

Credit and Hiring

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Abstract

We study an industry dynamics model where access to credit improves the bargaining position of firms with workers and increases the incentive to hire. To evaluate the importance of the bargaining channel for the hiring decisions of firms, we estimate the model structurally using data from Compustat and Capital IQ and find that the bargaining channel contributes to about 15% of variations in firm-level employment.

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Introduction

The idea that firms use leverage strategically to improve their bargaining position with workers is not new in the corporate finance literature. For example, Perotti and Spier (1993) developed a model where debt reduces the bargaining surplus for the negotiation of wages, allowing firms to lower the cost of labor. Recent studies by Klasa, Maxwell, and Ortiz-Molina (2009) and Matsa (2010) have tested this mechanism using firm-level data and found that more unionized firms—that is, firms where workers are likely to have more bargaining power—are characterized by higher leverage and lower cash holdings.

These studies provide empirical evidence that the bargaining power of workers is relevant for determining the financial structure of firms. However, whether this is also important for their hiring decisions has not been fully explored in the literature. In fact, if the bargaining strength of workers impacts on the financial structure of firms, the financial structure may in turn affect the hiring decision of firms. More specifically, if higher leverage allows employers to negotiate more favorable conditions with employees, the ability to issue more debt should increase the incentive to hire more workers. We will refer to this particular mechanism through which *debt* affects the *hiring* decisions of firms as the ‘bargaining channel’. The goal of this paper is to study the importance of this channel by estimating a dynamic model with wage bargaining and endogenous choice of financing.¹

In the model, the compensation of workers is determined at the firm level through bargaining. Firms choose the financial structure and employment optimally taking into account that these choices affect the cost of labor. Higher debt allows firms to negotiate lower wages which increases the incentive to hire more workers. Higher debt, however, also increases the likelihood of financial distress. Therefore, firms face a trade-off in the choice of the financial structure whose resolution determines the optimal financing and employment decisions.

¹The importance of the bargaining channel for *aggregate* dynamics is also studied in Monacelli, Quadrini and Trigari (2011) but in a model with a single-worker representative firm. In this paper, instead, we take a *micro* approach and explore the empirical relevance of this channel using a model with heterogeneous multi-worker firms that can be mapped to firm-level data.

When the financial condition of a firm improves, the likelihood of financial distress declines, making the debt more attractive. This, in turn, improves the bargaining position of the firm with its employees, increasing the incentive to hire. It is through this mechanism that the improved firm-level access to credit generates more demand for labor.

We evaluate the importance of this channel by estimating the model with the simulated method of moments. The empirical moments are constructed using firm-level data from Compustat and Capital IQ. The first database provides information on typical balance sheet and operational variables including employment. The second database provides firm-level data for unused lines of credit which is important for the identification of some of the key parameters characterizing the financial capability of a firm. More specifically, since the likelihood of financial distress increases with leverage, firms borrow less than their credit capacity to limit the possibility of distress. We interpret the difference between the maximum debt capacity and the actual borrowing in the model as unused credit lines. The Capital IQ database then provides valuable information for the identification of the parameter that determines the cost of financial distress.

After the estimation of the model, we evaluate the importance of the bargaining channel for the dynamics of employment by conducting a counterfactual exercise in which we simulate the model imposing that firms keep a constant level of debt. By comparing the simulation of this ‘constrained’ model to the simulation of the baseline model where firms choose the debt optimally, we find that the bargaining channel contributes to about 15% of the overall volatility of firm-level employment.

In addition to the structural estimation, we also investigate the importance of the bargaining channel for employment dynamics through reduced-form regressions based on a central property of the model. In particular, the model predicts that the growth of employment at the firm level is positively associated to the growth of debt. More importantly, the strength of this relation increases with the bargaining power of workers. To test this property empirically, we need a proxy for the bargaining power of workers. Following Klasa, Maxwell,

and Ortiz-Molina (2009) and Matsa (2010), we use the unionization index from the Union Membership and Coverage Database. We then regress the firm-level growth rate of employment on a set of variables that include the growth rate of debt, the unionization index and the interaction between debt growth and unionization (in addition to other controls). The main variable of interest is the *interaction* term between the growth rate of debt and the unionization index. We find that the estimated coefficient of the interaction term is positive and statistically significant, which is consistent with the theoretical prediction of the model.

The remaining sections of the paper are organized as follows. Sections 1 and 2 present the dynamic model and characterize some of its properties. Section 3 describes the data, the structural estimation and reports the results. Section 4 conducts the empirical analysis based on reduced-form regressions. Section 5 concludes.

1 A firm dynamics model with wage bargaining

To facilitate the presentation of the model and the role played by the bargaining channel, we first describe a simplified version without financial distress. After characterizing the properties of the simpler model, we will extend it with the addition of financial distress costs.

Consider a firm with production technology $y_t = z_t N_t$, where z_t is idiosyncratic productivity and N_t is the number of workers. Employment evolves according to

$$N_{t+1} = (1 - \lambda)N_t + E_t, \tag{1}$$

where λ is the separation rate and E_t denotes the newly hired workers.

Hiring is costly. A firm with current employment N_t that hires E_t workers incurs the cost $\Upsilon(E_t/N_t)N_t$, where the function $\Upsilon(\cdot)$ is strictly increasing and convex in $E_t > 0$.

The budget constraint of the firm is

$$B_t + D_t + w_t N_t + \Upsilon\left(\frac{E_t}{N_t}\right)N_t = z_t N_t + q_t B_{t+1}, \tag{2}$$

where B_t is the stock of bonds issued by the firm at $t - 1$ (liabilities), D_t is the equity payout, q_t is the price of bonds and w_t is the wage paid to each worker.

The issuance of debt is subject to the enforcement constraint

$$q_t B_{t+1} \leq \xi_t \beta \mathbb{E}_t S_{t+1}, \quad (3)$$

where S_{t+1} is the net surplus of the firm as defined below. The variable ξ_t is stochastic and captures the financial conditions of the firm, that is, its access to external credit.

1.1 Firm's policies and wages

The policies of the firm, including wages, are bargained collectively with its labor force. The labor force is defined broadly and includes workers with managerial positions. In this way the model also captures the potential conflicts between shareholders and managers as in Jensen (1986).

To derive the bargaining outcome, it will be convenient to define few terms starting with the *equity* value of the firm. This can be written recursively as

$$V_t(B_t, N_t) = D_t + \beta \mathbb{E}_t V_{t+1}(B_{t+1}, N_{t+1}). \quad (4)$$

The equity value of the firm depends on two endogenous states, debt B_t and employment N_t , in addition to the exogenous states z_t and ξ_t . To simplify the notation, the dependence on the exogenous states is not shown explicitly but it is captured by the time subscript t . We will continue to use this notational convention throughout the paper.

The value of an individual worker employed in a firm with liabilities B_t and with N_t employees is

$$W_t(B_t, N_t) = w_t + \beta \mathbb{E}_t \left[\lambda U_{t+1} + (1 - \lambda) W_{t+1}(B_{t+1}, N_{t+1}) \right], \quad (5)$$

where U_{t+1} is the value of being unemployed at $t+1$. Given the partial equilibrium approach, the value of being unemployed is exogenous in the model.

The value for the worker, $W_t(B_t, N_t)$, net of the outside value, U_t , can be rewritten recursively as

$$W_t(B_t, N_t) - U_t = w_t - U_t + \beta \mathbb{E}_t \left[U_{t+1} + (1 - \lambda) \left(W_{t+1}(B_{t+1}, N_{t+1}) - U_{t+1} \right) \right]. \quad (6)$$

The bargaining surplus, denoted by $S_t(B_t, N_t)$, is the sum of the net values for the firm and the workers, that is,

$$S_t(B_t, N_t) = V_t(B_t, N_t) + \left(W_t(B_t, N_t) - U_t \right) N_t. \quad (7)$$

We are now ready to define the bargaining problem. Given η the bargaining power of workers, the bargaining problem can be written as

$$\max_{w_t, D_t, E_t, B_{t+1}} \left[\left(W_t(B_t, N_t) - U_t \right) N_t \right]^\eta \cdot V_t(B_t, N_t)^{1-\eta},$$

subject to the law of motion for employment (1), the budget constraint (2), and the enforcement constraint (3).

Differentiating with respect to the wage w_t , we obtain the well-known result that workers receive a fraction η of the bargaining surplus while the firm receives the remaining fraction, that is,

$$\left(W_t(B_t, N_t) - U_t \right) N_t = \eta S_t(B_t, N_t), \quad (8)$$

$$V_t(B_t, N_t) = (1 - \eta) S_t(B_t, N_t). \quad (9)$$

Next we derive the first order conditions with respect to D_t , E_t , B_{t+1} . Using (8) and (9),

we find that dividend, employment, and financial policies simply maximize the *net surplus* $S_t(B_t, N_t)$. This property is intuitive: given that the contractual parties (firm and workers) share the net bargaining surplus, it is in the interest of both parties to make the surplus as big as possible. Therefore, in characterizing the hiring and financial policies of the firm we focus on the maximization of the net surplus which, in recursive form, can be written as

$$S_t(B_t, N_t) = \max_{e_t, B_{t+1}} \left\{ D_t + (w_t - u_t)N_t + \beta \left[1 - \eta + \eta(1 - \lambda) \left(\frac{N_t}{N_{t+1}} \right) \right] \mathbb{E}_t S_{t+1}(B_{t+1}, N_{t+1}) \right\}$$

subject to (1), (2), (3).

The recursive formulation is obtained by multiplying equation (6) by N_t , summing to (4), and using the sharing rules (8) and (9). The term $u_t = U_t - \beta \mathbb{E}_t U_{t+1}$ is exogenous, given that the analysis is in partial equilibrium.

We now take advantage of the linearity of the model and normalize the problem of the firm by N_t so that all variables will be expressed in per-worker terms.

$$s_t(b_t) = \max_{e_t, b_{t+1}} \left\{ d_t + w_t - u_t + \beta(g_{t+1} - \eta e_t) \mathbb{E}_t s_{t+1}(b_{t+1}) \right\} \quad (10)$$

subject to:

$$d_t + w_t = z_t - \Upsilon(e_t) + q_t g_{t+1} b_{t+1} - b_t$$

$$\xi_t g_{t+1} \beta \mathbb{E}_t s_{t+1}(b_{t+1}) \geq q_t g_{t+1} b_{t+1}$$

$$g_{t+1} = 1 - \lambda + e_t.$$

The variable $s_t(b_t) = S_t(b_t)/N_t$ is the per-worker surplus, $d_t = D_t/N_t$ is the per-worker dividend paid to shareholders, $b_t = B_t/N_t$ is the per-worker liabilities, $e_t = E_t/N_t$ denotes

the newly hired workers per existing employees, and $g_{t+1} = N_{t+1}/N_t$ is the gross growth rate of employment.

Of special interest is the discount factor for the next period's normalized surplus, $\beta(g_{t+1} - \eta e_t)$. When workers have zero bargaining power, that is, $\eta = 0$, the discount factor reduces to βg_{t+1} . Since the whole surplus goes to investors, they will also get the whole next period surplus. When $\eta > 0$, however, some of the next period surplus needs to be shared with the new hired workers. This is captured by the reduction in the discount factor by the term ηe_t . Of course, the 'lower discounting' is relevant only if firms add new workers in the next period, that is, $e_t > 0$. Therefore, the main conflict in the choice of the firm policies is not between shareholders and existing employees but between current stake holders (shareholders and existing employees) and new workers.

To characterize the hiring and financial policies of the firm, we derive the first order conditions with respect to e_t and b_{t+1} . Denoting by μ_t the lagrange multiplier for the enforcement constraint, the first order conditions read

$$\begin{aligned} q_t b_{t+1} + \beta(1 - \eta)\mathbb{E}_t s_{t+1}(b_{t+1}) &= \Upsilon'(e_t), \\ q_t g_{t+1} + \beta(q_{t+1} - \eta e_t)\mathbb{E}_t \frac{\partial s_{t+1}(b_{t+1})}{\partial b_{t+1}} + \mu_t g_{t+1} &\left[\xi_t \beta \mathbb{E}_t \frac{\partial s_{t+1}(b_{t+1})}{\partial b_{t+1}} - q_t \right] = 0. \end{aligned}$$

The envelope condition provides the derivative of the surplus, which is equal to $\partial s_t(b_t)/\partial b_t = -1$. The linearity allows us to rewrite the surplus as

$$s_t(b_t) = \bar{s}_t - b_t, \tag{11}$$

where \bar{s}_t depends only on the exogenous states (shocks). The first order conditions can then be rewritten as

$$q_t b_{t+1} + \beta(1 - \eta)(\mathbb{E}_t \bar{s}_{t+1} - b_{t+1}) = \Upsilon'(e_t), \tag{12}$$

$$q_t g_{t+1} = \beta(g_{t+1} - \eta e_t) + \mu_t g_{t+1}(\beta \xi_t + q_t). \tag{13}$$

1.2 Special case with $q_t = \beta$

Since we are focusing on a partial equilibrium and we abstract from aggregate shocks, it makes sense to assume that the price of a risk-free (zero coupon) bond is equal to the discount factor, that is, $q_t = \beta$. Then, the first order condition for debt, equation (13), becomes

$$g_{t+1} = (1 - \eta)g_{t+1} + \eta(1 - \lambda) + \mu_t g_{t+1}(1 + \xi_t). \quad (14)$$

The following proposition establishes an important property about the financial policy.

Proposition 1.1 *If $\eta > 0$, the firm borrows up to the limit whenever $e_t > 0$. If $\eta = 0$ or $e_t = 0$, the debt is undetermined.*

Proof 1.1 *If $\eta > 0$, equation (14) implies that the lagrange multiplier μ_t is strictly positive whenever $e_t = g_{t+1} - 1 + \lambda > 0$. Therefore, under the condition $e_t > 0$ the enforcement constraint is binding. When $\eta = 0$ or $e_t = 0$, equation (14) implies that μ_t must be zero.*

There is a simple intuition for this property. Whenever the firm chooses to hire, that is, $e_t > 0$, it adds new workers who will become part of the firm's employment starting in the next period. Therefore, new workers are going to share the next period surplus. Increasing the debt today reduces the future surplus and allows for lower compensation of new hired workers. This increases the current surplus of the firm which is shared by shareholders and *currently* employed workers, but not the new hired workers. It is then in the interest of both shareholders and existing employees to increase the debt of the firm. When the firm does not add new workers, however, higher borrowing does not increase the current surplus because more debt only reduces the future compensation of *existing* workers. In this case there are no gains from borrowing. Thus, as long as the firm adds new workers, bargaining introduces a motive to borrow, breaking the irrelevance of the financial structure as in Modigliani and Miller (1958). For this property, however, the bargaining power of workers must be positive, that is, $\eta > 0$. In the limiting case with $\eta = 0$ the Modigliani and Miller's result applies.

We now turn attention to the first order condition for hiring, equation (11). Under the assumption $q_t = \beta$, this condition can be rewritten as

$$\beta \left[\eta b_{t+1} + (1 - \eta) \mathbb{E}_t \bar{s}_{t+1} \right] = \Upsilon'(e_t). \quad (15)$$

Together with the normalized law of motion for employment, $g_{t+1} = 1 - \lambda + e_t$, this equation establishes a relation between the per-worker debt b_{t+1} and the growth of employment (which also depends on other factors affecting the surplus of the firm through the term $\mathbb{E}_t \bar{s}_{t+1}$). This relation is not linear and depends on the bargaining power of workers η .

Proposition 1.2 *The hiring decision e_t is strictly increasing in b_{t+1} if $\eta > 0$ but it is independent of b_{t+1} if $\eta = 0$.*

Proof 1.2 *It follows directly from (15) given that the convexity of the cost function $\Upsilon(\cdot)$ implies that $\Upsilon'(e_t)$ is strictly increasing in e_t .*

Therefore, the financial structure affects the hiring decision of the firm as long as workers have some bargaining power. When workers have zero bargaining power—which can be interpreted as the case of a competitive labor market where the determination of wages is external to an individual firm—debt is irrelevant for the hiring decision of firms.

2 Financial distress cost

The model presented so far abstracts from the possibility that higher debt increases the probability that the firm ends up in a situation of financial distress. As a result, a firm always borrows up to the limit (at least when the firm hires new workers). The borrowing limit is determined by the variable ξ_t which changes stochastically. A sudden drop in this variable forces the firm to substitute debt with equity and this can be done without any *direct* cost. The only cost is *indirect*, through the impact on wages. However, the assumption that the firm has full flexibility in substituting debt with equity is not very plausible, especially in

the short-run: if the firm is unexpectedly forced to replace debt with equity, the firm might incur some additional cost. To capture this idea, we now extend the model to allow for the possibility of financial distress costs.

Define b_t^* the maximum debt that can be collateralized. This is defined by the condition $b_t^* = \xi_t s_t(b_t^*)$. Since the surplus function $s_t(\cdot)$ is strictly decreasing, the maximum debt b_t^* is increasing in ξ_t .

The firm enters the period with debt b_t chosen in the previous period. Then, after the realization of ξ_t , the collateral constraint might no longer be satisfied, that is, $b_t > b_t^* = \xi_t s_t(b_t^*)$. In this case the firm will be forced to pay back the difference $b_t - b_t^*$ before it can access the equity market or retain earnings. In order to make the payment, the firm needs to raise $b_t - b_t^*$ with alternative sources that are costly. In particular, we assume that the cost incurred to access these alternative sources of funds is $\kappa(b_t - b_t^*)^2$. We call this cost ‘financial distress cost’ since it is paid to raise emergency funds and could also include, in the extreme, the cost of bankruptcy. The cost can be expressed more generally as $\varphi_t(b_t) = \kappa \cdot \max\{b_t - b_t^*, 0\}^2$.

With financial distress, the normalized problem of the firm becomes

$$s_t(b_t) = \max_{e_t, b_{t+1}} \left\{ d_t + w_t - u_t + \beta(g_{t+1} - \eta e_t) \mathbb{E}_t s_{t+1}(b_{t+1}) \right\} \quad (16)$$

subject to:

$$d_t + w_t = z_t - \Upsilon(e_t) + q_t g_{t+1} b_{t+1} - b_t - \varphi_t(b_t)$$

$$\xi_t g_{t+1} \beta \mathbb{E}_t s_{t+1}(b_{t+1}) \geq q_t g_{t+1} b_{t+1}$$

$$g_{t+1} = 1 - \lambda + e_t.$$

This problem is similar to problem (10). The only difference is that the budget constraint also includes the distress cost $\varphi_t(b_t)$. Notice that the surplus function $s_t(b_t)$ is net of the distress cost. If $\varphi_t(b_t) = 0$ for all b_t , we go back to the previous problem. Although this may

seem a minor modification, it has important implications for the optimal decisions of firms. As we will see, it generates a precautionary motive in the choice of b_{t+1} and, as a result, the borrowing constraint will be binding only occasionally.

2.1 Optimal policies with financial distress

To characterize the optimal hiring and financial policies, we derive the first order conditions of problem (16) by differentiating with respect to e_t and b_{t+1} , respectively. The resulting conditions are

$$q_t b_{t+1} + \beta(1 - \eta) \mathbb{E}_t s_{t+1}(b_{t+1}) = \Upsilon'(e_t), \quad (17)$$

$$q_t g_{t+1} + \beta(g_{t+1} - \eta e_t) \mathbb{E}_t \frac{\partial s_{t+1}(b_{t+1})}{\partial b_{t+1}} + \mu_t g_{t+1} \left[\beta \xi_t \mathbb{E}_t \frac{\partial s_{t+1}(b_{t+1})}{\partial b_{t+1}} - q_t \right] = 0, \quad (18)$$

where μ_t is the lagrange multiplier for the enforcement constraint. These conditions do not depend on b_t . Therefore, the optimal employment and next period debt are still independent of current liabilities.

The envelope condition returns $\partial s_t(b_t)/\partial b_t = -1 - \varphi'_t(b_t)$, which allows us to write the surplus function, net of the distress cost, as

$$s_t(b_t) = \bar{s}_t - b_t - \varphi_t(b_t). \quad (19)$$

As in the model without financial distress, the variable \bar{s}_t depends only on the exogenous shocks. The surplus function, however, is no longer linear in b_t . The convexity of the distress cost makes the surplus function concave, introducing a precautionary motive that discourages excessive borrowing. Effectively, the firm may choose not to borrow up to the limit and the borrowing constraint $\xi_t g_{t+1} \beta \mathbb{E}_t s_{t+1}(b_{t+1}) \geq q_t g_{t+1} b_{t+1}$ could be only occasionally binding.

Figure 1 provides a graphical illustration of the optimal debt policy of the firm. The first

panel depicts the model without financial distress. In this case the marginal benefit of debt is always bigger than the marginal cost of borrowing (provided that the firm chooses positive hiring and $\eta > 0$). This is because the marginal benefit of debt also includes the reduced future cost of labor generated by a marginal increase in debt. Therefore, the firm always borrows up to the limit, which is indicated in the graph by the vertical line.

The case with financial distress is depicted in the second panel of Figure 1. In this case the marginal cost is initially below the marginal benefit. However, as the debt increases, the expected cost of financial distress raises, inducing an increase in the marginal cost of debt. As a result, the firm does not borrow up to the limit. Furthermore, bigger is the distress cost captured by the parameter κ , and bigger is the difference between the borrowing limit and the actual debt chosen by the firm. As we will see, in the empirical estimation of the model we interpret the difference between the borrowing limit and the actual borrowing as unused lines of credit. Data on unused lines of credit will then allow us to identify the financial distress parameter κ .

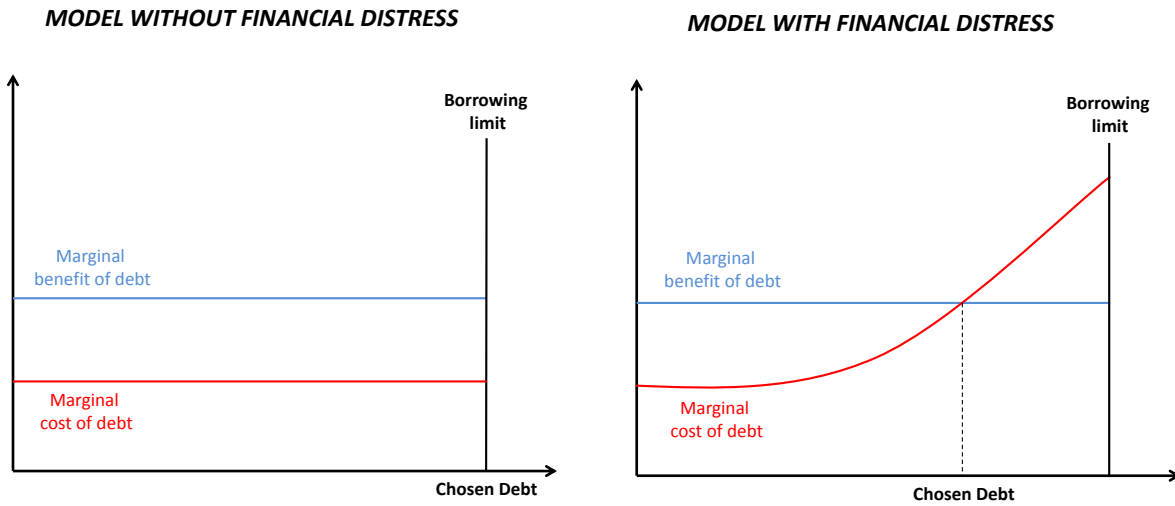


Figure 1: Optimal debt policy.

2.2 Reformulation of the optimization problem

We can now use the special form of the surplus function to derive expressions for the maximum collateralizable debt. First we use the condition that determines the maximum collateralizable debt, that is, $b_t^* = \xi_t s_t(b_t^*)$. Using (19) to eliminating $s_t(b_t^*)$, we obtain $b_t^* = \xi_t[\bar{s}_t - b_t^* - \varphi_t(b_t^*)]$. Since $\varphi(b_t^*) = 0$ by definition, we can solve the last equation for b_t^* , that is,

$$b_t^* = \left(\frac{\xi_t}{1 + \xi_t} \right) \bar{s}_t. \quad (20)$$

Therefore, the collateralizable debt is only determined by the exogenous states, z_t and ξ_t . Finally, the particular form of the surplus function derived in (19) allows us to write the firm's problem as

$$\bar{s}_t = \max_{e_t, b_{t+1}} \left\{ z_t - \Upsilon(e_t) + q_t g_{t+1} b_{t+1} - u_t + \beta(g_{t+1} - \eta e_t) \mathbb{E}_t \left[\bar{s}_{t+1} - b_{t+1} - \varphi_{t+1}(b_{t+1}) \right] \right\} \quad (21)$$

subject to:

$$\xi_t g_{t+1} \beta \mathbb{E}_t \left[\bar{s}_{t+1} - b_{t+1} - \varphi_{t+1}(b_{t+1}) \right] \geq q_t g_{t+1} b_{t+1}$$

$$g_{t+1} = 1 - \lambda + e_t.$$

This problem is recursive in \bar{s}_t , which depends only on the exogenous shocks. Therefore, to solve for the optimal policies we do not need to keep track of the endogenous state b_t . This makes the computational procedure extremely simple as we will describe below.

Using the particular form of the surplus function, the first order conditions (17) and (18)

can be rewritten as

$$q_t b_{t+1} + \beta(1 - \eta) \mathbb{E}_t \left[\bar{s}_{t+1} - b_{t+1} - \varphi_{t+1}(b_{t+1}) \right] = \Upsilon'(e_t), \quad (22)$$

$$q_t g_{t+1} = \beta(g_{t+1} - \eta e_t) \left(1 + \mathbb{E}_t \varphi'_{t+1}(b_{t+1}) \right) + \mu_t g_{t+1} \left[\beta \xi_t \left(1 + \mathbb{E}_t \varphi'_{t+1}(b_{t+1}) \right) + q_t \right]. \quad (23)$$

Some of the properties stated in Propositions 1.1 and 1.2 also apply to the model with financial distress. In particular, if workers do not have any bargaining power ($\eta = 0$) and $q = \beta$, we can see from equation (23) that the enforcement constraint is never binding ($\mu_t = 0$) and the expected distress cost is zero, that is, $\mathbb{E}_t \varphi_{t+1}(b_{t+1}) = 0$. Since debt does not provide any value when $\eta = 0$, the firm does not borrow to avoid the distress cost. At the same time, since the firm does not borrow and the expected distress cost is zero, the hiring decision characterized by condition (22) is not affected by the financial status of the firm ξ_t . Of course, there could be other reasons why firms have an incentive to borrow, such as the tax benefit of debt. However, since the goal of this paper is to study the role of the bargaining channel of debt, we abstract from other mechanisms.

2.3 Computation of the optimal policies

The solution to the normalized problem consists of functions for the hiring policy, e_t , for the borrowing policy, b_{t+1} , and for the surplus variable \bar{s}_t . The policies and the surplus variable do not depend on the endogenous state b_t but only on the exogenous shocks z_t and ξ_t . If the shocks take a finite number of values, \bar{s}_t also takes a finite number of values. Therefore, problem (21) is a Bellman's equation in an unknown vector $\bar{\mathbf{s}}$ containing the values of \bar{s}_t associated with all (finite) realizations of the shocks. The solution can be found by iterating on the Bellman equation until we find a fixed point for the vector $\bar{\mathbf{s}}$.

Denote by n_z and n_ξ the number of possible values for productivity and financial shocks. Each iteration starts with a guess for the vector $\bar{\mathbf{s}}_{t+1}$, that is, the vector that contains the

$n_z \times n_\xi$ elements of the surplus \bar{s}_{t+1} in the next period. For each combination of the two shocks in the current period and given the guess for the vector \bar{s}_{t+1} , we derive the optimal policies by solving the first order conditions (22) and (23) together with the enforcement constraint in problem (21). Since the enforcement constraint could be satisfied with equality (in which case $\mu_t > 0$) or with inequality (in which case $\mu_t = 0$), we have to verify the Kuhn-Tucker conditions for interior or binding solutions. The policy rules for employment and borrowing allow us to determine \bar{s}_t for each combination of the two shocks. Therefore, by solving the model for each realization of the two shocks we compute the vector \bar{s}_t (given the guess for the vector \bar{s}_{t+1}). The computed vector \bar{s}_t is then used as a new guess for \bar{s}_{t+1} . We continue the iteration until $\bar{s}_t = \bar{s}_{t+1}$.

Notice that, as long as the exogenous shocks take a finite number of values, the solution does not use any approximation technique. Therefore, even if we solve the model numerically, the solution is exact.

3 Structural estimation

In this section we describe how we estimate the model. We start with the description of the data and then we discuss the estimation and identification strategy.

3.1 Data

With the exception of unused lines of credit, all variables used in the structural estimation are from COMPUSTAT Annual. Data on unused lines of credit are not available in COMPUSTAT and some studies collect information about credit lines from firms' SEC 10-K files (see, for example, Sufi (2009)). We use data from Capital IQ database which contains a large sample of unused lines of credit from 2003 to 2010. The variable unused lines of credit also refers to *total undrawn credit*. See Ippolito and Perez (2012) for a detailed description.

Following the literature, we exclude utilities and financial firms with SIC codes in the

intervals 4900-4949 and 6000-6999, and firms with SIC codes greater than 9000. We also exclude firms with a missing value of assets, sales, number of employees, debt, and unused lines of credit during the sample period. To limit the impact of outliers, we also winsorize all level variables at 2.5% and 97.5% percentiles, and growth variables at 5% and 95% percentiles. Nominal variables are deflated by the Consumer Price Index. The final sample used in the structural estimation is a *balanced* panel (for each variable) of 1,508 firms over 8 years, from 2003 to 2010. Appendix A provides the detailed definitions of the variables used in the estimation.

3.2 Simulated method of moments

The model is solved numerically as described in Section 2.3 and most of the parameters are estimated through the simulated method of moments (SMM). The basic idea of SMM is to choose the parameters such that the moments generated by the model are close to those in the data.

As described in the previous subsection, the empirical data consists of a panel of heterogeneous firms while the artificial data is generated by simulating one firm over a number of periods. To keep consistency between the empirical and simulated data, the empirical moments are computed as averages of the moments for each firm in the sample. More specifically, we first calculate the empirical moments for each sample firm and then we compute the average of a particular moment across all firms. We use the bootstrap method to calculate the variance-covariance matrix associated with the target moments.

The estimation procedure consists of the following steps:

1. For each firm i , we choose moments $h_i(x_{it})$, where x_{it} is a vector of variables included in the empirical sample. The subscripts i and t identify, respectively, firm and year.
2. For each firm i we calculate the within-firm sample mean of moments as $f_i(x_i) = \frac{1}{T} \sum_{t=1}^T h_i(x_{it})$, where T is the number of years in the empirical sample.

3. The average of the within-firm sample mean is computed as $f(x) = \frac{1}{N} \sum_{i=1}^N f_i(x_i)$, where N is the number of firms in the data.
4. We then use the model to generate a panel of artificial data for N firms and for S periods. The vector of simulated data in period t and for firm s is denoted by y_{is} . We set $S = 100 \cdot T$ to make sure that the representative firm ends up in all possible states at least once.
5. At this point we calculate the average sample mean of moments in the model as $f(y, \theta) = \frac{1}{N \cdot S} \sum_{i=1}^N \sum_{s=1}^S h(y_{is}, \theta)$, where y_{is} is the simulated data and θ denotes the parameters to be estimated.
6. The estimator $\hat{\theta}$ is the solution to

$$\min_{\theta} \left[f(x) - f(y, \theta) \right]' \cdot \Omega \cdot \left[f(x) - f(y, \theta) \right]. \quad (24)$$

The weighting matrix Ω is defined as $\hat{\Sigma}^{-1}$, where $\hat{\Sigma}$ is the variance-covariance matrix associated with the average of sample mean $f(x)$ in the data. The matrix $\hat{\Sigma}$ is calculated using the bootstrap method. First, given the population of N firms in the empirical sample, we draw J random samples of size $\frac{N}{2}$. Second, for each draw j we compute the statistics of the artificial sample denoted as $f(x)^j$. Third, we approximate the variance-covariance matrix by the variance of $f(x)^j$, i.e.,

$$\hat{\Sigma} \approx \frac{1}{J} \sum_{j=1}^J \left[f(x)^j - \frac{1}{J} \sum_{j=1}^J f(x)^j \right]' \cdot \left[f(x)^j - \frac{1}{J} \sum_{j=1}^J f(x)^j \right]. \quad (25)$$

We set $J=50,000$ to have enough accuracy in bootstrapping.

3.3 Parameters and moments

In describing the model we have assumed that a fixed fraction of workers λ are separated from the firm. In reality, however, labor retention and hiring are likely to be uncertain at the firm level. To capture this idea, we also consider a shock to job separation. A separate shock to job creation is not necessary since this will be isomorphic to a shock that affects job separation.

Employment continues to evolve according to $N_{t+1} = (1 - \lambda_t)N_t + E_t$, but λ_t is stochastic and follows a first order Markov process. The problem takes the same form as in (21). Now, however, there are three shocks that affect the firm: productivity, z_t , credit, ξ_t , and separation, λ_t . The first order conditions are also similar. Each of the three shocks can take 9 possible values and follow independent first order Markov chains.

The only functional form that has not been specified is the hiring cost $\Upsilon(e)$. We assume that this function takes the form $\Upsilon(e_t) = \phi e_t + \zeta e_t^2$, where ϕ and ζ are parameters.

All parameters are estimated with the exception of the intertemporal discount factor, β , the average productivity \bar{z} , the hiring cost parameter ζ , and the average enforcement variable $\bar{\xi}$. The discount factor β is set to 0.97, which implies an interest rate close to 3 percent. The average productivity \bar{z} is normalized to 1. The hiring parameter ζ is chosen so that the average growth rate of firms is zero (given the other parameters). The value of $\bar{\xi}$ is chosen so that the available credit (used and unused) is 50 percent the total surplus of the firm.

We are then left with 11 parameters: the persistence and volatility of the productivity shock, ρ_z and σ_z , the persistence and volatility of credit shock, ρ_ξ and σ_ξ , the persistence and volatility of separation shock, ρ_λ and σ_λ , the financial distress cost, κ , the workers' bargaining power, η , the hiring cost, ϕ , the average separation, $\bar{\lambda}$, the unemployment flow, \bar{u} . To estimate these parameters we consider 15 moments: the mean of the ratio of unused credit over total credit (1 moment); the standard deviations and autocorrelations of the ratio of unused credit over total credit, employment growth, sales growth, and total credit growth (8 moments); the cross correlations of the ratio of unused credit over total credit, employment

growth, sales growth, and total credit growth (6 moments).

3.4 Estimation results

The values of the estimated parameters are reported in the bottom section of Table 1. The estimation assigns a sizable bargaining power to workers with $\eta = 0.478$. This is important for the bargaining channel to be relevant. Another parameter that is important for the bargaining channel is the average separation $\bar{\lambda}$, which is estimated to be 0.399. A high separation rate implies high turnover rates and, therefore, high rates of hiring. High rates of hiring increase the importance of the bargaining channel because, as we have seen in the theoretical section, higher debt allows for lower compensation of newly hired workers. We also observe that credit and productivity shocks are quite persistent while the separation shocks are not persistent.

The values of the moments (observed and simulated) are reported in the top section of Table 1. The model does a reasonable job in replicating the 15 moments used in the estimation. One moment for which there is a sizable divergence between the empirical and simulated moments is the autocorrelation of employment growth. In the data the autocorrelation is close to zero. The model, however, generates a positive autocorrelation of 0.2. This is a consequence of the particular structure of the model where the *level* of debt affects the *growth* of employment. As a result, a persistent increase in the debt *level* induces, through the bargaining channel, a persistent increase in the *growth* rate of employment. In the data, however, employment growth is not persistent while the debt level displays some persistence. This implies that the bargaining channel alone cannot replicate the absence of serial correlation in employment growth together with the persistence in debt level. The addition of separation shocks (stochastic λ_t) reduces the autocorrelation in employment growth because it affects the growth of employment without affecting the debt level.

The number of moments used in the estimation is larger than the number of parameters. Thus, there is not a one-to-one mapping between parameters and moments. To provide a

general idea about the identification of the various parameters, we conduct comparative static exercises in which we increase the value of one single parameter and check how the change affects the moments used in the estimation. The results, reported in Table 2, are generated by increasing the 11 estimated parameters by 10 percent, one at the time.

3.5 The importance of the bargaining channel

The key question we would like to address in this paper is whether the bargaining channel—that is, the channel through which debt impacts on the bargaining of wages—is quantitatively important for explaining employment fluctuations at the firm level. To address this question we compare the baseline model with an alternative model in which we do not allow firms to choose their debt. The model has the same parameter values as the baseline model but the level of debt is fixed at the average value for the baseline model. Then, conditional on having the constant level of debt, wages are determined in the same way they are determined in the baseline model and firms continue to optimize over the hiring policy. Since firms cannot use debt as a strategic tool to improve their bargaining position with workers, the bargaining channel is completely disabled.

Table 3 reports the results. Without the bargaining channel, the model generates a standard deviation of employment growth of 0.097, compared to 0.116 in the baseline model. Therefore, we conclude that the bargaining channel contributes 16.4 percent to the standard deviation of employment growth at the firm level.

From Table 3 we also observe that, with fixed debt, the level of unused credit decreases. By holding a smaller stock of unused credit as precautionary buffers, firms lose some financial flexibility. This could increase the volatility of employment compared to the case in which the firm could choose the debt optimally. Therefore, the 16.4 percent calculated in the counterfactual exercise can be interpreted as a lower-bound to the contribution of the bargaining channel to employment fluctuations.

3.6 The role of shocks

To evaluate the importance of the various shocks, we simulate the model with only one shock. For example, when we simulate the model with credit shocks only, we set the sequence of draws for z_t and λ_t to their unconditional means, \bar{z} and $\bar{\lambda}$ respectively. Similarly, when we simulate the model with productivity shocks only, we set the sequence of draws for ξ_t and λ_t to their unconditional means $\bar{\xi}$ and $\bar{\lambda}$. It is important to point out that, even if we set the realizations of the shocks to the unconditional means, this is not anticipated by firms. They continue to assume that the two shocks follows the process dictated by the estimated parameters. Table 4 reports the simulation results.

With only credit shocks, the model generates a standard deviation of employment growth of 0.056 which is about 48 percent of the benchmark standard deviation of 0.116. When we simulate the model with only productivity shocks, the standard deviation of employment growth is about 0.073. Finally, with only separation shocks the model generates a standard deviation of employment growth of 0.069. The fact that the sum of the standard deviations of each simulation does not sum to 0.116 means that the transmission mechanism of each shock is not independent of other shocks. For example, when productivity is low, the impact of a positive credit shock on employment is weaker since firms do not find convenient to hire many workers. In general, however, we can conclude that, based on the estimation, credit shocks contribute significantly to employment fluctuations.

Another feature worth emphasizing is that, with only credit (or productivity) shocks, the model generates a much higher autocorrelation of employment. With only separation shocks, instead, the model generates an autocorrelation of employment that is closer to zero. Thus, the addition of separation shocks brings the model closer to the data as we have already emphasized above.

4 Reduced-form analysis

The central mechanism explored in this paper—the impact of debt on hiring through the bargaining channel—is based on the idea that wages are bargained between workers and employers and, when a firm is able to increase the debt, it can negotiate better conditions with workers. In this section we conduct an empirical analysis of this mechanism using reduced-form regressions. Since the importance of the bargaining channel could change with the bargaining power of workers, the empirical approach will be based on the possible variation in the workers’ power. Before doing so, however, we illustrate the dependence of the bargaining channel on the bargaining power of workers through impulse responses.

Figure 2 plots the response of firm-level employment growth to credit shocks for different levels of the workers’ bargaining power η . The top panel shows that, when the bargaining share is $\eta = 0.47$ (estimated value), employment growth increases by 9% in response to a one-standard-deviation positive credit shock. However, if we increase the bargaining share to $\eta = 0.59$ (25% higher than the estimated value), the response of employment growth increases by 14%. This means that the higher the bargaining power of workers, the more sensitive is employment growth to credit growth.² In this section, we test this property of the model with reduced-form regressions.

4.1 Data description

In order to test the importance of the bargaining channel, we need a proxy for the workers’ power η . Following Klasa, Maxwell, and Ortiz-Molina (2009) and Matsa (2010), we use the unionization index from the Union Membership and Coverage Database. The Union Membership and Coverage Database is maintained by Barry Hirsch and David Macpherson and is publicly available at <http://www.unionstats.com>. It compiles industry union coverage

²Similarly, after a one-standard-deviation negative credit shock, the change in employment growth is larger in firms where workers have higher bargaining power. Overall, the impact of negative credit shocks is slightly smaller than that of positive credit shocks. Therefore, there is some asymmetry in the responses to positive and negative credit shocks.

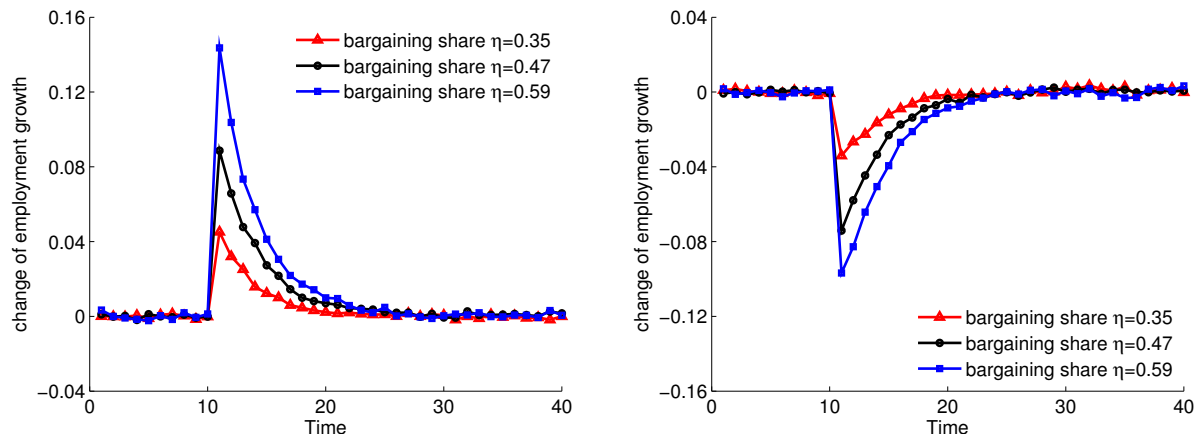


Figure 2: **Change in employment growth after credit shocks.** The left panel depicts the change in employment growth after a positive credit shock, and the right panel after a negative credit shock.

annually from the Current Population Survey (CPS). We first obtain firm-level employment and balance sheet variables from the COMPUSTAT and Capital IQ. We then merge the variables with the industry unionization rates for the same period 2003-2010.³

Ideally, we would like to use the unionization rate for each firm included in the sample. Unfortunately, for the most recent years, which is the focus of this paper, large-sample unionization data is only available at the industry level.⁴ Therefore, we are forced to proxy the bargaining power of workers of a firm with the average unionization index of the industry in which the firm operates. This is also the approach used by Klasa, Maxwell, and Ortiz-Molina (2009) to study the relation between cash holdings and bargaining power of workers. As a robustness check, we also consider a random sample of 300 firms for which unionization rates have been collected manually for each firm from the SEC 10k filings.

³COMPUSTAT uses the Standard Industrial Classification (SIC), while the Union Membership and Coverage Database uses the CPS Industry Classifications (CIC). We are able to match the SIC code with the CIC code using North American Industry Classification System code (NAICS). After matching the two data sets, we have 162 CIC industries.

⁴One consideration that makes the use of the industry index a good proxy for the bargaining power of workers at the firm level is that labor mobility and competitive pressure tends to be higher within the industry rather than across industries. This implies that, even if a firm do not have unionized workers, it will face higher competitive pressure from other firms if the industry is highly unionized.

4.2 Regression equation

To test the hypothesis that the relation between employment growth and credit growth depends on the bargaining power of workers, we consider the following regression equation:

$$\begin{aligned}
 \Delta employ_{it} = & \alpha + \beta_1 \cdot union_{cic,t} \cdot \Delta credit_{it} + \beta_2 \cdot union_{cic,t} + \beta_3 \cdot \Delta credit_{it} \\
 & + \beta_4 \cdot \frac{credit_{it-1}}{asset_{it-1}} + \beta_5 \cdot \log(employ_{it-1}) + \beta_6 \cdot Q_{it} \\
 & + \beta_7 \cdot \frac{cashflow_{it}}{asset_{it}} + \nu_i + \tau_t + \varepsilon_{it}.
 \end{aligned} \tag{26}$$

The dependent variable is employment growth, $\Delta employ_{it}$. The main independent variable is the interaction term between industry unionization rate and credit growth, $union_{cic,t} \cdot \Delta credit_{it}$. The bargaining power of workers is approximated by the unionization rate $union_{cic,t}$. We control for the lagged credit-to-asset ratio $\frac{credit_{it-1}}{asset_{it-1}}$ and the lagged log-employment $\log(employ)_{it-1}$. Following the investment literature, we also include market-to-book ratio Q_{it} , cash flow-to-asset ratio, $\frac{cashflow_{it}}{asset_{it}}$, firm-level fixed effects, ν_i , and year fixed effects, τ_t .

Of primary interest is the interaction term between credit growth and unionization rate, $union_{cic,t} \cdot \Delta credit_{it}$. We expect that this term has a positive effect on employment growth, that is, $\beta_1 > 0$. This is in addition to the direct effect of credit growth captured by the parameter β_3 .

The first column of Table 5 reports the estimation results for the baseline specification of the regression equation (26). The coefficient for the interaction term is 0.088 and it is statistically significant at 1% level. Therefore, the growth of credit in firms with more unionized labor is associated with higher growth rate of employment. However, these results should be taken with caution since we use industry level unionization rate to proxy for the bargaining power of workers employed by a particular firm. Furthermore, in conducting the estimation we are not testing for causality. We are only estimating conditional correlations.

Turning to the control variables, the first column of Table 5 shows that employment growth is negatively related to lagged employment, and positively related to lagged credit-

to-asset ratio, market-to-book ratio and cash flow-to-asset ratio.

An alternative way of testing the importance of unionization is by estimating equation (26) without the interaction term, separately for high and low unionization firms. The high unionization group includes firms that operate in industries with higher than median unionization rate. The estimation results are reported in the last two columns of Table 5. The coefficient of $\Delta credit_{it}$, is larger for firms with high unionization rates. Thus, the estimation confirms that the relation between employment growth and credit growth increases with the bargaining power of workers, consistent with the theory.

4.3 Robustness check

Table 6 reports the estimation results when we replace the *industry-level* unionization index with a *firm-level* index from a random sample of 300 firms. Since firms do not report union information every year in their 10k reports, we are only able to collect one constant unionization rate for each firm, and we make the assumption that firms retain the same unionization rate during the sample period. Thus, any variation in the strength of the relation between employment growth and debt growth would come from the cross-section variation of the unionization rate among firms.

Within the 300 randomly sampled firms, 93 firms report that they have at least some collective bargaining coverage. The average unionization rate is 0.08 (which is close to the average of the industry rates) and the standard deviation is 0.17. Among the 93 firms with non-zero unionization rate, the average rate is 0.26 and the standard deviation is 0.21.

As can be seen in the first column of Table 6, the coefficient for the interaction term, $union_{i,t} \cdot \Delta credit_{it}$, is positive and statistically significant at 1% level. The unionization rate is dropped from the regression because it is constant over the sample period.

The next two columns of Table 6 report the results from the estimation of equation (26) without the interaction term but separately for high and low unionization firms. Similar to those obtained with the industry-level unionization index (Table 5), the coefficient of

$\Delta credit_{it}$ is larger for high unionized firms.

5 Conclusion

There is a well-established literature in corporate finance exploring the use of debt as a strategic mechanism to improve the bargaining position of firms with workers. Less attention has been devoted to studying whether this mechanism is also important for the hiring decision of firms. In this paper we have investigated the theoretical and empirical relevance of this channel for the employment dynamics of firms.

Using an estimated firm dynamics model, we have shown that this mechanism contributes significantly to employment fluctuations at the level of the firm. We have also shown that the strength of the mechanism increases with the bargaining power of workers. This dependence is supported by the empirical estimation of reduced-form regressions. Although not explicitly explored in this paper, the bargaining channel could also be important for the long-run dynamics of the firm. In particular, greater uncertainty about the firm's access to credit could have sizable negative effects on its long-run growth of employment.

A Appendix: Variables definition and sources

Structural estimation	Model	Data	Data Sources
Total Credit ($credit_{it}$)	$\xi_t \beta \mathbb{E}_t S_{t+1}$	Long-Term Debt _t + Short-Term Debt _t + Total Undrawn Credit _t	COMPUSTAT, Capital IQ
Unused Credit Ratio ($\frac{unused_{it}}{credit_{it}}$)	$\frac{\xi_t \beta \mathbb{E}_t S_{t+1} - \beta B_{t+1}}{\xi_t \beta \mathbb{E}_t S_{t+1}}$	Total Undrawn Credit _t / Total Credit _t	COMPUSTAT, Capital IQ
Credit Growth ($\Delta credit_{it}$)	$\frac{\xi_t \beta \mathbb{E}_t S_{t+1}}{\xi_{t-1} \beta \mathbb{E}_{t-1} S_t}$	Total Credit _t / Total Credit _{t-1}	COMPUSTAT, Capital IQ
Employment Growth ($\Delta employ_{it}$)	$\frac{N_{t+1}}{N_t}$	Employees _{t+1} / Employees _t	COMPUSTAT
Sale Growth ($\Delta sale_{it}$)	$\frac{z_t N_t}{z_{t-1} N_{t-1}}$	Sales _t / Sales _{t-1}	COMPUSTAT
Reduced-form estimation		Data	Data Sources
Unionization Rate ($union_{cic,t}$)		Employees Covered by Collective Bargaining _t / Total Employees _t	Union Membership and Coverage Database
Credit Ratio ($\frac{credit_{it}}{asset_{it}}$)		Total Credit _t / Total Assets _t	COMPUSTAT, Capital IQ
Cash Flow Ratio ($\frac{cashflow_{it}}{asset_{it}}$)		Operating Income Before Depreciation _t / Total Assets _t	COMPUSTAT
Market to Book Ratio (Q_{it})		Market Value of Assets _t / Book Value of Assets _t	COMPUSTAT

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Table 1: Moments and Parameters

TARGET MOMENTS	<i>Observed</i>	<i>Simulated</i>
$Mean(\frac{unused_t}{credit_t})$	0.411	0.414
$Std(\frac{unused_t}{credit_t})$	0.172	0.168
$Std(\Delta employ_t)$	0.134	0.116
$Std(\Delta sales_t)$	0.181	0.168
$Std(\Delta credit_t)$	0.500	0.476
$Autocor(\frac{unused_{t-1}}{credit_{t-1}})$	0.317	0.404
$Autocor(\Delta employ_{t-1})$	-0.029	0.200
$Autocor(\Delta sales_{t-1})$	0.007	-0.024
$Autocor(\Delta credit_{t-1})$	-0.185	-0.108
$Cor(\frac{unused_t}{credit_t}, \Delta employ_t)$	-0.067	0.099
$Cor(\frac{unused_t}{credit_t}, \Delta sales_{it})$	-0.046	-0.044
$Cor(\frac{unused_t}{credit_t}, \Delta credit_{it})$	-0.001	0.261
$Cor(\Delta employ_t, \Delta sales_{it})$	0.497	0.428
$Cor(\Delta employ_t, \Delta credit_{it})$	0.296	0.292
$Cor(\Delta sales_t, \Delta credit_{it})$	0.197	0.207
ESTIMATED PARAMETERS		
Persistence productivity shock, ρ_z		0.627
Volatility productivity shock, σ_z		0.180
Persistence credit shock, ρ_ξ		0.892
Volatility credit shock, σ_ξ		0.148
Persistence separation shock, ρ_λ		-0.642
Volatility separation shock, σ_λ		0.093
Financial distress cost, κ		12.736
Workers' bargaining power, η		0.478
Hiring cost, ϕ		0.506
Average separation, $\bar{\lambda}$		0.399
Unemployment flow, \bar{u}		0.452

This table shows the results of the structural estimation. The first panel lists the target moments, and the second panel reports the estimated parameters.

Table 2: Sensitivity

	Benchmark	ρ_z	σ_z	ρ_ξ	σ_ξ	ρ_λ	σ_λ	κ	η	ϕ	$\bar{\lambda}$	\bar{u}
$Mean(\frac{unused_t}{credit_t})$	0.414	0.439	0.429	0.450	0.484	0.414	0.416	0.435	0.417	0.436	0.406	0.426
$Std(\frac{unused_t}{credit_t})$	0.168	0.187	0.165	0.223	0.289	0.168	0.168	0.208	0.179	0.186	0.165	0.165
$Std(\Delta employment_t)$	0.116	0.130	0.119	0.124	0.120	0.117	0.120	0.116	0.125	0.126	0.137	0.128
$Std(\Delta sales_t)$	0.168	0.169	0.180	0.173	0.169	0.169	0.171	0.168	0.169	0.166	0.167	0.166
$Std(\Delta credit_t)$	0.476	0.493	0.484	0.825	0.713	0.475	0.476	0.474	0.464	0.468	0.474	0.479
$Autocor(\frac{unused_{t-1}}{credit_{t-1}})$	0.404	0.281	0.412	0.414	0.145	0.395	0.400	0.221	0.294	0.263	0.388	0.397
$Autocor(\Delta employment_{t-1})$	0.200	0.306	0.215	0.287	0.251	0.152	0.144	0.198	0.304	0.308	0.373	0.306
$Autocor(\Delta sales_{t-1})$	-0.024	0.097	-0.034	0.041	0.019	-0.048	-0.044	-0.023	0.066	0.081	0.175	0.092
$Autocor(\Delta credit_{t-1})$	-0.108	-0.090	-0.106	-0.100	-0.108	-0.108	-0.108	-0.108	-0.103	-0.099	-0.091	-0.098
$Cor(\frac{unused_t}{credit_t}, \Delta employment_t)$	0.099	-0.021	0.094	-0.003	-0.095	0.113	0.115	-0.046	-0.030	-0.074	0.042	0.041
$Cor(\frac{unused_t}{credit_t}, \Delta sales_{it})$	-0.044	-0.149	-0.057	-0.055	-0.180	-0.057	-0.052	-0.090	-0.135	-0.192	-0.092	-0.105
$Cor(\frac{unused_t}{credit_t}, \Delta credit_{it})$	0.261	0.164	0.251	0.274	0.135	0.260	0.262	0.163	0.179	0.143	0.223	0.225
$Cor(\Delta employment_t, \Delta sales_{it})$	0.428	0.537	0.459	0.465	0.459	0.384	0.376	0.426	0.510	0.544	0.629	0.561
$Cor(\Delta employment_t, \Delta credit_{it})$	0.292	0.341	0.309	0.124	0.181	0.283	0.291	0.294	0.330	0.335	0.371	0.342
$Cor(\Delta sales_t, \Delta credit_{it})$	0.207	0.257	0.242	0.075	0.100	0.207	0.203	0.209	0.205	0.217	0.242	0.237

The first column reports the moments generated by the simulation of the model under the estimated parameters (benchmark parametrization as shown in Table 1). The remaining columns report the simulated moments after increasing the value of the specific parameter by 10%, except the persistence of credit shock ρ_ξ which is increased by 3%. The parameters are, respectively, the persistence and volatility of productivity, credit, and separation shock, $\rho_z, \sigma_z, \rho_\xi, \sigma_\xi, \rho_\lambda, \sigma_\lambda$, the financial distress cost, κ , the bargaining power of workers, η , the hiring cost, ϕ , the average separation, $\bar{\lambda}$, and the unemployment flow, \bar{u} .

Table 3: **The importance of the bargaining channel**

	Observed	Benchmark Model	Experiment Model
$Mean(\frac{unused_t}{credit_t})$	0.411	0.414	0.159
$Std(\frac{unused_t}{credit_t})$	0.172	0.168	0.748
$Std(\Delta employ_t)$	0.134	0.116	0.097
$Std(\Delta sales_t)$	0.181	0.168	0.162
$Std(\Delta credit_t)$	0.500	0.476	0.549
$Autocor(\frac{unused_{t-1}}{credit_{t-1}})$	0.317	0.404	0.680
$Autocor(\Delta employ_{t-1})$	-0.029	0.200	-0.130
$Autocor(\Delta sales_{t-1})$	0.007	-0.024	-0.195
$Autocor(\Delta credit_{t-1})$	-0.185	-0.108	-0.093
$Cor(\frac{unused_t}{credit_t}, \Delta employ_t)$	-0.067	0.099	0.038
$Cor(\frac{unused_t}{credit_t}, \Delta sales_{it})$	-0.046	-0.044	0.109
$Cor(\frac{unused_t}{credit_t}, \Delta credit_{it})$	-0.001	0.261	0.222
$Cor(\Delta employ_t, \Delta sales_{it})$	0.497	0.428	0.213
$Cor(\Delta employ_t, \Delta credit_{it})$	0.296	0.292	0.170
$Cor(\Delta sales_t, \Delta credit_{it})$	0.197	0.207	0.308

The first column reports the moments of the empirical data, the second column reports the moments of the benchmark model, and the third column reports the moments of the model with fixed debt. By fixing the debt and comparing the simulated moments with those of the baseline model we quantify the importance of the bargaining channel for the volatility of firm-level employment.

Table 4: **The contribution of the three shocks**

	Observed	Benchmark Model	Credit Shock	Productivity Shock	Separation Shock
$Mean(\frac{unused_t}{credit_t})$	0.411	0.414	0.421	0.481	0.483
$Std(\frac{unused_t}{credit_t})$	0.172	0.168	0.163	0.023	0.030
$Std(\Delta employ_t)$	0.134	0.116	0.056	0.073	0.069
$Std(\Delta sales_t)$	0.181	0.168	0.056	0.138	0.069
$Std(\Delta credit_t)$	0.500	0.476	0.436	0.137	0.044
$Autocor(\frac{unused_{t-1}}{credit_{t-1}})$	0.317	0.404	0.431	0.522	-0.535
$Autocor(\Delta employ_{t-1})$	-0.029	0.200	0.820	0.534	-0.536
$Autocor(\Delta sales_{t-1})$	0.007	-0.024	0.820	-0.021	-0.536
$Autocor(\Delta credit_{t-1})$	-0.185	-0.108	-0.121	-0.012	-0.182
$Cor(\frac{unused_t}{credit_t}, \Delta employ_t)$	-0.067	0.099	0.218	-0.984	0.999
$Cor(\frac{unused_t}{credit_t}, \Delta sales_{it})$	-0.046	-0.044	0.227	-0.802	-0.536
$Cor(\frac{unused_t}{credit_t}, \Delta credit_{it})$	-0.001	0.261	0.312	-0.816	0.930
$Cor(\Delta employ_t, \Delta sales_{it})$	0.497	0.428	0.820	0.824	-0.536
$Cor(\Delta employ_t, \Delta credit_{it})$	0.296	0.292	0.161	0.832	0.928
$Cor(\Delta sales_t, \Delta credit_{it})$	0.197	0.207	-0.201	0.997	-0.191

The first column reports the moments of the data, and the second column reports the moments of the benchmark model. The last three columns report the moments generated by simulating the model under the estimated parameters (benchmark parametrization as shown in Table 1) but with only one of the three shocks. The simulation with only one shock is obtained by setting the realizations of the other two shocks to their unconditional means. The decision rules, however, are computed under the assumption that firms expect all three shocks to be active.

Table 5: **Employment growth regression. Baseline regression**

		Unionization Rate	
		High	Low
$union_{cic,t} \cdot \Delta credit_{it}$	0.088*** (0.034)		
$union_{cic,t}$	-0.045 (0.054)		
$\Delta credit_{it}$	0.043*** (0.004)	0.060*** (0.005)	0.042*** (0.004)
$\frac{credit_{it-1}}{asset_{it-1}}$	0.048*** (0.015)	0.052** (0.023)	0.044** (0.022)
$\log(employ_{t-1})$	-0.153*** (0.009)	-0.158*** (0.010)	-0.151*** (0.014)
Q_{it}	0.019*** (0.004)	0.024*** (0.006)	0.017*** (0.005)
$\frac{cashflow_{it}}{asset_{it}}$	0.218*** (0.021)	0.258*** (0.035)	0.190*** (0.028)
Firm Fixed Effects	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Adjusted R ²	0.35	0.35	0.34
Observation	19,656	9,658	9,998

This table reports the regression results using the industry-level unionization data. The first column shows the results of the baseline regression of equation (26). The next two columns report the results of regressions without the interaction term, separately for high and low unionization firms. High unionization firms are those located in industries with higher than median unionization rate. The sample is an *unbalanced* panel of 3,528 firms during the period 2003 - 2010. The dependent variable is employment growth, $\Delta employ_{it}$, and independent variables include: interaction between industry unionization rate and credit growth, $union_{cic,t} \cdot \Delta credit_{it}$, industry unionization rate $union_{cic,t}$, credit growth, $\Delta credit_{it}$, lagged credit-to-asset ratio, $\frac{credit_{it-1}}{asset_{it-1}}$, lagged log-employment, $\log(employ)_{it-1}$, market-to-book ratio, Q_{it} , cash flow-to-asset ratio, $\frac{cashflow_{it}}{asset_{it}}$. Firm fixed effects and year dummies are also included. Standard errors (in parentheses) are heteroskedasticity robust and clustered at the firm level, and significance levels at 1%, 5%, and 10% are marked with superscripts ***, **, *.

Table 6: **Employment growth regression. Firm-level unionization**

		Unionization Rate	
		High	Low
$union_{i,t} \cdot \Delta credit_{it}$	0.238*** (0.046)		
$union_{i,t}$			
$\Delta credit_{it}$	0.058*** (0.008)	0.136*** (0.019)	0.054*** (0.008)
$\frac{credit_{it-1}}{asset_{it-1}}$	0.063 (0.042)	0.067 (0.062)	0.071 (0.051)
$\log(employ_{t-1})$	-0.130*** (0.017)	-0.134*** (0.027)	-0.130*** (0.020)
Q_{it}	0.013 (0.011)	-0.056 (0.039)	0.022** (0.010)
$\frac{cashflow_{it}}{asset_{it}}$	0.241*** (0.063)	0.266* (0.154)	0.249*** (0.067)
Firm Fixed Effects	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Adjusted R ²	0.38	0.38	0.38
Observation	2,084	673	1,411

This table reports the regression results using the firm-level unionization data. We randomly sample 300 firms from the unbalanced panel used in the baseline regression and then manually collect the firm-level unionization data from the 10k filings. Within the 300 firms, 93 firms have at least some collective bargaining coverage, and 207 firms do not have any union coverage. High unionization firms are those with higher than median unionization rate (which is zero in this case), and therefore they are also the firms who have at least some collective bargaining coverage. The dependent variable is employment growth, $\Delta employ_{it}$, and independent variables include: interaction between industry unionization rate and credit growth, $union_{cic,t} \cdot \Delta credit_{it}$, industry unionization rate $union_{cic,t}$, credit growth, $\Delta credit_{it}$, lagged credit-to-asset ratio, $\frac{credit_{it-1}}{asset_{it-1}}$, lagged log-employment, $\log(employ)_{it-1}$, market-to-book ratio, Q_{it} , cash flow-to-asset ratio, $\frac{cashflow_{it}}{asset_{it}}$. Firm fixed effects and year dummies are also included. Standard errors (in parentheses) are heteroskedasticity robust and clustered at the firm level, and significance levels at 1%, 5%, and 10% are marked with superscripts ***, **, *.