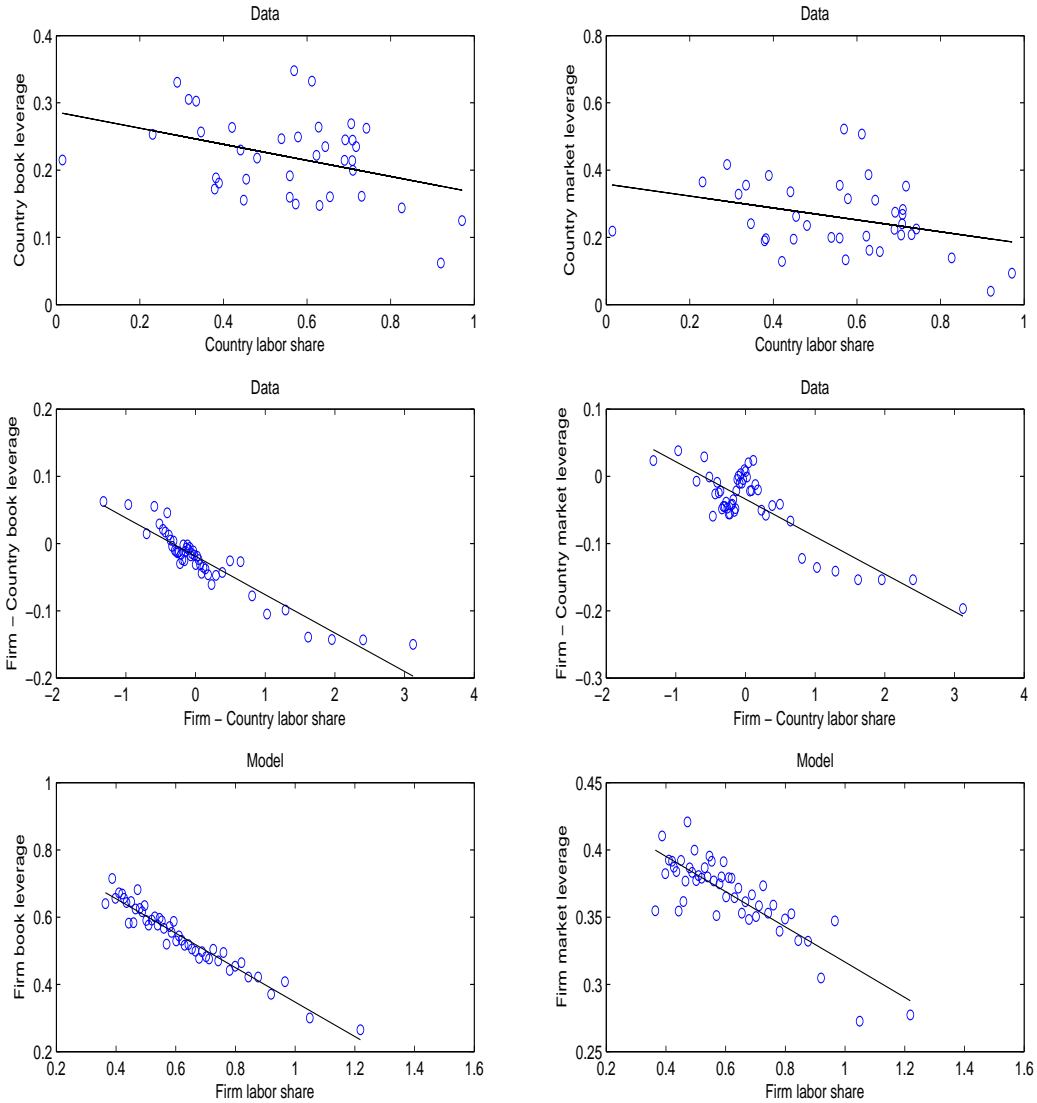
2.1.2 Predicting aggregate credit risk. In this subsection, we explore the predictability of wage growth and labor share for the credit spread. These results are in panels A and B of Table 1. As will be shown below, wage growth predicts the credit spread with a negative sign, and labor share predicts the credit spread with a positive sign.

The first column of panel A presents a univariate regression of one year ahead credit spread, CS_{t+1}, on current wage growth, ΔW_t. Consistent with our intuition, the relationship is negative, and significant, with a t-statistic of -4.15. It is also economically significant, with an R^2 of 0.28, which is as strong as other conventional predictors.[11]

The remaining columns present bivariate regressions, with one control at a time. The controls are labor share, investment growth, financial leverage, market volatility, the price-to-earnings ratio, the term spread, the risk free rate, GDP growth, consumption growth, employment growth, and the credit spread at t. In all cases, wage growth is significant. The lowest t-statistic is -2.22, when credit spread at t is included as a control; this regression has an R^2 of 0.59.

In panel B, we present the relationship between the credit spread at $t+1$ and labor share at t. The univariate relationship is in the second column. Consistent with our intuition, the relationship is positive, and significant, with a t-statistic of 2.55 and an R^2 of 0.09. The first column presents a bivariate regression which includes both labor share and wage growth; both are significant, with t-statistics of 3.13 and -4.41, and an R^2 of 0.34. The remaining columns present bivariate regressions with other controls. Labor share remains positive in all cases, and significant in all but two (financial leverage and market volatility).

We do not report multivariate regressions because there are 10 explanatory variables and only 66 data points, therefore overfitting and collinearity become concerns. However, in a multivariate regression which controls for financial leverage, market volatility, debt growth and investment growth, both wage growth and labor share remain statistically significant (results are not tabulated but are available upon request).

2.1.3 Predicting aggregate debt growth. Next we turn to an alternative measure of stress in the debt market, the issuance of debt. As argued before, high labor leverage, proxied by low wage growth or high labor share, makes debt especially unattractive, causing firms to issue less debt. We carry out exactly the same exercise as with credit spread, but using aggregate debt growth as the dependent variable. These results are in panels C and D of Table 1. Panel C presents the relationship between aggregate wage growth and debt growth. Consistent with our intuition, wage growth positively forecasts debt growth, with t-statistics around 4 in the univariate and bivariate regressions, although the R^2 is lower than with credit spread. Panel D presents the relationship between aggregate labor share and debt growth. Consistent with our intuition, labor share negatively forecasts debt growth, although this relationship is insignificant in most

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[11]For example, both financial leverage and stock market volatility positively predict credit spread, consistent with Collin-Dufresne, Goldstein, and Martin (2001), with R^2's of 0.37 and 0.22. However, the price-to-earnings ratio, term spread, and spot rate do not significantly predict credit spread.

specifications.[12]

2.2 Cross-sectional analysis

In this section, analogous to the previous section, we test the relationship between labor markets and credit markets. However, rather than using aggregate data, we use a large, international panel of individual firms. We describe the firm-level data first, followed by the cross-sectional regression results.

2.2.1 Data. Our accounting data come from Compustat North America (for U.S. and Canadian firms) and Compustat Global (for firms from other countries) Fundamentals Annual files. Similarly, the security data come from CRSP and Compustat Global Security Daily respectively. Our key explanatory variables are labor expense growth (ΔXLR_t),[13] and labor share (LS_t). We define $\Delta XLR_t = \frac{XLR_t - XLR_{t-1}}{0.5(XLR_t + XLR_{t-1})}$ and $LS_t = \frac{XLR_t}{XLR_t + EBITDA_t}$ where XLR is labor expenses from Compustat and EBITDA is earnings before interest.[14] Our key dependent variables are total debt growth $\Delta DEBT_{t+1}$ and Moody-KMV's Expected Default Frequency (EDF_{t+1}). We define $\Delta DEBT_{t+1} = \frac{DEBT_{t+1} - DEBT_t}{0.5(DEBT_{t+1} + DEBT_t)}$, where DEBT is total debt, computed as the sum of long-term debt (DLTT) and short-term debt (DLC).

We use EDF to measure the default probability for global firms from 1992 to 2011, which is also the sample period for most of our firm-level analysis. As far as we are aware, EDF is the best large-sample data set on credit risk available for an international setting. One concern with using EDF to measure credit risk is that EDF is computed by Moody's using the Merton model and captures credit risk only to the degree that inputs into the Merton model, namely estimates of equity volatility and financial leverage, capture credit risk. We believe this concern is misplaced. We control for both leverage and past volatility in our regressions, which does not change our main result – that labor market variables predict EDF. It is possible that Moody's uses variables correlated with our labor market variables to compute EDF or its inputs, which is why labor market variables predict EDF. But if this is the case, then Moody's is accounting for labor leverage risk

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[12]Our predictive results for credit spread and debt growth are also robust at the quarterly frequency. Refer to Table A4 in online appendix for details.

[13]Our model implies that both wage growth and labor expense growth should have similar forecasting power for credit market variables. We use labor expense growth (ΔXLR_t) as our primary variable. However, in the online appendix, we redo all regressions with wage growth $(\Delta WAGE_t)$ instead of labor expense growth. As long as we control for employee growth (HN), the coefficients on wage growth keep the same sign and similar significance to the coefficients on labor expense growth. The reason we focus on labor expense growth is that we believe wages are a noisier variable at the firm level. In order to compute the wage, we need to divide XLR by the number of employees (EMP). Baumol, Blinder, and Wolff (2005) and Michaels, Page, and Whited (2016) both caution against using Compustat employment data due to its low correlation with Census data. Any timing mismatch between XLR and EMP will lead to noise in the wage. For example Compustat reports that between 1997 and 1998, AMR corporation increased XLR from \$6.328B to \$6.507B (2.83%), even as the EMP fell from 113900 to 103400 (-9.22%), implying a 13.27% rise in wages. AMR's 10K filings, indicate that AMR consisted of three groups. AMR agreed to sell group 2 as of December 31, 1998. Comparing the 10K report to Compustat, we can deduce Compustat excludes the employment of group 2, but includes compensation of all three groups. As a result, the wage computed from Compustat appears to rise by 13.27%, even though the actual wage rose by only 3.6%.

[14]EBITDA+XLR is the value added by a firm, and LS is the labor share of value added.

exactly as our model suggests it should.

To further alleviate concerns about EDF, we supplement our analysis with data on single name corporate CDS spreads from 2000 to 2013, provided by IHS Markit. The online appendix describes the procedure of linking this to international firms in Compustat Global. Although CDS spreads, by virtue of being market prices, are potentially more reliable than EDF, we focus on EDF as our primary analysis because the sample size of our EDF data (10,000+ firms) is significantly larger than our CDS data (576 firms).[15]

The online appendix also reports summary statistics for our main variables of interest: ΔXLR, LS, ΔDEBT, EDF, and CDS. Both ΔXLR and LS show significant variation across regions. In general, developed countries have higher labor share and lower labor expenses growth, whereas developing countries have lower labor share and higher labor expenses growth.[16]

2.2.2 Predicting firm-level credit risk. In this subsection, we show that at the firm-level, high labor leverage, measured by low labor expense growth or high labor share, is associated with stress in the credit market, measured by EDF. These results are presented in Table 2, and are consistent with the aggregate results presented earlier in Table 1, and with our model results, to be presented in Table 8.

We first conduct univariate, firm-level, cross-sectional analysis. We use the Fama and MacBeth (1973) approach to analyze the predictive power of labor obligations for credit risk: within each period t, we run a cross-sectional regression of EDF_{t+1} on labor expenses growth realized in year t, or labor share in year t. In particular, when we use labor expenses growth (or labor share) as a determinant for default risk, we run the following cross-sectional regression

$$EDF_{i,t+1} = \beta_0 + \beta_1 \times \Delta XLR_{it}(\text{or } LS_{it}) + \beta_2 \times X_{it} + \epsilon_{it+1}, \qquad (1)$$

where X_{it} is a vector of firm characteristics, which, in the univariate regression, is empty.

These results are in the first and second columns of Panel A in Table 2, they are also identical to the univariate regressions for the data in Table 8 of the model section. Consistent with our intuition, the coefficient on ΔXLR is negative and statistically significant, while the coefficient on LS is positive and statistically significant, with t-statistics of -7.64 and 5.46, respectively.

We also perform several robustness tests. Panel B is identical to Panel A but with country-fixed effects. Panel C also adds time t book leverage and stock return volatility as controls. In

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[15]In the online appendix, we report the number and percentage of annual (firm-year) observations that have non-missing labor expenses (Compustat variable XLR) and EDF for each of the thirty-nine countries. We follow Gao, Parsons, and Shen (2015) to categorize the countries into seven different regions. For the U.S., only 7% (9588 of 135632) of the observations have non-missing labor expenses. If we further require non-missing EDF data, this percentage drops to 3.6%. Therefore, the sample with labor expenses based on U.S. firms is quite small and it is difficult to draw conclusions from this sample only. This is the main reason that we expand our scope to global firms for our firm-level analysis. Outside of the U.S., many countries have relatively good coverage of labor expenses, especially European countries. Japan is an exception – there are only 2 annual observations with XLR available – therefore our analysis does not include Japan.

[16]Both ΔXLR and LS are winsorized at 1% and 99% percentiles. The mean values of un-winsorized variables are much higher – an indication of outliers in labor expenses.

Panel D we control for additional well-known determinants of credit and distress risk, as suggested by Collin-Dufresne, Goldstein, and Martin (2001), Shumway (2001), and Campbell, Hilscher, and Szilagyi (2008). These include working capital, retained earnings, EBIT, sales growth, net income, current asset to liability ratio, investments, relative firm size, market capitalization. We also control for individual firm's stock excess return and the market return for its country in year t. In the online appendix we also present identical results but with market leverage replacing book leverage or with net hiring as an additional control (inclusion of net hiring significantly reduces the number of observations). In all cases, ΔXLR and LS remain highly significant; for example with the full set of controls, the t-statistics are -7.20 and 4.55, respectively.[17]

Taken together, these results indicate that labor obligations are an important determinant of credit risk.

2.2.3 Predicting firm-level debt growth.
We repeat exactly the same exercise as in the previous section, except that the left hand side variable is now debt growth between t and $t+1$, rather than EDF at $t+1$. Debt growth is regressed on time t labor expense growth ΔXLR_t or time t labor share LS_t, and a set of controls. These results are in the third and fourth columns of each panel in Table 2.

As expected, the coefficients have opposite signs to the EDF regressions. Times of high labor leverage (low labor expense growth, high labor share) are associated with low issuance of new debt. For example, when we include all control variables, the t-statistic is 5.70 for ΔXLR and -4.23 for LS. As with EDF, the positive coefficient on labor expense growth and the negative coefficient on labor share are consistent with our aggregate analysis in Table 1, and with our model in Table 8.[18]

2.2.4 Conditioning on rigidity.
As will be discussed below, our model's intuition suggests that the relationships described above should be stronger if wages are more rigid. In fact, in our model, if wages are perfectly flexible and the production function is Cobb-Douglas, then labor share is constant and cannot have any predictable power. We test this additional hypothesis in Table 3.

First, we must define rigidity. For each firm we compute its volatility of labor expense growth over its entire sample. We define the firm's level of rigidity, μ as the inverse of its volatility of labor

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[17]The online appendix also reports the correlation between EDF_{t+1} and either ΔXLR_t or LS_t within each country. In particular, for each firm we compute the time series correlation, and then average across all firms in a country. We also compute the t-statistic corresponding to the test $H_0 : Corr(\Delta XLR, EDF) = 0$. The average value of $Corr(\Delta XLR, EDF)$ is -0.04 for all countries (11,677 firms) with a t-stat of -7.89. The relationship is statistically significant for 16 of 38 countries, and the insignificant countries tend to have a small number of firms in the sample. The average value of $Corr(LS, EDF)$ is 0.18 for all countries (12,483 firms) with a t-stat of 34.24. The average value of this correlation is also positive and statistically significant for 31 of the 38 countries.

[18]We also compute correlations of debt growth with either labor expense growth, or labor share, as we did with EDF; these results are in the online appendix. The average value of $Corr(\Delta XLR, \Delta Debt)$ is 0.03 for all countries (15,447 firms) with a t-statistic of 7.47. Although the pooled result is highly significant, this relationship is generally weaker, with significance in only 10 of 38 countries. The average value of $Corr(LS, \Delta Debt)$ is -0.05 for all countries (16,972 firms) with a t-stat of -11.90. The average value of this correlation is negative and statistically significant for 19 of the 38 countries. As with EDF, these results indicate that labor obligations are an important determinant of firms' capital structure choices.

expense growth. This is a natural definition of rigidity, and consistent with our model.[19]

There are four panels in Table 3, one for each of the four relationships of interest: credit risk and labor expense growth, credit risk and labor share, debt growth and labor expense growth, and debt growth and labor share. Within each panel, we test whether the relationship is stronger for firms with high μ. We do this in one of two ways.

First, in the first column of each panel, we include an interaction term between our explanatory variable (either labor share or labor expense growth) and the degree of rigidity. For all four relationships of interest, the interaction term has the same sign as the original coefficient, and is significant, implying a stronger effect for more rigid firms. Thus, the relationship between EDF and labor expense growth is more negative for firms with more rigidity; for EDF and labor share it is more positive for firms with more rigidity; for debt growth and labor expense growth it is more positive for firms with more rigidity; and for debt growth and labor share it is more negative for firms with more rigidity.

Second, in the second and third columns, we separate all firms into high rigidity (top 25% μ) and low rigidity (bottom 75% μ) and rerun the regression within each subset. In all four cases, the magnitude of the coefficient is larger in the rigid subset, and the differences are significant. All results in Table 3 include country fixed effects and the full set of control variables.[20]

2.2.5 Predicting CDS spread.
One shortcoming of the above analysis is that EDF is not a price based measure, but is an estimate of credit risk by Moody's. In this subsection, we repeat the earlier analysis, but use the CDS spread, which is a price based measure, instead of EDF. These results are in Table 4.

The results using CDS spreads are fully consistent with the earlier results using EDF. Labor share is positively and significantly, while labor expense growth is negatively and significantly associated with the CDS spread. The significant interaction term indicates that this relationship is stronger in more rigid firms.

2.2.6 Labor share and financial leverage.
The determinants of a firm's capital structure are a major topic in corporate finance. In this section, we show that the level of a firm's labor share is negatively related to the level of financial leverage chosen by firms. These results are closely related to earlier results on labor share and debt growth, and the intuition is similar as well.

In Panel A of Table 5 we regress a firm's leverage, averaged over its entire life cycle, on its labor share, averaged over its entire life cycle. We present a univariate regression, a case with country fixed effects, and a case with a full set of controls. We do this for both market leverage (left panel)

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[19]In our model, two separate parameters make wages more rigid: μ, which controls the renegotiation frequency, and η which controls the complementarity between capital and labor. As can be seen in Panel A of Table 9, $1/\sigma(\Delta XLR)$ proxies for both of these.

[20]In the online appendix we also redo the same analysis but with an alternative measure of rigidity, the autocorrelation of labor expense growth. In our model in Section 3 below, both the inverse volatility of wage growth and the autocorrelation of wage growth proxy for either high μ or low η. These results are largely similar to the ones in the main text – the relationship between labor market variables and credit risk is stronger when wages are more rigid.

and book leverage (right panel). Labor share is highly significant at explaining financial leverage, with a univariate t-statistic of -32.86, and a t-statistic of -9.39 for a full set of controls. The R^2 is also economically significant, labor share alone explains 6.3% of the variation in financial leverage, which accounts for nearly a quarter of the total explained variation. In Panel B, we run Fama and MacBeth (1973) regressions of leverage at $t + 1$ on labor share at t, and a set of controls, including leverage at t. In these regressions as well, labor share is negatively related to financial leverage.

We also present these results graphically in Figure 1. The three panels on the left are for book leverage, while on the right are for market leverage. In the top two panels, we plot each country's median labor share against its median financial leverage. In the middle two panels, we compute each firm's relative labor share (leverage) by subtracting its country's labor share (leverage) from each firm's labor share (leverage). We then sort firms into 50 portfolios based on relative labor share and plot each portfolio's median. We present results from the model in the bottom two panels. These show a strikingly strong negative relationship between labor share and financial leverage.

The intuition for these results is that high labor share makes the firm riskier. High labor leverage firms behave optimally, by choosing less financial leverage in the capital structure. As before, we interpret these results as evidence that labor leverage is associated with more risk in credit markets.

3 Model

In this section, we present a dynamic general equilibrium model with heterogenous firms to understand links between labor market frictions, firms' credit risk, and debt issuance decisions. The departure from the existing literature (Gilchrist, Sim, and Zakrajsek (2014), Khan, Senga, and Thomas (2014), Favilukis and Lin (2016b), etc.) is that we incorporate both labor market frictions (staggered wage contracts) and risky long-term debt into a DSGE model. This allows us to study the implications of wage rigidity for both asset prices and firms' real and financing policies. We begin with the household's problem. We then outline the firm's problem, and describe the economy's key frictions. Finally we define the equilibrium.

We have also solved a 2-period, partial equilibrium version of our model, which is in section A.4 of the online appendix. This model qualitatively captures our two main results: a positive relationship between labor obligations and credit risk, and a negative relationship between labor obligations and debt issuance. The 2-period model carries similar intuition as our full model, but is easier to understand. The full model shows that the relationship between labor and credit risk can matter not only qualitatively, but also quantitatively.

3.1 Households

We consider one representative household who receives labor income, chooses between consumption and saving, and invests in a portfolio consisting of all financial assets in the economy. The household

maximizes utility as in Epstein and Zin (1989).

$$U_t = \max \left((1-\beta)C_t^{1-\frac{1}{\psi}} + \beta E_t[U_{t+1}^{1-\theta}]^{\frac{1-\frac{1}{\psi}}{1-\theta}} \right)^{\frac{1}{1-\frac{1}{\psi}}} \tag{2}$$

where C_t is the average consumption. For tractability, we assume that aggregate labor supply is inelastic and equal to one.[21] The preference parameters are the time discount factor β, the risk aversion θ, and the intertemporal elasticity of substitution ψ.

3.2 Firms

The interesting frictions in the model are on the firm's side. We assume that a large number of firms (indexed by i and differing in idiosyncratic productivity) choose investment, labor, and the mix of equity versus corporate debt in their capital structure, to maximize the present value of future dividend payments. The dividend payments are equal to the firm's output net of wages, operating costs, payments to creditors, taxes, investment, and adjustment costs. Output is produced from labor and capital. Firms hold beliefs about the discount factor M_{t+1}, which is determined in equilibrium.

3.2.1 Technology. The variable Z_t is an exogenously specified total factor (labor-augmenting) productivity common to all firms; idiosyncratic productivity of firm i is Z_t^i; their calibration is described below, in section 3.4.

Firm i's output is given by

$$Y_t^i = Z_t^i \left(\alpha(K_t^i)^\eta + (1-\alpha)(Z_t N_t^i)^{\eta\rho} \right)^{\frac{1}{\eta}}. \tag{3}$$

Output is produced with CES technology from capital (K_t^i) and labor (N_t^i). ρ determines the degree of return to scale (constant return to scale if $\rho = 1$), $\frac{1}{1-\eta}$ is the elasticity of substitution between capital and labor (Cobb-Douglas production if $\eta = 0$), and $(1-\alpha)\rho$ is related to the share of labor in production.

3.2.2 The wage contract. In standard production models, wages are reset each period and employees receive the marginal product of labor. We assume that any employee's wage will be

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[21]The assumption that the aggregate labor supply is inelastic is a potential concern about our model's generality. Although we do not extend the model to elastic labor because it would require us to keep track of an additional state variable (aggregate past employment), we do not believe this would change the model's asset pricing or capital structure implications. First, this concern is valid for our aggregate results only, because, as in a partial equilibrium model, individual firms are free to hire any number of workers. Second, Favilukis and Lin (2016b) solve a model similar to the current one, but without an endogenous capital structure or long-term debt. In that model, the labor supply is positively correlated with output growth and calibrated to match the behavior of employment in the data; they also solved a model with constant labor supply. By construction, the model with flexible labor is better at matching the joint behavior of employment, labor share, and output growth. However, both the constant labor and flexible labor models had similar quantitative implications for asset pricing, as long as the labor share behavior was similar.

reset in the current period with probability $1 - \mu$. When $\mu = 0$, our model is identical to models without labor market frictions: all wages are reset each period, and each firm freely chooses the number of its employees N_t^i such that its marginal product of labor is equal to the spot wage. When $\mu > 0$, we must differentiate between the spot wage (w_t) which is paid to all employees resetting wages this period, the economy's average wage ($\overline{w}_t$), and the firm's average wage ($\overline{w}_t^i$). This wage contract is similar to Gertler and Trigari (2009).

When a firm hires a new employee in a period with spot wage w_t, with probability μ it must pay this employee the same wage next period; on average this employee will keep the same wage for $\frac{1}{1-\mu}$ periods. All resetting employees participate in the same labor market, where the spot wage is selected to clear labor supply and demand. The firm chooses the total number of employees N_t^i each period. These conditions lead to a natural formulation of the firm's average wage at t, as the weighted average of the spot wage at t and the average wage at $t - 1$:

$$\overline{w}_t^i N_t^i = w_t(N_t^i - \mu N_{t-1}^i) + \overline{w}_{t-1}^i \mu N_{t-1}^i \tag{4}$$

Here $N_t^i - \mu N_{t-1}^i$ can be interpreted as the number of new employees that the firm hires at the spot wage, and μN_{t-1}^i as the number of tenured employees with average wage $\overline{w}_{t-1}^i$.[22]

Note that the rigidity in our model is a real wage rigidity, although our channel could in principle work through nominal rigidities as well. There is evidence for the importance of both real and nominal rigidities.[23]

3.2.3 The debt contract.

The firm can raise capital through equity, and through long-term, risky debt with a coupon payment κ_t^i. In any period t, if the firm is debt-free (i.e., $\kappa_t^i = 0$), the firm can choose to issue new debt with a promised coupon of κ_{t+1}^i, with repayment starting at $t + 1$. When issuing new debt, the firm receives the market value of this debt Ψ_t^i from the creditors; the pricing of this debt is described below.

If the firm currently has outstanding debt (i.e., $\kappa_t^i > 0$), then the firm cannot alter its debt contract, so that $\kappa_{t+1}^i = \kappa_t^i$, unless one of the following conditions occur: i) The debt randomly expires between t and $t + 1$, which happens with probability p^{exp}, ii) The firm chooses to default at the start of $t + 1$. In both of these cases, $\kappa_{t+1}^i = 0$, and the firm can issue new debt at $t + 1$. We also assume that a firm's debt cannot expire before it has paid its first coupon payment.[24] The

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[22]It is possible that $N_t^i < \mu N_{t-1}^i$, in which case μN_{t-1}^i cannot be interpreted as tenured employees. In this case we would interpret the total wage bill as including payments to prematurely laid-off employees. Note that the wage bill can be rewritten as $\overline{w}_t^i N_t^i = \overline{w}_{t-1}^i N_t^i + (\mu N_{t-1}^i - N_t^i)(\overline{w}_{t-1}^i - w_t)$. Here the first term on the right is the wage paid to current employees and the second term represents the payments to prematurely laid off employees.

[23]See Barwell and Schweitzer (2007), Devicenti, Maida, and Sestito (2007), and Bauer, Goette, and Sunde (2007), Dickens, Goette, Groshen, Holden, Messina, Schweitzer, Turunen, and Ward (2007).

[24]In the real world, long-term debt typically pays a fixed coupon payment and then expires on a predetermined date. However, modeling this would require a very large state space since time until expiry would need to be a state variable. A common alternative for modeling long-term debt is to assume that the coupon payment deterministically decreases over time at some rate, for example, as in Gomes, Jermann, and Schmid (2016). We choose to model random expiry because it strikes us as more realistic: real world coupon payments do not shrink over time. Furthermore, these models typically imply that firms continuously issue or retire their debt, whereas in the data, capital structure adjustment is done in clusters as documented in Leary and Roberts (2005). The trade-off is that random expiry

probability of debt expiration determines the expected maturity of the debt, i.e., the average length of the debt contract is $\frac{1}{p^{exp}}$. The firm defaults at t if its cum-dividend market value V_{t+1} is below 0.

In the event of bankruptcy, equity holders are left with nothing and creditors inherit a debt-free firm. We assume that the firm's labor obligations are honored by the creditors.[25] Such a firm's cum-dividend value is denoted by V_{t+1}^0. Note that unlike most models of corporate debt, there are no explicit distress costs. However, long-term debt endogenously generates a debt overhang problem, as in Myers (1977), which causes under-investment. Therefore, despite the tax advantages of debt, forward looking firms choose to limit the amount of debt they take on. We will come back to this when we discuss the model's results.

The market price of a bond is determined in equilibrium; it depends on both the aggregate state (through the discount rate) and the firm's individual state (through probability of default and recovery value). It satisfies the following equation,

$$\Psi_t^i = E_t M_{t+1} \left[1_{\{exp\}} \times 0 + (1 - 1_{\{exp\}}) \times 1_{\{V_{t+1} \leq 0\}} \times V_{t+1}^0 + (1 - 1_{\{exp\}}) \left(1 - 1_{\{V_{t+1} \leq 0\}} \right) \left(\kappa_{t+1}^i + \Psi_{t+1}^i \right) \right],$$
(5)

where Ψ_t^i is the price of debt with coupon payment κ_{t+1}^i, $1_{\{exp\}}$ is an indicator function that takes the value of one when the debt expires and zero otherwise, and $1_{\{V_{t+1} \leq 0\}}$ is an indicator function that takes the value of one when the firm is insolvent and zero otherwise.

It is useful to summarize the timing of debt and bankruptcy. A firm enters period t with capital K_t, existing employees $N_{t-1}^i \mu$, average wage $\overline{w}_{t-1}^i$, and coupon κ_t^i. If the value of equity conditional on this state (defined below in equation 8) is positive, the firm operates and chooses employment N_t^i and investment I_t^i. Additionally, if $\kappa_t^i = 0$ because its debt expired between $t-1$ and t, the firm also chooses a new debt level, defined by κ_{t+1}^i; otherwise $\kappa_{t+1}^i = \kappa_t^i$. If the value of equity conditional on this state is zero or less, then the firm defaults and is taken over by creditors. It now becomes an all equity firm with the same capital, existing employees, and average wage as before, but with zero debt ($\kappa_t^i = 0$). At this stage, the firm chooses employment N_t^i, investment I_t^i, and a new debt level κ_{t+1}^i. After these choices are made, the debt may randomly expire between t and $t+1$, although it cannot expire for any firm that chose new debt at t.

3.2.4 Accounting. The equation for after-tax profit is

$$\Pi(K_t^i) = (1 - \tau)\left(Y_t^i - \overline{w}_t^i N_t^i - F_t - \kappa_t^i\right) + \tau\delta K_t^i \tag{6}$$

$\Pi(K_t^i)$ is after-tax profit, which is output less labor, operating costs, coupon payments, and taxes, plus the capital depreciation tax shield. Operating costs are defined as $F_t = f \times K_t$; they depend on aggregate (but not firm specific) capital.[26] Labor costs are $\overline{w}_t^i N_t^i$.

Convex capital adjustment costs are given by

$$\Phi(I_t^i, K_t^i) = \upsilon\left(\frac{I_t^i}{K_t^i}\right)^2 K_t^i,$$

where $\upsilon > 0$. The total dividend paid by the firm is

$$D_t^i = \Pi(K_t^i) - I_t^i - \Phi(I_t^i, K_t^i) + \Psi_t^i 1_{\{Issue\}}, \tag{7}$$

which is after-tax profit less investment and capital adjustment costs, plus the cash from newly issued debt where $1_{\{Issue\}}$ is an indicator function that takes the value of one when the firm issues new debt and zero otherwise.

3.2.5 The firm's problem. We now formally write down firm i's problem. The firm maximizes the present discounted value of future dividends

$$V_t^i = \max\left\{0, \quad \max_{I_{t+j}^i, N_{t+j}^i, \kappa_{t+j+1}^i} E_t\left[\sum_{j=0,\infty} M_{t+j} D_{t+j}^i\right]\right\}, \tag{8}$$

subject to the standard capital accumulation equation

$$K_{t+1}^i = (1 - \delta)K_t^i + I_t^i, \tag{9}$$

as well as equations (3), (4), (5), (6), and (7).

3.2.6 Credit spread. We define the credit spread CS_t in the model as the difference between the yield ζ_t^B on the defaultable debt and the yield of a comparable bond without default risk, ζ_t, i.e.,

$$CS_t = \zeta_t^B - \zeta_t, \tag{10}$$

with $\zeta_t^B = \frac{\kappa_{t+1}^i}{\Psi_t^i}$ and $\zeta_t = \frac{\kappa_{t+1}^i}{\Psi_t^i(safe)}$ where $\Psi_t^i(safe)$ is the price of an identical bond (with the same expiry risk) but without the possibility of default.[27]

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[26]Because this is a non-stationary economy, fixed costs must be scaled by some variable that is co-integrated with the size of the economy. We choose aggregate capital because it is the smoothest state variable.

[27]The formula for $\Psi_t^i(safe)$ is identical to equation 5, but with $1_{\{V_{t+1}\leq 0\}} = 0$.

3.3 Equilibrium

We assume that there exists some underlying set of aggregate state variables S_t which is sufficient for this problem. Each firm's individual state variables are given by the vector $S_t^i = [Z_t^i, K_t^i, N_{t-1}^i, \overline{w}_{t-1}^i, \kappa_t^i]$. Because the household is a representative agent, we are able to avoid explicitly solving the household's maximization problem and simply use the first order conditions to find M_{t+1} as an analytic function of consumption or expectations of future consumption. For instance, with CRRA utility, $M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\theta}$ while for Epstein-Zin utility $M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\frac{1}{\psi}} \left(\frac{U_{t+1}}{E_t[U_{t+1}^{1-\theta}]^{\frac{1}{1-\theta}}}\right)^{\frac{1}{\psi}-\theta}$.

The equilibrium consists of:

- Beliefs about the transition function of the aggregate state and the realized shocks: $S_{t+1} = \Gamma(S_t, Z_{t+1})$.
- Beliefs about the realized stochastic discount factor as a function of the aggregate state and the realized shocks: $M(S_t, Z_{t+1})$.
- Beliefs about the aggregate spot wage as a function of the aggregate state: $w(S_t)$.
- Beliefs about the price of debt, as a function of the state today and the firm's choice of coupon next period: $\Psi_t^i \left(S_t, S_t^i, \kappa_{t+1}^i\right)$.
- Firm policy functions for labor demand N_t^i, investment I_t^i, and financing κ_{t+1}^i; these are functions of S_t and S_t^i.

It must also be the case that given the above policy functions, all markets clear and the beliefs are consistent with simulated data, and therefore rational:

- The firm's policy functions maximize the firm's problem given beliefs about the wages, the stochastic discount factor, and the transition of the aggregate state.
- The labor market clears: $\sum N_t^i = 1$.
- The goods market clears: $C_t = \sum D_t^i + \kappa_i^t - \Psi_t^i 1_{\{Issue\}} + \overline{w}_t^i N_t^i + T_t^i + \Phi_t^i + F_t$. Inside the sum, the terms represent, in order, dividends paid by the firm, coupon payments made by the firm, cash paid to the firm during debt issuances, wages paid by the firm, taxes paid by the firm, capital adjustment costs, and fixed costs. Note that here we are assuming that all costs are paid by firms to individuals and are therefore consumed. The results look similar if all costs are instead wasted.
- The beliefs about M_{t+1} are consistent with goods market clearing through the household's Euler Equation.
- The belief about the price of debt is consistent with equation 5.
- Beliefs about the transition of the state variables are correct. For instance if aggregate capital is part of the aggregate state vector S_t, then it must be that $K_{t+1} = (1-\delta)K_t + \sum I_t^i$ where I_t^i is each firm's optimal policy.

3.4 Calibration

We solve the model at a quarterly frequency using a variation of the Krusell and Smith (1998) algorithm. We discuss the solution method in the online appendix. The model requires us to choose the preference parameters: β (time discount factor), θ (risk aversion), ψ (IES); the technology parameters: α and ρ (these jointly determine the labor share of output and the degree of return to scale), $\frac{1}{1-\eta}$ (elasticity of substitution between labor and capital), δ (depreciation), f (operating cost), and ν (capital adjustment cost). Finally, we must choose μ, which determines the frequency of wage resetting, and p^{exp}, which determines the duration of corporate debt. Additionally, we must choose a process for aggregate productivity shocks, and for idiosyncratic productivity shocks. Table 6 presents parameters of the benchmark calibration.

Preferences β is set to 0.9975 per quarter, this parameter directly impacts the level of the risk-free rate and is also related to the average investment to output ratio. θ is set to 8, to get a reasonably high Sharpe ratio, while keeping risk aversion within the range recommended by Mehra and Prescott (1985). ψ (IES) is set to 2; this also helps with the Sharpe ratio, and its value is consistent with the LRR literature.

Technology δ is set to 0.0233, which is consistent with estimates of quarterly depreciation in the data. Our production function has constant elasticity of substitution (CES), which includes Cobb-Douglas production as a special case if $\eta = 0$. We set $\eta = -1$, which matches empirical estimates of the elasticity of substitution between labor and capital. In our model this elasticity is $\frac{1}{1-\eta} = 0.5$, which is consistent with estimates between 0.4 and 0.6 in a survey article by Chirinko (2008). We also present results for a Cobb-Douglas version of the model.

The parameters α and ρ are related to labor share, profit share, and the investment to capital ratio.[28] In the benchmark calibration, we set $\rho = 0.8$ and $\alpha = 0.5$, these allow the model with $\eta = -1$ to have roughly the same profit share (0.2), labor share (0.6), and investment-to-output ratio (0.2) as the U.S. economy.

Operating Cost $F_t = f * K_t$ is a fixed cost from the perspective of the firm, however it depends on the aggregate state of the economy, in particular on aggregate capital. We choose $f = 0.019$ to roughly match the average unlevered market-to-book ratio (1.33) and default rate (0.82% per year) in the U.S. economy. Recall that the level of productivity is non-stationary, and various endogenous quantities, such as output and capital, are co-integrated with productivity; for this reason, the operating cost must also be co-integrated with aggregate productivity. We chose F_t to be proportional to K_t because capital is the smoothest of our endogenous state variables; the results are similar when F_t is simply growing at the same rate as the economy.

Capital Adjustment Cost We choose the capital adjustment cost $\nu = 8$ to match the ratio of the volatility of aggregate investment growth relative to the volatility of private GDP growth. This ratio is around 2.12 in the data.

Productivity Shocks In order for the standard LRR channel (IES>1) to produce high Sharpe

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[28]In the Cobb-Douglas case, labor share, capital share, and profit share are $(1 - \alpha)\rho$, $\alpha\rho$, and $1 - \rho$. The more general CES case does not allow for simple analytic formulas for these relationships.

ratios, aggregate productivity must be non-stationary with a stationary growth rate. As in Bansal and Yaron (2004) and Croce (2014), we assume that productivity growth follows an ARMA(1,1) process: $g_{t+1} = x_t + \epsilon_{t+1}$ where $E_t[g_{t+1}] = x_t = \rho_x x_{t-1} + \eta_t$ is an AR(1) process and ϵ_{t+1} is an i.i.d. shock. We discretize x and ϵ to have 3 states each, and choose the process to roughly match the volatility of the growth rate of real private GDP, which is 3.21% (1948-2014).[29]

The idiosyncratic productivity of firm i is Z_t^i. This follows a three-state Markov chain $Z_t^i \in \{Z_1^i, Z_2^i, Z_3^i\}$, where $Pr(Z_{t+1}^i = Z_j | Z_t^i = Z_k) = \pi_{kj}^Z \geq 0$. The parameters of this process are identical for all firms but the process is independent across firms. Unlike aggregate productivity, the level of firm productivity is stationary. We choose parameters so that the annual autocorrelation and unconditional standard deviation of Z_t^i are 0.9 and 0.1 respectively.[30]

Frequency of wage resetting In standard models wages are reset once per period, and employees receive the marginal product of labor as compensation. This corresponds to the $\mu = 0$ case. However, wages are far too volatile in these models relative to the data. We choose the frequency of resetting to roughly match the volatility of wages in the data. We set $\mu = 0.9$ implying an average resetting frequency of ten quarters, this may be thought of as not only explicit contract length but also as any implicit mechanism which prevents more frequent resetting. Our calibrated wage contract is consistent with recent estimates in the literature, e.g., Rich and Tracy (2004) estimate that a majority of labor contracts last between two and five years with a mean of three years; Hobijn and Sahin (2009) and Shimer (2005) estimate separation rates of around 3%/month in the U.S., implying an average job length of 2.8 years, if separations are equally likely for all workers.

Debt and Taxes We set the corporate tax rate τ to be 30%, which is consistent with the U.S. tax code and similar to Jermann and Quadrini (2012). The only parameter governing debt is the probability of expiry p^{exp}, which is set to 0.025. This implies that corporate debt is repaid, on average, after 10 years, which is close to the estimate in Guedes and Opler (1996). We chose this number because the trade-off between the tax advantage of financial leverage, and the debt overhang costs of under-investment, which are induced by long-term debt, imply a leverage ratio similar to that in the data.

4 Model Results

In this section, we study the model implications for credit markets. First, as a preliminary analysis, we show that adding rigid wages to an otherwise standard model can improve the model's asset pricing performance. This is because rigid wages act like operating leverage, leading to more procyclical profits and dividends. On the other hand, frictionless models tend to have wages

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[29]$\epsilon = \{-0.043, 0, 0.043\}$ with equal probability. $x = \{1.002, 1.005, 1.008\}$ with transition probabilities $\pi_{11} = 0.938$, $\pi_{12} = 0.062$, $\pi_{13} = 0$, $\pi_{21} = 0.031$, $\pi_{22} = 0.938$, $\pi_{23} = 0.031$, $\pi_{31} = 0$, $\pi_{32} = 0.062$, $\pi_{33} = 0.938$.

[30]The actual values are $Z_L = 0.2125$, $Z_M = 0.25$, $Z_H = 0.2875$ and the transition probabilities are $\pi_{11}^Z = 0.965$, $\pi_{12}^Z = 0.035$, $\pi_{13}^Z = 0$, $\pi_{21}^Z = 0.0175$, $\pi_{22}^Z = 0.965$, $\pi_{23}^Z = 0.0175$, $\pi_{31}^Z = 0$, $\pi_{32}^Z = 0.035$, $\pi_{33}^Z = 0.965$. We set the mean of Z^i to be 0.25 so that the average capital in our model is roughly the same as in a model solved annually with the same production function.

that are too volatile, profits that are too smooth, and dividends that are countercyclical. Labor induced operating leverage caused by rigid wages greatly increases equity volatility. In addition, because labor leverage varies through time and in the cross-section, expected equity returns vary through time and across firms. In models of rigid wages, labor leverage is high when labor share is high, or when wage growth is low; the latter effect happens because after a negative productivity shock, output is falling but wages are falling by less. Favilukis and Lin (2016a) confirm that these theoretical results are empirically relevant for equity returns - wage growth negatively forecasts equity returns at the aggregate, industry, and U.S. state levels. Second, in our primary analysis, we focus on the impact of labor leverage on credit markets. We show that wage rigidity can explain much of the variation in both debt prices (credit spreads) and quantities (debt issuance policies), as observed in the data; it also matters for real quantities like employment growth, wage growth, and investment rate.

4.1 Policy and value functions

In this section, we analyze the model implied policy and value functions. We show that the model generates a tight link between past wages and firms' policies (hiring, investment and debt issuance) and equity and debt values. Online appendix section A.3 contains a detailed discussion and plots (figure A1 for policy functions and A2 for value functions). Firms with no current coupon payments invest relatively more, and those with high coupon payments relatively less – this is the classic debt overhang problem of Myers (1977). More importantly for the focus of this paper, firms with low past wages invest relatively more, while firms with high past wages relatively less. Employment policy is similar to investment – firms with high coupon or wage obligations hire fewer employees.

Turning to the value functions, the firm's equity value increases with its capital stock. However, conditional on capital, firms with high past wages, or high current debt obligations have lower equity values. Firms default if their equity value is zero, and this may happen even if they have positive capital. For the same level of capital, a firm with high coupon payments, or high past wages is more likely to default. The price of debt of firms with high past wages is worth less (per dollar of coupon payments), as these firms are more likely to see their value erode due to high wage obligations, and to subsequently default. Firms with higher past wages also issue less new debt.

4.2 Aggregate quantities

Table 7 presents aggregate statistics from our model; although the model is solved quarterly, we aggregate all results to an annual frequency. Panel A shows that the model does a reasonably good job at matching macroeconomic moments, with the volatilities of investment, consumption, and wages all about the right magnitude relative to the volatility of output.

In a standard model with Cobb-Douglas ($\eta = 0$) production and no labor market frictions ($\mu = 0$), wages are perfectly correlated with output and the labor share is constant. In our model, labor leverage arises due to a combination of wage rigidity ($\mu > 0$) and labor-capital complementarity ($\eta < 0$). Favilukis and Lin (2016b) show that these two departures from the

standard model both induce labor leverage by reducing the volatility of wages and the correlation of wages with output.[31] Because labor expenses are such a large fraction of the firm's total expenses, labor leverage can have a large influence on asset prices.

Panel B reports the means and volatilities of the risk free rate and the excess equity return, and the average excess return on a corporate bond portfolio. Due to a relatively high IES, the risk free rate is low and smooth and there is no risk free rate puzzle. The model also generates a sizable equity premium (3%) and equity volatility (8.2%). This happens because when output falls, wages do not fall by as much, causing profits and dividends to fall more in bad times, which in turn makes equity extra risky, consistent with Favilukis and Lin (2016b). Although the equity volatility is only about half of what it is in the data, this is already a significant improvement over what a frictionless model would produce.

Leverage Panel C reports several credit market variables: the leverage ratio, the default rate, and the credit spread. Even though debt issuance is procyclical, both market and book leverage[32] are countercyclical, as in the data, because the market value of equity is more sensitive to aggregate shocks than the market or book value of debt. Importantly, the under leverage puzzle – the quantitative observation that, in static models, trade-off theory between taxes and bankruptcy costs implies leverage that is much higher than in the data – is not present in our model. As in standard trade-off theory, firms in our model take advantage of the interest tax deduction by issuing debt. In standard trade-off theory, this force is countered by the higher probability of paying bankruptcy costs when leverage is high. In our model, explicit bankruptcy costs are absent, however, the debt overhang problem limits the amount of debt financing firms choose to use.

The debt overhang problem, as described by Myers (1977), is that firms with outstanding debt tend to invest too little. Underinvestment is optimal for equity, but decreases the firm's enterprise value (debt plus equity). In our model, equity holders anticipate future under-investment, and limit the amount of debt issued, despite its tax advantage. Hennessy (2004), Moyen (2007), Gomes, Jermann, and Schmid (2016) have pointed out that the debt overhang problem may be more severe for long-term assets and long-term debt. We find that allowing for long-term debt, even without bankruptcy costs or financing frictions, is enough to generate a realistic leverage ratio. We also find that long-term debt overhang, and long run risk interact to make the effect quantitatively stronger.[33]

Default The default rate, which is closely related to the size of idiosyncratic shocks and the fixed cost f, has a similar magnitude and volatility as in the data, although it is more countercyclical than in the data.[34] It is countercyclical because when the economy is hit by negative shocks and

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[31]Donangelo, Gourio, and Palacios (2016) also use complementarity between capital and labor to build labor leverage into their model.

[32]We define market (book) leverage as the ratio of the market (book) value of the debt to the market value of the equity plus the market (book) value of the debt. In the data, we only have book value of debt.

[33]Hennessy and Whited (2005), Hennessy and Whited (2007), DeAngelo, DeAngelo, and Whited (2007), Chen (2010), and Li, Whited, and Wu (2015), among others, have shown that a combination of financial frictions and distress costs can also generate a realistic leverage ratio; we abstract from such frictions in our model.

[34]The default rate time-series is computed as the average across all rated bonds each year, 1948-2006.

revenues fall, firms are unable to reduce the interest payments on long-term debt contracts, and find it optimal to default. This effect is magnified by the presence of wage rigidity: not only do firms need to make fixed payments to creditors, which rise relative to revenues in bad times, firms must also make semi-fixed payments to employees, which also rise relative to revenues in bad times.

Credit spread Finally, the credit spread in our model has similar magnitude, volatility, and cyclicality to the credit spread in the data. In section 4.5 below, we also show that expected loss accounts for a fairly small fraction of the spread, as in the data. The credit spread is countercyclical because, as discussed above, expected defaults are highest after a series of negative output shocks. This is when both interest and wage obligations are highest relative to revenues. Because shocks are persistent, this is also when the credit spread is highest.

Jones, Mason, and Rosenfeld (1984), Huang and Huang (2012), among others, argue that the size of the credit spread is difficult to rationalize in standard models; this is referred to as the credit spread puzzle. In our model, the credit spread is large due to an interaction between long-term corporate debt and long run risk. Bhamra, Kuehn, and Strebulaev (2010a) have previously shown that long run risk can account for a sizable credit spread, we show below that wage rigidity can further increase the credit spread. In a long run risk world, shocks to the long-term growth rate of the economy are especially important for the price of risk. Safe long-term debt is a very good hedge against such shocks, because it promises a fixed set of payments far into the future, even if the economy experiences a long sequence of low growth. However, unlike safe long-term debt, corporate debt is likely to default exactly after such a low growth sequence. As a result, the spread between risky and safe corporate debt is large. As mentioned earlier, rigid wages magnify this effect because firms are limited in their ability to reduce their labor expenses when negative economic shocks hit. It is useful to compare this mechanism to Chen, Collin-Dufresne, and Goldstein (2009), who argue that defaults are likely to occur when the price of risk is high and use Campbell and Cochrane (1999) habit preferences to rationalize a large credit spread.

4.3 The interaction of labor and credit markets

As discussed earlier, if wages are rigid, labor leverage is especially high when wage growth is low, or when labor share is high. Our model suggests that times when labor leverage is high, as measured by low wage growth or high labor share, are times when the credit markets are especially risky. Thus, low wage growth and high labor share should be associated with stress in the credit markets.

To test the effect of labor leverage on credit markets, we regress the credit spread at $t+1$, or the issuance of debt between t and $t+1$, on either labor share or on wage growth (labor expense growth when done at the firm-level). We define the issuance of debt to be the growth in the book value of debt between t and $t+1$. Table 8 reports these results for aggregate U.S. data, and aggregate model data in Panel A; and for firm-level international data, and firm-level model data in Panel B. Firm-level regressions employ the Fama and MacBeth (1973) cross-sectional approach. The results in this table are all univariate to facilitate the comparison of model and data, but the data section, above, presented a more thorough empirical analysis.

Consistent with the labor leverage intuition, wage growth (negatively) and labor share (positively) forecast credit spread. At the same time, wage growth (positively) and labor share (negatively) forecast issuance of debt. These results suggest that high labor leverage is associated with distress in the credit market. These are times when losses are high, issuance costs are high, and firms are hesitant to take on new debt. Of the eight regressions (aggregate versus firm level, credit spread versus debt growth as the dependent variable, wage growth versus labor share as the independent variable), the only statistically insignificant relationship is between aggregate labor share and aggregate debt growth (the t-statistic is -0.93).

We also regress, in the cross-section, the credit spread at $t + 1$ on both financial leverage and labor share (not reported in tables). In the model, both are positively associated with the credit spread and contribute to the R^2, which is 0.07 for just labor share, 0.49 for just financial leverage, and 0.55 for both. Note that models with frictionless labor markets predict that only financial leverage should affect risk, but with labor market frictions, it is total leverage, including labor leverage, that matters. Thus, labor leverage and financial leverage are both important for credit risk. In the data both financial leverage and labor share positively and significantly forecast credit spread, with adjusted R^2's of 0.04, 0.04, and 0.08 for just labor share, just financial leverage, or both forecasting CDS spread; and adjusted R^2's of 0.01, 0.07, and 0.08 for forecasting EDF.

In addition to predicting debt issuance, labor share is also strongly negatively related to contemporaneous financial leverage in the cross-section of firms. This can be seen in Figure 1, where we plot labor share against book (left panel) and market (right panel) leverage.

4.4 The real effect of labor and financial leverage

In this section, we explore how labor leverage and financial leverage affect real quantities in the model and in the data. Results are reported in Panels C and D of Table 8. We run bivariate Fama and MacBeth (1973) regressions of several real quantities on these two key determinants of credit risk at the firm level.[35] Labor share and financial leverage both negatively forecast employment growth ΔN_{t+1}^i, and investment rate IK_{t+1}^i, as firms are overburdened with excess labor and financial debt overhang. These patterns are also apparent in the policy function plots in the online appendix figure A1. Consistent with these firm level findings, aggregate financial and labor leverage both negatively forecast future aggregate wage growth ΔW_{t+1}^{agg}. This is because high leverage at the firm level weakens demand for labor, therefore aggregate wages must fall to clear the labor market.[36] In addition to predicting real quantities, labor share and financial leverage are both positively related to future equity volatility.[37] Lastly, we rerun the same regressions but use credit spread itself as

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[35]We use bivariate regressions for ease of exposition, results are similar when we include controls.

[36]Aggregate labor share and financial leverage negatively predicts future aggregate employment growth in the data, the same as in the firm level regression. We cannot look at this relationship in the model because aggregate labor supply is fixed in the model.

[37]They are also positively related to asset volatility (this is not in the table to conserve space). Interestingly, while labor share remains strong, financial leverage becomes much weaker and contributes far less to the R^2 of asset volatility. This is sensible in light of Modigliani and Miller (1958), who predict that financial leverage should affect equity risk, but not asset risk. Modigliani and Miller (1958) does not hold exactly in our model, due to taxes and

the key explanatory variable, rather than labor and financial leverage. Credit spread negatively forecasts investment, employment growth, and wage growth; and positively forecasts volatility. Panel D presents analogous results with real world data, they are consistent with the model results in Panel C.[38] Our findings are consistent with Gilchrist and Zakrajsek (2012) who show that the excess bond risk premium negatively forecasts aggregate investment, employment growth, and GDP growth.

4.5 Inspecting the mechanism

In this section, we inspect the model mechanism by first analyzing the impulse responses and then studying different model specifications quantitatively. We also decompose the credit spread into expected loss and credit risk premium to understand their different roles in contributing to the magnitude and the variation of the credit spread.

4.5.1 Impulse responses. We first discuss the impulse responses for key variables of interest in the baseline (figure A3) and the frictionless, Cobb-Douglas (figure A4) models, a more detailed discussion is in section A.3 of the online appendix. First, consider the response where initial labor share is equal to its unconditional average. In the frictionless, Cobb-Douglas model, after a negative shock, wages and profit fall immediately by exactly the same amount, and are afterwards constant, resulting in a constant labor share, whereas wages fall by far less on impact and then continue to fall slowly in the baseline model, causing the labor share to rise and profit to fall by much more. Thus, the capital owners - debt and equity - absorb a much larger fraction of the negative shock in the baseline model. This is the key channel where wage rigidity makes profit more responsive to shocks than wages. Investment falls, the credit spread rises, and leverage rises on impact in the two models with roughly the same percentage terms, although the initial levels of credit spread and leverage are different.

Next, consider conditioning on high initial labor share in the baseline model. Following a negative shock, firms delever very quickly through both less new issuance and default. In contrast, in the case of low initial labor share, delevering is slow despite a negative shock, because low labor leverage makes financial leverage not particularly risky. Furthermore, the initial credit spread is much higher with high initial labor share because high labor obligations leave less for creditors to claim. Thus, the model implies a tight link between labor obligations and credit spreads. On the other hand, in the frictionless, Cobb-Douglas model, labor share is constant thus the model is unable to speak to these interesting interactions between labor leverage and credit risk.

4.5.2 Quantitative analysis. We now discuss how various model ingredients contribute to the results, by comparing several alternative models. In Table 9 we present data moments (1st row), results from our baseline model (2nd row), a model with no labor market frictions (3rd row), a

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debt overhang, thus financial leverage affects asset risk, but to a far weaker degree than equity risk.

[38]To be consistent with the model, the results we present do not have country fixed effects. The significance of labor share rises in all of these regressions when we do include country fixed effects.

model with Cobb-Douglas production (4th row), a model with Cobb-Douglas production and no labor market frictions (5th row), a model with short-term debt (6th row), a model with low IES (7th row), and a model with low risk aversion (8th row).[39] An analogous table, where we compare models with alternative preference parameters is in the online appendix (Table A2).

In panel A we present several moments related to asset prices and credit markets from these models and the data. Panels B (aggregate) and C (firm-level) highlight the effect of labor leverage on credit markets. In these two panels we present correlations of the credit spread with either residual wage growth, or residual labor share; and correlations of debt issuance with either residual wage growth, or residual labor share. We define residual wage growth as the residual from regressing wage growth on output growth (sales growth in firm level regressions), and similarly for labor share and labor expense growth. In Panel D we decompose the credit spread into expected loss and a credit risk premium.

The reason we compute residual wage growth and labor share is that in the model, output growth has predictive power for credit spread and debt growth that is independent of the labor leverage effect, and output growth is correlated with labor market variables.[40] We are interested in isolating just the effect of labor leverage. Whether we compute raw correlations (not reported), or residual correlations, has no effect on the sign and little effect on the magnitude of the correlation in the data or in our baseline model.[41] However, as will be discussed below, it does make a difference for the frictionless, Cobb-Douglas model.

The impact of labor frictions First, consider a model identical to our baseline model, but with no labor market frictions ($\mu = 0$, No rigidity). As discussed in Favilukis and Lin (2016b), even in a frictionless model ($\mu = 0$), when labor and capital are more complementary ($\eta < 0$) than in the Cobb-Douglas case ($\eta = 0$), the wage is smoother than output, therefore, most of the intuition from our baseline model carries over to this model. Smooth wages imply that labor payments will induce operating leverage for the same reason as in a model with infrequent renegotiation of contracts. Thus, as in our baseline model, Panels B and C show that in this model, wage growth is negatively associated with credit spreads, and positively with debt growth; labor share is positively associated with credit spreads, and negatively with debt growth. However, Panel A shows that without labor market frictions, the model implies credit spreads and default rates that are too low. In addition, the equity premium and volatility are also lower than the data and the baseline model.

Now, consider a model identical to our baseline model, but with Cobb-Douglas production

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[39]For each model, we change the fixed cost f and adjustment cost υ to match the market-to-book ratio and investment volatility, as in the baseline model. For the Cobb-Douglas models, we also change α to 0.25, implying an average labor share of 0.6 and profit share of 0.2, as in the baseline model. For the short-term debt model, the debt-overhang channel is not active, therefore we reduce the recovery rate at default from 100% to get an intermediate level of the capital structure; we choose 91% to match the default rate.

[40]The predictability of output growth is driven by its high correlation with productivity growth, which is inversely related to the stress in credit market, and by its correlation with interest rates, which are positively related to the tax advantage of debt.

[41]Although the signs of the correlations in the firm level data are consistent with our intuition, their magnitudes are relatively low. The reason for this is that firms in the data are quite diverse. When we control for country fixed effects, the magnitudes of the correlations rise.

($\mu = 0.9$, CD). Again, most of the intuition from our baseline model carries over to this model. Thus, labor share is positively associated with credit spreads, and negatively with debt growth for both aggregate and firm level simulated data; wage growth is negatively associated with credit spreads, and positively with debt growth for aggregate simulated data. However, at the firm level, the relationship of labor expense growth with credit market variables is mostly gone when controlling for output growth. This is not the case in the data or in our baseline model. Additionally, with $\eta = 0$, the equity return is far less volatile. Finally, because the market value of equity is not procyclical enough, market leverage is actually procyclical, unlike the data and our baseline model. Thus, the model with CES production ($\eta = -1$) is a much better fit to the data.

Next, consider a model with Cobb-Douglas production and frictionless labor markets ($\mu = 0$, CD, rigidity). In this model wage growth is equal to output growth, and the labor share is constant. Labor share now has zero association with either the credit spread or debt growth, regardless of whether we use raw or residual labor share. When we control for output growth, there is zero association between residual wage growth and either the credit spread or debt growth. Raw wage growth is still negatively associated with credit spreads, and positively with debt growth (not reported), but only because of its perfect correlation with output growth. In all of our empirical results, we control for output growth and find that wage growth is still a significant predictor of credit spreads and of debt growth – a fact that a frictionless Cobb-Douglas model cannot match.

The impact of household preferences and debt contract maturity Next, we explore the importance of preferences for our results by solving a version the model with either lower IES, or lower risk aversion. These models are qualitatively similar to our baseline model, however, in both cases, the agent is less fearful of risky assets. The equity return premium, debt return premium, and credit spread are all lower, and financial leverage is higher.

We also compare the baseline model to a model with short-term debt. With short-term debt, the market leverage ratio is far too high, this is the under-leverage puzzle.[42] If we were to lower the recovery rate, the default rate would become too low, but leverage would not fall by much. This is because firms do not face much uncertainty in the short-term, and can issue a high amount of short-term debt with a negligible chance of default. The credit spread is also far too low in this model, because with short-term debt, defaults are more likely to happen for idiosyncratic reasons, and are less correlated with priced risk. Counter-factually, the leverage ratio is highly procyclical because firms issue much more debt when the tax advantage of debt is higher. This happens in good times, when interest rates are high. In the long-term debt model, the tax advantage of debt is also higher in good times, and debt issuance is also procyclical. However, firms are hesitant to issue too much debt because they fear having high coupon payments when a downturn comes. Thus, in the long-term debt model and in the data, the leverage ratio is countercyclical because firm value is strongly procyclical. Overall, the short-term debt model is poor quantitative fit for credit market data.

The short-term debt model also fails to produce the kinds of correlations that we document in

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[42]This counter-factually high leverage is also why this model has a higher equity volatility.

the data and in our baseline model. One reason for this, is that as discussed earlier, firms face very little short-term risk. Another reason is that, consistent with the labor leverage channel, there is a strong negative association between labor share, and financial leverage. Thus, low labor share firms are not necessarily less risky, because they have so much financial leverage. As shown in Figure 1, this negative association between labor share and financial leverage is also present in our baseline model, but this effect is much stronger in the short-term debt model.

Decomposition of credit spreads In Panel D we decompose the credit spread into its two components: expected loss and the credit risk premium. We compute expected loss as the probability of default multiplied by the loss conditional on default for each firm in each period.[43] The probability of default in the baseline model is 0.84% per year, which matches the average probability, and is somewhere between BBB and BB, as reported by Elton et al. (2001). The loss conditional on default in the baseline model is 49%, which is very similar to the 51% for BBB reported in Elton et al. (2001), and 48.7% in Huang and Huang (2012), who report the average recovery rates from the Moody's report of Keenan, Shtogrin, and Sobehart (1999). These numbers imply a value-weighted one year expected loss that is 17% of the aggregate credit spread in our model, the remainder being the risk premium. Elton et al. (2001) report expected one year losses between 9% and 39% of the credit spread for BBB bonds, depending how the state tax deductions are treated. Thus, as in the data, the credit risk premium, rather than expected loss, accounts for most of the credit spread in our model.

We earlier showed that labor share is an important driver of the credit spread. In Panel D, we compute the contemporaneous correlation of labor share with the two components of the credit spread. Labor share is positively related to both expected loss, and the credit risk premium, though the relationship to the credit risk premium is stronger. We do a similar decomposition in the data. As in the model, all three correlations are positive, with the risk premium correlation being much bigger than expected loss correlation, although the magnitudes of the correlations are lower than the model.[44]

Comparing across models, although different versions of the model have different levels of the credit spread, the fraction attributed to expected losses is about the same in most models. Models with lower IES or lower risk aversion are an exception, here expected losses are a larger fraction of the credit spread, since the risk premium matters relatively less. The positive relationship between labor share and the credit risk premium is present in the model with CES and $\mu = 0$ (No rigidity) and the model with Cobb-Douglas productivity and $\mu = 0.9$ (CD) because, as discussed above, in both models wages are smoother than the marginal product of labor. The frictionless, Cobb-Douglas model has no relationship between labor share and credit risk because labor share

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[43]The probability of default is computed using a Probit regression of defaults on firm and aggregate state variables using simulated data, while the loss given default is computed with a linear regression with the same set of regressors. This is similar to the procedure in Elton et al. (2001).

[44]Because of data availability, we are unable to decompose the aggregate credit spread in the same way as Elton et al. (2001) or as we do in the model. Instead, we use the aggregate default rate from Moody's at t to forecast the default rate at $t+1$, this alone delivers an R^2 of 0.52. We then multiply the expected default by 0.5 (this is equal to the average loss given default) to compute expected loss.

is constant, while in the short term debt model, the relationship is actually negative.

To summarize, our model's key features are frictions in the labor market, a high degree of complementarity between capital and labor, and a long maturity of debt. When we turn off some of these features one at a time, the model can still match some parts of the data, however all three features are necessary to produce sizable credit spreads with realistic default rates and expected losses, a realistic leverage ratio, volatile debt and equity returns, and a positive relationship between credit market stress (high credit spreads or low debt growth) with high labor share or low wage growth.

5   Conclusion

We argue that understanding labor markets is crucial for understanding credit markets. We solve a model with labor market frictions and show that in such a model, the credit spread is predicted by wage growth (negatively) and labor share (positively). Conversely, debt growth is predicted by wage growth (positively) and labor share (negatively). This is because each of these variables is related to labor induced operating leverage, which makes debt more risky. In addition to time-series dynamics, the model performs well quantitatively along several dimensions, including the average size of the credit spread, the default rate, the financial leverage ratio, and the mean and volatility of equity returns. We explore this model's implications in both aggregate and firm-level data and find broad support for the labor leverage channel.

Regarding credit risk, we find that the aggregate U.S. Baa-Aaa credit spread is negatively predicted by wage growth and positively by labor share. Similarly, we find that the firm-level Moody-KMV expected default probability (for a large cross-section of international firms) is negatively predicted by labor expense growth, and positively by labor share.

Regarding capital structure, we find that the growth rate of aggregate debt in the U.S. is positively predicted by wage growth and negatively by labor share. Similarly, we find that the firm-level debt growth (for a large cross-section of international firms) is positively predicted by labor expense growth, and negatively by labor share.

Finally, we find that firms with higher labor share tend to have lower financial leverage, suggesting that labor leverage and financial leverage are substitutes.

Taken together, these results suggest that labor markets have an important effect on credit markets. Information from labor markets should be considered when computing the cost of debt capital, and the decision to issue debt.

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Table 1: Aggregate credit spread, debt growth, and labor market variables

This table reports regressions of either credit spread at $t+1$ (CS, panels A and B) or debt growth between t and $t+1$ (ΔDEBT, panels C and D) on either wage growth at t (ΔW, panels A and C) or labor share at t (LS, panels B and D). Each panel includes the univariate relationship, as well as bivariate regressions with one control at a time in the columns. In each panel, the first row presents the coefficient on the variable of interest (either ΔW or LS), the second row presents its t-stat, the third row presents the coefficient on the control variable, and the fourth row presents its t-stat. The last row presents the adjusted R^2. CS is the Moody's Baa-Aaa corporate bond yield; ΔDEBT is the growth rate of 'Nonfinancial business' credit market instruments; liability' from Flow of Funds Table L102; ΔW is the growth rate of real wages and salaries per employee; LS is the aggregate compensation divided by GDP. The controls are the growth rate of real private nonresidential fixed investment (ΔINV); financial leverage, measured as the book value of nonfinancial credit instruments divided by the sum of the market value of equities and credit instruments of nonfinancial corporate sector (FinLev); the equity price to earnings ratio from Robert Shiller's website (P/E); the long-term (10 year) government bond yield minus the short-term (1 year) government bond yield (TS); the annual volatility of CRSP value-weighted market premium (MktVol); the real 1 year government bond yield from Robert Shiller's website (RF); the real GDP growth from NIPA (ΔGDP); the real consumption growth from NIPA (ΔC); the employment growth from NIPA (ΔN); and the lagged value of the dependent variable (lag y). Below the coefficients, we report heteroscedasticity and autocorrelation consistent t-statistics (Newey and West (1987)). The sample is from 1948 to 2014.

	ΔW	LS	ΔINV	FinLev	MktVol	P/E	TS	RF	ΔGDP	ΔC	ΔN	lag y
Panel A: Credit spread and wage growth												
$\beta_{\Delta W}$	-15.40	-14.47	-14.82	-8.08	-13.04	-14.86	-15.29	-16.67	-11.9	-12.24	-14.84	-7.80
	(-4.15)	(-4.41)	(-3.75)	(-2.86)	(-4.32)	(-4.92)	(-4.90)	(-3.68)	(-2.90)	(-2.89)	(-3.94)	(-2.22)
β_x		8.52	-0.63	2.17	2.84	0.00	-5.36	4.63	-4.03	-4.07	-2.94	0.62
		(3.13)	(-1.24)	(4.77)	(6.35)	(-0.49)	(-1.62)	(2.61)	(-2.05)	(-1.32)	(-1.83)	(7.47)
adj. R^2	0.28	0.34	0.28	0.42	0.41	0.28	0.30	0.37	0.32	0.29	0.29	0.59
Panel B: Credit spread and labor share												
β_{LS}	8.52	10.66	10.33	6.33	6.33	11.14	9.83	9.28	8.57	11.23	10.43	5.82
	(3.13)	(2.55)	(2.09)	(1.46)	(1.45)	(2.04)	(2.19)	(1.83)	(2.57)	(3.76)	(2.33)	(3.11)
β_x	-14.47		-1.20	2.71	3.14	-0.01	-3.79	2.24	-6.72	-9.84	-4.09	0.70
	(-4.41)		(-2.45)	(5.73)	(4.68)	(-1.06)	(-0.71)	(0.98)	(-3.01)	(-3.57)	(-1.97)	(12.58)
adj. R^2	0.34	0.09	0.11	0.40	0.24	0.13	0.09	0.10	0.25	0.29	0.12	0.56
Panel C: Debt growth and wage growth												
$\beta_{\Delta W}$	1.35	1.33	1.25	1.12	1.19	1.43	1.36	1.29	1.10	0.68	1.29	0.71
	(4.51)	(4.10)	(4.90)	(3.04)	(3.61)	(4.06)	(4.46)	(4.58)	(5.23)	(2.55)	(4.90)	(2.35)
β_x		-0.22	0.12	-0.07	-0.20	-0.00	-0.15	0.22	0.37	0.87	0.32	0.50
		(-0.69)	(1.33)	(-0.81)	(-2.37)	(-1.51)	(-0.41)	(2.76)	(1.43)	(2.66)	(1.02)	(4.91)
adj. R^2	0.25	0.25	0.28	0.26	0.32	0.26	0.24	0.27	0.29	0.37	0.27	0.44
Panel D: Debt growth and labor share												
β_{LS}	-0.22	-0.42	-0.37	-0.15	-0.05	-0.42	-0.47	-0.67	-0.24	-0.49	-0.40	-0.45
	(-0.69)	(-0.93)	(-0.83)	(-0.32)	(-0.10)	(-0.92)	(-1.13)	(-1.59)	(-0.66)	(-1.59)	(-0.97)	(-2.19)
β_x	1.33		0.17	-0.17	-0.27	-0.00	-0.21	0.40	0.61	1.19	0.43	0.64
	(4.10)		(1.68)	(-1.96)	(-1.96)	(-0.09)	(-0.35)	(4.04)	(2.03)	(3.95)	(1.14)	(8.60)
adj. R^2	0.25	0.00	0.07	0.13	0.13	-0.01	-0.01	0.07	0.14	0.35	0.04	0.41

Table 2: Firm level credit risk and labor market variables

This table reports the results of cross-sectional regressions using labor expense growth (ΔXLR) or labor share (LS) at t to predict default risk (EDF) at $t+1$ or the debt growth between t and $t+1$ (ΔDEBT). There are four relationships of interest, presented in columns 1-4 of each panel: EDF on ΔXLR, EDF on LS, ΔDEBT on ΔXLR, and ΔDEBT on LS. The four panels present different specifications of these four relationships. Panel A presents univariate regressions, Panel B presents univariate regressions with country fixed effects (FE), Panel C adds book leverage (LEVB) and past equity volatility σ as controls, and Panel D has additional controls. The control variables include working capital ($WCTA$), retained earnings ($RETA$), EBIT ($EBITTA$), sales (STA), net income ($NITA$), current asset to liability ($CACL$), investment ($Invest$), equity excess return (R_{excess}), relative size ($RSIZE$), market return (R_m), market capitalization ($MCAP$). The online appendix provides additional details on variable construction. All the results are estimated using Fama and MacBeth (1973) cross-sectional regressions. The t-statistics reported in the parentheses below each coefficient estimate are heteroscedasticity and autocorrelation consistent (Newey and West (1987)).

	Panel A				Panel B			
y	EDF	EDF	ΔDEBT	ΔDEBT	EDF	EDF	ΔDEBT	ΔDEBT
ΔXLR	-0.92		0.10		-0.98		0.10	
	(-7.64)		(6.32)		(-8.47)		(5.98)	
LS		0.43		-0.03		0.61		-0.03
		(5.46)		(-7.32)		(6.11)		(-5.96)
Controls	No	No	No	No	No	No	No	No
FE	No	No	No	No	Yes	Yes	Yes	Yes
Obs.	77082	76553	105313	104627	77082	76553	105313	104627
Avg.R^2	0.007	0.004	0.005	0.001	0.085	0.086	0.026	0.022
	Panel C				Panel D			
y	EDF	EDF	ΔDEBT	ΔDEBT	EDF	EDF	ΔDEBT	ΔDEBT
ΔXLR	-0.87		0.09		-0.45		0.06	
	(-8.85)		(6.33)		(-7.20)		(5.70)	
LS		0.66		-0.03		0.61		-0.02
		(7.01)		(-6.11)		(4.55)		(-4.23)
LEVB	6.30	6.15	-0.49	-0.49	4.75	4.62	-0.49	-0.49
	(4.73)	(4.75)	(-11.44)	(-11.77)	(4.05)	(3.99)	(-8.63)	(-8.81)
σ	1.52	1.49	-0.00	-0.00	1.48	1.47	-0.01	-0.01
	(4.88)	(4.63)	(-1.80)	(-1.67)	(6.78)	(6.75)	(-4.11)	(-4.26)
Controls	No	No	No	No	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	76527	76021	104203	103555	74786	73376	103314	101517
Avg.R^2	0.173	0.174	0.048	0.044	0.290	0.296	0.059	0.058

Table 3: Firm level credit risk, labor market variables, by degree of rigidity

This table reports the results of cross-sectional regressions using labor expense growth (ΔXLR) or labor share (LS) at t to predict default risk (EDF) at $t+1$ or the debt growth between t and $t+1$ (ΔDEBT). Here, we are interested in this relationship, conditional on the degree of wage rigidity. We define rigidity μ as the inverse of the volatility of each firm's labor expense growth. There are four relationships of interest: EDF on ΔXLR, EDF on LS, ΔDEBT on ΔXLR, and ΔDEBT on LS. For each set of relationships, we present three regressions. The first regression includes an interaction between rigidity μ and our explanatory variable of interest (either ΔXLR or LS), and controls for μ as well. The second regression is restricted to include only firms in the top 25th percentile of μ, while the third regression includes only firms in the bottom 75th percentile of μ. All results include country fixed effects (FE) and the following controls: book leverage (LEVB), past equity volatility σ, working capital ($WCTA$), retained earnings ($RETA$), EBIT ($EBITTA$), sales (STA), net income ($NITA$), current asset to liability ($CACL$), investment ($Invest$), equity excess return (R_{excess}), relative size ($RSIZE$), market return (R_m), market capitalization ($MCAP$). The online appendix provides additional details on variable construction. All the results are estimated using Fama and MacBeth (1973) cross-sectional regressions. The t-statistics reported in the parentheses below each coefficient estimate are heteroscedasticity and autocorrelation consistent (Newey and West (1987)).

Sample	EDF and ΔXLR			EDF and LS			ΔDEBT and ΔXLR			ΔDEBT and LS		
	All	High μ	Low μ	All	High μ	Low μ	All	High μ	Low μ	All	High μ	Low μ
ΔXLR	-0.08	-1.50	-0.42				-0.01	0.28	0.05			
	(-1.35)	(-9.24)	(-7.18)				(-1.32)	(6.28)	(5.94)			
LS				0.50	1.14	0.55				-0.02	-0.04	-0.02
				(3.35)	(7.62)	(4.06)				(-2.21)	(-4.19)	(-3.41)
ΔXLR$\times\mu$	-0.21						0.03					
	(-4.94)						(10.57)					
LS$\times\mu$				0.06						-0.02		
				(7.41)						(-2.61)		
μ	-0.05			-0.10			-0.01			-0.00		
	(-4.54)			(-11.68)			(-11.29)			(-1.78)		
LEVB	4.66	3.41	5.07	4.53	3.39	4.92	-0.49	-0.36	-0.54	-0.49	-0.36	-0.54
	(3.98)	(2.83)	(4.43)	(3.92)	(2.93)	(4.34)	(8.74)	(-9.32)	(-8.36)	(-8.80)	(-9.66)	(-8.61)
σ	1.45	1.39	1.47	1.42	1.38	1.45	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(6.74)	(4.99)	(7.00)	(6.40)	(4.59)	(7.08)	(-4.20)	(-6.23)	(-3.36)	(-4.05)	(-5.38)	(-3.65)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	74655	19057	55729	73229	18865	54511	103107	26065	77249	101185	25836	75681
Avg.R^2	0.296	0.319	0.301	0.301	0.330	0.308	0.060	0.078	0.067	0.058	0.076	0.086

Table 4: Firm level CDS spread and labor market variables

This table reports the results of cross-sectional regressions using labor expense growth (ΔXLR) or labor share (LS) or their interactions with wage rigidity (μ) at t to predict CDS spread at $t+1$. Columns (1) to (4) present the results for 5-year CDS spread and columns (5) to (8) present the results for the 1-year CDS spread. All the independent variables are defined in the main text of the paper. All the results are estimated using Fama and MacBeth (1973) cross-sectional regressions. The t-statistics reported in the parentheses below each coefficient estimate are heteroscedasticity and autocorrelation consistent (Newey and West (1987)).

	CDS 5-year Spread				CDS 1-year Spread			
ΔXLR	-0.363		0.106		-0.528		0.133	
	(-2.06)		(0.65)		(-2.80)		(0.56)	
LS		1.535		0.725		1.275		0.297
		(5.32)		(1.45)		(3.74)		(0.48)
ΔXLR $\times \mu$			-0.345				-0.547	
			(-3.42)				(-3.27)	
LS $\times \mu$				0.288				0.302
				(2.50)				(2.04)
μ			-0.031	-0.222			0.003	-0.221
			(-1.90)	(-3.19)			(0.07)	(-2.39)
LEVB	1.427	1.723	1.464	1.879	1.302	1.308	1.423	1.437
	(3.07)	(3.72)	(3.23)	(4.24)	(1.75)	(1.79)	(2.00)	(2.03)
σ	1.197	1.194	1.159	1.102	1.915	1.769	1.878	1.671
	(2.59)	(2.56)	(2.59)	(2.59)	(2.73)	(2.67)	(2.74)	(2.70)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3793	3793	3793	3793	3498	3498	3498	3498
Avg.R^2	0.383	0.393	0.390	0.403	0.368	0.375	0.379	0.384

Table 5: Leverage and labor share

This table reports results of cross-sectional regressions of financial leverage on labor share (LS). In the top Panel we regress a firm's average financial leverage on its average labor share over the entire sample. In the bottom panel, we use labor share (LS) at t to predict financial leverage at $t+1$. Financial leverage is either market leverage (LEVM on the left) or book leverage (LEVB on the right). We present univariate regressions, add just country fixed effects (FE), or fixed effects and various controls. In the top panel, controls are averaged over the entire sample; in the bottom panel controls are computed at t. The controls are volatility (σ), past leverage (bottom panel only), working capital ($WCTA$), retained earnings ($RETA$), EBIT ($EBITTA$), sales (STA), net income ($NITA$), current asset to liability ($CACL$), investment ($Invest$), equity excess return (R_{excess}), relative size ($RSIZE$), market return (R_m), market capitalization ($MCAP$). The online appendix provides additional details on variable construction. In the bottom panel, all the results are estimated using Fama and MacBeth (1973) cross-sectional regressions. The t-statistics reported in the parentheses below each coefficient estimate, in the bottom panel, all are heteroscedasticity and autocorrelation consistent (Newey and West (1987)).

Panel A

	LEVM			LEVB		
LS	-0.066	-0.043	-0.026	-0.045	-0.034	-0.015
	(-32.86)	(-19.95)	(-9.39)	(-30.27)	(-20.57)	(-7.19)
Controls	No	No	Yes	No	No	Yes
FE	No	Yes	Yes	No	Yes	Yes
Obs.	16046	16046	15752	16046	16046	15752
Avg R^2	0.063	0.143	0.261	0.054	0.123	0.258

Panel B

	LEVM$_{t+1}$				LEVB$_{t+1}$			
LS$_t$	-0.041	-0.029	-0.005	-0.006	-0.031	-0.028	-0.002	-0.003
	(-4.72)	(-19.16)	(-5.73)	(-7.75)	(-5.57)	(-15.23)	(-2.55)	(-2.38)
LEVM$_t$			0.859	0.857				
			(60.94)	(51.54)				
LEVB$_t$							0.866	(0.859)
							(143.11)	(124.74)
σ				-0.025				-0.016
				(-3.66)				(-3.66)
Controls	No	No	No	Yes	No	No	No	Yes
FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Obs.	95225	95225	90015	88001	95225	95225	94740	92412
Avg R^2	0.017	0.142	0.766	0.773	0.018	0.09	0.754	0.762

Table 6: Calibration

This table presents the model's calibrated parameters. The model is solved at a quarterly frequency.

Parameter	Description	Benchmark
	Preferences	
β	Time Preference	0.9975
θ	Risk Aversion	8
ψ	IES	2
	Production	
$(1-\alpha)\rho$	Related to Labor Share	0.4
$\alpha + \rho - \alpha\rho$	Returns to Scale	0.9
$\frac{1}{1-\eta}$	Labor Capital Elasticity	0.5
δ	Depreciation	0.0233
υ	Capital Adj. Cost	8
f	Operating Cost	0.019
μ	Probability No Resetting	0.90
τ	Corporate Tax Rate	0.3
p^{exp}	Debt Expiration Probability	0.025

Table 7: Aggregate statistics

This table compares aggregate moments (annual) from the data to the model. Panel A presents macroeconomic moments. In the data all variables are real and deflated by CPI. y is GDP (private sector), c is consumption (services, non-durable, and durable), i is investment (private non-residential fixed), and w is compensation per employee. These variables are expressed either as HP filtered, or in growth rates. Note that the table reports the volatility of quantities relative to GDP volatility. The volatilities of HP filtered GDP and growth of GDP in the data are 2.42% and 3.21% respectively; the model volatilities are very close to these. Panel B presents asset pricing moments: the means and volatilities of the risk free rate and the equity return, the Sharpe ratio, and the average return on corporate debt. The superscript e indicates the return is in excess of the risk free return. Panel C presents variables related to credit markets: market leverage, credit spread, and the default rate. The business cycle statistics are from BEA 1948-2014. The risk free rate and equity return are from Ken French's website 1948-2014. The corporate debt return is the BofA 10-15 year return from the St. Louis Fed minus the 10 year US Treasury rate from CRSP 1978-2014. The annual default rate is from Moody's DRD 1948-2006, the credit spread is the Baa-Aaa from St. Louis Fed 1948-2014, and leverage is the book value of credit market instruments divided by the sum of the market value of equities and book value of credit instruments of nonfinancial corporate business sector from Flow of Funds 1948-2014.

Panel A: Macro

x	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$AC(x)$	$\frac{\sigma(\Delta x)}{\sigma(\Delta y)}$	$\rho(\Delta x, \Delta y)$	$AC(\Delta x)$
	Data					
y	1.00	1.00	0.31	1.00	1.00	0.06
c	0.67	0.89	0.41	0.66	0.88	0.30
i	2.36	0.91	0.46	2.12	0.90	0.19
w	0.52	0.59	0.50	0.55	0.60	0.39
	Model					
y	1.00	1.00	0.38	1.00	1.00	0.28
c	0.69	0.97	0.42	0.74	0.97	0.43
i	2.31	0.97	0.35	2.18	0.95	0.14
w	0.40	0.52	0.69	0.51	0.59	0.85

Panel B: Asset pricing

	$E[R^F]$	$\sigma(R^F)$	$E[R^{E,e}]$	$\sigma(R^{E,e})$	SR	$E[R^{D,e}]$
Data	1.10	2.27	8.42	18.08	0.47	1.20
Model	0.79	0.48	3.01	8.19	0.37	0.82

Panel C: Credit market

	Data			Model		
	$E[x]$	$\sigma(x)$	$\rho(x,\Delta y)$	$E[x]$	$\sigma(x)$	$\rho(x,\Delta y)$
LEVM	0.44	0.09	-0.24	0.37	0.02	-0.30
CS	0.95	0.40	-0.52	1.31	0.25	-0.61
DEF	0.82	0.98	-0.29	0.84	0.51	-0.54

Table 8: Credit markets are related to labor markets

This table presents univariate regressions of the form $y_{t+1} = a + bx_t + \epsilon_{t+1}$ where y_{t+1} is either the credit spread realized at $t+1$, or debt growth between t and $t+1$; and where x_t is either the labor share at t, or the wage growth (labor expense growth for firm level) between $t-1$ and t. Panel A presents these regressions for aggregate variables and Panel B for firm-level variables. Panel C presents Fama and MacBeth (1973) bivariate regressions from model simulated data of equity volatility $\sigma_{t+1}^{E,i}$, employment growth ΔN_{t+1}^i, and investment rate IK_{t+1}^i on firm level labor share LS_t and financial leverage LEV_t; and a time series regression of aggregate wage growth ΔW_{t+1}^{agg} on aggregate labor share and financial leverage. It also presents the same regressions but with credit spread CS_t as the explanatory variable. Panel D is identical to Panel C but uses actual data. The model's t-statistics for simulated data were computed as an average over many samples, each the same size as actual data. We do not do this for firm level simulated data, because the firm data is an unbalanced panel with data from various countries over various time periods. Firm level investment rate and employment growth are winsorized at 1%.

Panel A: Aggregate

	$y = CS_{t+1}$		$y = \Delta DEBT_{t+1}$	
	$x = \Delta W$	$x = LS$	$x = \Delta W$	$x = LS$
		Data		
b	-0.154	0.107	1.350	-0.420
t(b)	(4.15)	(2.55)	(4.51)	(-0.93)
R^2	0.28	0.09	0.25	0.00
		Model		
b	-0.114	0.076	1.691	-1.064
t(b)	(-9.56)	(10.90)	(8.82)	(-8.44)
R^2	0.59	0.64	0.49	0.48

Panel B: Firm-level

		Data		
b	-0.092	0.043	0.10	-0.03
t(b)	(-7.64)	(5.46)	(6.32)	(-7.32)
R^2	0.01	0.01	0.01	0.00
		Model		
b	-0.022	0.045	0.930	-1.30
R^2	0.15	0.07	0.05	0.01

Panel C: Real effects, model

	ΔN_{t+1}^i		IK_{t+1}^i		ΔW_{t+1}^{agg}		$\sigma_{t+1}^{E,i}$	
LS_t	-0.252		-0.250		-0.571		0.659	
LEV_t	-0.245		-0.149		-0.089		0.725	
CS_t		-0.009		-0.014		-0.059		0.12
R^2	0.06	0.03	0.30	0.45	0.80	0.71	0.10	0.12

Panel D: Real effects, data

	ΔN_{t+1}^i		IK_{t+1}^i		ΔW_{t+1}^{agg}		$\sigma_{t+1}^{E,i}$	
LS_t	-0.003		-0.001		-0.170		0.015	
t(b)	(-1.62)		(-2.03)		(-0.75)		(1.72)	
LEV_t	-0.087		-0.157		-0.070		0.518	
t(b)	(-5.21)		(-7.26)		(-4.77)		(12.05)	
CS_t		-0.007		-0.004		-0.990		0.022
t(b)		(-13.65)		(-9.70)		(-2.55)		(6.57)
R^2	0.01	0.02	0.04	0.06	0.19	0.06	0.01	0.08

Table 9: Model comparisons

This table compares selected results from several alternative models to our baseline model. Our baseline model has $\eta = -1$ (CES labor-capital complementarity), $\mu = 0.9$ (wage rigidity), and long-term debt; it is in the second row of every panel, after the data. The models in the third through eighth rows have, respectively, $\mu = 0$ (no rigidity), $\eta = 0$ (Cobb-Douglas), $\eta = 0$ and $\mu = 0$ (Cobb-Douglas and no rigidity), short-term debt, $\psi = 1.5$ (low IES), and $\theta = 4$ (low risk aversion). Panel A presents the volatility of the wage, the average excess return and volatility of equity, the average excess return on debt, the average (market) leverage, credit spread, and default probability, as well as the correlation of leverage with output growth. Panel B presents correlations between the credit spread at $t + 1$ and either residual wage growth or residual labor share at t; or correlations between debt (book-value) growth between t and $t + 1$ and either residual wage growth or residual labor share at t. These correlations are computed from aggregate time-series data. Residuals are computed by first regressing either wage growth, or labor share on output growth. Panel C is similar to Panel B, but uses pooled firm-level data. Panel D presents expected loss as a fraction of the credit spread, and the correlations of labor share with contemporaneous credit spread (CS), credit risk premium ($CSRP$), and expected loss ($LOSS$).

Panel A: Selected moments

	$\sigma(\Delta W)$	$E[R^{E,e}]$	$\sigma(R^{E,e})$	$E[R^{D,e}]$	LEVM	CS	DEF	$\rho(LEVM, \Delta y)$
Data	1.77	8.42	18.08	1.20	0.44	0.95	0.82	-0.24
Baseline	1.63	3.01	8.19	0.82	0.37	1.31	0.84	-0.30
No rigidity	2.45	1.99	6.38	0.46	0.39	0.73	0.39	-0.20
CD	1.72	1.15	3.71	0.82	0.16	2.20	0.75	0.21
CD, no rigidity	2.94	0.77	2.40	0.52	0.16	1.27	0.34	0.20
Short term debt	1.76	3.83	12.58	0.09	0.62	0.19	0.57	0.67
Low IES	1.63	2.52	7.98	0.78	0.38	1.30	0.85	-0.32
Low RA	1.64	1.07	8.16	0.54	0.39	1.21	0.66	-0.01

Panel B: Aggregate correlations

	$\rho(\Delta W^{res}, CS)$	$\rho(LS^{res}, CS)$	$\rho(\Delta W^{res}, \Delta DEBT)$	$\rho(LS^{res}, \Delta DEBT)$
Data	-0.41	0.27	0.38	-0.08
Baseline	-0.55	0.57	0.40	-0.34
No rigidity	-0.58	0.61	0.30	-0.26
CD	-0.39	0.39	0.46	-0.39
CD, no rigidity	0.00	0.00	0.00	0.00
Short term debt	0.48	-0.46	0.48	0.31
Low IES	-0.81	0.84	0.68	-0.67
Low RA	-0.84	0.86	0.64	-0.62

Panel C: Firm level correlations

	$\rho(\Delta W^{res}, CS)$	$\rho(LS^{res}, CS)$	$\rho(\Delta W^{res}, \Delta DEBT)$	$\rho(LS^{res}, \Delta DEBT)$
Data	-0.02	0.05	0.04	-0.03
Baseline	-0.25	0.08	0.15	-0.06
No rigidity	-0.40	0.24	0.07	0.00
CD	0.01	0.06	-0.02	-0.14
CD, no rigidity	0.00	0.00	0.00	0.00
Short term debt	-0.03	-0.64	-0.26	-0.09
Low IES	-0.31	0.02	0.19	-0.06
Low RA	-0.33	0.06	0.21	-0.06

Panel D: Decomposing the credit spread

	$\frac{LOSS}{CS}$	$\rho(LS_t, CS_t)$	$\rho(LS_t, CSRP_t)$	$\rho(LS_t, LOSS_t)$
Data	0.11-0.39	0.38	0.35	0.17
Baseline	0.17	0.92	0.71	0.36
No rigidity	0.14	0.94	0.46	0.31
CD	0.12	0.88	0.49	0.30
CD, no rigidity	0.18	0.00	0.00	0.00
Short term debt	0.16	-0.77	-0.62	-0.73
Low IES	0.19	0.93	0.65	0.40
Low RA	0.22	0.92	0.61	0.37

A Online appendix

A.1 The balanced growth path and detrending the model

Note that the model is not stationary, because Z_t is not stationary. In order to solve it numerically, we must rewrite it in terms of stationary quantities. The balanced growth path of a frictionless version of this model follows Z_t^ρ. If a balanced growth path of the model with frictions exists, and if this problem, detrended by some quantity, has a stationary solution, then that quantity must also be Z_t^ρ.[45] To see this, define $k_t^i = \frac{K_t^i}{Z_t^\rho}$ and plug it into the production function:

$$Y_t^i = Z_t^i \left(\alpha (K_t^i)^\eta + (1 - \alpha)(Z_t N_t^i)^{\eta\rho} \right)^{\frac{1}{\eta}} = Z_t^i \left(\alpha (k_t^i)^\eta + (1 - \alpha)(N_t^i)^{\eta\rho} \right)^{\frac{1}{\eta}} Z_t^\rho = y_t^i Z_t^\rho \qquad (11)$$

We will now rewrite the rest of the firm's problem in terms of detrended quantities. The firm's original problem is:

$$
\begin{aligned}
V(Z_t^i, K_t^i, N_{t-1}^i, \overline{W}_{t-1}^i, \kappa_t^i; Z_t, x_t, \widehat{K}_t, \overline{W}_{t-1}) = \max \Big(0, \\
\max_{I_t^i, N_t^i, \kappa_{t+1}^i} (1 - \tau) \left(Y_t^i - \overline{W}_t^i N_t^i - F_t - \kappa_t^i \right) + \tau \delta K_t^i \\
- I_t^i - \Phi(K_t^i, I_t^i) + \Psi_t^i 1_{\{Issue\}} \\
+ E_t[M_{t+1} V(Z_{t+1}^i, K_{t+1}^i, N_t^i, \overline{W}_t^i, \kappa_{t+1}^i; Z_{t+1}, x_{t+1}, \widehat{K}_{t+1}, \overline{W}_t)] \Big)
\end{aligned}
\qquad (12)
$$

Where Z_t^i is the idiosyncratic productivity, K_t^i is the firm's individual capital, N_{t-1}^i is the firm's employment last period, κ_t^i is the current coupon payment paid, Ψ_t^i are the proceeds from issuing new debt, $\overline{W}_{t-1}^i$ is the firm's average wage last period, Z_t is aggregate productivity, x_t is the conditional mean of aggregate productivity growth, $\overline{W}_{t-1}$ is the aggregate average wage from last period, and W_t is the spot wage this period.[46] Following Krusell and Smith (1998) the state space potentially contains all information about the joint distribution of capital and productivity. $\widehat{K}_t$ is a vector of aggregate state variables which summarize the distribution of capital, it includes the first moment or average level of capital K_t, but may include higher moments, as suggested by Krusell and Smith (1998).

Households have beliefs about the spot wage W_t, aggregate output Y_t, and aggregate consumption C_t as a function of the aggregate state, about the evolution of the aggregate quantities M_{t+1} and $\widehat{K}_t$, and about the price of debt Ψ_t^i. The price of debt is a function of the aggregate state at t, the firm's productivity at t, and the choices firm makes at t that impact its state at $t + 1$.[47] The

---

[45]No other quantity X allows $\frac{Y}{X} = f(\frac{K}{X})$ where f(.) is not a function of Z.

[46]Note that we changed the notation slightly from the main text. Here, wage related variables are written as capital letters, so that we can write the detrended variable as lower case.

[47]In particular, beliefs at t about the firm's future repayment ability depend on κ_t^i, K_{t+1}^i, $\overline{W}_t^i$, and N_t^i which are all functions of choices the firm makes at t. This will be explained in more detail in the next section.

aggregate wage and average capital evolve as

$$
\begin{aligned}
\overline{W}_t &= \mu\overline{W}_{t-1} + (1-\mu)W_t \\
K_{t+1} &= (1-\delta)K_t + I_t
\end{aligned}
\tag{13}
$$

The evolution of the individual state variables depend on the firm's choices:[48]

$$
\begin{aligned}
K_{t+1}^i &= (1-\delta)K_t^i + I_t^i \\
\overline{W}_t^i &= \frac{\overline{W}_{t-1}^i N_{t-1}^i \mu + (N_t^i - N_{t-1}^i \mu)W_t}{N_t^i}
\end{aligned}
\tag{14}
$$

We can define $k_t = \frac{K_t}{Z_t^\rho}$, $\widehat{k}_t = \frac{\widehat{K}_t}{Z_t^\rho}$, $i_t^i = \frac{I_t^i}{Z_t^\rho}$, $\varrho_t^i = \frac{\Psi_t^i}{Z_t^\rho}$, $\widetilde{\kappa}_t^i = \frac{\kappa_t^i}{Z_t^\rho}$, $w_t = \frac{W_t}{Z_t^\rho}$, $\overline{w}_t^i = \frac{\overline{W}_t^i}{Z_{t+1}^\rho}$, and $\overline{w}_t = \frac{\overline{W}_t}{Z_{t+1}^\rho}$
(note that the timing of $\overline{w}_t^i$ and $\overline{w}_t$ differs from the others).

With this normalization, it can be shown by induction that the value function is linear in Z_t^ρ.
Suppose this is true at t+1:

$$
V(Z_{t+1}^i, K_{t+1}^i, N_t^i, \overline{W}_t^i, \kappa_t^i; Z_{t+1}, x_{t+1}, \widehat{K}_{t+1}, \overline{W}_t) = Z_{t+1}^\rho v(Z_{t+1}^i, k_{t+1}^i, N_t^i, \overline{w}_t^i, \widetilde{\kappa}_{t+1}^i; 1, x_{t+1}, \widehat{k}_{t+1}, \overline{w}_t)
\tag{15}
$$

Then we can rewrite the firm's problem as:[49]

$$
\begin{aligned}
v(Z_t^i, k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i, \widetilde{\kappa}_t^i; x_t, \widehat{k}_t, \overline{w}_{t-1}) = \max\Big(0, \\
\max_{i_t^i, N_t^i, \widetilde{\kappa}_{t+1}^i} (1-\tau)\left(y_t^i - \overline{w}_t^i N_t^i - F_t - \widetilde{\kappa}_t^i\right) + \tau\delta K_t^i \\
- i_t^i - \Phi(k_t^i, i_t^i) + \varrho_t^i 1_{\{Issue\}} \\
+ E_t\big[\big(\tfrac{Z_{t+1}}{Z_t}\big)^\rho M_{t+1} v(Z_{t+1}^i, k_{t+1}^i, N_t^i, \overline{w}_t^i, \widetilde{\kappa}_{t+1}^i; x_{t+1}, \widehat{k}, \overline{w}_t)\big]\Big)
\end{aligned}
\tag{16}
$$

where the aggregate capital and wage evolve as

$$
\begin{aligned}
k_{t+1} &= ((1-\delta)k_t + i_t)\left(\tfrac{Z_{t+1}}{Z_t}\right)^{-\rho} \\
\overline{w}_t &= (\mu\overline{w}_{t-1} + (1-\mu)w_t)\left(\tfrac{Z_{t+1}}{Z_t}\right)^{-\rho}
\end{aligned}
\tag{17}
$$

and the individual state variables evolve as:

$$
\begin{aligned}
k_{t+1}^i &= \left((1-\delta)k_t^i + i_t^i\right)\left(\tfrac{Z_{t+1}}{Z_t}\right)^{-\rho} \\
\overline{w}_t^i &= \left(\frac{\overline{w}_{t-1}^i N_{t-1}^i \mu + (N_t^i - N_{t-1}^i \mu)w_t}{N_t^i}\right)\left(\tfrac{Z_{t+1}}{Z_t}\right)^{-\rho} \\
\widehat{\kappa}_{t+1}^i &= \begin{cases} 0 & \text{if expiry or default at } t+1 \\ \widehat{\kappa}_t^i\left(\tfrac{Z_{t+1}}{Z_t}\right)^{-\rho} & \text{otherwise} \end{cases}
\end{aligned}
\tag{18}
$$

---

[48]Note that past employment N_{t-1}^i is also part of the state; we are not including its evolution in this equation because its choice at t is exactly equal to its value at $t+1$.

[49]For notational convenience, we have suppressed the value function's dependence on the level of productivity (first argument of the aggregate state) because in the detrended value function, that argument is always equal to one.

As long as the firm believes that $\left(\frac{Z_{t+1}}{Z_t}\right)^\rho$, M_{t+1}, k_{t+1}, w_{t+1}, and ϱ_t^i are stationary (by stationary, we mean that they do not depend on the level of aggregate productivity Z_t), then this is a well defined problem, similar to many standard problems in finance and economics. Whether it has a finite solution depends on the parameters (for example, if $M_{t+1} = \beta > 1$ then it likely does not have a finite solution), however this is a problem that can be solved numerically by dynamic programming if a finite solution exists. If a finite solution exists, then the firm's optimal policy (i_t^i, N_t^i, $\tilde{\kappa}_t^i$) will also be stationary.

Note that if a finite solution to this problem exists, then all endogenous firm level variables will be stationary when detrended by Z_t^ρ. A stationary individual capital k_t^i implies that the aggregate detrended capital stock $k_{t+1} = \sum k_{t+1}^i$ and aggregate investment are stationary too. A stationary labor demand N_t^i implies that the aggregate labor demand $N_t = \sum N_t^i$ is stationary too. In equilibrium, the aggregate labor demand is equal to the aggregate labor supply, which is one, but since the aggregate labor demand is a simple function of the detrended spot wage, inverting the relationship implies a stationary detrended spot wage as well. A stationary detrended output puts an upper bound on coupon payments, which implies a stationary price of debt.

Thus, if the firm believes that the detrended capital, average wage, spot wage, and bond price are stationary, and if the firm's detrended problem given these beliefs has a finite solution, then indeed these quantities must be stationary.

Finally, we can rewrite the stochastic discount factor and bond price in terms of stationary quantities. The original utility function and stochastic discount factor were defined as:

$$C_t = Y_t - I_t$$

$$U_t = \left(C_t^{1-\frac{1}{\psi}} + \beta E_t[U_{t+1}^{1-\theta}]^{\frac{1-\frac{1}{\psi}}{1-\theta}}\right)^{\frac{1}{1-\frac{1}{\psi}}}$$

$$M_{t+1} = \beta \left(\frac{U_{t+1}}{E_t[U_{t+1}^{1-\theta}]^{\frac{1}{1-\theta}}}\right)^{\frac{1}{\psi}-\theta} \left(\frac{C_{t+1}}{C_t}\right)^{-\frac{1}{\psi}}$$

Define $c_t = \frac{C_t}{Z_t^\rho}$ and $u_t = \frac{U_t}{Z_t^\rho}$ and note that the firm's optimal policy implies that $c_t = y_t - i_t$ is stationary. We can rewrite the above equations as:

$$c_t = y_t - i_t$$

$$u_t = \left(c_t^{1-\frac{1}{\psi}} + \beta E_t\left[\left(\frac{Z_{t+1}}{Z_t}\right)^\rho u_{t+1}^{1-\theta}\right]^{\frac{1-\frac{1}{\psi}}{1-\theta}}\right)^{\frac{1}{1-\frac{1}{\psi}}} \tag{19}$$

$$M_{t+1} = \beta \left(\frac{\left(\frac{Z_{t+1}}{Z_t}\right)^\rho u_{t+1}}{E_t\left[\left(\frac{Z_{t+1}}{Z_t}\right)^\rho u_{t+1}^{1-\theta}\right]^{\frac{1}{1-\theta}}}\right)^{\frac{1}{\psi}-\theta} \left(\frac{c_{t+1}}{c_t}\right)^{-\frac{1}{\psi}} \left(\frac{Z_{t+1}}{Z_t}\right)^{-\frac{\rho}{\psi}}$$

which are stationary as long as c_t is stationary.

The original equation for the bond price is

$$\Psi_t^i = E_t M_{t+1}\left[1_{\{exp\}} \times 0 + 1_{\{V_{t+1}\leq 0\}} \times V_{t+1}^0 + \left(1 - 1_{\{exp\}} - 1_{\{V_{t+1}\leq 0\}}\right)\left(\kappa_{t+1}^i + \Psi_{t+1}^i\right)\right].$$

This can be rewritten as

$$\varrho_t^i = E_t M_{t+1} \left(\frac{Z_{t+1}}{Z_t} \right)^\rho \left[1_{\{exp\}} \times 0 + 1_{\{v_{t+1} \le 0\}} \times v_{t+1}^0 + \left(1 - 1_{\{exp\}} - 1_{\{v_{t+1} \le 0\}} \right) \left(\widetilde{\kappa}_{t+1}^i + \varrho_{t+1}^i \right) \right],$$

(20)

where v_{t+1}^0 is the detrended value of a firm with zero debt.

A.2 Numerical algorithm

We will now describe the numerical algorithm used to solve the stationary problem above, which is described by equations 16, 17, 18, 19, and 20. The algorithm is a variation of the algorithm in Krusell and Smith (1998). Generally, there is no proof that an equilibrium exists. This solution method is referred to as an approximate bounded rational equilibrium. It consists of performing two steps and then repeating them until convergence. The first (partial equilibrium) step solves the firm's problem given a particular set of beliefs; the inputs are beliefs and the outputs are policy functions. The second (general equilibrium) step updates these beliefs from simulating the economy; the inputs are policy functions and the outputs are beliefs. These steps are repeated until the beliefs have converged and are consistent with simulated data. We will refer to the sequence of step one, followed by step two as a single outer iteration. This is to differentiate these iterations from the value function iteration which occurs during step one.

In the previous section, for generality, we allowed the aggregate state space to include a vector of variables describing he distribution of capital across firms, $\widehat{k}_t$. However, in practice, we only keep track of the first moment of capital, therefore $\widehat{k}_t = \{k_t\}$. To ease notation, we summarize the aggregate state by the vector $\Theta_t = \{x_t, k_t, \overline{w}_{t-1}\}$, which includes expected productivity growth, average capital, and past average wage. The individual state space is summarized by the vector $\Theta_t^i = \{Z_t^i, k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i, \widetilde{\kappa}_t^i\}$, which includes individual productivity, capital, past labor, past average wage, and the current coupon due.

For numerical reasons, we find it better to rescale two of the state variables. In particular instead of $\overline{w}_{t-1}^i$ we use $N_{t-1}^i \overline{w}_{t-1}^i$. This rescaling is innocuous because one can easily go back and forth. It can be shown that when there is no debt or adjustment costs, the firm's problem is linear in $N_{t-1}^i \overline{w}_{t-1}^i$ and N_{t-1}^i, and thus we believe the rescaling leads to a more efficient algorithm. Further, it allows us to check the accuracy of our solution in the special case of $\nu = 0$. Instead of $\overline{w}_{t-1}$, we use $\overline{w}_{t-1}$ scaled by the aggregate marginal product of labor. This is done because $\overline{w}_{t-1}$ is highly correlated with k_t, which makes formation of beliefs more difficult without rescaling. Further, when two state variables are correlated, large areas of the grid are left unused, which wastes computing power. The scaling reduces this correlation. Even though we rescale the variables in our code, we write everything in terms of the original variables here, to make the exposition easier.

The grid sizes are 43 for firm capital k_t^i, 18 for the firm's past average wage $\overline{w}_{t-1}^i$, 13 for the firm's past employment N_{t-1}^i, 13 for the firm's owed coupon (which is equivalent to the firm's book value of debt) $\widehat{\kappa}_t^i$, 20 for aggregate capital k_t, 6 for the aggregate past average wage $\overline{w}_{t-1}$, 3 for the Markov chain governing the conditional expectation of aggregate productivity growth x_t, 3 for the

short-run shock to productivity growth ϵ, and 3 for the Markov chain governing firm productivity Z_t^i. We have experimented with grid sizes extensively and set them large enough that our results are not affected by any further increases.[50] It is important to set the grid edges some distance away from where typical variables reside, despite these values being "off-equilibrium." At the same time, setting the edges too far away from model equilibrium will require a very large number of grid points, which is numerically infeasible; therefore, some experimentation is in order. We find that the results are more sensitive to the sizes of firm level grids than to the aggregate grids.

The problem is solved using Fortran 77, and parallelized using OpenMP. It then runs on eight parallel processors. The full model takes about 3 hours per outer iteration and requires 50 to 100 outer iterations to converge. We are appreciative of The Ohio State University high-performance computing center for the computational resources.

Step 1. We begin this step with beliefs about aggregate output, the spot wage, and aggregate consumption as a function of the aggregate state. As will be shown below, these are sufficient to predict the aggregate state next period. There is also a belief about the stochastic discount factor as a function of the aggregate state, and the realized shock next period. These beliefs are $\sum y_t^i = \vartheta^n(\Theta_t)$, $w_t = \omega^n(\Theta_t)$, $c_t = \zeta^n(\Theta_t)$ and $M_{t+1} = \mathbb{M}^n(\Theta_t, j_{t+1})$, where j_{t+1} is the discrete realization of the aggregate productivity shock. Here n indicates the number of the outer iteration.

Additionally, there is a belief about the bond price. The bond price deserves a special explanation. The bond price at t (ϱ_t^i) must depend on the aggregate state Θ_t since this affects beliefs about both aggregate productivity, and the stochastic discount factor; the first of which affects default probability, and the second discounting of future cash flows. It must also depend on individual productivity Z_t^i since this affects beliefs about future productivity and the firm's ability to repay. Importantly, it must depend on the firm's choice of coupon payments $\widetilde{\kappa}_{t+1}^i$ since the level of the coupon payment affects the firm's default decision, thus, the firm receives a menu of bond prices over all possible choices of coupons.

It must also depend on the firm's other characteristics: its capital level, past average wage, and past labor. However, here we must make a modeling choice. If the firm chooses its time t investment i_t^i and labor N_t^i after the time t debt has been issued, then the price of debt should depend on $\{k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i\}$. However, if the firm chooses its time t investment and labor concurrently to issuing its time t debt, then the price of debt will depend on the firm's choices, just like it does on its choice of coupon payments.

We choose the later approach, because we want to prevent the firm from gaming the creditors. Consider the following example. If the price of debt depended only on time t capital k_t^i, then the firm could issue a large amount of debt, then immediately pay a large dividend, leaving it with a tiny capital stock going forward, and high likelihood of future default. Of course, creditors would

---

[50]More specifically, we have solved the same problem but where all of the grids have approximately 30% fewer grid points (with the exception of the productivity shock grids, as we keep those shocks discrete). We have also solved the same problem but where each grid, one at a time, has approximately 50% more grid points (we are unable to simultaneously increase all grid points due to computing limitations). We find that the moments of interest are very similar to the ones reported in the text.

anticipate this and demand very high returns. This scenario does not strike us as a realistic descrip-
tion of lending markets; in the real world, debt covenants typically prevent this from happening.
For this reason, the price of debt is not a function of the firm's capital at t (k_t^i), but rather is a
function of its choice of capital for $t + 1$, which is known at t $(k_t^i(1 - \delta) + i_t^i)$. Similarly, it is not
a function of the firm's time t lagged labor (N_{t-1}^i) and lagged average wage $(\overline{w}_{t-1})$, but rather a
function of the firm's time t choice of labor (N_t^i), and its average wage $(\frac{\overline{w}_{t-1}^i N_{t-1}^i \mu + (N_t^i - N_{t-1}^i \mu) w_t}{N_t^i})$.
The beliefs about the bond price are defined over the same grids over which the aggregate and
individual state spaces are defined. We express the belief about the bond price as

$$\varrho_t^i = \sigma^n(\Theta_t, Z_t^i, k_t^i(1 - \delta) + i_t^i, N_t^i, \frac{\overline{w}_{t-1}^i N_{t-1}^i \mu + (N_t^i - N_{t-1}^i \mu) w_t}{N_t^i}, \widetilde{\kappa}_{t+1}^i)$$

which depends explicitly on the firm's choices $\{i_t^i, N_t^i, \widetilde{\kappa}_{t+1}^i\}$.

These beliefs, together with equations 16, 17, and 18, specify a well-defined partial equilibrium
firm problem. We solve this problem using value function iteration.

Once the value function iteration is complete, it produces three policy functions for the firm:
investment $i^n(\Theta_t^i, \Theta_t)$, employment $N^n(\Theta_t^i, \Theta_t)$, and choice of coupon payment $\widehat{\kappa}_{t+1}^n(\Theta_t^i, \Theta_t)$. Recall
that the coupon payment is a choice only for firms who are resetting their debt, all others (who
defaulted or whose debt expired) have no coupon payments. The value function iteration also
produces an equity value as a function of the state $v^n(\Theta_t^i, \Theta_t)$, and a default policy because the
firm defaults any time the equity value is less than or equal to zero. The updating of the debt
pricing function is described further below.

Step 2. In this step we use the policy functions to simulate the economy and then use simulated
data to update the beliefs. We simulate the economy for 10,000 firms, and a higher number does not
affect any of our results. Before beginning the simulation we must specify an initial distribution of
idiosyncratic productivity, capital, past wages, and past labor. We simulate the economy for 3,500
periods and throw away the first 500 periods to let the simulation settle into its normal behavior;
this also assures that the initial distribution has no effect on our results.

One complication during the simulation is that we must clear the labor market each period.
The difficulty is that each firm's choice of labor at t is a function of the state variables at t. The
state variables are fixed and known at the beginning of t, thus labor is determined at the start
of the period. The firms have beliefs about the spot wage as a function of the state; however,
before convergence these beliefs may be incorrect, and, therefore, labor demand may not equal
labor supply. The actual market clearing spot wage (as opposed to the belief) is undefined because
at this stage in the simulation, nothing can change the state variables or firms' labor demand. To
deal with this problem we use the following workaround: during the simulation, we assume that
each firm's labor demand is $N_t^i = \mathbb{N}^i(Z_t^i, k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i; \Theta_t)\frac{\omega^n(\Theta_t)}{w_t}$, where $\mathbb{N}(Z_t^i, k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i; \Theta_t)$
is the policy function from step 1, and $\omega^n(\Theta_t)$ is the belief about the spot wage used during the
value function iteration step. Each period, we choose the spot wage w_t in order to clear the
labor market, that is, to ensure that $\sum N_t^i = 1$. This implies that the spot wage each period

is $w_t = \omega^n(\Theta_t) \times \sum \mathbb{N}^i(Z_t^i, k_t^i, N_{t-1}^i, \overline{w}_{t-1}^i; \Theta_t)$. Note that once our algorithm has converged, as long as the R^2 (discussed below) is sufficiently high, the belief is consistent with the spot wage: $w_t \cong \omega^n(\Theta_t)$. However, before convergence we are able to pick the spot wage in any period so as to clear markets.[51]

Once the simulation is complete, we have a time series for all relevant aggregate variables. We use these time series to update the beliefs. Krusell and Smith (1998) have suggested regressing the relevant variables on the state variables. However we find this problematic in our setting because linear regressions imply strange behavior "off-equilibrium," which leads to problems in the value-function iteration step. Adding higher-ordered terms does not help because it leads to overfitting.

We propose an alternative, nonparametric approach. Rather than defining the belief as a parametric function of the state space variables, we will define a belief separately for each grid point in the aggregate state space. Before getting into the specifics, the basic idea is to define the belief about a variable at a point in the state space as the typical value of that variable in all simulated data near that point.

Recall that the aggregate state space is a triple $\Theta_t = \{x_t, k_t, \overline{w}_{t-1}\}$. First, we separate all grid points on the aggregate state space into two types: those that are near where the simulated data resides ("on-equilibrium") and those that are not ("off-equilibrium"). We define a grid point as "on-equilibrium" if there are more than 20 periods during the simulation, in which i) the discrete aggregate productivity state x_t in simulation is identical to the one at the grid point, and ii) the distance between the simulated k_t and the state is less than one standard deviation of the simulated k. All other points are defined as "off-equilibrium points".[52] Our procedure for defining beliefs is different for the two types of points.

If a point is "on-equilibrium", we run a regression of our variables of interest (consumption, output, and the spot wage) on the state variables $\{k_t, \overline{w}_{t-1}\}$, but only among periods in which conditions i) and ii) above are satisfied. The predicted value of our variable of interest computed at the grid point is then our updated belief at this grid point. Note that this is very similar to the Krusell and Smith (1998) approach, with the difference being that they run a regression using all data, and we run separate regressions for each point in the state space, using only data close to that point.

For the remaining "off-equilibrium" grid points, the procedure of computing beliefs is more complicated, because the simulated data may not be a good estimate of how the model would behave at this point. Instead of running a regression using simulated data, we start the model off exactly at the "off-equilibrium" grid point (recall this is just a triple $\Theta_t = \{x_t, k_t, \overline{w}_{t-1}\}$), and we simulate it for one period to compute the belief about our variables of interest (consumption, output, and the spot wage). One complication is that to simulate the model starting from this grid

---

[51]For example, suppose that in state 1, the belief is that the spot wage is 0.3 and the average firm's labor demand is 1.1. In this case, during simulation, the spot wage would be set to 0.33, so that $1.1\frac{0.3}{0.33} = 1.0$ and the average firm would hire 1.0 workers. In the following iteration, the belief about the spot wage in state 1 would be revised up from 0.3 towards 0.33.

[52]We have experimented with the definition of "on-equilibrium" by using alternative measures of distance and, for reasonable measures, this does not affect our results.

point, we must know not only the average capital and past wage, but also on the entire distribution of capital, past wage, past labor, debt obligations, and productivity across firms. We do this in the following way. We find the period in the simulated data that is closest to the grid point. We define closest as the smallest root-mean-square distance computed for $\{k_t, \overline{w}_{t-1}\}$ among points with the same discrete aggregate productivity state x_t as the grid point. We then shift the mean of the distribution of capital and past labor from that period to match the level of the "off-equilibrium" grid point $\{k_t, \overline{w}_{t-1}\}$. For example, suppose the grid point has capital and past wage $(k_a, \overline{w}_a)$. Suppose the nearest simulated period has distributions of capital and past wages with average values $(k_b, \overline{w}_b)$. Then each firm's capital and average wage are shifted by $k_b - k_a$ and $\overline{w}_b - \overline{w}_a$. We then take the shifted distribution as an initial distribution and simulate it forward for one period.

There is one additional caveat. It is important to put a weight on old beliefs during updating; without it the procedure may not converge. We have found that the lower the capital adjustment cost, the higher the required weight. For zero adjustment cost, the weight may sometimes need to be as high as 0.998. For our baseline model, the weight we use is 0.85, and likely an even lower weight would have sufficed.[53]

The procedure above describes how to form updated beliefs for output, spot wages, and consumption as a function of the state. These updated beliefs are $y_t = \sum y_t^i = \vartheta^{n+1}(\Theta_t)$, $w_t = \omega^{n+1}(\Theta_t)$, and $c_t = \zeta^{n+1}(\Theta_t)$. Noting that $i_t = y_t - c_t$ and plugging these into equation 17, the firm can use these beliefs to compute the aggregate state next period.

It still remains to update the belief for the stochastic discount factor. Note that with CRRA utility, this would be straightforward: $\mathbb{M}^{n+1}(\Theta_t, j_{t+1}) = \beta \left(\frac{Z_{t+1}}{Z_t}\right)^{-\rho\theta} \left(\frac{\zeta^{n+1}(\Theta_{t+1})}{\zeta^{n+1}(\Theta_t)}\right)^{-\frac{1}{\psi}}$, where j_{t+1} is the discrete realization of the aggregate productivity shock. For the more general case, we instead set

$$\mathbb{M}^{n+1}(\Theta_t, j_{t+1}) = \beta \left(\frac{Z_{t+1}}{Z_t}\right)^{-\rho\theta} \left(\frac{\zeta^{n+1}(\Theta_{t+1})}{\zeta^{n+1}(\Theta_t)}\right)^{-\frac{1}{\psi}} \left(\frac{u(\Theta_{t+1})}{E_t\left[\left(\frac{Z_{t+1}}{Z_t}\right)^{\rho(1-\theta)} u(\Theta_{t+1})^{1-\theta}\right]^{\frac{1}{1-\theta}}}\right)^{\frac{1}{\psi}-\theta},$$

where $u(\Theta_t)$ comes from separately solving the recursion:

$$u(\Theta_t) = \left((1-\beta)\zeta^{n+1}(\Theta_t)^{1-\frac{1}{\psi}} + \beta E_t\left[\left(\frac{Z_{t+1}}{Z_t}\right)^{\rho(1-\theta)} u(\Theta_{t+1})^{1-\theta}\right]^{\frac{1-\frac{1}{\psi}}{1-\theta}}\right)^{\frac{1}{1-\frac{1}{\psi}}}.$$

This recursion is also solved with value function iteration using the same aggregate grids as the firm's problem. However, it typically takes less than a second because the state space is much smaller (there are no individual firm variables), and because there are no choice variables.

Finally, we must update the bond pricing functions. We use the newly updated stochastic

[53]This is because even if rational equilibria exist, they are only weakly stable in the sense described by Marcet and Sargent (1989).

discount factor to compute the recursion in equation 20 by value function iteration. This recursion has both aggregate and individual state variables, however it has no choice variables. As inputs, it uses the value and default functions from the solution to the firm's problem.

Once steps one and two are complete, we check whether the algorithm has converged. If it has not, we restart step one with updated beliefs. Convergence means that the absolute distance between $\vartheta^{n+1}(\Theta_t)$ and $\vartheta^n(\Theta_t)$ is sufficiently small (same for $\zeta^{n+1}(\Theta_t)$ and $\omega^{n+1}(\Theta_t)$).

In addition to confirming that the beliefs have converged, it is standard to perform other checks. This solution method is referred to as an approximate bounded rational equilibrium. It is rational because the beliefs of the firms and agents are exactly equal to the best forecast an econometrician could achieve with in simulated data using the state defined variables. However, it is bounded because the forecast may still not be very good, as evidenced by a low R^2.

The lowest R^2 in our forecasting equations is 0.998 for consumption, the others are both above 0.999.[54]

There is one final component of the algorithm worth discussing. Typically, within each outer iteration, the value function iteration in step one would be implemented until convergence of the value function, before moving on to step two. To speed up the algorithm, this is not what we do. During step one of outer iteration n, we iterate the value function for 5 iterations before moving on to step two. Of course, 5 iterations is not enough for the value function to fully converge. However, during step $n+1$, we initialize the value function to be the final value function from the n iteration, $v^n(\Theta_t^i, \Theta_t)$. Thus, rather than waiting for the value function to fully converge, before updating beliefs, we update the value function a bit at a time, then update beliefs, then update the value function a bit more, and so on. Thus, over n outer iterations, the value function is iterated $5n$ times. Once the beliefs, which are inputs into step one, have converged, this algorithm produces exactly the same result as if we waited for the value function to converge during each outer iteration. However, this process works much faster.

A.2.1 Other checks. We have used the algorithm to solve several special cases of the model to confirm that where we know the exact solution, the algorithm gives us the same result.

Case 1: A partial equilibrium problem where the stochastic discount factor M_{t+1} and the spot wage W_t are exogenously specified. There is no debt. Returns to scale are constant $\rho = 1$, and the production function is Cobb-Douglas $\eta = 0$. For convenience, we do not differentiate between the aggregate and individual shock, so that both are in Z_t. $WB_t = \overline{W}_t N_t$ is the firm's wage bill at t.

---

[54]Because we apply a nonparametric approach, we define the $R^2 = 1 - \frac{\sum(x_t - E[x_t|\Theta_t])^2}{\sum(x_t - E[x_t])^2}$ where $E[x_t]$ is the unconditional mean of x and $E[x_t|\Theta_t]$ is our forecast of x, using the beliefs. More specifically, consider the spot wage. $E[w_t|\Theta_t]$ is a linear interpolation of the spot wage, using the belief $\omega^n(\Theta_t)$ at the aggregate state grid points around the simulated realization of Θ_t.

The firm's problem is:

$$
\begin{aligned}
V(Z_t, K_t, N_{t-1}, WB_{t-1}) &= Z_t K_t^\alpha N_t^{1-\alpha} - WB_t - I_t - \upsilon\left(\frac{I_t}{K_t} - \delta\right)^2 K_t + \\
&\quad E_t[M_{t+1} V(Z_{t+1}, K_{t+1}, N_t, WB_t)] \\
K_{t+1} &= (1-\delta)K_t + I_t \\
WB_t &= WB_{t-1}\mu + (N_t - N_{t-1}\mu)W_t
\end{aligned}
\tag{21}
$$

It can be shown that the value function has the form

$$
V(Z_t, K_t, N_{t-1}, WB_{t-1}) = Q_t^K K_t + Q_t^N N_t + Q_t^{WB} WB_t
\tag{22}
$$

where the $Q_t^N = -W_t Q_t^{WB}$, while Q_t^{WB} and Q_t^K follow the recursions:

$$
Q_t^{WB} = \mu(E_t[M_{t+1}(Q_{t+1}^{WB} - 1)])
\tag{23}
$$

and

$$
Q_t^K = S_t\left(Z_t S_t^{-\alpha} - W_t + E_t[M_{t+1}(W_t - W_{t+1})Q_{t+1}^{WB}]\right) - \delta + \upsilon\left(\frac{E_t[M_{t+1}Q_{t+1}^K] - 1}{2\upsilon}\right)^2 + E_t[M_{t+1}Q_{t+1}^K]
\tag{24}
$$

and S_t is defined as

$$
S_t = \left(\frac{W_t + E_t[M_{t+1}Q_{t+1}^{WB}(W_{t+1} - W_t)]}{(1-\alpha)Z_t}\right)^{-1/\alpha}
\tag{25}
$$

Note that if we specify laws of motion for Z_{t+1}, M_{t+1}, and W_{t+1} as a function of some underlying state, it is straight forward to solve the recursions in equations 23 and 24 numerically (there are no choice variables, so this is not only easy but also fast). Conditional on solving the recursions, we can solve the firm's problem analytically. We have compared this analytic solution to our model's numerical solution for several reasonable $(Z_{t+1}, M_{t+1}, W_{t+1})$ and the numerical solution is very close to the analytic solution.

Case 2: Similar to Case 1 but there are no capital adjustment costs ($\upsilon = 0$), instead we allow for decreasing return to scale $\rho < 1$. Note that we cannot analytically solve the case with both capital adjustment costs and decreasing returns to scale.

$$
\begin{aligned}
V(Z_t, K_t, N_{t-1}, WB_{t-1}) &= Z_t K_t^\alpha N_t^{\rho(1-\alpha)} - WB_t - I_t + \\
&\quad E_t[M_{t+1} V(Z_{t+1}, K_{t+1}, N_t, WB_t)] \\
K_{t+1} &= (1-\delta)K_t + I_t \\
WB_t &= WB_{t-1}\mu + (N_t - N_{t-1}\mu)W_t
\end{aligned}
\tag{26}
$$

It can be shown that the value function has the form

$$
V(Z_t, K_t, N_{t-1}, WB_{t-1}) = Q^0 + Q_t^1 K_t^\psi + Q_t^2 K_t + Q_t^N N_t + Q_t^{WB} WB_t
\tag{27}
$$

where $\psi = \frac{\alpha}{1-\rho(1-\alpha)}$; Q_t^N and Q_t^{WB} are defined the same as in Case 1, $Q^2 = 1 - \delta$, and

$$Q_t^1 = S_t \left(Z_t S_t^{(1-\alpha)\rho-1} - W_t + E_t[M_{t+1}(W_t - W_{t+1})Q_{t+1}^{WB}] \right)$$
$$S_t = \left(\frac{W_t + E_t[M_{t+1}Q_{t+1}^{WB}(W_{t+1} - W_t)]}{(1-\alpha)Z_t} \right)^{\frac{-1}{1-\rho(1-\alpha)}} \tag{28}$$

and

$$Q_t^0 = E_t[M_{t+1}Q_{t+1}^0] - X_t + E_t[M_{t+1}Q_{t+1}^1]X_{t+1}^{\psi} + E_t[M_{t+1}Q_{t+1}^2]X_t$$
$$X_t = \left(\frac{1 + E_t[M_{t+1}Q_{t+1}^2]}{\psi E_t[M_{t+1}Q_{t+1}^1]} \right)^{\frac{1}{\psi-1}} \tag{29}$$

As with Case 1, we have compared this analytic solution to our model's numerical solution for several reasonable $(Z_{t+1}, M_{t+1}, W_{t+1})$ and the numerical solution is very close to the analytic solution.

Case 3: If the conditions of the First Welfare Theorem hold, then a decentralized problem should give us the same solution as the planner's problem. If we shut down the appropriate frictions in the model ($\mu = 0$, $\tau = 0$) these conditions hold. In this case, for the parameters of our baseline model, we have checked that our decentralized algorithm gives a very similar solution as a solution using the planner's method. While this is not a proof that the algorithm works, the planner's method is a relatively straight forward, established technique. Furthermore, we have used the same planner's method algorithm to replicate certain existing published papers, in particular Prescott (1986), and Kaltenbrunner and Lochstoer (2010). The latter is a model with capital, adjustment costs, inelastic labor, and long run risk – relatively similar to a frictionless version of our baseline model.

A.3 Value, policy, and impulse response functions

In this subsection we plot several sample value and policy functions. The state space is multidimensional and plotting the entire value function is infeasible, for this reason we focus on a particular region within the state space. We set capital k_t, past wage $\overline{w}_{t-1}$, and expected productivity growth x_t to their simulated means; we also set the firm's past employment N_{t-1}^i and idiosyncratic productivity Z_t^i to their simulated means. We plot policy and value functions for different values of the firm's capital K_t^i, past average wage $\overline{w}_{t-1}^i$, and current coupon payment $\overline{\kappa}_t^i$.

The top two panels of Figure A1 plot the quarterly investment-to-capital ratio as a function of (detrended) firm capital. As a point of reference, the average (detrended) capital in the model is 3.1. The solid line in both the left and right panels is a firm whose past average wage, and current coupon payment are equal to the simulated means. The investment-to-capital ratio is decreasing in capital, except for very low levels of capital.[55] The dotted and dashed lines in the left panel represent the same firm but with low, or high past average wages; recall that past average wages are a proxy for future wage obligations. Firms with low past wages invest relatively more, while firms

---

[55]If a firm with average coupon and wage payments has a very low level of capital, it is better off shutting down as the obligations are too high relative to expected future cash flows. However, due to adjustment costs, it is better to deaccumulate capital slowly over time, then to shut down immediately. This is why, unlike in more standard models, investment is low when capital is low. When the firm has no current debt obligations (dotted line in the top right panel), the firm's investment-to-capital ratio is highest when capital is low, confirming standard intuition.

with high past wages relatively less. The dotted and dashed lines in the right panel represent the same firm but with zero debt, or above average current interest expenses. Firms with no current coupon payments invest relatively more, and those with high coupon payments relatively less - this is the classic debt overhang problem of Myers (1977). The bottom two panels are analogous to the top two, but show employment rather than investment policy. As with investment, firms with high coupon or wage obligations choose fewer employees. The sharp drop off at low capital represents default, discussed below.

The top two panels of Figure A2 plot the firm's equity value as a function of (detrended) firm capital. As above, the top left panel plots a firm with low, average, or high past average wages; the top right panel plots a firm with zero, average, or high current coupon payments. Both high past wages and high current debt obligations reduce the firm's equity value. Firms default if their equity value is zero, and this may happen even if they have positive capital. For the same level of capital, a firm with high coupon payments, or high past wages is more likely to default. The bottom left panel shows the price of debt (whose coupon payment is equal to the simulated average) for a firm with low, average, or high past wages. The debt of firms with more capital is worth more, as there is more collateral. The debt of firms with high past wages is worth less, as these firms are more likely to see their value erode due to high wage obligations, and to subsequently default. Note that there is a kink in the price of debt at the point where the firm defaults. Finally, the bottom right panel shows the debt issuance policy of firms with low, average, or high past wages. Note that only firms with zero current debt obligations may issue new debt, all other firms maintain their current level of debt. Firms with more capital issue more debt, but conditional on the same level of capital, firms with higher past wages issue less debt.

We also plot the impulse response functions for the wage, EBITDA (this is economic profit, before taxes or payments to creditors are subtracted), labor share, financial leverage, the credit spread, and investment in Figure A3 for the baseline model, and Figure A4 for the Cobb-Douglas model with no rigidity. This is done for an average initial conditions (All), as well as initial conditions with high or low labor share, or high or low financial leverage (labor share is constant for the second model, so we condition on leverage only).

First, consider the average response only, and compare the two models. In the frictionless, Cobb-Douglas model, after a negative shock, wages and EBITDA fall immediately by exactly the same amount, and are afterwards constant, resulting in a constant labor share. In the baseline model, wages fall by far less on impact, and then continue to fall slowly. Because wages fall slowly, the labor share rises, and EBITDA falls by much more in this model. Thus the capital owners - debt and equity - absorb a much larger fraction of the negative shock. This is the same channel as in Favilukis and Lin (2016a), who show that it is consistent with the data, where profit is also much more responsive to shocks than wages. Investment falls, the credit spread rises, and leverage rises[56] on impact. In percentage terms these changes are about the same in the two models, although the initial levels of credit spread and leverage are different. However, the baseline model delevers more

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[56]Leverage rises because the output, and firm value, which is the denominator, falls.

quickly because long term labor obligations make leverage riskier.

Next, consider conditioning on high initial labor share in the baseline model. Initial wages are low (this is somewhat counterintuitive but occurs because labor share is typically high during bad times), as are initial profits and investment. Initial financial leverage is close to its unconditional average when labor share is high, however following a negative shock, firms delever very quickly – this delevering happens through both less new issuance and default. This can be compared to the very slow delevering in the case of low initial labor share – despite a negative shock, financial leverage is not particularly risky because labor leverage is low. On the other hand, the initial credit spread is high because high labor obligations leave less for creditors to claim, but it falls very fast as firms delever. Labor share is constant in the frictionless, Cobb-Douglas model, thus the model is unable to speak to these interesting interactions between labor leverage and credit risk.

A.4 Two-period model

In this section, we solve a two period, partial equilibrium model that is, otherwise, as similar as possible to our baseline model. This model can qualitatively match the key results in our main model: a positive relationship between labor obligations and credit risk, and a negative relationship between labor obligations and debt issuance. Because this model is far less complicated than our baseline model, it may be easier to understand the intuition by focusing on this model.

The firm lives for two periods only, t and $t+1$. The firm enters period $t+1$ with the following state variables: productivity Z_{t+1}, capital K_{t+1}, face value of outstanding debt B_{t+1}, previous period employees N_t, and the previous period average wage $\overline{W}_t$. The firm's problem at $t+1$ is:

$$V_{t+1}(Z_{t+1}, K_{t+1}, B_{t+1}, \overline{W}_t, N_t) = \max\left(0, \max_{N_{t+1}} Z_{t+1} K_{t+1}^\alpha N_{t+1}^{1-\alpha} - \overline{W}_{t+1} N_{t+1} + K_{t+1} - B_{t+1}\right) \quad (30)$$

where the wage bill depends on the average past wage $\overline{W}_t$, past employees N_t, and the current spot wage W_{t+1}:

$$\overline{W}_{t+1} N_{t+1} = W_{t+1}(N_{t+1} - N_t \mu) + \overline{W}_t N_t \mu \quad (31)$$

We assume that the spot wage is perfectly correlated with productivity $W_{t+1} = (1-\alpha)Z_{t+1}$, which implies that $N_{t+1} = K_{t+1}$ and that the firm's value function at $t+1$ is:

$$V_{t+1}(Z_{t+1}, K_{t+1}, B_{t+1}, \overline{W}_t, N_t) = \max\left(0, \alpha Z_{t+1} K_{t+1} + K_{t+1} - B_{t+1} - \mu N_t(\overline{W}_t - (1-\alpha)Z_{t+1})\right) \quad (32)$$

Thus, the firm's equity value at $t+1$, is a simple, linear function of the state variables. At t, the firm takes the $t+1$ continuation value as given, and chooses how much to invest, hire, and borrow. It enters t with productivity $Z_t = 1$, capital $K_t = 1$, past employees N_{t-1}, and past wage $\overline{W}_{t-1}$. The firm faces a trade-off between tax shields and bankruptcy costs.

Figure A1: Policy functions

This figure plots policy functions for the investment-to-capital ratio (top two panels), and the labor demand-to-capital ratio (bottom two panels), as functions of capital. The state variables z_t, k_t, $\overline{w}_{t-1}$, Z_t^i and N_t^i are set to their simulated means. The state variable $\overline{\kappa}_t^i$ is set to 0, or 0.06, or 0.10, corresponding to no debt, average debt (Avg Debt) and high debt, respectively. The state variable $\overline{w}_{t-1}^i$ is set to 0.16, or 0.20, or 0.24, corresponding to low wage, average wage (Avg Wage) and high wage, respectively.
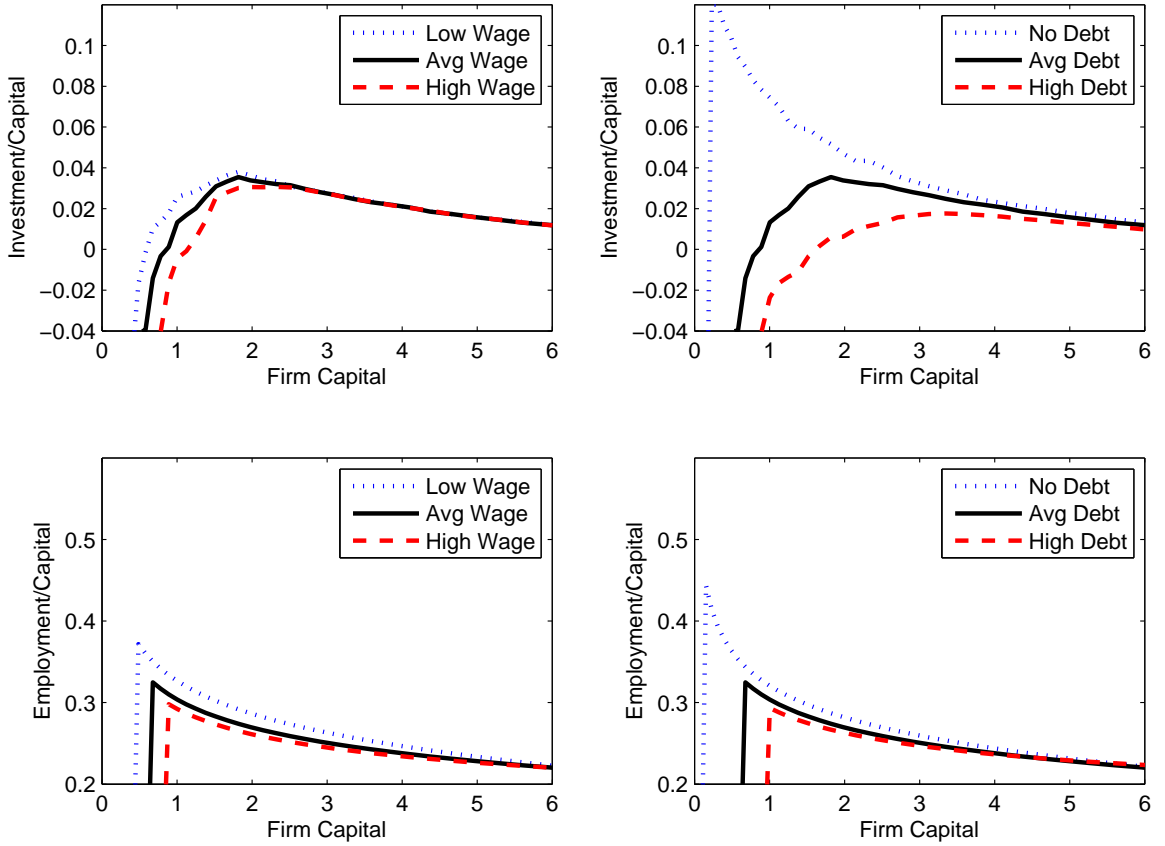
Figure A2: Value and policy functions

This figure plots the value of equity (top two panels), the price of debt (bottom left panel), and the policy for issuing new debt (bottom right panel) as functions of capital. The state variables z_t, k_t, $\overline{w}_{t-1}$, Z_t^i and N_t^i are set to their simulated means. The state variable $\overline{\kappa}_t^i$ is set to 0, or 0.06, or 0.10, corresponding to no debt, average debt (Avg Debt) and high debt, respectively. The state variable $\overline{w}_{t-1}^i$ is set to 0.16, or 0.20, or 0.24, corresponding to low wage, average wage (Avg Wage) and high wage, respectively.
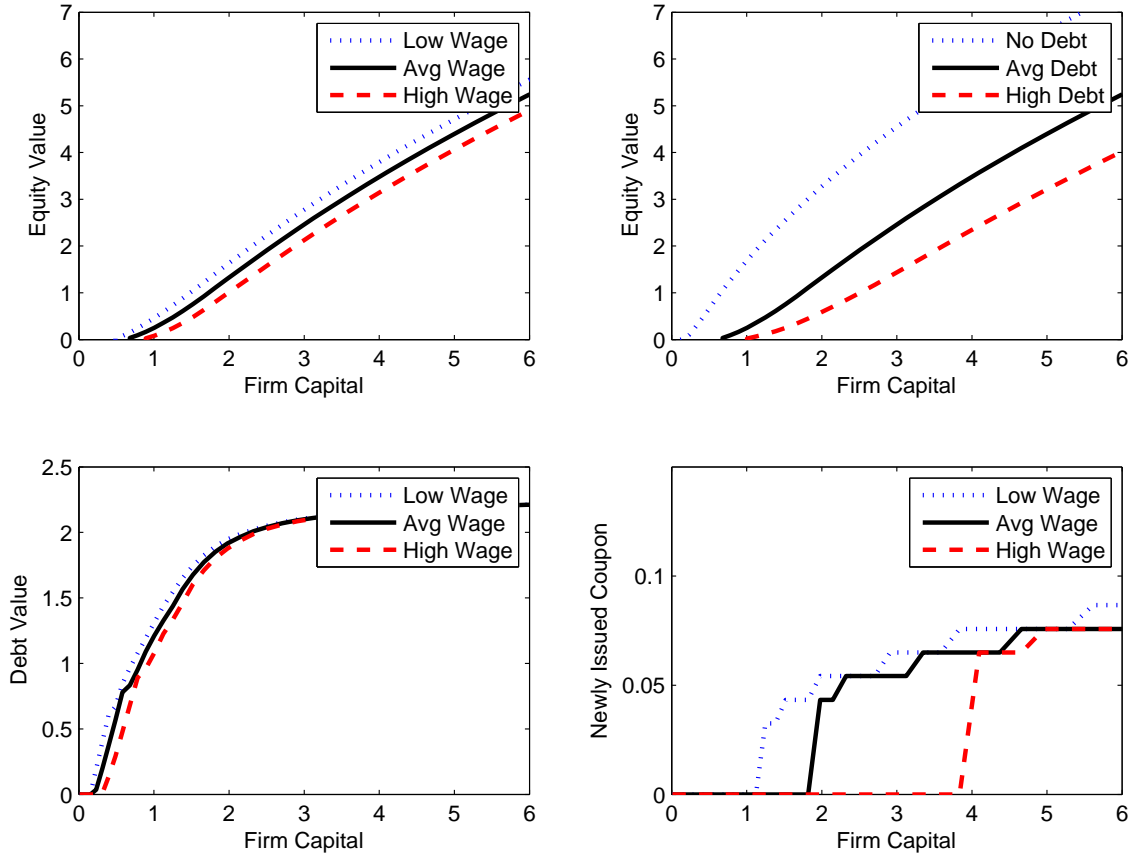
Figure A3: Impulse response functions in baseline model

This figure plots impulse response functions for wage, profit (EBITDA), labor share, financial leverage, the credit spread, and investment for a negative TFP growth realization at $t = 1$ in the baseline model. This is done for an average initial conditions (All), as well as initial conditions with high or low labor share, or high or low financial leverage. High or low is defined as top or bottom 33%. We scale each realization x_t^i where $i \in (\text{All}, \text{Low LS}, \text{High LS}, \text{Low FinLev}, \text{High FinLev})$ by the average realization at $t = 0$, that is by x_0^{All}
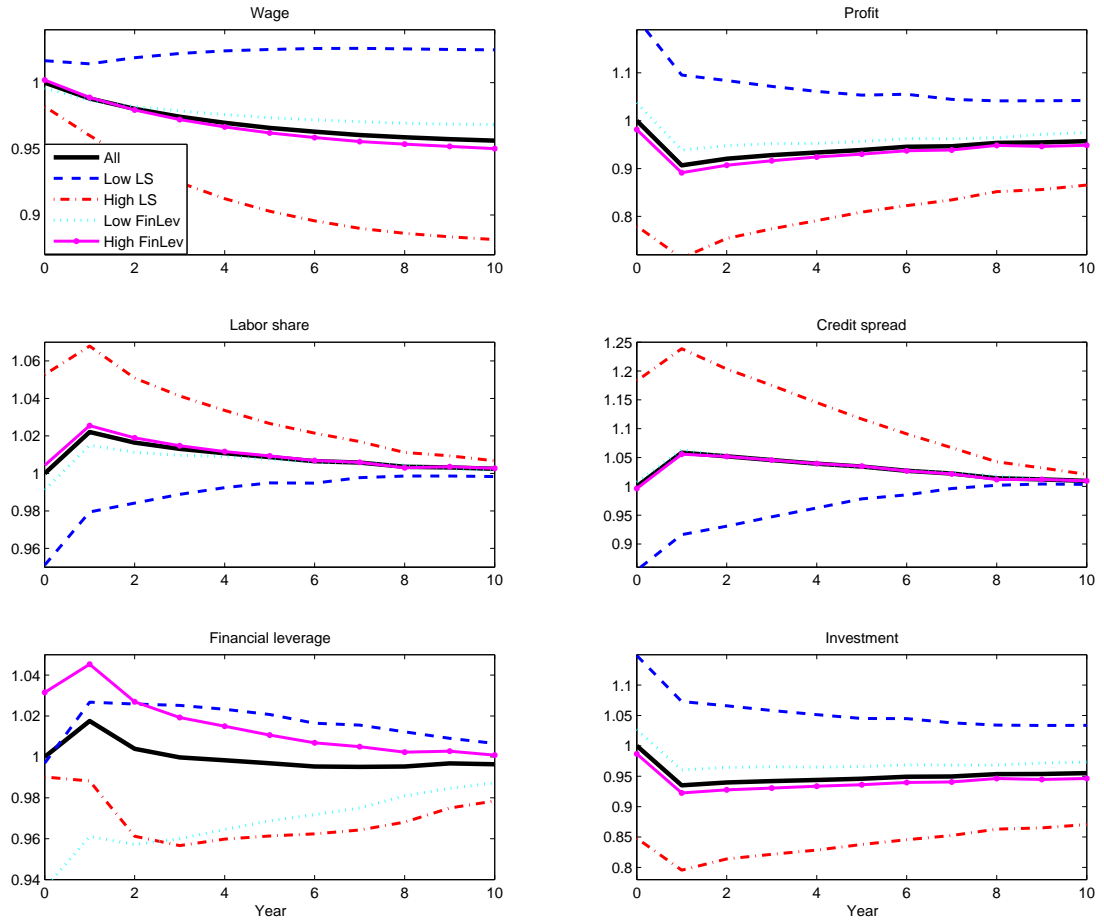
Figure A4: Impulse response functions in Cobb-Douglas model with no rigidity

This figure plots impulse response functions for wage, profit (EBITDA), labor share, financial leverage, the credit spread, and investment for a negative TFP growth realization at $t = 1$ in the Cobb-Douglas model with no rigidity. This is done for an average initial conditions (All), as well as initial conditions with high or low financial leverage. High or low is defined as top or bottom 33%. We scale each realization x_t^i where $i \in (\text{All}, \text{Low FinLev}, \text{High FinLev})$ by the average realization at $t = 0$, that is by x_0^{All}
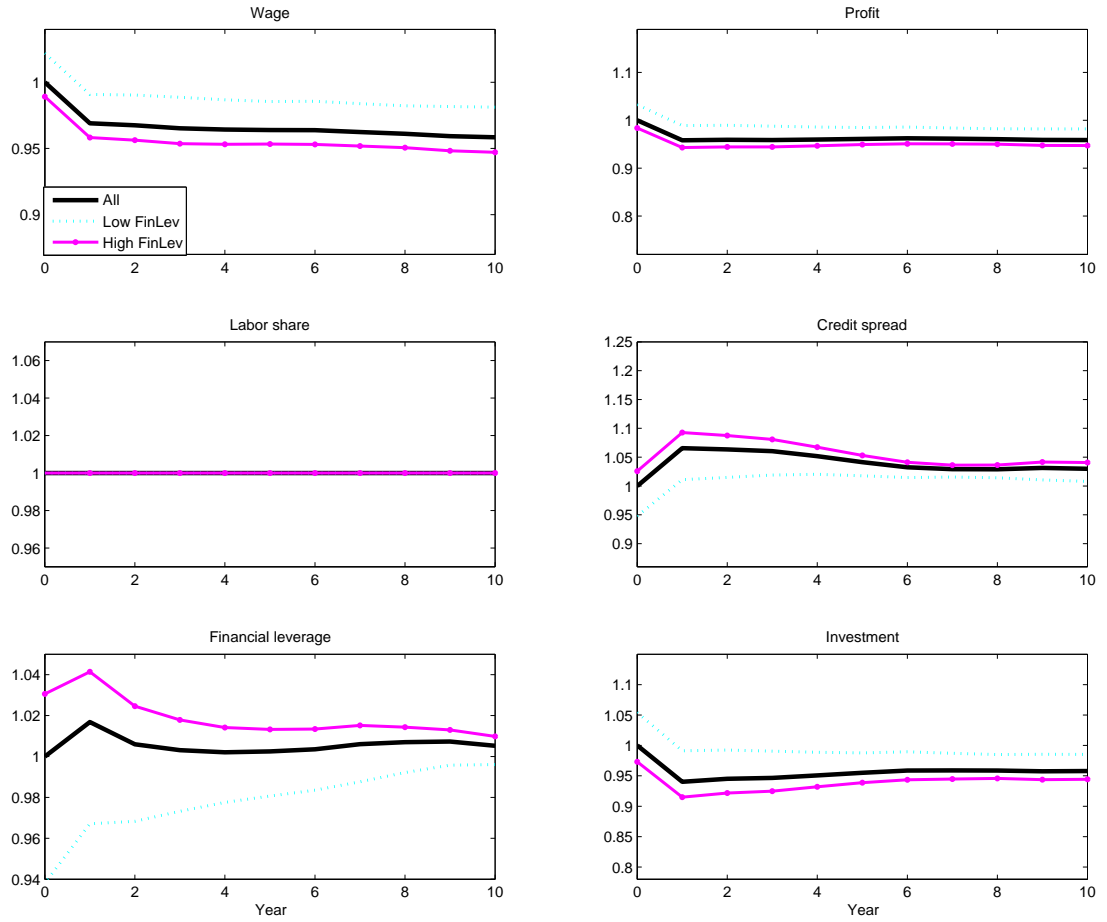
Table A1: Business cycle statistics for additional models

This table compares business cycle statistics (annual) from the data to the baseline model and to the additional models we have solved. In each panel, we list only the features different from the baseline model. The parameters of interest are μ (wage rigidity), η (CES), ψ (IES), and θ (risk aversion).

x	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	AC(x)	$\frac{\sigma(\Delta x)}{\sigma(\Delta y)}$	$\rho(\Delta x, \Delta y)$	AC(Δx)	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	AC(x)	$\frac{\sigma(\Delta x)}{\sigma(\Delta y)}$	$\rho(\Delta x, \Delta y)$	AC(Δx)
				Data						Baseline model		
y	1.00	1.00	0.32	1.00	1.00	0.07	1.00	1.00	0.38	1.00	1.00	0.28
c	0.67	0.89	0.44	0.65	0.88	0.31	0.69	0.97	0.42	0.74	0.97	0.43
i	2.35	0.91	0.47	2.12	0.90	0.20	2.31	0.97	0.35	2.18	0.95	0.14
w	0.52	0.59	0.52	0.54	0.60	0.41	0.40	0.52	0.69	0.51	0.59	0.85
				$\eta = 0$						$\mu = 0$		
y	1.00	1.00	0.39	1.00	1.00	0.30	1.00	1.00	0.39	1.00	1.00	0.29
c	0.59	0.96	0.43	0.67	0.95	0.50	0.70	0.98	0.42	0.75	0.98	0.41
i	2.51	0.97	0.38	2.31	0.95	0.18	2.23	0.97	0.37	2.10	0.95	0.17
w	0.50	0.59	0.68	0.59	0.66	0.82	0.71	0.99	0.42	0.75	0.98	0.41
				$\eta = 0$, $\mu = 0$						Short term debt		
y	1.00	1.00	0.41	1.00	1.00	0.33	1.00	1.00	0.42	1.00	1.00	0.32
c	0.62	0.98	0.45	0.69	0.96	0.51	0.67	0.98	0.45	0.73	0.98	0.46
i	2.33	0.98	0.38	2.17	0.95	0.19	2.25	0.98	0.39	2.12	0.96	0.20
w	1.00	1.00	0.41	1.00	1.00	0.33	0.43	0.53	0.72	0.53	0.61	0.85
				$\psi = 1.5$						$\psi = 2.5$		
y	1.00	1.00	0.39	1.00	1.00	0.29	1.00	1.00	0.39	1.00	1.00	0.29
c	0.71	0.98	0.42	0.75	0.98	0.42	0.68	0.97	0.43	0.73	0.96	0.45
i	2.24	0.97	0.37	2.10	0.95	0.16	2.40	0.96	0.36	2.25	0.94	0.15
w	0.40	0.52	0.69	0.52	0.60	0.86	0.41	0.53	0.70	0.53	0.61	0.86
				$\theta = 4$						$\theta = 12$		
y	1.00	1.00	0.39	1.00	1.00	0.29	1.00	1.00	0.39	1.00	1.00	0.29
c	0.69	0.97	0.43	0.74	0.97	0.44	0.69	0.98	0.42	0.74	0.97	0.43
i	2.33	0.96	0.36	2.18	0.94	0.15	2.35	0.97	0.37	2.20	0.94	0.17
w	0.40	0.53	0.69	0.52	0.61	0.85	0.40	0.52	0.70	0.53	0.60	0.86
				$\psi = 0.125$								
y	1.00	1.00	0.37	1.00	1.00	0.27						
c	1.00	0.97	0.33	1.02	0.97	0.22						
i	1.75	0.67	0.37	1.62	0.65	0.19						
w	0.29	0.47	0.69	0.43	0.54	0.88						

Define next period's capital, the average wage, and the pre-tax profit as:

$$K_{t+1} = (1 - \delta)K_t + I_t$$
$$\overline{W}_t N_t = W_t(N_t - N_{t-1}\mu) + \overline{W}_{t-1} N_{t-1}\mu \tag{33}$$
$$\Pi_t = Z_t K_t^\alpha N_t^{1-\alpha} - \overline{W}_t N_t$$

The firm's problem is:

$$
\begin{aligned}
V_t(Z_t, K_t, \overline{W}_{t-1}, N_{t-1}) \;=\; & \max_{I_t, N_t, B_{t+1}} \Pi_t(1 - \tau) - I_t - \upsilon(\tfrac{I_t}{K_t} - \delta)K_t \\
& + \; Q_t B_{t+1} + \min(\tau(1 - Q_t)B_{t+1}, \tau\Pi) \\
& + \; E_t[M_{t+1} V_{t+1}(Z_{t+1}, K_{t+1}, B_{t+1}, \overline{W}_t, N_t)]
\end{aligned} \tag{34}
$$

where the first piece on the right is after tax profit, the second and third pieces are investment and adjustment costs, the fourth piece is proceeds from issuance of new debt, the fifth piece is the

Table A2: Model comparisons

This table compares selected results from several alternative models to our baseline model. Our baseline model has $\theta = 8$ (risk aversion) and $\psi = 2.0$ (IES); it is in the second row of every panel, after the data. The model in the third row has $\psi = 1.5$ (lower IES), in the fourth row has $\psi = 2.5$ (higher IES), in the fifth row has $\theta = 4$ (lower risk aversion), in the sixth row has $\theta = 12$ (higher risk aversion), and in the seventh row has $\psi = 1/\theta = 0.125$ (CRRA). Panel A presents the volatility of the wage, the average excess return and volatility of equity, the average excess return on debt, the average (market) leverage, credit spread, and default probability, as well as the correlation of leverage with output growth. Panel B presents correlations between the credit spread at $t+1$ and either residual wage growth or residual labor share at t; or correlations between debt (book-value) growth between t and $t+1$ and either residual wage growth or residual labor share at t. These correlations are computed from aggregate time-series data. Residuals are computed by first regressing either wage growth, or labor share on output growth. Panel C is similar to Panel B, but uses pooled firm-level data. Panel D presents expected loss as a fraction of the credit spread, and the correlations of labor share with contemporaneous credit spread CS, credit risk premium $CSRP$, and expected loss $LOSS$.

Panel A: Selected moments

	$\sigma(\Delta W)$	$E[R^{E,e}]$	$\sigma(R^{E,e})$	$E[R^{D,e}]$	LEVM	CS	DEF	$\rho(LEVM, \Delta y)$
Data	1.77	8.42	18.08	1.20	0.44	0.95	0.82	-0.24
Baseline	1.63	3.01	8.19	0.82	0.37	1.31	0.84	-0.30
Low IES	1.63	2.52	7.98	0.78	0.38	1.30	0.85	-0.32
High IES	1.67	3.08	8.25	0.83	0.36	1.32	0.86	-0.26
Low RA	1.64	1.07	8.16	0.54	0.39	1.21	0.66	-0.01
High RA	1.64	4.23	7.98	1.10	0.36	1.40	1.21	-0.61
CRRA	1.20	0.55	2.40	0.70	0.34	2.17	1.72	-0.47

Panel B: Aggregate correlations

	$\rho(\Delta W^{res}, CS)$	$\rho(LS^{res}, CS)$	$\rho(\Delta W^{res}, \Delta DEBT)$	$\rho(LS^{res}, \Delta DEBT)$
Data	-0.41	0.27	0.38	-0.08
Baseline	-0.55	0.57	0.40	-0.34
Low IES	-0.81	0.84	0.68	-0.67
High IES	-0.83	0.84	0.66	-0.65
Low RA	-0.84	0.86	0.64	-0.62
High RA	-0.79	0.81	0.76	-0.74
CRRA	0.01	-0.14	0.83	-0.77

Panel C: Firm level correlations

	$\rho(\Delta W^{res}, CS)$	$\rho(LS^{res}, CS)$	$\rho(\Delta W^{res}, \Delta DEBT)$	$\rho(LS^{res}, \Delta DEBT)$
Data	-0.02	0.05	0.04	-0.03
Baseline	-0.25	0.08	0.15	-0.06
Low IES	-0.31	0.02	0.19	-0.06
High IES	-0.31	0.02	0.20	-0.06
Low RA	-0.33	0.06	0.21	-0.06
High RA	-0.23	0.01	0.18	-0.06
CRRA	-0.33	0.00	0.45	-0.17

Panel D: Decomposing the credit spread

	$\frac{LOSS}{CS}$	$\rho(LS_t, CS_t)$	$\rho(LS_t, CSRP_t)$	$\rho(LS_t, LOSS_t)$
Data	0.11-0.39	0.38	0.35	0.17
Baseline	0.17	0.92	0.71	0.36
Low IES	0.19	0.93	0.65	0.40
High IES	0.16	0.92	0.68	0.33
Low RA	0.22	0.92	0.61	0.37
High RA	0.15	0.91	0.83	0.29
CRRA	0.42	0.07	0.01	0.06

interest tax deduction, and the sixth piece is the continuation value.

Simultaneously we need to solve for the bond price. Define the indicator $\mathbf{1}_D$ to be 1 when $V_{t+1}(Z_{t+1}, K_{t+1}, B_{t+1}, \overline{W}_t, N_t) \leq 0$ and zero otherwise. Then we can define the price of debt as:

$$Q_t(K_{t+1}, \overline{W}_t, N_t, B_{t+1}) = E_t[M_{t+1}\left(\mathbf{1}_D + (1 - \mathbf{1}_D)\frac{V_{t+1}^0}{B_{t+1}}\right)] \tag{35}$$

where

$$V_{t+1}^0 = (Z_{t+1}K_{t+1} + K_{t+1} - \mu N_t(\overline{W}_t - (1-\alpha)Z_{t+1}))(1-\theta) \tag{36}$$

is the post-default firm value that goes to the creditors, and θ is the default cost. Note that like in our full model, the price of debt Q_t is a function of the choices that the firm makes at t.

If debt is forced to be zero, then this problem can be solved analytically, with $\frac{I_t}{K_t} = \frac{\alpha E_t[M_{t+1}Z_{t+1}]+E_t[M_{t+1}]-1}{2\upsilon}$ and $N_t = K_t\left(1 + \mu(E_t[M_{t+1}] - E_t[M_{t+1}Z_{t+1}/Z_t])\right)^{-1/\alpha}$. Because the interaction between bankruptcy, the price of debt, and firm choices is complicated, we solve the full problem numerically.

We assume that the stochastic discount factor is $\beta\left(\frac{Z_{t+1}}{Z_t}\right)^{-\gamma}$ and we choose the following parameters: $\alpha = 0.4$, $\delta = 0.1$, $\upsilon = 1.0$, $\beta = 0.8$, $\gamma = 0.5$, $\mu = 0.9$, $\tau = 0.35$, and $\theta = 0.17$. We choose Z_{t+1} to be normal with mean one and standard deviation 0.25. In figure A5, we plot the amount of debt issued, the default rate, and the interest rate, as a function of the past average wage $\overline{W}_{t-1}$, while setting past labor $N_{t-1} = 1$ at its frictionless value. We do this for four models.

The first model is the model described above, we call this the short term debt (STD) model because the firm is unconstrained as to how much debt to issue. As the firm's past average wage increases, it issues progressively less debt. This is consistent with our full model. This happens because, all else equal, high labor obligations from $t-1$ will still affect the ability to pay at $t+1$, making default more likely, interest rates higher, and debt less attractive. As labor obligations rise, the default rate and the interest rise as well. However, eventually, for high enough labor obligations, firms reduce debt by so much that they actually become safer, resulting in lower default rates and interest rates as a function of the past average wage – this is different from our baseline model.

To make debt in the model above more like long term debt, we assume that the firm enters period t with an additional state variable B_t, which represents the long term level of debt. We assume that 25% of firms can change their debt, and behave just as the short term debt firms described above. The remaining firms must set $B_{t+1} = B_t$.[57] In figure A5, we plot, for the average firm, the amount of debt issued, default rate, and interest rate, as a function of the past average wage $\overline{W}_{t-1}$. We set past labor $N_{t-1} = 1$ at its frictionless value. We do this for low, medium, and high debt firms.[58] In this long term debt model, as the past average wage rises, debt issuance falls, as in the short term debt model and in our full model. However, it falls much slower than in the short term debt model because many firms are unable to adjust their debt. As a result, the default

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[57]To make the model comparable to the short term debt model, we assume that B_t is not actually paid to creditors at t, its only purpose is to make deviations from past B_t impossible for some firms.

[58]The medium $B_t = 1.3$ is set to equal the optimal debt amount in the short term debt model, at the point where the past average wage is equal to the spot wage ($\overline{W}_{t-1} = 0.6$). The high and low values are 1.1 and 1.5.

rate and the interest rate rise even at higher levels of wage obligations.[59]

Thus, this simple two period model qualitatively reproduces our key results: a positive relationship between labor share and the credit spread, and a negative relationship between labor share and debt issuance. The intuition in the full model is the same, but it is also quantitatively close to the data.

A.5 Variable construction

A.5.1 Aggregate data. Table A3 reports the descriptive statistics for the variables we use in our aggregate regressions. Note that wage growth is far less volatile than GDP growth – evidence against a frictionless Cobb-Douglas model. The relationship between the credit spread, wage growth, and labor share is also evident in Figure A6, where credit spread moves together with labor share, and in the opposite direction of wage growth. The variable definitions are below.

- Credit spread. We use the Moody's Baa corporate bond yield in excess of Aaa corporate bond yield from the Federal Reserve. Chen, Collin-Dufresne, and Goldstein (2009) argue that the Baa-Aaa spread mostly reflects credit risk, because the components due to taxes, call/put/conversion options and liquidity are of similar magnitude for Aaa and Baa bonds.
- Debt growth. Aggregate debt growth is the growth rate of credit market instrument liabilities for non-financial business from the Flow of Funds Table L102. Although the most recent Table L102 does not report this as a separate item, this is also equal to the sum of commercial paper, munis, bonds, and loans.
- Wage growth. We use the growth rate in the real wages and salaries per full-time equivalent employee from NIPA Table 6.6.
- Labor share. Labor share is the ratio of aggregate compensation of employees to GDP. Aggregate compensation is from NIPA and includes noncash benefits.
- Controls. The empirical finance literature has identified several variables related to the credit spread (see Collin-Dufresne, Goldstein, and Martin (2001)). We measure financial leverage as the book value of credit market instruments of nonfinancial business sector divided by the sum of the market value of equity in the nonfinancial corporate business sector and the book value of the credit market instruments from the Flow of Funds Accounts. Stock market volatility is the annualized volatility of monthly CRSP stock market returns in excess of risk free rate. Term spread is the difference between the ten-year Treasury bond yield and the three-month Treasury bill yield from the Federal Reserve. The spot rate is the one-year Treasure bill rate. The growths of GDP, consumption, and employment are from BEA. Our sample is from 1948 to 2014.[60]

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[59]There appears to be some non-monotonicity at intermediate values W_{t-1}. We do not have intuition for why this is so, but do not believe this is a mistake.

[60]We start in 1948 because financial leverage from Flow of Funds is available after 1946. We do not start in 1946 to avoid the influence of WWII on our results. However, the predictability of wage growth for the credit spread holds in a longer sample starting from 1929.

Figure A5: Policy functions

This figure plots the debt choice, default probability, and interest rate as a function of the past average wage for a firm in the 2-period model
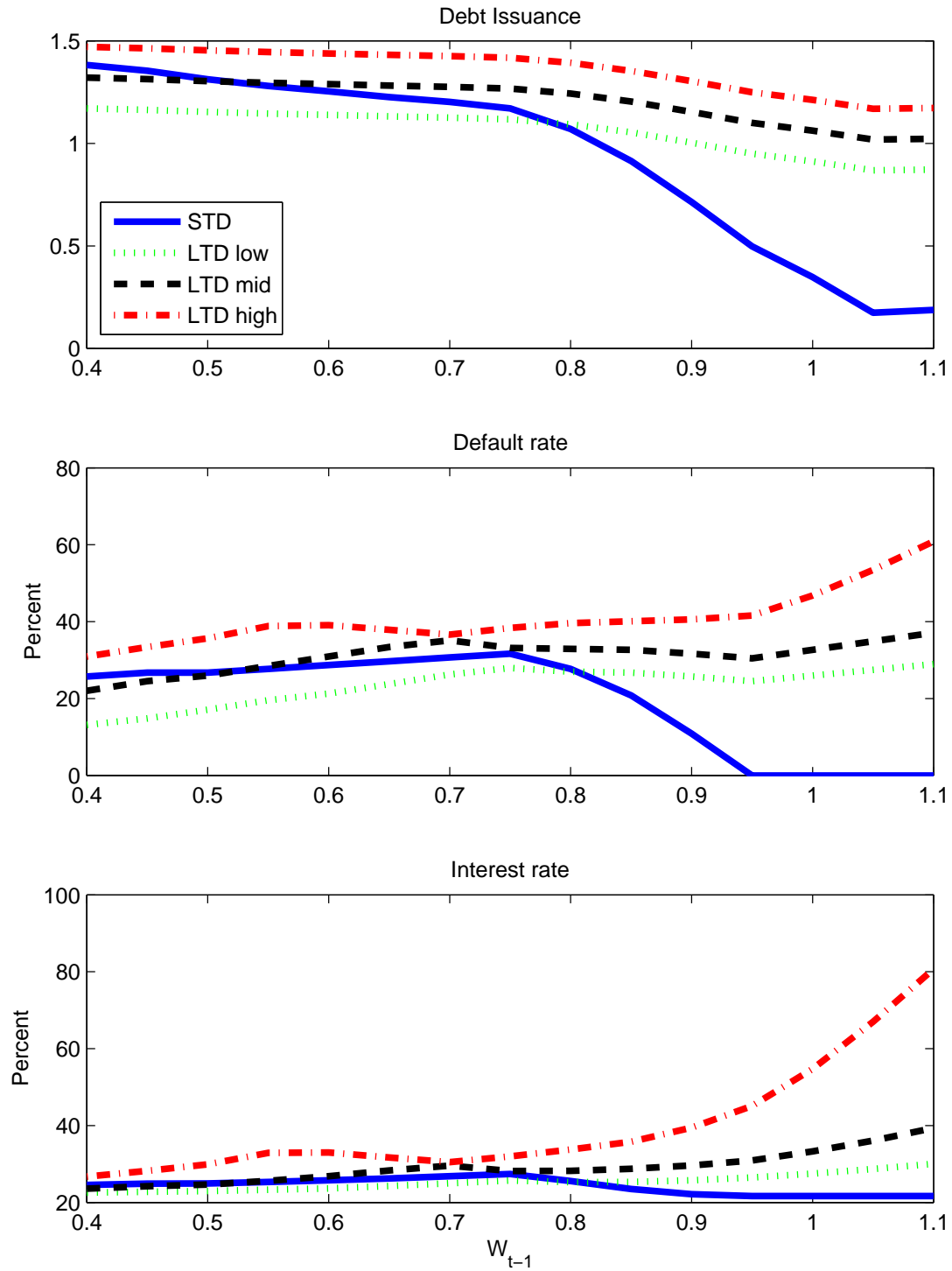
A.5.2   Firm level data. Our firm-level control variables are constructed as follows:

- $WCTA$: Working capital is the ratio of Compustat item WCAP to total assets (Compustat item AT).
- $RETA$: Retained earnings is the ratio of Compustat item RE to total assets.
- $EBITTA$: EBIT is the ratio of Compustat item EBIT to total assets.
- $Leverage$: We define book leverage as $(DLTT + DLC)/AT$, where $DLTT$ and DLC are Compustat items for long-term and short-term debt respectively. We also calculate an alternative measure using $(DLTT+DLC)/(DLTT+DLC+AT+TXDITC-PSTK-LT)$ but find that empirically the correlation between these two measures is high (95% correlation). Therefore we only report the results based on our main definition of book leverage. We define market leverage as $(DLTT+DLC)/(DLTT+DLC+PRCC*CSHO)$, where $PRCC$ is the price per share and $CSHO$ is the shares outstanding.
- STA: Sales is the ratio of Compustat item SALE to total assets.
- $NITA$: Net income is the ratio of Compustat item NI (for North America) and NICON (for Global) to total assets.
- $CACL$: Current ratio is the ratio of Compustat item ACT (current assets) to LCT (current liabilities).
- σ: Stock return volatility is the standard deviation of monthly returns. For US firms, stock returns are retried from CRSP. For firms in other countries, we use data from Compustat Global Security Daily to calculate stock return in month t as

$$RET_t = \frac{PRCCD_t/AJEXDI_t \times TRFD_t - PRCCD_{t-1}/AJEXDI_{t-1} \times TRFD_{t-1}}{PRCCD_{t-1}/AJEXDI_{t-1} \times TRFD_{t-1}}$$

   where $PRCCD_t$ is the closing price at month end, $AJEXDI_t$ and $TRFD_t$ are the corresponding share and return adjustment factors.
- $Invest$: Investment ratio is defined as the ratio of Compustat item CAPX to lagged PPENT (Property, Plant and Equipment).
- $MCAP$: The market capitalization of a firm at year for is defined as the logarithm of the product of year end closing price (PRCCD) and shares outstanding (CSHOC).
- $RSIZE$: Relative size is defined as the logarithm of the ratio of company's market capitalization to the total market capitalization in its country at the year end. In other words, it is a company's weight in its country's value-weighted market portfolio.
- R_m: The return on the value-weighted market portfolio for each country at annual frequency.
- R_{excess}: The excess return of a firm's stock is defined as the difference between firm's raw return (RET) and the value-weighted market portfolio return (R_m).
- HN: Net hiring is defined as $HN_t = \frac{(EMP_t-EMP_{t-1})}{0.5\times(EMP_t+EMP_{t-1})}$, where EMP is the number of employees from Compustat.
- $\Delta WAGE$: Wage growth is defined as $\Delta WAGE_t = \frac{(WAGE_t-WAGE_{t-1})}{0.5\times(WAGE_t+WAGE_{t-1})}$, where $WAGE = XLR/EMP$.

A.5.3 CDS data. We obtain the single name corporate CDS spread data come from IHS Markit. We discuss below how we link the Markit identifiers to the Compustat Global identifies and the sample coverage.

The main Markit identifiers that might be used to link to other databases are company name and company (6-digit) CUSIP. In Compustat Global, the identifier that might be matched to Markit is company name. Note that for North American firms, we can extract the historical CUSIP (NCUSIP) from CRSP and used it to match with the company CUSIP in Markit. Therefore, we conduct a multi-step matching process to create the linking table between Markit and Compustat Global. First, for North American firms, we match the CUSIP from Markit with the NCUSIP (6-digit) from the CRSP to obtain the corresponding PERMCO which is then used to obtain the GVKEY for Compustat. Second, for firms outside North America, we match the company name from Markit with the company name from Compustat Global and only keep the exact matches to obtain the GVKEY from Compustat. Third, for the remaining firms outside North America, we use a name match algorithm in Python to generate scores between the Markit company name and the Compustat Global company name. We keep the firms with scores above 0.5 and manually go through them to identify the correct matches. For the unmatched firms and the firms with lower than 0.5 matching scores, we use the Capital IQ ID look-up function to extract the GVKEY directly by using Markit company name as the input. To check the accuracy of the Capital IQ look-up function, we use the exact name matches that we identify from the previous step as an experiment sample. We find that for this exact-match subsample, Capital IQ look-up function has a success rate of 92%. For the Capital IQ ID look-up step, sometimes it will return multiple GVKEYs, and we manually filter out the correct ones in these cases. After going through the whole matching process and keeping firms with at least 1 non-missing labor expenses growth rate, we have 1006 unique firms left in the CDS sample with non-missing GVKEYs.

For each firm date in the CDS dataset, there might be multiple observations representing different CDS contracts. The main variables that characterize these contracts are Tier, DocClause, and Ccy (currency). We select the CDS contracts following the literature (Longstaff, Mithal, and Neis (2005); Zhang, Zhou, and Zhu (2009); Augustin, Subrahmanyam, Tang, and Wang (2014); Bai and Wei (2017)). For example, Tier represents the seniority of the underlying debt that the CDS contract is written on. For the matched CDS sample more than 96% of the observations have the Tier value as SNRFOR, which represents senior unsecured debt. Therefore, we keep only the CDS contracts with Tier of SNRFOR.

Second, DocClause represents the document clause and restructuring type that the CDS is priced on. This defines what constitutes a credit event for the contract as well as any limitations on the deliverable debt in the event of a credit event. This variable follows the ISDA (International Swap and Derivative Association) definitions (2003 and 2014 versions) and have four different types: CR – Full Restructuring, MR – Modified Restructuring, MM – Modified Modified Restructuring, and XR – No Restructuring.[61] We follow the literature to use the main DocClause for different

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[61]See Bai and Wei (2017) for more detailed discussions.

regions/different years. For example, for North American firms, we use MR before 2009 and XR after 2009 (due to CDS big bang). To increase the sample coverage, we use CDS contracts with our DocClause when the primary ones do not have CDS spreads available. Specifically, for the North American firms, if MR is not available before 2009, we use other DocClause in the sequence of XR, CR, and MM (this also reflects a descending coverage percentage order in the data). For the North American firms after 2009, if XR is not available, we use other DocClause in the sequence of MR, CR, and MM. For other regions, the DocClause convention varies because of differences in bankruptcy laws. For European firms, MM is the most common one, followed by CR, MR, and XR, so this is also the sequence we use to find the CDS contracts with non-missing spreads. For Asian and other emerging markets, we use the sequence of CR, MR, MM14, and XR. And for Oceanian markets, we use the sequence of MR, CR, MM, and XR.

Third, when a CDS contract is traded in multiple currencies, the CDS spreads are the same as these are expressed as basis points of 100 currency units of the notional amount. So we only need to one CDS spread when a contract is traded in multiple currencies.

After filtering through the above CDS contract features, we have one CDS contract left for each firm date. We follow the literature (e.g.,Longstaff, Mithal, and Neis (2005)) to use the most liquid CDS contracts spread, 5-year CDS spreads as our main measure, and we also conduct the analysis using 1-year CDS spreads, which also has decent coverage. For example, 93% of our sample has non-missing 5-year CDS spread and 83% of the sample has non-missing 1-year CDS spread.

Figure A6: Labor Market Variables and Credit Spread

This figure plots the Baa-Aaa credit spread (CS), wage growth (ΔW) and labor share (LS). Wage growth is the growth rate of real wages and salaries per employee; labor share is the total compensation scaled by GDP, and credit spread is the Moody's Baa-Aaa corporate bond yield. The sample is from 1948 to 2014. The grey bars are the NBER recessions. All variables are standardized to allow for an easy comparison in one plot.
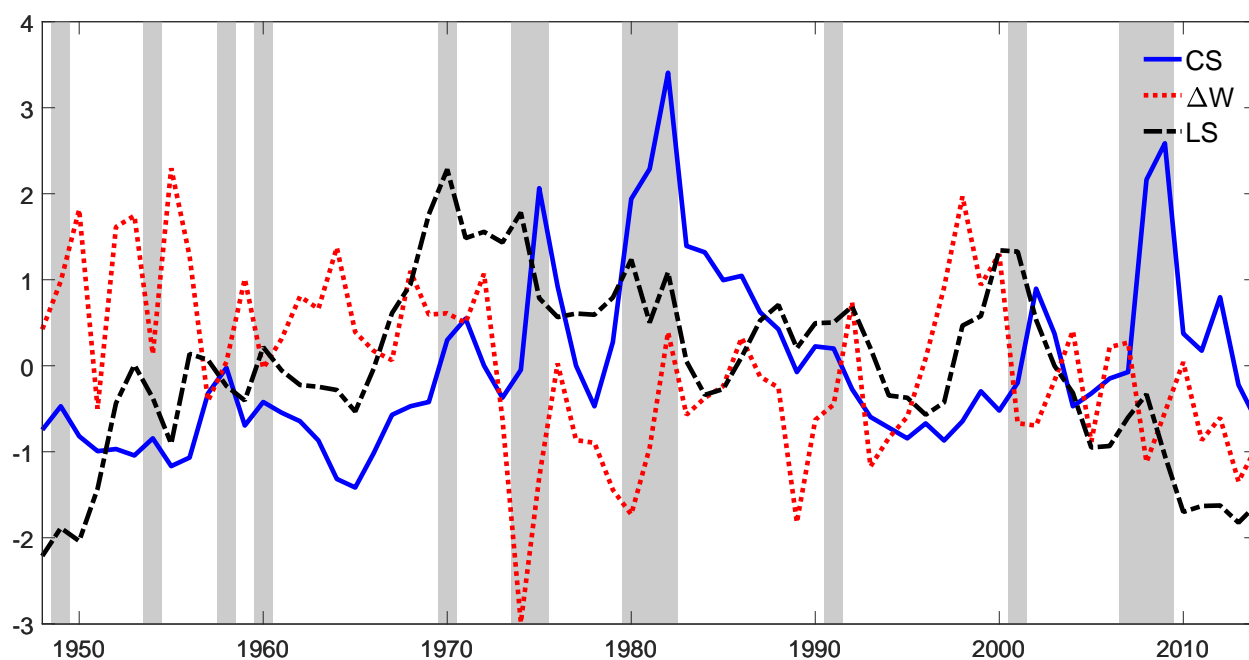
Table A3: Descriptive Statistics

This table reports the descriptive statistics of the variables of interests. GDP growth (ΔGDP) is the real GDP growth. Wage growth (ΔW) is the growth rate of real wages & salaries per employee. Labor share (LS) is the aggregate compensation divided by GDP. Investment growth (ΔINV) is the growth rate of real private nonresidential fixed investment. Employment growth (ΔN) is the growth rate of total employment. Consumption growth ΔC uses personal consumption expenditure. The above statistics are all form BEA. Debt growth (ΔDEBT) is the growth rate of credit market instrument liabilities for non-financial business from the Flow of Funds Table L102. P/E is the equity price to earnings ratio, and spot rate (RF) is the real 1 year government bond yield, both from Robert Shiller's webpage. Term spread (TS) is the long-term government bond yield (10 year) minus the short-term government bond yield (3 months). Financial leverage (FinLev) is book value of nonfinancial credit instruments divided by the sum of the market value of equities and credit instruments of nonfinancial corporate sector from Flow of Funds. Market volatility (MktVol) is the annual volatility of CRSP value-weighted market premium. The default rate (DEF) is average default rate of all rate bonds from 1948 to 2006 from Moody's. Credit spread (CS) is the Moody's Baa-Aaa corporate bond yield. GDP growth, wage growth, labor share, investment growth, debt growth, term spread, spot rate, default rate, and credit spread are in percentage terms. The sample is from 1948 to 2014.

	Mean	StDev	AC
ΔGDP	3.22	2.39	0.15
ΔW	1.50	1.77	0.47
LS	55.29	1.23	0.86
ΔINV	4.46	6.31	0.20
ΔDEBT	4.65	3.71	0.63
P/E	16.58	16.16	0.82
TS	1.37	1.28	0.44
FinLev	0.44	0.09	0.88
MktVol	0.14	0.05	0.33
RF	1.57	2.73	0.56
DEF	0.82	0.98	-0.29
CS	0.95	0.40	0.74
ΔN	1.61	2.01	0.29
ΔC	3.34	1.85	0.30

Table A4: Quarterly regressions

This table reports quarterly regressions of either credit spread at $t+1$ (CS, panels A, B and C) or debt growth between t and $t+1$ (ΔDEBT, panels D, E and F) on either compensation growth (panels A and D), wage growth at t (panels B and E) or labor share at t (LS, panels C and F). CS is the Moody's Baa-Aaa corporate bond yield; DEBT is the growth rate of 'Nonfinancial business; credit market instruments; liability' from Flow of Funds Table L102; W is the growth rate of real wages and salaries per employee; LS is the aggregate compensation divided by GDP. The controls are the growth rate of real private nonresidential fixed investment (ΔINV); financial leverage, measured as the book value of nonfinancial credit instruments divided by the sum of the market value of equities and credit instruments of nonfinancial corporate sector (FinLev); the equity price to earnings ratio from Robert Shiller's website (P/E); the long-term (10 year) government bond yield minus the short-term (1 year) government bond yield (TS); the annual volatility of CRSP value-weighted market premium (MktVol); the real 1 year government bond yield from St Lious Fed; the real GDP growth from NIPA (ΔGDP); the real consumption (personal consumption expenditures) growth from NIPA (ΔCon); and the lagged value of the dependent variable (lag y). Below the coefficients, we report heteroscedasticity and autocorrelation consistent Newey and West (1987) t-statistics. The sample is from 1948 to 2014.

	ΔW	LS	ΔInv	FinLev	MktVol	P/E	TS	RF	ΔGDP	lag y	ΔCon
A. Compensation growth and CS											
b(ΔW)	-17.23	-16.3	-11.51	-10.83	-14.71	-15.91	-18.67	-20.18	-13.5	-2.78	-15.22
t(ΔW)	-4.31	-4.05	-3.23	-3.64	-4.34	-4.24	-4.02	-4.73	-3.66	-2.49	-4.03
b(ctrl)		7.12	-3.89	2.97	0.01	-0.02	1.46	6.49	-5.48	0.88	-4.9
t(ctrl)		2.64	-1.64	6.14	5.82	-2.87	0.33	3.63	-0.96	20.99	-0.98
Adj R^2	0.15	0.19	0.18	0.45	0.31	0.24	0.15	0.32	0.15	0.82	0.15
B: Wage growth (per job) and CS											
b(ΔW)	-11.64	-10.96	-6.97	-3.44	-11.1	-9.7	-10.88	-9.71	-5.22	-3.22	-7.74
t(ΔW)	-3.65	-3.48	-2.36	-1.27	-3.48	-3.04	-3.02	-2.76	-1.63	-2.53	-2.4
b(ctrl)		8.1	-6.15	3.23	0.01	-0.02	3.26	5.92	-13.56	0.9	-11.47
t(ctrl)		2.57	-2.66	5.95	5.48	-2.76	0.67	2.68	-2.48	20.65	-1.86
Adj R^2	0.04	0.09	0.15	0.4	0.24	0.14	0.03	0.17	0.11	0.82	0.08
C. Labor share and CS											
b(LS)		8.44	6.79	4.11	7.74	8.17	9.13	-0.98	6.22	1.91	8
t(LS)		2.51	2.13	1.6	2.5	2.44	2.43	-0.27	1.94	1.88	2.53
b(ctrl)			-6.19	3.18	0.01	-0.02	6.74	6.26	-13.38	0.89	-13.08
t(ctrl)			-2.71	6.15	5.05	-3.34	1.31	2.73	-2.49	20.7	-2.08
Adj R^2		0.06	0.17	0.41	0.25	0.17	0.05	0.14	0.14	0.82	0.12
D. Compensation growth and ΔDEBT											
b(ΔW)	0.51	0.51	0.46	0.44	0.49	0.5	0.49	0.52	0.47	0.27	0.43
t(ΔW)	6.36	6.3	5.63	5.3	6.28	6.19	6.05	6.36	5	4.64	5.17
b(ctrl)		0	0.03	-0.03	0	0	-0.27	0.05	0.06	0.46	0.16
t(ctrl)		0.06	0.73	-2.24	-2.99	0.85	-2.69	1.4	0.7	5.89	1.58
Adj R^2	0.2	0.19	0.2	0.24	0.21	0.2	0.27	0.21	0.2	0.37	0.2
E. Wage growth (per job) and ΔDEBT											
b(ΔW)	0.34	0.34	0.25	0.23	0.33	0.31	0.35	0.35	0.19	0.16	0.16
t(ΔW)	3.74	3.76	2.82	2.75	3.74	3.7	3.58	3.59	2.15	2.17	1.78
b(ctrl)		-0.01	0.12	-0.04	0	0	-0.32	0.06	0.33	0.55	0.44
t(ctrl)		-0.13	2.66	-2.46	-3.09	1.1	-2.77	1.51	3.81	7.11	4.02
Adj R^2	0.05	0.05	0.12	0.13	0.08	0.06	0.15	0.07	0.12	0.33	0.12
F. Labor share and ΔDEBT											
b(LS)		-0.01	0.05	0.07	0	0.01	-0.13	-0.1	0.05	-0.03	0.01
t(LS)		-0.09	0.51	0.67	-0.05	0.11	-1.44	-0.93	0.51	-0.7	0.08
b(ctrl)			0.15	-0.04	0	0	-0.36	0.08	0.39	0.57	0.51
t(ctrl)			3.08	-2.74	-2.79	1.36	-3.09	1.71	4.62	8.27	5.05
Adj R^2		0	0.09	0.11	0.03	0.01	0.11	0.02	0.1	0.32	0.11

Table A5: Annual observations with non-missing labor expenses and EDF

This table reports the number of annual (firm-year) observations for each individual country. The number of annual observations with non-missing labor expenses (Compustat variable XLR) and the EDF is reported in the column titled "# Obs w XLR/EDF". The percentage of observations with non-missing labor expenses and EDF is reported for each country (column titled "Within country % of obs w XLR/EDF"). The last column titled "For all countries % of obs w XLR/EDF" presents the percentage of observations with non-missing labor expenses and EDF contributed by each country to the final sample of all observations with non-missing labor expenses, hiring, and EDF (total # of obs = 92553).

Country	Start Year	End Year	All Obs	# Obs w XLR	# Obs w EDF	# Obs XLR/EDF	Within Country % of obs w/ XLR/EDF	For all Countries % of obs w/ XLR/EDF
Region: Europe								
Austria	1992	2011	1425	1318	981	914	64.14	0.99
Belgium	1992	2011	1769	1597	1224	1118	63.20	1.21
Denmark	1992	2011	2244	2048	1457	1347	60.03	1.46
Finland	1992	2011	1995	1897	1544	1474	73.88	1.59
France	1992	2011	10855	10055	8105	7597	69.99	8.21
Germany	1992	2011	11151	10005	7200	6612	59.30	7.14
Greece	1994	2011	2443	1443	1724	1002	41.02	1.08
Italy	1992	2011	3631	3425	2584	2448	67.42	2.64
Netherlands	1992	2011	2756	2492	2085	1919	69.63	2.07
Norway	1992	2011	3021	2607	1900	1672	55.35	1.81
Poland	1994	2011	3722	2699	1457	1072	28.80	1.16
Portugal	1992	2011	857	771	643	585	68.26	0.63
Spain	1992	2011	2216	2149	1674	1657	74.77	1.79
Sweden	1992	2011	5712	4798	3041	2644	46.29	2.86
Switzerland	1992	2011	3485	3176	2378	2195	62.98	2.37
United Kingdom	1992	2011	26546	21034	18954	16223	61.11	17.53
Region: North America								
Canada	1992	2011	23575	3228	11908	1769	7.50	1.91
United States	1992	2011	135632	9588	69610	4877	3.60	5.27
Region: Japan								
Japan	1992	2011	50011	2	42403		0.00	0.00
Region: Asia Pacific (ex. Japan)								
Australia	1992	2011	19885	11285	12018	7472	37.58	8.07
China	1992	2011	27448	1210	10755	594	2.16	0.64
Hong Kong	1992	2011	3468	2363	1812	1244	35.87	1.34
India	1992	2011	29938	26949	6603	6283	20.99	6.79
Indonesia	1992	2011	4017	2705	2377	1607	40.00	1.74
Malaysia	1992	2011	12457	7986	9084	6777	54.40	7.32
New Zealand	1992	2011	1633	563	1029	435	26.64	0.47
Philippines	1992	2011	2198	1296	995	651	29.62	0.70
Singapore	1992	2011	7903	5210	5211	3779	47.82	4.08
S. Korea	1993	2011	8701	75	5916	49	0.56	0.05
Taiwan	1992	2011	14520	214	10868	106	0.73	0.11
Thailand	1992	2011	5749	3171	3240	1978	34.41	2.14
Region: Other America (ex. Canada and U.S.)								
Argentina	1992	2011	934	352	667	266	28.48	0.29
Brazil	1992	2011	4558	2039	671	414	9.08	0.45
Chile	1992	2011	2171	346	1303	231	10.64	0.25
Mexico	1992	2011	1674	282	993	145	8.66	0.16
Region: Middle East								
Israel	1992	2011	2975	2058	1008	735	24.71	0.79
Pakistan	1994	2011	2814	2033	993	738	26.23	0.80
Turkey	1992	2011	1905	854	1443	670	35.17	0.72
Region: Africa								
South Africa	1992	2011	3761	1893	2330	1254	33.34	1.35
Total			451755	157216	260188	92553		

Table A6: Annual observations with non-missing labor expenses and CDS

This table reports the number of annual (firm-year) observations for each individual country, and each individual year. To count as non-missing, we require that all of the independent variables in year t are available, and the 5-year CDS spread in year $t+1$ is available.

Year	# Obs.	% Obs	Country	# Obs	% Obs	Mean	St.D.
2000	101	2.66	Finland	84	2.21	1.61	1.50
2001	129	3.40	France	409	10.78	1.71	2.29
2002	162	4.27	Germany	323	8.52	1.51	1.83
2003	186	4.90	Italy	141	3.72	2.95	7.01
2004	214	5.64	Netherlands	99	2.61	1.26	1.22
2005	230	6.06	Spain	118	3.11	2.14	2.53
2006	255	6.72	Sweden	162	4.27	1.06	1.32
2007	318	8.38	Switzerland	91	2.40	0.81	0.65
2008	361	9.52	United Kingdom	551	14.53	1.41	3.09
2009	360	9.49	Canada	70	1.85	2.63	5.89
2010	376	9.91	United States	558	14.71	3.49	7.71
2011	371	9.78	Australia	183	4.82	1.70	1.86
2012	372	9.81	Hong Kong	113	2.98	1.33	1.52
2013	358	9.44	India	252	6.64	6.59	15.27
			Malaysia	71	1.87	1.04	0.67
			Brazil	73	1.92	3.16	2.68
			South Africa	65	1.71	3.49	3.25
			Other	430	11.32	3.72	8.38
Total	3793	100		3793	100	2.51	6.31

Table A7: Summary statistics on labor expenses and EDF

This table reports the summary statistics on EDF, labor expenses growth, and labor share. We define labor expenses growth as $\Delta XLR = (XLR_t - XLR_{t-1})/[0.5 \times (XLR_t + XLR_{t-1})]$ and labor share as $LS_t = XLR_t/(XLR_t + EBITDA_t)$ for year t. We report the mean and standard deviation of these variables within each country; we also report the same summary statistics for all countries in the last row "Total".

Country	EDF		ΔXLR			LS		
	Mean	St.D.	Mean (EW)	Mean (VW)	St.D.	Mean (EW)	Mean (VW)	St.D.
Region: Europe								
Austria	1.57	3.90	0.06	0.02	0.39	0.67	0.72	0.39
Belgium	1.25	3.14	0.10	0.06	0.50	0.55	0.72	0.53
Denmark	1.34	3.45	0.11	0.14	0.43	0.65	0.72	0.64
Finland	1.03	2.79	0.10	0.12	0.43	0.67	0.65	0.32
France	1.94	4.15	0.11	0.10	0.42	0.65	0.70	0.57
Germany	2.47	5.44	0.09	0.08	0.46	0.66	0.70	0.74
Greece	3.71	6.09	0.05	0.19	0.56	0.53	0.83	0.99
Italy	1.39	3.22	0.08	0.02	0.42	0.57	0.75	0.51
Netherlands	1.30	3.72	0.08	0.12	0.47	0.62	0.73	0.43
Norway	2.50	5.50	0.17	0.13	0.52	0.52	0.71	1.41
Poland	2.40	4.80	0.08	0.04	0.38	0.58	0.51	0.74
Portugal	2.27	4.52	0.08	0.12	0.28	0.56	0.70	0.30
Spain	0.85	2.38	0.09	0.07	0.25	0.58	0.72	0.34
Sweden	1.73	4.18	0.15	0.08	0.42	0.57	0.79	1.46
Switzerland	0.82	2.74	0.09	0.16	0.43	0.61	0.64	0.40
United Kingdom	2.07	4.50	0.16	0.20	0.64	0.46	0.53	0.89
Region: North America								
Canada	4.14	7.61	0.15	0.05	0.64	(0.02)	0.59	0.94
United States	2.77	6.12	0.10	0.05	0.32	0.44	0.70	1.05
Region: Japan								
Japan	2.31	4.22	0.13	0.07		0.51	0.51	0.03
Region: Asia Pacific (ex. Japan)								
Australia	2.50	5.15	0.27	0.32	0.79	(0.05)	0.60	1.91
China	0.87	1.74	0.24	0.23	0.40	0.40	0.59	0.51
Hong Kong	1.79	3.73	0.21	0.25	0.57	0.37	0.51	0.99
India	4.00	6.30	0.13	0.24	0.49	0.33	0.52	0.61
Indonesia	6.71	9.50	0.14	0.22	0.57	0.32	0.49	0.59
Malaysia	2.98	5.43	0.10	0.17	0.39	0.42	0.45	0.85
New Zealand	1.63	4.25	0.18	0.21	0.58	0.30	0.55	1.18
Philippines	5.67	8.98	0.08	0.23	0.64	0.22	0.47	0.70
Singapore	2.59	4.41	0.13	0.23	0.53	0.50	0.41	0.95
S. Korea	4.15	6.51	0.12	0.04	0.41	0.27	0.30	0.83
Taiwan	1.74	3.29	0.21	0.09	0.40	0.39	0.56	0.77
Thailand	3.53	6.76	0.12	0.20	0.35	0.46	0.48	0.71
Region: Other America (ex. Canada and U.S.)								
Argentina	4.31	7.15	0.16	0.24	0.42	0.41	0.47	0.43
Brazil	3.68	7.06	0.19	0.35	0.69	0.31	0.85	0.68
Chile	1.55	4.17	0.19	0.17	0.54	0.38	0.63	0.45
Mexico	2.91	6.12	0.05	0.12	0.84	0.16	0.75	0.28
Region: Middle East								
Israel	1.92	4.13	0.16	0.31	0.77	0.35	0.56	0.62
Pakistan	5.84	8.93	0.08	0.10	0.53	0.29	0.35	0.43
Turkey	1.68	2.81	0.14	0.07	0.53	0.42	0.47	0.51
Region: Africa								
South Africa	3.61	6.97	0.19	0.26	0.64	0.52	0.62	0.45
Total	2.56	5.39	0.13	0.15	0.53	0.43	0.60	0.94

Table A8: EDF and ΔXLR

This table presents cross-sectional regressions of EDF on labor expense growth (ΔXLR). These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls (columns 1-4). Additionally, we redo all of the regressions, but replace book leverage by market leverage (columns 5-8).

Data	Book Leverage				Market Leverage			
	All	All	High μ	Low μ	All	All	High μ	Low μ
ΔXLR	-0.45	-0.08	-1.50	-0.42	-0.344	-0.188	-1.234	-0.319
	(-7.20)	(-1.35)	(-9.24)	(-7.18)	(-5.22)	(-2.67)	(-5.50)	(-5.60)
$\Delta XLR \times \mu$		-0.21				-0.091		
		(-4.94)				(-2.21)		
μ		-0.05				-0.037		
		(-4.54)				(-9.32)		
LEV	4.75	4.66	3.41	5.07	5.719	5.692	4.337	6.123
	(4.05)	(3.98)	(2.83)	(4.43)	(5.03)	(5.03)	(3.98)	(5.32)
σ	1.48	1.45	1.39	1.47	1.767	1.723	1.569	1.767
	(6.78)	(6.74)	(4.99)	(7.00)	(7.70)	(7.56)	(5.96)	(7.88)
$WCTA$	-2.58	-2.68	-1.32	-2.81	-1.830	-1.862	-0.962	-1.983
	(-7.18)	(-7.02)	(-2.49)	(-8.55)	(-5.22)	(-5.33)	(-1.97)	(-6.37)
$RETA$	-0.14	-0.16	-0.65	-0.15	-0.121	-0.124	-0.511	-0.139
	(-0.71)	(-0.84)	(-1.92)	(-0.74)	(-0.91)	(-0.98)	(-2.63)	(-0.97)
$EBITTA$	-2.83	-2.72	-3.76	-2.75	-2.065	-2.008	-2.219	-2.123
	(-3.52)	(-3.19)	(-4.09)	(-3.41)	(-2.74)	(-2.53)	(-2.32)	(-2.71)
$SaleGr$	-0.64	-0.63	-0.35	-0.65	-0.567	-0.592	-0.308	-0.575
	(-8.63)	(-7.62)	(-4.21)	(-7.83)	(-8.77)	(-7.81)	(-2.91)	(-8.16)
$NITA$	-0.51	-0.57	-2.19	-0.23	-0.515	-0.560	-2.458	-0.211
	(-1.30)	(-1.65)	(-5.90)	(-0.48)	(-1.48)	(-1.70)	(-5.88)	(-0.48)
$CACL$	0.01	0.01	-0.06	0.02	0.032	0.033	-0.014	0.038
	(0.42)	(0.45)	(-11.11)	(0.69)	(4.46)	(4.05)	(-0.59)	(3.10)
$Invest$	0.02	0.02	0.01	0.02	0.016	0.017	0.018	0.018
	(5.66)	(6.10)	(1.54)	(4.01)	(5.85)	(5.50)	(1.87)	(3.57)
R_{excess}	-0.36	-0.32	-0.37	-0.31	-0.804	-0.778	-0.661	-0.775
	(-0.66)	(-0.57)	(-0.36)	(-0.75)	(-1.54)	(-1.47)	(-0.66)	(-1.91)
$RSIZE$	0.50	0.49	0.26	0.57	0.521	0.513	0.242	0.589
	(0.94)	(0.90)	(0.57)	(0.99)	(0.97)	(0.96)	(0.54)	(1.02)
R_m	9.36	9.41	6.38	10.36	7.840	7.846	5.231	8.658
	(3.40)	(3.48)	(3.54)	(3.41)	(3.46)	(3.50)	(3.84)	(3.41)
$MCAP$	-1.00	-0.99	-0.61	-1.10	-0.927	-0.921	-0.508	-1.034
	(-1.62)	(-1.59)	(-1.14)	(-1.68)	(-1.56)	(-1.55)	(-1.04)	(-1.62)
Observations	74786	74655	19057	55729	72041	71915	18294	53747
Avg. R^2	0.290	0.296	0.319	0.301	0.363	0.367	0.376	0.377
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A9: EDF and LS

This table presents cross-sectional regressions of EDF on labor share (LS). These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls (columns 1-4). Additionally, we redo all of the regressions, but replace book leverage by market leverage (columns 5-8).

Data	Book Leverage				Market Leverage			
	All	All	High μ	Low μ	All	All	High μ	Low μ
LS	0.61	0.50	1.14	0.55	0.491	0.474	1.015	0.439
	(4.55)	(3.35)	(7.62)	(4.06)	(3.63)	(2.68)	(6.86)	(3.17)
LS×μ		0.06				0.026		
		(7.41)				(2.17)		
μ		-0.10				-0.059		
		(-11.68)				(-5.28)		
LEV	4.62	4.53	3.39	4.92	5.585	5.553	4.268	5.982
	(3.99)	(3.92)	(2.93)	(4.34)	(4.92)	(4.87)	(3.98)	(5.18)
σ	1.47	1.42	1.38	1.45	1.747	1.692	1.560	1.742
	(6.75)	(6.40)	(4.59)	(7.08)	(7.78)	(7.30)	(5.53)	(8.07)
$WCTA$	-2.54	-2.64	-1.32	-2.80	-1.762	-1.799	-0.976	-1.923
	(-7.76)	(-7.49)	(-2.77)	(-9.79)	(-5.37)	(-5.48)	(-2.25)	(-6.68)
$RETA$	-0.19	-0.19	-0.81	-0.19	-0.134	-0.131	-0.640	-0.150
	(-0.83)	(-0.93)	(-2.47)	(-0.84)	(-1.01)	(-1.08)	(-2.87)	(-1.05)
$EBITTA$	-2.84	-2.71	-3.45	-2.73	-2.109	-2.037	-1.827	-2.164
	(-3.32)	(-3.05)	(-3.98)	(-3.15)	(-2.58)	(-2.43)	(-1.99)	(-2.54)
$SaleGr$	-0.79	-0.82	-0.55	-0.81	-0.676	-0.705	-0.442	-0.697
	(-9.33)	(-8.94)	(-6.63)	(-8.47)	(-9.48)	(-9.27)	(-7.44)	(-9.05)
$NITA$	-0.64	-0.70	-2.27	-0.40	-0.566	-0.616	-2.516	-0.276
	(-1.63)	(-1.96)	(-4.99)	(-0.83)	(-1.55)	(-1.79)	(-5.15)	(-0.62)
$CACL$	0.02	0.02	-0.04	0.03	0.037	0.040	0.003	0.044
	(0.71)	(0.77)	(-9.97)	(0.91)	(4.32)	(3.76)	(0.17)	(2.97)
$Invest$	0.02	0.02	0.01	0.03	0.016	0.016	0.021	0.018
	(6.40)	(5.53)	(1.14)	(3.84)	(6.02)	(5.19)	(1.70)	(2.96)
R_{excess}	-0.45	-0.32	-0.51	-0.40	-0.859	-0.758	-0.810	-0.834
	(-0.76)	(-0.57)	(-0.54)	(-0.82)	(-1.49)	(-1.42)	(-0.85)	(-1.74)
$RSIZE$	0.51	0.51	0.25	0.59	0.544	0.542	0.226	0.624
	(1.00)	(0.98)	(0.57)	(1.05)	(1.06)	(1.06)	(0.52)	(1.13)
R_m	9.25	9.18	5.78	10.35	7.748	7.659	4.646	8.667
	(3.43)	(3.41)	(3.46)	(3.45)	(3.48)	(3.39)	(3.86)	(3.42)
$MCAP$	-0.99	-0.99	-0.57	-1.11	-0.936	-0.933	-0.461	-1.058
	(-1.67)	(-1.65)	(-1.10)	(-1.75)	(-1.64)	(-1.65)	(-0.95)	(-1.73)
Observations	73376	73229	18865	54511	70649	70507	18101	52548
Avg. R^2	0.296	0.301	0.330	0.308	0.365	0.370	0.384	0.381
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A10: ΔDEBT and ΔXLR

This table presents cross-sectional regressions of debt growth (ΔDEBT) on labor expense growth (ΔXLR). These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls (columns 1-4). Additionally, we redo all of the regressions, but replace book leverage by market leverage (columns 5-8).

Data	Book Leverage				Market Leverage			
	All	All	High μ	Low μ	All	All	High μ	Low μ
ΔXLR	0.06	-0.01	0.28	0.05	0.051	0.001	0.251	0.045
	(5.70)	(-1.32)	(6.28)	(5.94)	(6.29)	(0.06)	(6.89)	(6.28)
$\Delta XLR \times \mu$		0.03				0.025		
		(10.57)				(8.76)		
μ		-0.01				-0.003		
		(-11.29)				(-6.10)		
LEV	-0.49	-0.49	-0.36	-0.54	-0.408	-0.401	-0.273	-0.457
	(-8.63)	(-8.74)	(-9.32)	(-8.36)	(-10.35)	(-10.36)	(-7.09)	(-10.48)
σ	-0.01	-0.01	-0.01	-0.01	-0.006	-0.006	-0.013	-0.005
	(-4.11)	(-4.20)	(-6.23)	(-3.36)	(-1.44)	(-1.54)	(-2.52)	(-1.01)
$WCTA$	-0.04	-0.04	-0.08	-0.03	-0.029	-0.031	-0.072	-0.027
	(-0.91)	(-0.94)	(-2.16)	(-0.66)	(-1.39)	(-1.42)	(-3.06)	(-1.18)
$RETA$	-0.02	-0.02	-0.04	-0.02	-0.002	-0.002	-0.010	-0.001
	(-2.22)	(-2.21)	(-2.33)	(-2.29)	(-1.48)	(-1.41)	(-1.47)	(-1.14)
$EBITTA$	0.12	0.13	0.15	0.12	0.025	0.035	0.103	0.017
	(2.03)	(2.03)	(2.17)	(2.11)	(0.69)	(0.86)	(2.93)	(0.50)
$SaleGr$	0.08	0.06	0.03	0.08	0.069	0.058	0.047	0.063
	(10.55)	(12.63)	(2.01)	(11.31)	(8.63)	(11.91)	(2.75)	(10.48)
$NITA$	-0.01	-0.00	0.02	-0.01	0.022	0.022	0.040	0.035
	(-0.22)	(-0.12)	(0.54)	(-0.32)	(1.54)	(1.52)	(0.72)	(3.37)
$CACL$	0.00	0.00	-0.00	0.00	0.001	0.001	-0.003	0.002
	(1.02)	(0.97)	(-0.26)	(1.00)	(1.23)	(1.47)	(-0.71)	(1.85)
$Invest$	0.00	0.00	-0.00	0.00	0.002	0.002	0.001	0.003
	(1.82)	(1.65)	(-0.69)	(3.32)	(1.23)	(1.23)	(0.22)	(2.31)
R_{excess}	0.03	0.04	0.02	0.04	0.066	0.069	0.038	0.074
	(1.55)	(1.65)	(0.62)	(1.29)	(2.69)	(2.68)	(1.05)	(1.94)
$RSIZE$	-0.00	-0.00	0.00	-0.01	-0.012	-0.012	-0.005	-0.016
	(-1.19)	(-0.90)	(0.39)	(-1.44)	(-1.84)	(-1.77)	(-0.67)	(-1.56)
R_m	-0.23	-0.23	-0.27	-0.20	-0.156	-0.155	-0.171	-0.144
	(-3.91)	(-3.80)	(-4.91)	(-2.98)	(-2.59)	(-2.54)	(-2.86)	(-1.96)
$MCAP$	0.01	0.01	0.00	0.02	0.016	0.016	0.009	0.020
	(5.50)	(4.51)	(0.64)	(4.27)	(2.93)	(2.81)	(1.57)	(2.34)
Observations	103314	103107	26065	77249	80610	80445	20095	60515
Avg. R^2	0.059	0.060	0.078	0.067	0.065	0.065	0.090	0.075
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A11: ΔDEBT and LS

This table presents cross-sectional regressions of debt growth (ΔDEBT) on labor share (LS). These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls (columns 1-4). Additionally, we redo all of the regressions, but replace book leverage by market leverage (columns 5-8).

	Book Leverage				Market Leverage			
Data	All	All	High μ	Low μ	All	All	High μ	Low μ
LS	-0.02	-0.02	-0.04	-0.02	-0.016	-0.017	-0.032	-0.015
	(-4.23)	(-2.21)	(-4.19)	(-3.41)	(-2.70)	(-1.65)	(-2.86)	(-2.22)
LS×μ		-0.002				-0.001		
		(-2.61)				(-0.60)		
μ		-0.00				-0.001		
		(-1.78)				(-0.98)		
LEV	-0.49	-0.49	-0.36	-0.54	-0.408	-0.405	-0.285	-0.456
	(-8.81)	(-8.80)	(-9.66)	(-8.61)	(-10.33)	(-10.38)	(-7.18)	(-10.47)
σ	-0.01	-0.01	-0.01	-0.01	-0.005	-0.005	-0.011	-0.004
	(-4.26)	(-4.05)	(-5.38)	(-3.65)	(-1.43)	(-1.44)	(-2.08)	(-1.02)
$WCTA$	-0.04	-0.04	-0.08	-0.03	-0.039	-0.042	-0.076	-0.042
	(-0.94)	(-0.91)	(-1.89)	(-0.74)	(-1.57)	(-1.56)	(-2.42)	(-1.40)
$RETA$	-0.02	-0.02	-0.03	-0.02	0.000	-0.000	-0.009	0.001
	(-2.25)	(-2.17)	(-1.75)	(-2.47)	(0.09)	(-0.01)	(-1.29)	(0.42)
$EBITTA$	0.12	0.13	0.13	0.13	0.020	0.031	0.055	0.017
	(2.17)	(2.23)	(1.32)	(2.31)	(0.56)	(0.79)	(0.86)	(0.46)
$SaleGr$	0.11	0.11	0.15	0.10	0.094	0.093	0.147	0.085
	(8.16)	(8.71)	(7.01)	(8.82)	(7.68)	(8.15)	(4.54)	(9.70)
$NITA$	-0.01	-0.01	0.04	-0.02	0.018	0.016	0.082	0.027
	(-0.57)	(-0.49)	(0.97)	(-0.85)	(1.09)	(0.97)	(1.38)	(2.57)
$CACL$	0.00	0.00	-0.00	0.00	0.002	0.002	-0.003	0.003
	(0.86)	(0.83)	(-0.28)	(0.90)	(1.20)	(1.31)	(-0.60)	(1.66)
$Invest$	0.00	0.00	-0.00	0.00	0.002	0.002	0.000	0.003
	(1.69)	(1.61)	(-0.75)	(2.88)	(1.06)	(0.94)	(0.15)	(2.10)
R_{excess}	0.03	0.04	0.01	0.05	0.067	0.067	0.026	0.081
	(1.51)	(1.56)	(0.32)	(1.33)	(2.40)	(2.42)	(0.69)	(1.85)
$RSIZE$	-0.00	-0.00	0.00	-0.01	-0.010	-0.010	-0.002	-0.014
	(-0.65)	(-0.62)	(0.54)	(-1.10)	(-1.54)	(-1.51)	(-0.31)	(-1.38)
R_m	-0.22	-0.22	-0.25	-0.20	-0.148	-0.147	-0.158	-0.136
	(-3.76)	(-3.69)	(-5.59)	(-2.83)	(-2.43)	(-2.40)	(-2.64)	(-1.85)
$MCAP$	0.01	0.01	0.00	0.01	0.014	0.014	0.007	0.017
	(5.04)	(4.54)	(0.59)	(3.95)	(2.62)	(2.53)	(1.16)	(2.13)
Observations	101517	101185	25836	75681	79131	78938	19897	59234
Avg. R^2	0.058	0.058	0.076	0.066	0.064	0.064	0.089	0.074
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A12: ΔDEBT, EDF and ΔXLR

This table presents cross-sectional regressions of EDF and debt growth (ΔDEBT) on labor expense growth (ΔXLR). These regressions are similar to those presented in the main text, but here, we add net hiring (HN).

	EDF				ΔDEBT			
Data	All	All	High μ	Low μ	All	All	High μ	Low μ
ΔXLR	-0.193	0.009	-1.389	-0.151	0.019	-0.029	0.247	0.014
	(-2.40)	(0.15)	(-7.91)	(-1.73)	(4.20)	(-2.42)	(6.72)	(2.46)
$\mu \times \Delta$XLR		-0.120				0.024		
		(-2.59)				(7.27)		
μ		-0.019				-0.003		
		(-4.89)				(-6.10)		
HN	-0.801	-0.758	-0.284	-0.831	0.161	0.150	0.148	0.148
	(-8.03)	(-7.44)	(-1.49)	(-8.63)	(9.25)	(8.06)	(6.30)	(9.05)
$BLEV$	4.271	4.260	2.668	4.613	-0.526	-0.523	-0.378	-0.578
	(3.98)	(4.01)	(3.23)	(4.12)	(-7.90)	(-8.01)	(-8.20)	(-7.94)
σ	1.789	1.773	1.818	1.794	-0.016	-0.016	-0.018	-0.016
	(4.70)	(4.67)	(3.35)	(4.68)	(-4.32)	(-4.31)	(-4.12)	(-3.52)
$WCTA$	-2.435	-2.421	-0.914	-2.718	-0.077	-0.077	-0.103	-0.069
	(-6.17)	(-6.13)	(-2.04)	(-6.86)	(-2.04)	(-2.03)	(-3.29)	(-1.73)
$RETA$	-0.184	-0.176	-0.797	-0.219	-0.021	-0.021	-0.014	-0.021
	(-0.84)	(-0.83)	(-3.16)	(-0.91)	(-2.09)	(-2.10)	(-0.83)	(-2.22)
$EBITTA$	-2.894	-2.901	-3.767	-2.818	0.124	0.132	0.217	0.117
	(-3.00)	(-2.83)	(-2.86)	(-3.01)	(1.49)	(1.54)	(5.05)	(1.32)
$SaleGr$	-0.562	-0.559	-0.273	-0.574	0.048	0.037	-0.025	0.048
	(-5.66)	(-5.08)	(-1.77)	(-4.98)	(4.86)	(3.15)	(-1.45)	(5.17)
$NITA$	-0.439	-0.520	-2.088	-0.109	-0.020	-0.016	-0.054	-0.013
	(-0.84)	(-1.07)	(-5.08)	(-0.17)	(-0.59)	(-0.49)	(-1.30)	(-0.30)
$CACL$	0.011	0.011	-0.085	0.023	0.004	0.004	-0.004	0.005
	(0.52)	(0.49)	(-5.87)	(0.88)	(1.53)	(1.58)	(-0.65)	(1.90)
$Invest$	0.031	0.031	0.008	0.037	0.007	0.008	0.006	0.008
	(2.75)	(2.76)	(0.96)	(3.40)	(1.60)	(1.65)	(1.28)	(1.85)
R_{excess}	-1.090	-1.059	-1.281	-1.038	0.042	0.044	0.048	0.048
	(-2.97)	(-2.88)	(-2.04)	(-2.65)	(2.30)	(2.10)	(1.04)	(1.59)
$RSIZE$	0.497	0.503	-0.061	0.559	-0.001	-0.001	0.004	-0.006
	(1.20)	(1.20)	(-0.24)	(1.38)	(-0.21)	(-0.18)	(0.59)	(-0.84)
R_m	8.435	8.324	6.308	9.250	-0.215	-0.210	-0.284	-0.181
	(3.71)	(3.73)	(3.56)	(3.75)	(-4.24)	(-4.22)	(-4.38)	(-2.92)
$MCAP$	-0.966	-0.973	-0.256	-1.072	0.012	0.011	0.006	0.016
	(-1.95)	(-1.95)	(-0.83)	(-2.18)	(1.95)	(1.74)	(0.79)	(2.12)
Observations	48458	48382	12983	35475	57412	57298	15155	42257
Avg. R^2	0.294	0.297	0.332	0.310	0.069	0.069	0.099	0.078
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A13: ΔDEBT, EDF and ΔXLR, alternative rigidity measure

This table presents cross-sectional regressions of EDF and debt growth (ΔDEBT) on labor share (LS). These regressions use an alternative measure of rigidity: $\mu = AC(\Delta XLR)$, where AC represents the first order autocorrelation.

Data	EDF			ΔDEBT		
	All	High μ	Low μ	All	High μ	Low μ
ΔXLR	-0.330	-0.514	-0.177	0.041	0.117	0.005
	(-4.24)	(-2.89)	(-2.72)	(4.31)	(2.63)	(0.73)
$\mu \times \Delta$XLR	-0.969			0.165		
	(-6.55)			(4.35)		
μ	0.710			-0.010		
	(5.11)			(-1.36)		
HN	-0.694	-0.910	-0.704	0.145	0.128	0.154
	(-5.76)	(-8.01)	(-4.80)	(9.48)	(3.77)	(11.54)
$BLEV$	4.183	5.443	3.689	-0.526	-0.543	-0.521
	(4.03)	(4.60)	(3.69)	(-8.21)	(-7.12)	(-8.40)
σ	1.755	1.925	1.755	-0.015	-0.008	-0.017
	(4.55)	(3.87)	(4.45)	(-3.96)	(-0.92)	(-5.32)
$WCTA$	-2.415	-2.682	-2.392	-0.084	-0.141	-0.067
	(-5.84)	(-15.29)	(-4.84)	(-2.54)	(-4.20)	(-1.85)
$RETA$	-0.195	-0.776	-0.048	-0.021	-0.018	-0.027
	(-0.86)	(-1.24)	(-0.41)	(-2.16)	(-2.93)	(-2.01)
$EBITTA$	-2.929	-4.314	-2.649	0.132	0.096	0.158
	(-3.03)	(-4.45)	(-2.74)	(1.43)	(1.79)	(1.37)
$SaleGr$	-0.574	-0.639	-0.525	0.035	0.068	0.022
	(-5.35)	(-1.96)	(-4.96)	(2.50)	(2.75)	(1.76)
$NITA$	-0.561	-0.792	-0.666	-0.015	0.072	-0.031
	(-1.28)	(-1.26)	(-1.73)	(-0.51)	(3.45)	(-0.85)
$CACL$	0.011	-0.015	0.023	0.004	0.012	0.002
	(0.55)	(-0.86)	(0.93)	(1.70)	(6.30)	(0.76)
$Invest$	0.029	0.027	0.029	0.007	0.009	0.006
	(2.27)	(1.94)	(2.58)	(1.46)	(1.92)	(1.32)
R_{excess}	-1.063	-1.527	-0.955	0.040	0.039	0.025
	(-2.94)	(-3.44)	(-2.26)	(1.95)	(1.53)	(1.00)
$RSIZE$	0.493	0.301	0.474	-0.001	-0.008	0.002
	(1.21)	(0.73)	(1.26)	(-0.19)	(-1.06)	(0.32)
R_m	8.305	10.439	7.500	-0.214	-0.206	-0.208
	(3.78)	(3.66)	(3.74)	(-4.07)	(-2.36)	(-4.14)
$MCAP$	-0.954	-0.851	-0.905	0.012	0.018	0.009
	(-1.96)	(-1.83)	(-1.97)	(1.93)	(2.24)	(1.15)
Observations	47827	11515	36312	56674	13551	43123
R-squared	0.296	0.402	0.285	0.070	0.126	0.071
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table A14: ΔDEBT, EDF and LS

This table presents cross-sectional regressions of EDF and debt growth (ΔDEBT) on labor share (LS). These regressions are similar to those presented in the main text, but here, we add net hiring (HN).

	EDF				ΔDEBT			
Data	All	All	High μ	Low μ	All	All	High μ	Low μ
LS	0.562	0.439	1.123	0.502	-0.023	-0.023	-0.029	-0.022
	(3.34	(2.10)	(5.98)	(2.78)	(-2.53)	(-1.32)	(-2.71)	(-2.00)
$\mu\times$LS		0.058				-0.002		
		(-3.68)				(-0.76)		
μ		-0.068				-0.000		
		(-5.23)				(-0.15)		
HN	-0.818	-0.828	-0.712	-0.840	0.171	0.169	0.230	0.155
	(-10.17)	(-9.75)	(-4.71)	(-13.00)	(9.31)	(9.28)	(7.99)	(9.55)
$BLEV$	4.178	4.172	2.712	4.502	-0.522	-0.519	-0.381	-0.572
	(3.89)	(3.94)	(3.31)	(4.02)	(-8.09)	(-8.15)	(-9.30)	(-8.04)
σ	1.766	1.738	1.815	1.767	-0.015	-0.015	-0.017	-0.016
	(4.53)	(4.52)	(3.20)	(4.51)	(-4.52)	(-4.49)	(-3.92)	(-3.72)
$WCTA$	-2.378	-2.373	-0.939	-2.686	-0.078	-0.078	-0.105	-0.071
	(-6.51)	(-6.50)	(-2.44)	(-7.47)	(-1.90)	(-1.86)	(-3.58)	(-1.52)
$RETA$	-0.187	-0.182	-0.958	-0.209	-0.019	-0.019	-0.002	-0.018
	(-0.78)	(-0.78)	(-3.68)	(-0.81)	(-2.06)	(-2.05)	(-0.09)	(-2.36)
$EBITTA$	-2.904	-2.891	-3.271	-2.784	0.120	0.132	0.151	0.120
	(-2.76)	(-2.61)	(-2.46)	(-2.73)	(1.41)	(1.47)	(1.56)	(1.34)
$SaleGr$	-0.591	-0.594	-0.403	-0.617	0.051	0.048	0.058	0.050
	(-6.58)	(-6.31)	(-5.09)	(-5.77)	(5.80)	(4.69)	(2.80)	(6.53)
$NITA$	-0.622	-0.705	-2.175	-0.342	-0.020	-0.016	-0.020	-0.019
	(-1.10)	(-1.35)	(-4.18)	(-0.54)	(-0.63)	(-0.53)	(-0.49)	(-0.47)
$CACL$	0.02	0.021	-0.064	0.035	0.003	0.003	-0.003	0.004
	(0.78)	(0.75)	(-5.43)	(1.02)	(1.39)	(1.47)	(-0.64)	(1.75)
$Invest$	0.032	0.031	0.005	0.039	0.007	0.007	0.006	0.008
	(3.38)	(3.30)	(0.61)	(4.12)	(1.53)	(1.50)	(1.31)	(1.75)
R_{excess}	-1.125	-1.076	-1.337	-1.068	0.043	0.042	0.033	0.054
	(-3.10)	(-3.00)	(-2.28)	(-2.70)	(2.03)	(1.87)	(0.73)	(1.55)
$RSIZE$	0.499	0.511	-0.055	0.57	-0.000	-0.001	0.006	-0.005
	(1.28)	(1.29)	(-0.22)	(1.51)	(-0.03)	(-0.15)	(1.10)	(-0.70)
R_m	8.255	8.103	5.874	9.107	-0.200	-0.191	-0.265	-0.169
	(3.57)	(3.57)	(3.29)	(3.61)	(-3.99)	(-3.90)	(-4.08)	(-2.58)
$MCAP$	-0.950	-0.959	-0.227	-1.067	0.010	0.011	0.005	0.014
	(-2.02)	(-2.02)	(-0.76)	(-2.31)	(1.56)	(1.61)	(0.92)	(1.77)
Observations	47728	47660	12886	34842	56579	56474	15055	41524
Avg. R^2	0.3	0.305	0.347	0.316	0.069	0.069	0.100	0.078
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A15: ΔDEBT, EDF and LS, alternative rigidity measure

This table presents cross-sectional regressions of EDF and debt growth (ΔDEBT) on labor share (LS). These regressions use an alternative measure of rigidity: $\mu = AC(\Delta XLR)$, where AC represents the first order autocorrelation.

	EDF			ΔDEBT		
Data	All	High μ	Low μ	All	High μ	Low μ
LS	0.617	0.871	0.495	-0.027	-0.027	-0.026
	(2.96)	(2.32)	(3.35)	(-2.34)	(-1.67)	(-2.55)
$\mu \times$LS	0.346			-0.001		
	(1.65)			(-0.06)		
μ	0.332			0.013		
	(3.61)			(1.74)		
HN	-0.816	-1.230	-0.701	0.167	0.180	0.160
	(-8.92)	(-10.84)	(-6.21)	(9.25)	(3.42)	(13.08)
$BLEV$	4.087	5.322	3.617	-0.521	-0.540	-0.516
	(3.93)	(4.67)	(3.58)	(-8.32)	(-7.16)	(-8.53)
σ	1.726	1.830	1.749	-0.015	-0.006	-0.017
	(4.32)	(3.61)	(4.24)	(-4.33)	(-0.83)	(-5.16)
$WCTA$	-2.377	-2.706	-2.328	-0.084	-0.145	-0.068
	(-6.41)	(-14.53)	(-5.38)	(-2.29)	(-4.02)	(-1.81)
$RETA$	-0.213	-0.810	-0.069	-0.020	-0.013	-0.028
	(-0.84)	(-1.18)	(-0.51)	(-2.09)	(-2.09)	(-2.13)
$EBITTA$	-2.893	-4.225	-2.662	0.123	0.074	0.161
	(-2.80)	(-3.95)	(-2.62)	(1.31)	(1.29)	(1.39)
$SaleGr$	-0.619	-0.653	-0.560	0.046	0.098	0.021
	(-6.53)	(-2.13)	(-5.27)	(4.45)	(5.58)	(1.91)
$NITA$	-0.751	-0.738	-0.832	-0.012	0.071	-0.031
	(-1.58)	(-0.90)	(-2.27)	(-0.44)	(3.83)	(-0.90)
$CACL$	0.022	-0.002	0.033	0.004	0.013	0.001
	(0.85)	(-0.08)	(1.06)	(1.63)	(7.69)	(0.51)
$Invest$	0.029	0.045	0.026	0.007	0.010	0.006
	(2.80)	(3.19)	(2.98)	(1.43)	(1.89)	(1.26)
R_{excess}	-1.061	-1.439	-0.992	0.038	0.025	0.027
	(-2.90)	(-3.15)	(-2.39)	(1.65)	(1.21)	(1.05)
$RSIZE$	0.501	0.228	0.499	0.000	-0.003	0.002
	(1.28)	(0.70)	(1.37)	(0.05)	(-0.45)	(0.23)
R_m	8.045	9.954	7.351	-0.195	-0.154	-0.201
	(3.59)	(3.24)	(3.70)	(-3.71)	(-2.07)	(-3.89)
$MCAP$	-0.943	-0.743	-0.914	0.010	0.014	0.009
	(-2.00)	(-1.93)	(-2.05)	(1.52)	(1.79)	(1.08)
Observations	47119	11276	35843	55875	13293	42582
R-squared	0.305	0.418	0.291	0.069	0.126	0.071
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table A16: ΔDEBT, EDF and ΔWAGE

This table presents cross-sectional regressions of EDF and debt growth (ΔDEBT) on wage growth (ΔWAGE). These regressions are similar to those presented in the main text, but here, we replace ΔXLR by ΔWAGE and add net hiring (HN).

Data	EDF				ΔDEBT			
	All	All	High μ	Low μ	All	All	High μ	Low μ
ΔWAGE	-0.224	-0.093	-1.265	-0.194	0.026	0.017	0.251	0.020
	(-3.89)	(-1.35)	(-5.28)	(-3.16)	(5.57)	(2.69)	(6.56)	(3.50)
$\mu \times$ ΔWAGE		-0.079				0.005		
		(-2.64)				(3.77)		
μ		-0.032				-0.002		
		(-9.92)				(-3.68)		
HN	-1.025	-1.094	-1.654	-1.018	0.186	0.192	0.405	0.167
	(-10.21)	(-8.65)	(-4.62)	(-13.66)	(8.74)	(7.97)	(8.63)	(8.82)
$BLEV$	4.265	4.250	2.671	4.606	-0.526	-0.523	-0.377	-0.578
	(3.97)	(4.00)	(3.22)	(4.10)	(-7.90)	(-8.00)	(-8.21)	(-7.95)
σ	1.788	1.768	1.816	1.792	-0.016	-0.016	-0.018	-0.016
	(4.69)	(4.67)	(3.36)	(4.66)	(-4.29)	(-4.31)	(-4.10)	(-3.50)
$WCTA$	-2.439	-2.423	-0.910	-2.723	-0.078	-0.076	-0.104	-0.069
	(-6.16)	(-6.12)	(-2.05)	(-6.86)	(-2.04)	(-2.02)	(-3.30)	(-1.73)
$RETA$	-0.184	-0.176	-0.795	-0.219	-0.021	-0.021	-0.014	-0.021
	(-0.84)	(-0.83)	(-3.18)	(-0.91)	(-2.10)	(-2.13)	(-0.82)	(-2.23)
$EBITTA$	-2.881	-2.905	-3.756	-2.802	0.123	0.135	0.216	0.117
	(-2.98)	(-2.87)	(-2.87)	(-2.98)	(1.49)	(1.59)	(5.07)	(1.31)
$SaleGr$	-0.557	-0.558	-0.298	-0.567	0.046	0.037	-0.025	0.045
	(-5.91)	(-5.26)	(-1.67)	(-5.19)	(4.63)	(3.13)	(-1.41)	(4.92)
$NITA$	-0.446	-0.502	-2.079	-0.115	-0.020	-0.018	-0.054	-0.013
	(-0.84)	(-1.03)	(-5.10)	(-0.18)	(-0.59)	(-0.54)	(-1.28)	(-0.30)
$CACL$	0.011	0.011	-0.084	0.024	0.004	0.004	-0.004	0.005
	(0.54)	(0.49)	(-5.90)	(0.91)	(1.52)	(1.58)	(-0.64)	(1.89)
$Invest$	0.032	0.031	0.009	0.038	0.007	0.007	0.006	0.008
	(2.81)	(2.78)	(0.94)	(3.49)	(1.60)	(1.61)	(1.28)	(1.85)
R_{excess}	-1.094	-1.063	-1.284	-1.041	0.042	0.042	0.050	0.048
	(-2.98)	(-2.89)	(-2.05)	(-2.66)	(2.31)	(2.03)	(1.08)	(1.58)
$RSIZE$	0.496	0.506	-0.059	0.559	-0.001	-0.001	0.005	-0.006
	(1.20)	(1.19)	(-0.23)	(1.38)	(-0.23)	(-0.25)	(0.60)	(-0.85)
R_m	8.433	8.353	6.293	9.251	-0.214	-0.211	-0.287	-0.181
	(3.72)	(3.74)	(3.55)	(3.76)	(-4.24)	(-4.24)	(-4.44)	(-2.91)
$MCAP$	-0.965	-0.976	-0.258	-1.071	0.012	0.012	0.006	0.016
	(-1.95)	(-1.93)	(-0.83)	(-2.18)	(1.97)	(1.87)	(0.77)	(2.14)
Observations	48452	48376	12983	35469	57407	57294	15155	42252
Avg. R^2	0.294	0.297	0.332	0.310	0.069	0.068	0.100	0.079
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A17: Firm level CDS spread and labor market variables

This table presents cross-sectional regressions of the CDS spread at $t+1$ on labor share (LS) or labor expense growth (ΔXLR) at t. These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls (columns 1-4).

	CDS 5-year Spread				CDS 1-year Spread			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔXLR	-0.363		0.106		-0.528		0.133	
	(-2.06)		(0.65)		(-2.80)		(0.56)	
LS		1.535		0.725		1.275		0.297
		(5.32)		(1.45)		(3.74)		(0.48)
ΔXLR $\times \mu$			-0.345				-0.547	
			(-3.42)				(-3.27)	
LS $\times \mu$				0.288				0.302
				(2.50)				(2.04)
μ			-0.031	-0.222			0.003	-0.221
			(-1.90)	(-3.19)			(0.07)	(-2.39)
$Leverage$	1.427	1.723	1.464	1.879	1.302	1.308	1.423	1.437
	(3.07)	(3.72)	(3.23)	(4.24)	(1.75)	(1.79)	(2.00)	(2.03)
σ	1.197	1.194	1.159	1.102	1.915	1.769	1.878	1.671
	(2.59)	(2.56)	(2.59)	(2.59)	(2.73)	(2.67)	(2.74)	(2.70)
$SaleGr$	-0.746	-1.184	-0.465	-1.256	1.124	0.252	1.660	0.185
	(-1.13)	(-1.50)	(-0.65)	(-1.55)	(1.27)	(0.26)	(1.57)	(0.18)
$Invest$	0.099	0.024	0.039	-0.016	-0.473	-0.451	-0.523	-0.484
	(0.44)	(0.09)	(0.18)	(-0.06)	(-1.82)	(-2.21)	(-1.73)	(-2.23)
$WCTA$	1.396	1.601	1.461	1.382	1.216	1.360	1.266	1.060
	(2.56)	(3.44)	(2.65)	(3.02)	(3.13)	(3.16)	(3.51)	(2.11)
$RETA$	-2.488	-2.422	-2.433	-2.303	-2.384	-2.369	-2.331	-2.287
	(-6.75)	(-5.71)	(-6.47)	(-5.67)	(-3.62)	(-3.56)	(-3.53)	(-3.57)
$EBITTA$	-7.245	-5.017	-7.485	-4.784	-4.304	-3.527	-4.672	-3.439
	(-6.05)	(-7.23)	(-6.39)	(-6.78)	(-3.43)	(-3.22)	(-3.91)	(-3.10)
$NITA$	-5.805	-5.642	-5.680	-5.693	-8.914	-9.250	-8.728	-9.191
	(-4.20)	(-3.99)	(-4.17)	(-4.01)	(-3.69)	(-3.53)	(-3.68)	(-3.52)
$CACL$	-0.181	-0.192	-0.187	-0.171	-0.223	-0.218	-0.228	-0.191
	(-4.24)	(-3.98)	(-4.11)	(-4.19)	(-5.59)	(-4.57)	(-5.48)	(-5.21)
R_{excess}	1.091	0.837	1.100	1.041	0.407	0.639	0.288	0.958
	(1.30)	(1.19)	(1.31)	(1.35)	(0.60)	(0.93)	(0.43)	(1.24)
$RSIZE$	-0.115	0.017	-0.075	0.013	0.012	0.145	0.100	0.117
	(-0.26)	(0.04)	(-0.18)	(0.03)	(0.02)	(0.29)	(0.18)	(0.23)
R_m	-0.263	-1.251	-0.208	-1.246	-4.953	-5.327	-4.910	-5.392
	(-0.10)	(-0.44)	(-0.08)	(-0.45)	(-1.29)	(-1.34)	(-1.27)	(-1.36)
$MCAP$	-0.266	-0.227	-0.301	-0.210	-0.292	-0.267	-0.377	-0.232
	(-0.92)	(-0.77)	(-1.06)	(-0.74)	(-0.74)	(-0.71)	(-0.96)	(-0.62)
Constant	7.490	6.325	8.463	6.286	7.783	7.444	9.603	6.922
	(0.97)	(0.81)	(1.11)	(0.83)	(0.73)	(0.73)	(0.91)	(0.68)
Obs.	3793	3793	3793	3793	3498	3498	3498	3498
Avg.R^2	0.383	0.393	0.390	0.403	0.368	0.375	0.379	0.384
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A18: Leverage and labor share

This table presents cross-sectional regressions of leverage at $t+1$ on labor share (LS) at t. These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls.

	LEVM$_{t+1}$				LEVB$_{t+1}$			
LS$_t$	-0.041	-0.029	-0.005	-0.006	-0.031	-0.028	-0.002	-0.003
	(-4.72)	(-19.16)	(-5.73)	(-7.75)	(-5.57)	(-15.23)	(-2.55)	(-2.38)
LEVM$_t$			0.859	0.857				
			(60.94)	(51.54)				
LEVB$_t$							0.866	0.859)
							(143.11)	(124.74)
σ				-0.025				-0.016
				(-3.66)				(-3.66)
WCTA				0.002				-0.001
				(4.42)				(-0.49)
RETA				-0.021				-0.008
				(-3.89)				(-1.67)
EBITTA				0.009				0.004
				(4.62)				(6.62)
SaleGr				0.015				-0.006
				(3.05)				(-1.47)
NITA				0.001				0.000
				(4.57)				(0.37)
CACL				0.000				-0.001
				(0.06)				(-0.54)
Invest				0.000				-0.000
				(-0.72)				(-0.41)
R$_{exc}$				-0.006				-0.014
				(-2.17)				(-9.13)
RSIZE				-0.009				-0.001
				(-4.12)				(-2.56)
R$_m$				-0.005				-0.022
				(-0.26)				(-5.49)
MCAP				0.008				0.002
				(4.25)				(4.46)
FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Obs.	95225	95225	90015	88001	95225	95225	94740	92412
Avg R^2	0.017	0.142	0.766	0.773	0.018	0.09	0.754	0.762

Table A19: Average leverage and labor share

This table presents cross-sectional regressions of each firm's average leverage over the entire sample, on average labor share (LS). These regressions are the same as those presented in the main text, but here, we also report coefficients associated with all of the controls.

	LEVM			LEVB		
LS	-0.066	-0.043	-0.026	-0.045	-0.034	-0.015
	(-32.86)	(-19.95)	(-9.39)	(-30.27)	(-20.57)	(-7.19)
σ			0.017			0.005
			(6.48)			(2.49)
WCTA			-0.280			-0.230
			(-43.91			(-48.62)
RETA			0.011			0.006
			(15.32)			(10.89)
EBITTA			0.029			0.072
			(2.07)			(7.02)
SaleGr			-0.060			-0.016
			(11.92)			(-4.36)
NITA			0.021			-0.015
			(2.09)			(-2.02)
CACL			-0.002			-0.001
			(7.08)			(-4.55)
Invest			0.001			0.000
			(1.23)			(-0.24)
R_{exc}			0.084			0.007
			(4.55)			(0.52)
RSIZE			0.003			0.007
			(0.97)			(3.09)
R_m			0.231			-0.003
			(5.92)			(-0.10)
MCAP			-0.018			-0.005
			(-6.31)			(-2.17)
FE	No	Yes	Yes	No	Yes	Yes
Obs.	16046	16046	15752	16046	16046	15752
Avg R^2	0.063	0.143	0.261	0.054	0.123	0.258

Table A20: Time-series correlation between labor expenses and EDF

This table reports the distribution of the firm-level time-series correlation between labor expenses growth and EDF ($Corr(\Delta XLR, EDF)$), and the correlation between labor share and EDF ($Corr(LS, EDF)$). ΔXLR and LS are time t variables, whereas EDF is a $t+1$ variable. For every firm, we calculate $Corr(\Delta XLR, EDF)$ and $Corr(LS, EDF)$ using its time-series observations. Then we report the mean and standard deviation of these two correlations within each country; we also report the same summary statistics for all countries in the last row "Total". The t-stat is for testing whether $Corr(\Delta XLR, EDF) = 0$ or $Corr(LS, EDF) = 0$.

Country	$Corr(\Delta XLR, EDF)$				$Corr(LS, EDF)$			
	Mean	St.D.	No of firms	t-stat	Mean	St.D.	No of firms	t-stat
Region: Europe								
Austria	-0.10	0.54	95	-1.73	0.16	0.54	101	3.06
Belgium	-0.00	0.53	115	-0.06	0.23	0.54	123	4.77
Denmark	-0.11	0.44	131	-2.96	0.25	0.50	137	5.80
Finland	-0.08	0.40	135	-2.37	0.31	0.41	139	8.76
France	-0.12	0.50	793	-6.84	0.25	0.51	822	14.16
Germany	-0.11	0.50	701	-5.67	0.22	0.53	719	10.95
Greece	-0.30	0.61	141	-5.85	0.25	0.61	157	5.22
Italy	-0.13	0.46	263	-4.69	0.26	0.54	272	8.07
Netherlands	-0.12	0.50	179	-3.17	0.17	0.56	186	4.25
Norway	-0.11	0.57	199	-2.75	0.24	0.57	215	6.16
Poland	0.01	0.64	191	0.21	0.25	0.61	200	5.88
Portugal	-0.14	0.56	57	-1.85	0.23	0.53	60	3.43
Spain	-0.07	0.46	151	-1.89	0.21	0.53	155	4.85
Sweden	-0.07	0.53	296	-2.19	0.23	0.59	313	6.80
Switzerland	-0.08	0.47	211	-2.44	0.23	0.47	211	7.13
United Kingdom	-0.05	0.55	1736	-4.19	0.21	0.59	1929	15.63
Region: North America								
Canada	-0.06	0.66	257	-1.34	0.06	0.69	290	1.49
United States	-0.10	0.65	671	-3.89	0.16	0.67	777	6.84
Region: Japan								
Japan								
Region: Asia Pacific (ex. Japan)								
Australia	-0.01	0.61	1204	-0.35	0.11	0.57	1291	6.86
China	0.04	0.58	79	0.65	0.23	0.59	88	3.58
Hong Kong	0.17	0.53	169	4.13	0.08	0.53	171	1.95
India	0.00	0.58	1242	0.21	0.16	0.58	1271	9.93
Indonesia	0.07	0.61	213	1.79	0.02	0.58	224	0.65
Malaysia	-0.04	0.54	863	-2.18	0.11	0.55	895	5.94
New Zealand	0.08	0.73	84	1.04	0.23	0.65	95	3.45
Philippines	-0.01	0.52	85	-0.12	0.14	0.53	87	2.50
Singapore	0.04	0.55	507	1.83	0.17	0.52	524	7.51
S. Korea	-0.16	0.96	6	-0.42	-0.04	0.92	10	-0.14
Taiwan	0.94		1		0.57	0.87	4	1.30
Thailand	0.06	0.63	278	1.72	0.17	0.60	293	4.89
Region: Other America (ex. Canada and U.S.)								
Argentina	0.08	0.66	36	0.72	0.29	0.53	42	3.59
Brazil	0.10	0.73	73	1.17	0.09	0.68	76	1.12
Chile	-0.06	0.86	9	-0.22	-0.04	0.94	40	-0.29
Mexico	0.15	0.80	28	1.01	0.38	0.73	36	3.10
Region: Middle East								
Israel	-0.13	0.59	104	-2.20	0.11	0.57	110	2.11
Pakistan	-0.04	0.52	97	-0.70	0.06	0.58	103	1.04
Turkey	0.19	0.61	102	3.23	0.19	0.62	114	3.34
Region: Africa								
South Africa	-0.02	0.65	175	-0.34	0.17	0.62	203	3.90
Total	-0.04	0.57	11677	-7.89	0.18	0.58	12483	34.24

Table A21: Time-series correlation between labor expenses and debt growth

This table reports the distribution of the firm-level time-series correlation between labor expense growth and debt growth ($Corr(\Delta XLR, \Delta Debt)$), and the correlation between labor share and debt growth ($Corr(LS, \Delta Debt)$). ΔXLR and LS are time t variables, whereas $\Delta Debt = \frac{Debt_{t+1} - Debt_t}{0.5(Debt_{t+1} + Debt_t)}$ is a $t+1$ variable. For every firm, we calculate $Corr(\Delta XLR, \Delta Debt)$ and $Corr(LS, \Delta Debt)$ using its time-series observations. Then we report the mean and standard deviation of these two correlations within each country; we also report the same summary statistics for all countries in the last row "Total". The t-stat is for testing whether $Corr(\Delta XLR, \Delta Debt) = 0$ or $Corr(LS, \Delta Debt) = 0$.

Country	$Corr(\Delta XLR, \Delta Debt)$				$Corr(LS, \Delta Debt)$			
	Mean	St.D.	No of firms	t-stat	Mean	St.D.	No of firms	t-stat
Region: Europe								
Austria	0.02	0.44	111	0.45	-0.08	0.50	121	-1.87
Belgium	-0.07	0.45	141	-1.71	-0.02	0.46	149	-0.66
Denmark	0.01	0.47	172	0.35	-0.09	0.46	183	-2.55
Finland	-0.09	0.40	153	-2.65	-0.13	0.42	161	-3.98
France	-0.02	0.45	909	-1.52	-0.05	0.45	960	-3.22
Germany	-0.01	0.48	833	-0.60	-0.07	0.47	876	-4.66
Greece	0.10	0.55	203	2.56	-0.09	0.47	211	-2.87
Italy	-0.06	0.45	323	-2.45	-0.04	0.44	341	-1.56
Netherlands	-0.01	0.46	199	-0.29	-0.13	0.45	215	-4.16
Norway	0.08	0.55	248	2.25	-0.05	0.58	281	-1.45
Poland	0.07	0.57	389	2.30	-0.09	0.55	422	-3.20
Portugal	-0.06	0.50	73	-1.04	-0.04	0.49	77	-0.69
Spain	-0.01	0.38	171	-0.26	-0.04	0.43	178	-1.24
Sweden	0.10	0.54	418	3.68	-0.07	0.55	455	-2.60
Switzerland	0.04	0.44	250	1.27	-0.10	0.40	255	-3.83
United Kingdom	0.07	0.54	1861	5.39	-0.07	0.56	2084	-5.62
Region: North America								
Canada	0.12	0.72	231	2.49	-0.05	0.83	488	-1.33
United States	0.01	0.62	1011	0.54	-0.04	0.63	1233	-2.20
Region: Japan								
Japan								
Region: Asia Pacific (ex. Japan)								
Australia	0.09	0.63	1024	4.60	-0.08	0.61	1142	-4.56
China	0.07	0.51	153	1.78	0.01	0.51	164	0.30
Hong Kong	0.02	0.56	318	0.56	-0.01	0.54	336	-0.48
India	0.05	0.43	2452	5.37	-0.02	0.42	2503	-2.69
Indonesia	-0.03	0.51	312	-1.13	0.04	0.53	345	1.44
Malaysia	0.06	0.53	900	3.18	-0.05	0.48	938	-2.92
New Zealand	0.04	0.58	88	0.72	-0.09	0.59	107	-1.53
Philippines	0.02	0.53	132	0.42	-0.02	0.52	144	-0.37
Singapore	0.02	0.55	637	0.83	-0.01	0.48	657	-0.36
S. Korea	-0.37	0.70	7	-1.40	0.04	0.87	14	0.18
Taiwan	0.19	0.73	17	1.09	-0.31	0.65	21	-2.14
Thailand	0.01	0.55	410	0.27	-0.05	0.51	433	-2.16
Region: Other America (ex. Canada and U.S.)								
Argentina	-0.13	0.61	47	-1.41	-0.09	0.59	55	-1.12
Brazil	-0.04	0.57	272	-1.08	-0.09	0.52	294	-3.13
Chile	-0.02	0.87	93	-0.20	0.06	0.76	117	0.86
Mexico	0.01	0.75	39	0.06	0.03	0.70	64	0.32
Region: Middle East								
Israel	0.03	0.61	240	0.83	-0.04	0.60	261	-1.16
Pakistan	0.02	0.56	241	0.53	0.04	0.51	262	1.11
Turkey	0.02	0.58	127	0.41	0.00	0.62	157	0.10
Region: Africa								
South Africa	0.02	0.61	241	0.63	-0.07	0.55	267	-2.03
Total	0.03	0.53	15447	7.47	-0.05	0.53	16972	-11.90