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Variable Pay: Is It For The Worker Or The Firm?

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Abstract

Why do firms pay their workers with variable pay? The standard explanation appeals to a problem that the worker faces, e.g., agency. We develop a model of variable pay endogenously driven by the capital structure problem of the firm, and not a worker related problem. If workers face a low probability of job termination, firms use more variable pay, and more leverage. This can have important implications for understanding compensation practices in organizations. We provide empirical evidence consistent with firms using variable pay to increase leverage.

Keywords: Worker compensation; Leverage

JEL: G32, G24, J33

1 Introduction

When risk averse workers implement risky projects, how should they be paid if the firm is risk neutral? There is an extensive literature showing that a worker-related problem, such as agency, can justify the use of variable pay. In the absence of such problems, standard theory says that fixed pay is optimal. We re-visit this question and show that variable pay can arise endogenously by incorporating a firm's capital structure problem. Thus, although the terms *incentive pay* and *variable pay* are often used interchangeably, we draw an important distinction between the two since the latter need not provide any incentives to the worker.

To understand why the interaction of the worker compensation and firm financing decisions is important, consider the following: When a firm's underlying project risk increases, the optimal response is to reduce overall leverage ex ante—the combination of operating leverage and financial leverage. One may be tempted to think that a firm will reduce *both* operating *and* financial leverage in response to an increase in project risk. To the contrary, if underlying project risk is also correlated with increased job termination risk to the worker, she may demand more fixed versus variable pay to compensate. Thus, operating leverage actually increases, so financial leverage needs to fall by more than one may anticipate when project risk increases. Thus, when analyzing the relationship between project risk and leverage, we show that an important element may be missing if one does not consider worker pay structure.

The outline of the model is as follows: Consider workers who implement (non-diversifiable) risky projects for firms that can yield a high or low return. Firms pay workers through fixed and variable wages; the latter conditional on a high return. For expositional simplicity, assume that workers are terminated if the return is low (job termination risk); the worker incurs a cost of termination. In this environment, it is optimal to pay workers with fixed pay since they are risk averse and the firm is risk neutral. The reason is that fixed pay hedges the low state in which the worker is terminated, and so minimizes the firm's wage bill (e.g., Laffont and Martimort (2002)).

Now consider a firm that raises money for projects through debt and equity. Assuming that debt is subsidized relative to equity, the firm opts to take on as much debt as possible, while avoiding bankruptcy costs. Fixed pay now works against debt, since it is itself a form of debt on the operation side of the firm. In choosing the amount of fixed pay to offer workers, the firm trades off the benefit (decreased wage bill from fixed pay due to worker risk aversion) versus the cost

(having to reduce debt to avoid bankruptcy costs). Firms with less risky projects will pay workers with more variable pay, since the flexibility of variable pay can be thought of as akin to equity, except on the operations side of the firm. This occurs because the value of fixed pay, in utility terms, is lower for these types of workers, since it is less likely that they will be terminated. Thus, firms with less employment uncertainty will have more variable pay and higher financial leverage.

Oyer (2004) also considers a non-agency mechanism related to the worker to help explain the prevalence of variable pay. He constructs a model in which variable pay is used to avoid costly renegotiation. If the outside option of a worker is dependent on firm value, then (costly) stock options can prevent a worker from leaving without renegotiation. In contrast, in our model, the worker is replaceable, so the interim participation constraint does not imply variable wages. Instead, variable pay arises from the firm's capital structure problem.

Our work is related to Berk et al. (2010), who considers the role of workers in firms' capital structure decisions. Workers invest in firm-specific human capital and lose it when fired. Firms trade off the tax benefits of debt with higher (fixed) wages for workers who internalize the increased probability of being fired due to an increase in debt. In contrast, we consider the case in which the worker is fired due to project non-performance, not bankruptcy, where the relationship between the worker and capital structure arises through a novel mechanism: pay structure. In other words, we show the importance of the *composition* of wages. In the context of banks, Thanassoulis (2012) argues that banks prefer variable wages to share the risk of financial distress with workers. The essence of the risk-sharing incentive in that paper is present here; however, we model heterogeneous workers and explicitly consider the capital structure problem. As such, we are able to obtain predictions on what types of firms should have more variable pay and higher leverage.

Our work is also related to the literature on pay-for-performance, which has largely focused on an agency environment to explain issues like risk taking; Lazear and Oyer (2012) provide a summary. John and John (1993) related executive pay-for-performance to the mix of external claims on firms. For management compensation it makes sense to consider variable pay as being sensitive to firm value. However, we consider variable pay throughout the organization, and so are considering workers who may not have a large influence on overall firm value. As such, having variable pay that depends on their individual performance would seem to make sense. There is strong evidence that variable compensation is important beyond management and thus worth examining in greater detail. Using the PSID, Lemieux et al. (2009) report that 41.6% of

non-management workers receive variable compensation, going as high as 75% for non-management professionals. Aon Hewitt report that over 90% of the companies they surveyed in 2015 had some form of variable compensation, which now comprises 12.7% of payrolls.¹ An interesting case in point comes from Caterpillar, the world's largest maker of mining and construction equipment, which has a variable pay plan for all of its non-union employees.²

Finally, our paper contributes to the debate on the empirical relationship between unemployment risk and financial leverage. Simintzi et al. (2015) and Serfling (2016) provide evidence that employment protection crowds out financial leverage. The main hypothesis is that higher employment protection increases financial distress costs, thereby increasing the cost of debt.³ On the other hand, Agrawal and Matsa (2013) find that higher employment protection allows firms to increase financial leverage. The mechanism is through a labor channel—less unemployment risk allows for lower pay and higher debt. These papers use exogenous changes in the cost of job termination to identify a relationship between unemployment risk and financial leverage. We take the cost of firing as fixed but focus instead on job termination risk and, importantly, the role of variable pay. Using novel firm-level panel data on variable wages for Canadian bankers as well as information on their balance sheets, income statements, and employment, we provide evidence consistent with the wage-mechanism highlighted in our model.

2 Model

¹ <http://ir.aon.com/about-aon/investor-relations/investor-news/news-release-details/2015/US-Organizations-Report-Highest-Compensation-Spend-in-39-Years/default.aspx>

² <http://www.reuters.com/article/us-usa-workers-pay-analysis-idUSBRE98005N20130901>

³ In contrast, in models by Bronars and Deere (1991), Dasgupta and Sengupta (1993), and Perotti and Spier (1993), high leverage is used to mitigate operational risk by limiting workers' bargaining power. Hanka (1998) provides an empirical test linking leverage to overall worker pay. He shows that prior to the 1960's, leverage and worker pay were positively related, while afterwards they are negatively related. The negative relationship is consistent with decreased bargaining power of workers. More recently, Quadrini and Sun (2007) shows how the use of debt can improve the bargaining position in wage negotiations, thereby leading firms to hire more workers. Importantly, we shut down the bargaining channel that is explored in these papers and instead focus on the *type* of compensation (fixed versus variable), as opposed to the *level* of compensation which these papers consider.

In this section, we first outline the workers' problem and then solve the firms' problem.

2.1 Worker Problem

There are three periods indexed $t = 0, 1, 2$. We assume that a worker can neither save nor borrow and derives utility u_t from consumption C_t in period t , which is given by: $u_t = -\exp(-\alpha C_t)$, where α is the coefficient of absolute risk aversion.⁴ We assume for simplicity that lifetime utility is additively separable over time and is stationary. Without loss of generality (see Section 3.3), we assume that workers do not discount per-period utility.

A worker is penniless but can provide labor to an investment project that has a rate of return at $t = 1$ of $r_H(p)$ with probability p and $r_L(p)$ with probability $1 - p$, where $r_H(p) > r_L(p)$ for any p . One can think of workers as possessing the skills to implement a specific project characterized by p .⁵ Although it makes sense to allow r_H and r_L to be functions of p , since different projects should have both different risk and returns, the main results of this paper can be derived under the simple case in which r_H and r_L are constant.

A worker's decision is simple: either engage in the project or take an outside option, which is discussed below. Within each firm, workers have the same (perfectly correlated) project risk; however between firms, the level of project risk is the key distinguishing feature. To this end, let there be a measure 1 of workers that are uniformly distributed on $[0, 1]$ along the continuum of project risk level p . Thus, for a given p , there is a continuum of workers with the same perfectly correlated probability of achieving the high return. Therefore, firms have infinitely many workers who can be thought of as completing a shared firm-wide project. Firms can then be described by a risk level p .⁶ We assume that, if the high state occurs, the investment returns r_H at $t = 2$ as it did at $t = 1$. Conversely, if the low state occurs, the investment returns nothing at $t = 2$. The firm

⁴ CARA exponential utility allows a closed-form solution in our setting. It is, however, not crucial, since the results do not depend on the lack of wealth effects that characterize these utility functions.

⁵ Note that we could re-cast this as a learning model in which neither the worker nor the firm know the worker type, but learn about it through the production process.

⁶ Alternatively, we could instead think of a representative worker who implements a project of type p for a firm. In this case, firms would still be differentiated based on project risk.

may terminate a worker at $t = 1$, which we assume comes with a (exogenous) cost $\phi > 0$ to that worker.^{7,8} The timing and payoffs of the investment are found in Figure 1.

Figure 1: **Timing and payoffs of the investment**

We assume that the investment opportunity requires an amount of funding that is normalized to 1 at both $t = 0$ and $t = 1$. In addition, we assume that the firm is essential to project implementation, i.e., the firm is the owner of the project and workers cannot raise funds on their own. Workers have an outside option (e.g., other employment) that yields (instantaneous) utility \underline{u} , which is a constraint that must be satisfied at $t = 0$. The outside option of a worker still applies at $t = 1$, but the strategy space is larger since the firm may fire the worker at a cost of ϕ to that worker. We assume a simple bargaining game: the firm makes an offer consisting of a firing decision and a wage, and the worker can accept the offer or counter-offer. If no agreement can be reached after the counter-offer, the worker is fired and bears the cost ϕ . Given this setup, we show in Section 3.3 that the firm will always terminate workers in the low state, and will not terminate workers in the high state. Let \underline{C} denote the consumption that gives utility \underline{u} such that

$$\underline{u} = -\exp(-\alpha \underline{C}). \quad (1)$$

Clearly, this problem must be solved by backward induction. Importantly, we have a model where the second period solution is straightforward. In Section 3.3, we solve the termination problem and determine workers' wages. All that we require from this problem to analyze the problem $t = 0, 1$ is the termination decision. Thus, for expositional purposes, we begin by analyzing the model at $t = 0$.

Of note, we rule out two cases that merit discussion. First, firms do not offer 2-period

⁷ Note that this cost could also be interpreted as a loss of firm specific human capital.

⁸ In practice, one might think it would be less costly for the firm to lower wages than to fire workers. As will become clear in Section 3.3, since a project in the low state pays zero at $t = 2$, a firm would not be willing to pay a worker anything. If we allow some project value in the low state at $t = 2$, then the question of whether to simply cut wages instead of terminating the worker would be present. There is an extensive literature on downward wage rigidities that supports the difficulty firms have cutting fixed wages (c.f. Bewley (1998)).

contracts wherein they commit to never firing the worker, and thus eliminate job termination risk.⁹ If this were the case, workers save ϕ but firms would incur the costs associated with keeping an unproductive worker. Since the firm is risk neutral and the worker risk averse, this seems natural. However, this is not dynamically consistent, since a worker in the low state produces nothing at $t = 2$ (shown formally in Section 3.3), and the firm does not carry over funds from $t = 0$ to $t = 1$. If, on the other hand, contracts could be written wherein the firm could legally commit to not firing a worker and funds could be carried over, then a condition on ϕ (sufficiently small) could be derived to rule out this case, and the results of the paper carry through.¹⁰ The second case that we rule out is that of the firm pre-committing to paying ϕ for the worker in the case when the worker is terminated. As with the firm pre-committing to not firing the worker, this case is also not dynamically consistent.¹¹

Since workers do not own equity in the project, they do not receive proceeds from the investment directly; instead, the firm offers a compensation contract that pays a fixed amount F at time $t = 1$, regardless of the state of the world, and an amount V when the return is r_H . We think of F as fixed wages, since they are paid regardless of the state of the world, and V as variable wages, since these are contingent on state H . Alternatively, we could define a general state-contingent payoff, and interpret the difference between the high and low states as variable pay. Our approach allows us to obtain variable pay directly. Both F and V will be solved in equilibrium as solutions to the firm's optimization problem outlined below. The utility of a worker

⁹ This is in contrast to the multi-period wage contracting studied in papers like Harris and Holmström (1982). In that model, the firm promises a downward rigid wage contract wherein workers' pay can go up over time whenever that market wage exceeds the current wage. The key difference in our paper is the termination decision, which arises from the stark production function of the firm: once in the low-state, the worker can no longer be productive and so the firm finds it optimal to terminate. On the contrary, in Harris and Holmström (1982), the firm receives a draw from a random production distribution each period, and so the firm effectively commits to never fire the worker.

¹⁰ If we were to enrich the model by adding more periods, wherein the low state workers would continue to be unproductive, then ϕ could become arbitrarily large and the firm would never commit to keep a worker in the low state since it would become increasingly expensive to do so.

¹¹ There are, however, real-world cases of firms offsetting some worker expenses. For example, Ellul et al. (2017) document that family firms are more likely to commit than non-family firms. We could allow for such pre-commitment so long as we interpret ϕ as costs that are not easily quantified and therefore not contractible.

for time $t = 1$ who invests in a project characterized by p is given by

$$p[u_1(V + F)] + (1 - p)[u_1(F - \phi)]. \quad (2)$$

The first term represents the high state of the investment, which occurs with probability p . Here the worker receives both variable and fixed wages. The second term represents the low state of the investment, where the worker receives only the fixed wage and suffers the job termination cost ϕ .

2.2 Firm Problem

We build a simple model of firm-worker relationships. One could imagine a matching process in which workers of different skills match with firms of different risks. This could create potentially interesting, but unrelated dynamics that would complicate our analysis without offering further insight into our mechanism. What is important is that workers are essential in the production process. As detailed above, firms are differentiated by the types of workers that are hired, i.e. project riskiness. A firm hires a measure 1 of workers, each with identical (and perfectly correlated) p , and raises an amount of funds normalized to 1 .¹² The firm is created at $t = 0$ and owners raise one-period (for simplicity) debt, D , where the remainder, $E \equiv 1 - D$, is provided by the owners. The firm chooses F and V so as to provide the worker with at least \underline{u} ; in the analysis to come we provide a condition under which $F \geq 0$ and $V \geq 0$ and focus our attention on this case. We assume that firms (equity holders) are risk neutral but are subject to a bankruptcy cost B , which can sensitize them to default risk. Given that equity holders are risk neutral, we assume the same for debtholders, and let the (gross) risk-free rate be r_f . In addition, we make the important assumption that debt is subsidized relative to equity. This is a standard assumption in the corporate finance and banking literature, driven by factors like tax shields or deposit insurance. To this end, from the perspective of the firm, we let the cost of debt be subsidized by a factor of η .¹³ Although we could more realistically model η as a function of the

¹² The implication of p being identical among workers within a firm is that firm and worker performance are perfectly correlated. Alternatively, we could have firms hire from the continuum of workers so that each firm has workers with projects of all levels of risk. The key in that case is to differentiate and rank firms based on the average risk of their projects. What would be required is simply a positive correlation between worker and firm performance.

¹³ In essence, we analyze the case in which debt comes with a direct subsidy. We could instead model a more traditional corporate finance tax shield, in which the firm reduces its total tax bill by the amount of the interest paid;

amount of debt, it is simplest to employ our linear form. To rule out the case where a firm could raise an infinitely large amount of subsidized debt, we assume that $\eta > 0$ whenever $D \leq \hat{D}$ and $\eta = 0$ otherwise. We also set $\hat{D} = 1$ so that the firm cannot raise more than the required investment size of \bar{I} of subsidized debt. Thus, the investment size will act as the upper bound on the amount of debt that a firm will issue. Why a firm may wish to be below that upper bound will become clear when we introduce a bankruptcy cost and analyze the wage choice.

The model features a stark setup that allows us to focus on one of two outcomes for the firm: either the firm succeeds or fails in the low state. We then explore the model within the parameter space in which the firm chooses a sufficiently low level of debt so that it does not default in the low state (and by extension, the high state as well). Thus, the required interest rate is constant (denoted r_D) for any amount of debt, while we assume that the opportunity cost of the owners, i.e., the (expected) rate of return on equity is $r_E(D)$, where $r_E(D) \geq 0$.¹⁴ Given the subsidy to debt, and using the fact that debtholders are risk neutral, the case of no bankruptcy then occurs when $D \leq \frac{r_L - F}{(1 - \eta)r_f}$, where $(1 - \eta)r_f$ is the *effective* cost of debt. To ease the analysis, we make a stark assumption on the bankruptcy cost B : it is sufficiently large such that upon default, debtholders and workers receive nothing. It is important to note that this assumption shuts down issues of seniority, since in bankruptcy, neither shareholders, debtholders, nor workers receive any payoff. In Section 5.2 we relax this assumption and consider both the case in which workers have priority and the case in which debtholders have priority.

however, the qualitative results will remain unchanged. Note that wages in general also create a tax shield; for example, Babenko and Tserlukevich (2009) show how state-contingent tax rates increase the value to the firm of stock options and the usage of riskless debt. In our model with risky debt, state-contingent taxes would further amplify the use of variable pay. As we will show, the reason for this is that using variable pay will require the firm to pay more overall to workers.

¹⁴ Since a firm contracts with workers with the same project characteristics, it is clear that firms will not share the same risk of being in the low state. As will become clear after Assumption 1, we simplify the analysis and explore the case in which the firm opts to avoid default. Thus, the interest rate on debt will be independent of p . Since equity holders are risk neutral, their required rate of return is r_f , and thus also independent of p . We can relax this to allow r_E to decrease in p with risk aversion without impacting our qualitative results.

Assumption 1 $B = r_L$

Under Assumption 1, when $D > \frac{r_L - F}{(1-\eta)r_f}$, debtholders receive no payment when the firm fails, so

the required interest rate must satisfy $pr_D + (1-p)(0) = r_f$, thus $r_D = \frac{r_f}{p} > r_f$. Similarly, equity

holders do not receive a payoff in the failed state, therefore the required (expected) rate of return to equity is constant and given by $E(r_E) = r_f$. We can now write the firm payoff (i.e., the payoff to

the equity holders over and above the equity cost of capital) when it can and cannot fail. Consider

first the case in which the firm cannot fail, $D \leq \frac{r_L - F}{(1-\eta)r_f}$. The firm's payoff for a given $\{V, F, D\}$

is given by

$$p \underbrace{\left[r_H - V - F - (1-\eta)r_f D \right]}_{\text{high state return}} + (1-p) \underbrace{\left[r_L - F - (1-\eta)r_f D \right]}_{\text{low state return}} - \underbrace{r_f(1-D)}_{\text{opportunity cost of equity}} \quad (3)$$

The first term represents the high state of the investment: r_H is earned by the firm, $V + F$ is paid to the workers, and $r_f D$ to the debtholders however, the firm receives the subsidy of $\eta r_f D$. The

second term represents the payoff when the investment is in the low state. Note that only F is paid to the workers in this case. The final term represents the opportunity cost of equity capital.

Now consider the case in which the firm goes bankrupt in the low state. The firm's payoff for a given $\{V, F, D\}$ is given by

$$p \left[r_H - V - D(1-\eta)r_D \right] - r_f(1-D). \quad (4)$$

The key difference between (3) and (4) is that when the investment return is low there is no payoff for the firm when it defaults. In addition, Assumption 1 implies that, upon default, there is nothing left for workers or debtholders. Therefore, the firm cannot offer a fixed wage since it cannot pay the wage in the low state. Thus, it is equivalent to the firm being restricted to using variable wages.

We now consider the constrained optimization problem of the firm both when it can and cannot

fail. Consider first the case in which it cannot fail, $D \leq \frac{r_L - F}{(1-\eta)r_f}$:

$$\begin{aligned}
\max_{V,F,D} \Pi &= p[r_H - V - F - (1-\eta)r_f D] + (1-p)[r_L - F - (1-\eta)r_f D] - r_f(1-D) \\
&\text{subject to } pu_1(V+F) + (1-p)u_1(F-\phi) \geq \underline{u}, \\
&\quad (\text{Profit}) \Pi \geq 0, \\
&\quad (\text{Leverage}) D \in (0,1), \\
&\quad (\text{Wages}) V, F > 0,
\end{aligned} \tag{5}$$

The first constraint represents the restriction that workers must earn at least their reservation utility; the worker participation constraint. The second constraint (Profit) is the firm participation constraint. The third (Leverage) and fourth (Wages) constraints allow us to focus on the most interesting case in which debt attains an interior solution and the firm uses both fixed and variable wages simultaneously in equilibrium.¹⁵ This will ultimately allow us to analyze how these three choice variables co-move. Given that a firm's payoff is strictly decreasing in V and F , the Kuhn-Tucker conditions imply that the worker constraint must hold with equality.

Now consider the problem when the firm fails in the low state, $D > \frac{r_L - F}{(1-\eta)r_f}$. Recall from

Assumption 1 that, upon failure, there is nothing left for workers, so although the firm could offer a fixed wage, it is equivalent to a variable wage since workers only receive it in the high state. Thus, we include only V as worker pay:

$$\begin{aligned}
\max_{V,D} \Pi &= p[r_H - V - D(1-\eta)r_f] + (1-p)[0] - r_f(1-D) \\
&\text{subject to } pu_1(V) + (1-p)u_1(-\phi) \geq \underline{u}, \\
&\quad (\text{Profit}) \Pi \geq 0, \\
&\quad (\text{Leverage}) D > 0, \\
&\quad (\text{Wages}) V > 0,
\end{aligned} \tag{6}$$

where again, $r_D = \frac{r_f}{p}$. In this case, we allow flexibility in D and do not restrict ourselves to interior solutions since in fact the solution will be on a boundary. It is straightforward to see that the non-negativity constraint $V > 0$ is redundant, since it is satisfied whenever the

¹⁵ The interpretation of $V < 0$ is that of variable pay only in the L state. In particular, the amount of variable pay in the L state is $|V^*|$ and fixed pay would be $F - |V^*|$. One interpretation of variable pay in low states is that of severance pay. However, since we are interested in the most empirically relevant case for our data, we focus on the situation in which total pay is higher in the H state, $V^* > 0$.

worker-outside-option constraint is satisfied. Since the objective function is strictly increasing in D , it follows that $D^* = 1$ (given $\eta = 0$ for $D > 1$). Problems (5) and (6) imply that the firm has two choices. First, it can choose the highest level of debt that will still maintain its solvency in all states. Alternatively, it can finance the investment exclusively with debt and face the bankruptcy cost in the low state. The following lemma summarizes these choices.

Lemma 1 *The firm either sets $D^* = \frac{r_L - F}{(1-\eta)r_f}$ and remains solvent in both states, or sets $D^* = 1$ and fails in the low state.*

The intuition behind this result is straightforward. Conditional on no bankruptcy, the firm payoff is increasing in the amount of debt. Thus, the firm chooses a debt level that just ensures it remains solvent. Conditional on bankruptcy, the firm chooses to raise funds completely with debt since it is subsidized and, by Assumption 1, bankruptcy costs do not increase in the amount of debt. Given that we are interested in analyzing how leverage relates to wages, we proceed by considering the case in which the firm chooses never to fail, i.e., $D^* = \frac{r_L - F}{(1-\eta)r_f}$. In Lemma 4, we analyze the

parameter set under which this case prevails and show that such a set is non-empty.¹⁶ Given $D^* = \frac{r_L - F}{(1-\eta)r_f}$ from Lemma 1, the firm optimization problem becomes that of (5) where the objective function simplifies to:

$$\Pi = p[r_H - V - F - (1-\eta)r_f D^*] - r_f(1-D^*). \quad (7)$$

3 Equilibrium and Comparative Statics

3.1 Without Variable Pay ($V \equiv 0$)

To begin, consider the base case in which variable pay is not possible, $V \equiv 0$. Importantly, this case is distinct from that in which the firm can choose to set $V = 0$; here we analyze the case in

¹⁶ It is important to point out that we can enrich the model to allow the firm to endogenously choose to go bankrupt with some probability. In Section 5.1, we consider project/investment with three potential states instead of two and analyze the case in which the firm chooses to fail in one of the states.

which V cannot be used. Given that p is related to a fixed wage and firm debt even in the absence of variable pay, this presentation allows us to highlight the incremental effect of our mechanism. Setting $V=0$ in (7), it is straightforward to show that the problem collapses down to the worker utility constraint. Thus, the solution for the fixed wage, denoted F_{NV}^* (where NV stands for ‘(N)o (V)ariable wage’) is given by:

$$pu_1(F_{NV}^*) + (1-p)u_1(F_{NV}^* - \phi) \geq \underline{u}. \quad (8)$$

Using the assumption that utility is exponential yields the following:

$$F_{NV}^* = \frac{\log(p + (1-p)\exp(\alpha\phi))}{\alpha} + \underline{C}. \quad (9)$$

Defining $\frac{dD}{dp}|_{NV}$ to be the change in debt due to a change in the probability of the high state in the absence of variable pay, the following lemma summarizes two key comparative statics:

Lemma 2 (i) $\frac{dF_{NV}^*}{dp} < 0$ and (ii) $\frac{dD}{dp}|_{NV} > 0$.

Proof. See Appendix.

The intuition behind this result is straightforward. As the probability that a worker is terminated decreases (p increases), the worker bears less risk and so requires less compensation, which in this case can only come from fixed wages. Since Lemma 1 showed $D^* = \frac{r_L - F}{(1-\eta)r_f}$, the second part of Lemma 2 follows easily.

3.2 With Variable Pay

With variable pay, we consider the problem (5) given D^* , but exclude the non-negativity constraints (to be enforced in Lemma 3). After obtaining the first-order conditions, we have the following solutions:

$$V^* = \frac{\log\left(\frac{1-p(1-\eta)}{(1-\eta)\exp(\alpha\phi)(1-p)}\right)}{\alpha}, \quad (10)$$

$$F^* = \frac{\log\left(\frac{(1-p)}{1-p(1-\eta)}\right)}{\alpha} + \phi + \underline{C}. \quad (11)$$

We now restrict the parameter space to implement the Profit, Leverage, and Wage constraints in the problem outlined in (7). The following result derives the necessary and sufficient conditions under which $\Pi \geq 0$, $D^* \in (0,1)$, $V^* > 0$, $F^* > 0$, and shows that parameters exist such that all of these conditions are satisfied simultaneously.

Lemma 3

1. (Profit) If $r_H \geq V^* + r_L + \frac{r_f}{p} \left(1 - \frac{r_L - F^*}{r_f(1-\eta)}\right)$, then $\Pi \geq 0$, where V^* and F^* are defined by (10) and (11).
2. (Leverage) If $(1-\eta)r_f > r_L - F^* > 0$, then $D^* \in (0,1)$, where F^* is defined by (11).
3. (Wages) If $\frac{1-p(1-\eta)}{(1-p)(1-\eta)} > \exp(\alpha\phi) > \frac{1-p(1-\eta)}{(1-p)\exp(\alpha\underline{C})}$, then $V^* > 0$ and $F^* > 0$.

There exist parameters under which these conditions hold simultaneously.

Proof. See Appendix.

We wish to gain a deeper understanding of the third constraint (Wages). Consider that, when the cost of job termination (ϕ) is high, fixed pay is favored since it hedges the state in which the worker is terminated. Alternatively, when the cost of job termination is low, the firm favors variable pay. It is this second case that is most interesting, since in standard non-agency models of worker compensation, having a risk-neutral firm and a risk-averse worker implies that the worker will receive full insurance through a fixed wage (Laffont and Martimort (2002)). To understand how variable pay can be optimal in our setting without a worker agency problem, we re-arrange the condition under which $V^* > 0$ (the left hand inequality of the third constraint (Wages)):

$$\eta > \frac{(1-p)(\exp(\alpha\phi) - 1)}{\exp(\alpha\phi)(1-p) + p}. \quad (12)$$

As the subsidy to debt (η) increases, variable pay becomes more attractive. In other words, it is the

capital structure decision of the firm that allows variable pay to be optimal. The results that follow help us understand why: the flexibility of variable pay allows the firm to carry more financial debt (without incurring potential bankruptcy costs), which, if sufficiently subsidized, is desirable. In other words, comparing the case in which variable pay is not possible relative to the case in which it is, (12) implies that $V^* > 0$ so that $F^* < F_{NV}^*$.¹⁷ Since $D^* = \frac{r_L - F}{(1 - \eta)r_f}$ both with and without variable pay, it is clear that the firm takes on more debt with variable pay.

Given V^* and F^* defined in (10) and (11), we can provide a simple condition under which the firm always chooses a level of debt such that it never defaults. Although we have assumed that bankruptcy costs are large, it turns out that it is possible that for a given level of debt subsidization (η), the firm may choose to finance the project entirely with debt, and so fail in the low state. The reason is that debtholders are risk neutral, and thus the firm simply needs to compensate them for their expected loss due to bankruptcy $((1 - p)r_f)$. On the other hand, if the firm uses all debt and η is sufficiently high, the overall effective payment to debtholders may be lower. This of course neglects an important party that must be compensated if the firm fails: workers. Workers cannot receive a fixed wage since there is nothing left to pay them if the firm fails. Thus, we can ensure the firm never wishes to default if workers demand a sufficient premium to take on default risk, relative to the case of no default, where they can be paid a fixed wage. The following lemma summarizes this result.

Lemma 4 *There exists a \hat{C} such that for any $\underline{C} \geq \hat{C}$, the firm chooses never to default. For $\underline{C} \geq \hat{C}$, there exist parameters for which all three conditions of Lemma 3 are satisfied.*

Proof. See Appendix.

¹⁷ If the restriction that $V^* > 0$ were not implemented, the (Wages) condition shows that the two key parameters are α and ϕ . Imagine the unrestricted equilibrium supports $V^* = 0$ for some $\phi = \hat{\phi}$. Now consider $\phi > \hat{\phi}$ and α remains unchanged. The only way to offset the increased cost is to increase F . However, to break even, the firm must simultaneously set $V < 0$. Similar intuition holds for α .

This result can be looked at as similar to that of Berk et al. (2010) in which the firm explicitly considers worker risk aversion in the capital structure decision. It is important to point out that the preceding lemma is merely a sufficient but not necessary condition to ensure that the firm never defaults. In fact, when $\underline{c} < \hat{c}$, there still exists values for η such that the firm chooses never to default. If the firm can fail, it chooses to only use debt to raise the required funds. Although this case exists, for what remains we wish to consider the case in which $\underline{c} \geq \hat{c}$ so that the firm has a meaningful choice of debt. We make the following assumption on the parameter space to ensure this case prevails:

Assumption 2 $\underline{c} \geq \hat{c}$, conditions (i) and (ii) of Lemma 3 are satisfied.

We can now determine how variable pay changes with the risk of job termination.

Proposition 1 Variable pay (Fixed pay) is decreasing (increasing) in the probability of job termination. Fixed pay increases faster in job termination than the case in which $V \equiv 0$.

Proof. See Appendix.

The intuition behind the result comes from worker risk aversion. When variable pay is not possible ($V \equiv 0$), only fixed pay can be used. When the probability of job termination increases, a worker must be paid more to compensate, and thus, fixed pay increases (part (i) of Lemma 2). When variable pay is allowed, it acts as a substitute for fixed pay. When the probability of job termination increases, risk aversion of the worker implies that the firm must respond by decreasing variable pay and increasing fixed pay. In addition to fixed pay increasing in response to variable pay decreasing, fixed pay must also increase because the probability of job termination has increased (as in the case in which $V \equiv 0$). Thus, fixed pay increases faster when variable pay is considered.

Prior to analyzing the relationship of employment risk to leverage, it is instructive to consider the relationship between leverage and variable pay.

Lemma 5 Debt is negatively correlated with the amount of fixed pay, and positively correlated with the amount of variable pay:

Proof. See Appendix.

Importantly, this result is needed for our main proposition to come; it is a result on pairwise correlations that would be somewhat misleading if one were to try to take it directly to the data. The reason for this is that in the model, debt is a direct function of fixed pay, but only indirectly affected by variable pay. We show this result by analyzing the relationship between the variables exogenous to debt, fixed pay, and variable pay. In each case, when a relationship exists, the sign of the derivative is the opposite for debt versus that of fixed pay, and the same for debt versus that of variable pay. To understand this result consider the bankruptcy costs of debt, and the fact that debt is subsidized relative to equity. Given these features, the firm wishes to maximize debt while avoiding bankruptcy. Fixed pay is essentially debt on the operating side of the firm. The more fixed pay that the firm uses, the less financial debt that it can sustain. Thus, if the relative amount of fixed pay exogenously decreases, the firm can take on more financial debt. If the amount of variable pay exogenously increases, then debt increases due to a corresponding decrease in F . This result is consistent with the leverage-tradeoff hypothesis (Van Horne (1977), with empirical support found in Mandelker and Rhee (1984)) wherein operating and financial leverage are substitutes. The result can also be used to explore the relationship between the cost of job termination (ϕ), and leverage. In the proof to Lemma 5 we show that as ϕ increases, variable pay decreases, fixed pay increases, and so leverage decreases. This is consistent with Agrawal and Matsa (2013), who show empirically that as the cost of workers being terminated decreases, firms increase financial leverage.

From part (ii) of Lemma 2, it is clear that even absent variable pay, p is related to leverage. Importantly, variable pay and fixed pay act as substitutes, so the relationship between employment risk and leverage is more complex in the presence of variable pay. We can now explore the incremental (and overall) implications of our model for leverage.

Proposition 2 (i) leverage is decreasing in the risk of job termination. (ii) The existence of variable wages amplifies the effect of job termination on leverage.

Proof. See Appendix.

The intuition behind this result comes from Proposition 1 and Lemma 5. A higher

probability of job termination means more fixed pay and less variable pay. The more fixed pay that is used, the less debt a firm can employ. The second part of the proposition represents a comparison of the case in which $V \equiv 0$, relative to the case where variable pay can be used. Part (i) of Lemma 2 shows that without variable pay, leverage is also decreasing in the risk of job termination. However, we show that the existence of variable pay makes the relationship between leverage and risk of job termination even stronger. This is because variable and fixed pay are substitutes. As in Proposition 1, an increase in the probability of job termination causes a decrease in variable pay, and thus fixed pay increases in response. Since the probability of job termination is perfectly correlated with the firm project risk, it follows that firms with riskier projects will have lower debt. This should not be too surprising. What is noteworthy is that operating leverage actually goes up when project risk goes up. It is worthwhile defining overall leverage (OL) as being the amount of fixed pay and interest payments that a firm has, relative to the payoff in the low state:

$$OL = \frac{r_f(1-\eta)D + F}{r_L}. \quad (13)$$

Plugging D^* into (13) yields the result that overall leverage is constant and equal to 1. This follows from the fact that all firms choose the amount of debt such that they do not default. This better illuminates the mechanism behind Proposition 2: when project risk increases, the firm increases operating leverage and, as a result, must decrease financial leverage to offset the effect that this would otherwise have on overall leverage.

3.3 The Optimal Decision at $t = 1$

The firm's decision between $t = 1$ and $t = 2$ differs based on whether the workers' investment is in the high or low state. Recall that we assumed workers are essential, i.e., the firm must continue to employ workers to realize any payoff at $t = 2$. Define V_H^2 (F_H^2) as variable (fixed) wage at time $t = 2$ if the state is H , the return on debt is the same as at $t = 0$, $(1-\eta)r_f$, and the required return on equity is as at $t = 0$, r_f . If the investment is in the high state, then it returns r_H with certainty. A firm has an option to terminate workers, even in the high state. Recall the simple structure of the bargaining game: first the firm makes an offer consisting of a termination decision and a wage. A worker can then make a counter-offer. The following lemma

details the equilibrium:

Lemma 6 *In the low state, the worker is terminated; in the high state, the worker is not terminated and is paid the outside option \underline{C} .*

To understand this result, first consider the project in the low state. Since there is no continuation value for the project, the firm will have no resources to pay the worker, so it cannot offer any positive wage and break even. Thus, the worker is terminated.¹⁸ In the high state it is straightforward to see that a worker should only be terminated if the worker demands $C > \underline{C}$, since \underline{C} is all that needs to be offered to an outside worker. Now consider a worker having received an offer $C < \underline{C}$. It is optimal to submit a counter-offer \underline{C} since the firm is indifferent between accepting and rejecting (where we assume acceptance, otherwise one can imagine the worker offering $\underline{C} - \epsilon$ for ϵ small). Thus, the equilibrium in the first round is for the firm to offer, in utility terms, $[u(0), u(\underline{C})]$ with any termination decision, and the outcome is decided based on the second-round offer, $u(\underline{C})$, and the worker is not terminated.

Given $\eta > 0$, the firm optimally sets the amount of debt to 1 since it cannot go bankrupt.¹⁹

The firm problem becomes

$$\max_{V_H^2, F_H^2} r_H - V_H^2 - F_H^2 - (1 - \eta)r_f \quad \text{subject to: } u_2(V_H^2 + F_H^2) \geq u(\underline{C}). \quad (14)$$

It is straightforward to show that the choice between fixed and variable pay is irrelevant since variable pay is not actually variable given there is no project risk from $t = 1$ to $t = 2$. Thus, the solution is simply given by the firm paying the worker consumption $C_2 = \underline{C}$ with certainty.

It is important to recognize that the wage at $t = 1$ is set in isolation of the problem at

¹⁸ Note that a worker still receives the outside option when terminated, just not from the firm in question.

¹⁹ It is simplest to assume (as we do) that profits earned between $t = 0$ and $t = 1$ are paid out as a dividend at $t = 1$, so we do not have to consider them when analyzing the decision at $t = 1$. Given $\eta > 0$, clearly is optimal. Note that as in the $t = 0$ problem, we assume that r_H is sufficiently large that the firm is solvent in the high state. Given that the amount of debt is normalized to 1, the condition under which this is true is $r_H > V_H^2 + F_H^2 + (1 - \eta)r_f > 0$, where the fixed and variable pay are given as the solution to (14).

$t = 0$. Therefore, the only information we require from the problem at $t = 1$ to solve the problem at $t = 0$ is found in Lemma 6, namely, that workers will be terminated in the low state at $t = 1$, and not terminated in the high state at $t = 1$. Thus, if we relaxed the assumption that the worker does not discount utility over time, it will not affect the solution at $t = 0$.

4 Empirical Implications

Our theoretical model produces two key predictions: leverage is negatively correlated with the probability of job separation, and variable pay is negatively correlated with the probability of job separation. With the right data set one can test these predictions: one needs firm-level data on variable wages and leverage to test correlations, but to test causation one needs exogenous changes in job separation across firms. In this section we introduce a data set that allows us to examine the correlation between job termination risk, wage composition, and leverage.

4.1 Data

The data set we rely on to examine the model predictions is a complete proprietary panel of investment brokers and dealers in Canada from January 1992 to December 2010. This includes banks as well as large and small institutional and retail investors. Regulatory financial reports are collected by the Investment Industry Regulatory Organization of Canada (IIROC). IIROC oversees investment dealer activity in Canadian debt and equity markets as well as personal and wholesale investing. Income and balance sheet data are reported monthly, although we aggregate annually given that compensation is annual.²⁰

Table 1 presents summary statistics on the cross-section of firms for the main variables of interest. Since few firms are publicly traded, we measure leverage as book value of liabilities over assets. In addition, we introduce a second measure of leverage that incorporates subordinated debt. Broker-dealers have two types of subordinated debt on their balance sheet: subordinated loans

²⁰The blank report schedules are here: http://www.iiroc.ca/Rulebook/MemberRules/Form1_en.pdf. IIROC's membership grew from 119 in 1992 to 201 by 2010 but also experienced exits and several mergers. We drop firms that appear for fewer than 5 years and keep track of all mergers. Many small firms first start off trading only mutual funds and therefore MFDA members and not IIROC members. In order to trade securities, they join IIROC. However, after several years they terminate their IIROC membership, either returning to trading only mutual funds with their MFDA membership or succumbing to failure. We do not observe the reason for exit.

within the industry and subordinated loans from non-industry investors. We treat the latter as debt and the former as equity given that it is often from the parent and therefore closer to equity than debt.²¹ Our results are qualitatively similar when non-industry-subordinated debt is included. The average broker-dealer leverage is around 63%, while median leverage is 72%. The 90th-percentile firm leverage is 94%. Leverage as we define it is slightly lower, on average, in our sample relative to what is reported for the U.S. in Gornall and Strebulaev (2013). This likely stems from the substantial heterogeneity in our sample of broker-dealers relative to the typical set of bank holding companies studied in the literature. More than two-thirds of the broker-dealers with leverage below 50 are small retail firms.

Table 1: **Summary statistics**

The sample is from 1992 to 2010 and on average comprises 178 firms. We present the mean, standard deviation, 10th, 50th, and 90th percentile after collapsing the data in the cross-section. **L** is total liabilities and **A** is total assets. **SD** is subordinated debt. **VW** is contractual variable wage, and **Bonus** is purely discretionary bonuses. Total wages are denoted **TW**, and total variable wages denoted **TVW**. Fixed wages are denoted **FW**. ROA is return on assets. I(dividend) is an indicator variable equal to 1 if the firm issued a dividend and 0 otherwise. I(trading income) is an indicator variable equal to 1 if a bank generated trading revenue. Non-allowable assets are those assets deemed illiquid by IROC. All dollar amounts are in 2002 CAD.

Variables	mean	std. dev.	Percentiles		
			p10	p50	p90
Leverage ((L+SD)/A)	0.63	0.29	0.17	0.72	0.94
Leverage (L/A)	0.60	0.29	0.15	0.69	0.92
Job termination (%)	20.30	17.27	0	17.65	42.86

²¹ To prevent dealers from taking out subordinated debt and simply depositing unused funds at the provider of the debt, IROC introduced a provider of capital concentration charge in January 2000. Standby subordinated loans for the most part found their way into subordinated loans from industry investors, where "Industry Investors" refer to individuals who own a beneficial interest in an investment in the Dealer Member or holding company (of the Dealer Member) (IROC, accessed 2011). By analyzing the capital charges, we determined that within-industry subordinated loans are almost exclusively from the parent.

Bonus/TW (%)	14	18	0	6	44
VW/TW (%)	39	28	0	45	73
Fixed wage/employee (\$)	83,529	89,537	26,490	59,321	169,663
Bonus/employee (\$)	52,882	129,786	0	8,468	165,618
VW/employee (\$)	69,413	74,280	0	57,957	15,4274
TVW/employee (\$)	122,296	163,344	12,202	84,154	231,906
Number of employees	223	638	6	34	388
ROA	5.5	20.6	-3.1	1.8	14.2
Revenue/employee (\$)	471,140	1,299,080	118,110	233,600	823,100
Profits/employee (\$)	132,472	874,086	-6,118	15,451	127,262
Revenue/assets	0.89	1.06	.07	0.40	2.41
I(dividend) (%)	30	32			
I(trading income) (%)	81	34			
Non-allowable assets/assets (%)	11	14	1	6	26

Our measure of job termination is firm-specific and meant to capture employment uncertainty. A firm is given a 1 if it laid off at least 5% of its workforce between two years and 0 otherwise. We generate a firm-specific turnover rate by averaging over the ones and zeros. The average turnover rate is about 20% and there is substantial heterogeneity across firms. The interpretation of our variable is firm-level expected job risk.²²

Wages are decomposed into three segments.²³ First, there are discretionary bonuses (Bonus), which is self-explanatory, but also includes dividends to employees. Second, variable compensation (VW) includes all other bonuses, such as commissions and other bonuses of a contractual nature. These are payouts only to registered representatives and institutional and

²² Note that we cannot separately identify firing from voluntary departures. Job termination in banking might be considered involuntary because of the prevalence of no-compete clauses and because bonuses are often deferred, which can lead to large switching costs (Morris and Wilhelm (2007)) and reduce turnover (Aldatmaz et al. (2014)).

²³ Wages are based on average wages for all broker-dealers in the firm, irrespective of hierarchy. Efung et al. (2014) do not find that the correlation between variable pay and trading volume/volatility is overly sensitive to whether or not wages are equally weighted or weighted by hierarchy within their set of European banks. This provides some assurance that our approach is a reasonable approximation to capture the cross-section heterogeneity in firms' wages.

professional trading personnel. Importantly, the theoretical model relates leverage and job separation to variable pay, and therefore we need variable pay to be correctly measured. We also include a measure of fixed wages, taken as a fixed proportion of operating expenses.²⁴

Total wages is the sum of its three components. In 2002 Canadian dollars, the average fixed wage per employee is approximately \$83,529. Discretionary bonuses are on average \$52,882 per employee. However, about 10% of firms never pay a discretionary bonus. Variable wages are on average \$69,413 per employee and, similar to discretionary bonuses, about 10% of firms do not pay variable wages. Interestingly, these are not necessarily the same 10% as those that do not pay discretionary bonuses. Firms that do not pay discretionary bonuses tend to be small retail firms. Firms that pay little to no contractual bonuses tend to be an equal mix of small retail firms and large institutional firms.

The average return on assets is an impressive 5.5%, but with substantial variation (median of 1.8). The ROA for the broker-dealers in this sample is substantially higher than that reported for the banking sector, which is closer to 1. Given the extreme outliers that generate the large differences in the mean and median, we winsorize the data at the 1% level before estimating our econometric specifications. We also report revenue per employee and revenue per asset. The average employee generates \$471,140 per year with substantial variation across firms and time. Net profits are approximately \$132,472 per year per employee. Average net profits are higher than the 90th percentile, however, highlighting the fact that a few firms are generating very large profits compared to most firms. An average firm has 223 employees, where employee includes only registered representatives of the firm. A dollar of assets generates about 89 cents of revenue. Finally, 81% of firms are involved in trading.

4.2 Empirical Results

In this section we present evidence consistent with Propositions 1 and 2. Our empirical strategy is to compare firms with varying degrees of job termination risk and thus variable wages and leverage. The dependent variables are variable pay, fixed pay, and leverage. The explanatory

²⁴ Based on a sub-sample of 12 banks where we have access to more detailed data, we know that fixed wages represent about 50% of operating costs, while the other 50% is buildings/equipment, with very little variation across lenders. An alternative would be to re-interpret the model as fixed versus variable costs, where variable costs are bonuses and fixed costs are everything else.

variables we include are firm size, revenue-per-employee, fraction of assets that are non-allowable, an indicator variable for whether or not the firm paid dividends, and an indicator variable for whether or not the firm generated any trading income. We include size as a control because there is evidence that firms offer increasing wage profiles to loosen the effects of financial constraints (Michelacci and Quadrini (2008)). In our context, this implies smaller firms would have a larger fraction of their wage flexible relative to larger firms. We use revenue-per-employee to capture potential productivity differences across firms, and thus variation in wages coming from realized project outcomes. Thus, the correlation between variable wages and job termination will be driven by cross-sectional differences in firms' pay structures and not on a mechanical relationship between outcomes and realized wages. The dividend indicator variable potentially captures financial flexibility, while the trading indicator variable captures the fact that equity traders are more likely to be paid with variable wages than other types of broker-dealers.²⁵ The prediction from Proposition 1 is that $\beta < 0$ if the capital structure channel is relevant for the determination of variable pay:

$$y_{it} = \alpha + \beta \text{pr}(\text{job termination})_i + \gamma X_{it} + \delta_j + \epsilon_{it}, \quad (15)$$

where the explanatory variables, X , are highlighted above, and δ_j are group fixed effects meant to capture differences between institutional and retail firms. We do not include firm fixed effects since we are interested in the cross-sectional variation in job termination risk, wages, and leverage. We estimate the model using a system of seemingly unrelated regressions (SUR), but because the regressors are the same in all three equations it is equivalent to three separate OLS regressions. Table 2 presents the results. The first result is that we easily reject the null hypothesis that the residuals are independent (BP test over 360). We find that firms with high probability of job termination are less likely to use variable wages and more likely to use fixed wages. This result is consistent with Proposition 1.

In addition to the correlation between job termination risk and variable and fixed wages, we find a positive correlation between size and fixed wages. Consistent with Michelacci and Quadrini (2008), we find that larger firms tend to offer wage contracts that are skewed towards fixed wages. We also find that dividend-paying firms have high variable wages, but firms with

²⁵ Although our theory model in its current form does not address this heterogeneity, we could extend it to allow for different levels of verifiability of worker output.

illiquid assets tend to have more fixed pay. Finally, we point out that both the correlation of variable and fixed wages with revenues-per-employee is positive, although only statistically significant for fixed wages. Our interpretation is that more productive firms pay employees higher wages.

In columns (3) and (4) of Table 2 we provide evidence that is consistent with Proposition 2. Firms with higher probabilities of job termination have lower leverage. This evidence is, of course, suggestive. Given that job uncertainty is likely endogenous to firm leverage, we would need an exogenous shock to the probability of job termination, as in Simintzi et al. (2015) and Serfling (2016), in addition to our data on wages and leverage, to provide a causal link between job termination to leverage via wages. Note, finally, that the impact of employment uncertainty is in addition to the impact of size on leverage and what one might expect to be the impact of size on employment uncertainty.

Table 2: SUR estimation

The dependent variable in column (1) is log of total variable wage, defined as discretionary bonuses plus contractual bonuses. The dependent variable in column (2) is log of fixed wages. The dependent variable in column (3) is leverage defined as liabilities plus subordinated debt over assets and in column (4) the dependent variable is leverage defined as liabilities over assets. Firm size is measured by total assets. I(dividend) is an indicator equal to 1 if the firm pays out a dividend and 0 otherwise. Non-allowable assets is the fraction of a bank's assets that are illiquid. I(trading income) is an indicator variable equal to 1 if the firm generates trading income and 0 otherwise. Continuous variables are demeaned. There are on average 178 firms in the sample and therefore 1,783 observations. Standard errors are robust and clustered at the firm level. The levels of significance are *** $p < 0.01$, ** $p < 0.05$.

	log(TVW)	log(F)	(L+SD)/A	L/A
pr(job termination)	-0.535***	0.180***	-0.0430***	-0.0525***
	(0.163)	(0.0273)	(0.0112)	(0.0106)
log(size)	-0.0444	0.0406***	0.0644***	0.0653***
	(0.0276)	(0.00462)	(0.00189)	(0.00179)
Nonallowable assets	-3.970***	0.663***	-0.934***	-1.054***

	(0.543)	(0.0910)	(0.0373)	(0.0353)
log(rev/employee)	0.475***	0.712***	-0.0590***	-0.0599***
	(0.0902)	(0.0151)	(0.00620)	(0.00586)
I(dividend)	0.290**	-0.131***	-0.0207**	-0.00138
	(0.140)	(0.0234)	(0.00959)	(0.00907)
I(trading income)	1.349***	-0.154***	-0.0442***	-0.0378***
	(0.183)	(0.0307)	(0.0126)	(0.0119)
Constant	4.738***	1.488***	0.415***	0.390***
	(1.022)	(0.171)	(0.0702)	(0.0664)
R^2	0.08	0.65	0.61	0.67
Breusch-Pagan test			362	368
pvalue			[0.000]	[0.000]

5 Robustness

5.1 Positive Probability of Bankruptcy

We modify the model to show that, in equilibrium, the firm can have a positive probability of bankruptcy. To accomplish this in a simple way, we add one new element to the model. In addition to the H and L states at time $t=1$, we add a state M . Let the probability that state H occurs be p_H , the probability of state L be p_L , and, consequently, the probability of state M , p_M , is $1 - p_H - p_L$. Let the return in state M be r_M where $r_H > r_M > r_L$. The goal of this section is to show that the subsidy to debt can be high enough that the firm wishes to default with positive probability, but not too high that they wish to default any time a low state is realized. To keep the analysis as close to the base model as possible, let $B = r_M$. The firm offers a compensation contract that promises to pay F in all states, and V only in state H . As before, let r_D represent the interest rate on debt without default, and r_E represent the cost of equity in that case. As in the base model, if the firm does not default, the debtholders receive the same regardless of the probabilities of the states, thus r_D is constant. If a firm chooses not to default on

debt in any state, the subsidy to debt implies that it sets $D = \frac{r_L - F}{r_f(1-\eta)}$, and the firm payoff for a given $\{V, F\}$ is:

$$p_H(r_H - V - r_L) + p_M(1-p)(r_M - r_L) - r_E \left(1 - \frac{r_L - F}{r_f(1-\eta)} \right). \quad (16)$$

Next, consider the case in which the firm defaults on the debt only in state L . Let $r_D \geq r_D$ ($E(r_E) = r_f$) be the interest rate (cost of equity) in the presence of bankruptcy costs B with failure only in state L . Given $B = r_M$, debtholders receive nothing upon default. Additionally, debtholders receive the same when the firm does not fail, regardless of the probability, thus r_D is given by the solution to $p_H r_D + (1 - p_H + p_L) r_D = r_f$:

$$r_D = \frac{r_f}{1 - p_L}. \quad (17)$$

Given that debt is subsidized, the firm sets $D = \frac{r_M - F}{r_D(1-\eta)}$ so as to remain solvent in state M . The firm's payoff for a given $\{V, F\}$ is

$$p_H(r_H - V - r_M) - r_E \left(1 - \frac{r_M - F}{r_D(1-\eta)} \right). \quad (18)$$

Finally, the firm may default on its debt in both states M and L . Define $r_D \geq r_D$ as the cost of debt, given that the firm defaults in states M and L , where r_D is given by:

$$r_D = \frac{r_f}{p_H}. \quad (19)$$

In this case, the firm sets $D = 1$. The firm's payoff for a given $\{V, F\}$ is

$$p_H(r_H - V - F - r_D(1-\eta)). \quad (20)$$

The following result shows that (18) can yield the highest payoff for a firm.

Lemma 7 *There exist parameters such that a firm with workers characterized by project risks*

defined by p_H , p_M , and p_L sets debt equal to $\frac{r_M - F}{r_D(1-\eta)}$ and defaults with probability p_L .

Proof. See Appendix.

The intuition behind this result is that a firm chooses to default in state L because the benefits of using more debt (i.e., the subsidy to debt) outweighs the bankruptcy costs associated with failure. Conversely, the firm chooses not to default on the debt in state M because the cost of bankruptcy in that state outweighs the benefit of increased debt. To show that the results of the paper do not change when a firm can go bankrupt, we are left with defining a worker's problem. Importantly, we need to consider time $t = 2$. When the return to the project is zero at $t = 2$ in both states M and L , then the problem is identical to the base model, where $1 - p$ is replaced by $1 - p_H$. Thus, all the results remain unchanged. Conversely, if in state M there is a sufficient return at $t = 2$ so that the worker is not terminated (i.e., the return is sufficiently high such that it is optimal to pay workers their outside option), then the worker problem, which constitutes the constraint in (7), involves another distinct term. Consequently, the new V^* and F^* are slightly altered; however, they share the same properties as before and, consequently, the results of the paper still hold.

5.2 Bankruptcy Cost

Assumption 1 ($B = r_L$) is stark; in reality, bankruptcy costs are not usually sufficiently high to wipe out workers and debtholders. There has been an extensive literature that tries to estimate firm bankruptcy costs. Recently, Glover (2016) estimates that expected (realized) bankruptcy costs are 45(25)% of firm value. We consider the case in which $B < r_L$ so that workers or debtholders may recover some value in bankruptcy. In this case the order or priority between worker wages and debtholder claims is important. Although the case of worker seniority is most common, ellul/pagano:17 report that there is substantial heterogeneity between countries. For example, the seniority of employee, relative to other creditor claims is higher in countries such as France compared to countries like Germany, where worker claims are the most junior. Consider first the case of worker seniority.

5.2.1 Worker Seniority

When workers are senior to debtholders, the latter cannot receive any payment until the

former have been fully paid. In the main part of the paper, the assumption that bankruptcy costs were high meant that a firm, which chooses a level of debt so as to remove the possibility of bankruptcy, would do so for two reasons. First, if the firm defaults in the low state, it must compensate the (risk-neutral) debtholders for the risk of bankruptcy, wherein there would be no recovery value. Second, the firm must compensate the (risk-averse) workers for the risk of bankruptcy wherein they do not receive any wages. Relaxing the assumption on bankruptcy costs, consider the case in which $r_L - F^* - B \geq 0$, where F^* is given by (11). In this case, workers bear no bankruptcy risk since they are always paid. Thus, a worker's problem remains unchanged from the base model under which the firm cannot fail. We wish to show that all of the results from the base model can still hold. Given the subsidization to debt, the two potential choices for the firm are

identical to the base model. The firm chooses $D^* = \frac{r_L - F^*}{(1-\eta)r_f}$ and always remains solvent, or sets

$D^* = 1$ and remains solvent only in the high state, where the key difference now is that there is a recovery value of $r_L - F^* - B$ to the debtholders in the low state. Define π_{ND} as the payoff to the

firm when it cannot default and $D_{ND} = \frac{r_L - F^*}{(1-\eta)r_f}$ as the corresponding debt level:

$$\pi_{ND} = p(r_H - V^* - F^* - (1-\eta)r_f D_{ND}) + (1-p)(r_L - F_{ND} - (1-\eta)r_f D_{ND}) - r_f(1 - D_{ND}). \quad (21)$$

With default in the low state, define $D_{Def} = 1$, and the corresponding payoff denoted π_{Def} . Since workers are always paid, even in default, V^* and F^* are the same as in (21). Consequently,

$$\pi_{Def} = p(r_H - F^* - V^* - (1-\eta)r_D D_{Def}) - r_f(1 - D_{Def}), \quad (22)$$

where r_D represents the promised rate of return on debt. Given risk neutrality of the debtholders, such a rate must satisfy: $pr_D + (1-p)(r_L - F^* - B) = r_f$ and so is given by:

$$r_D = \frac{r_f}{p} - \frac{1-p}{p}(r_L - F^* - B). \quad (23)$$

Plugging in values for D_{ND} , D_{Def} , and r_D yields the following condition under which the firm chooses to remain solvent in all states $\pi_{ND} - \pi_{Def} \geq 0$:

$$(r_L - F^*) \left(\frac{1}{1-\eta} - p \right) - \eta r_f - (1-p)(1-\eta)(r_L - F^* - B) \geq 0. \quad (24)$$

A trivial numerical example can be used to show that parameters exist which satisfy this inequality; we omit this for brevity. We can now consider the case in which $r_L - F^* - B < 0$. In this case workers bear bankruptcy risk, and there is no recovery value for debtholders in default. When the firm chooses the debt level such that they do not default in the low state, this case becomes identical to the case in which $r_L - F^* - B \geq 0$ above, thus π_{ND} is as defined above. The payoff to the firm if it sets $D^* = 1$ (and defaults in the low state) is necessarily less in this case than in the case in which $r_L - F^* - B \geq 0$. The reason for this is two-fold. First, debtholders demand a higher promised payment because they know they will receive nothing in bankruptcy. Second, workers will require more pay overall due to risk aversion since they know they will not be paid fully when the firm is insolvent. Thus, it is straightforward to show that the parameter set here, under which the equilibrium exists, is larger here than the case in which $r_L - F^* - B \geq 0$. Interestingly, because of worker risk aversion, we can allow B to become arbitrarily small and still obtain parameters under which the equilibrium exists. The proof is similar to that of Lemma 4, where now the worker can receive some pay in the default state (and such pay is a function of B). The intuition behind this result comes from the worker's problem. If a worker is subjected to bankruptcy risk, i.e., risk that wages owed to them will not be paid, they require higher pay in the high state. The higher the worker risk aversion is, the more they will require in compensation to bear the risk of bankruptcy. In other words, the reason for the firm choosing to avoid bankruptcy need not come from bankruptcy costs at all. For brevity, we will not formalize this result here.

5.2.2 Debtholder Seniority

With debtholder seniority, the workers bear the risk of default first. This case turns out to be analogous to the case in which the worker has priority and $r_L - F^* - B < 0$. In both cases, the worker's wages are subjected to default risk; however, now the debtholder payoff is simply higher in the default state, while the worker payoff is lower. As in the case of worker priority in which $r_L - F^* - B < 0$, one can then show that due to worker risk aversion (and the fact that debtholders are risk neutral), the equilibrium can exist, even as $B \rightarrow 0$.

6 Conclusion

We provide a model that links worker employment risk, pay structure, and firm capital structure. Firms use variable pay to lower operating leverage in order to increase the amount of subsidized debt that they can take on. Even in the absence of any agency problems, variable pay arises endogenously when fixed pay would otherwise be optimal due to worker risk aversion. The probability of job termination is shown to be negatively correlated with the amount of variable pay. This represents the first empirical prediction of the model—and we find supporting evidence for our capital structure mechanism of variable pay. Our second empirical prediction is that the probability of job termination and leverage are negatively correlated. We find empirical evidence consistent with this result and show the importance of worker pay structure when considering the relationship of worker risk (which is correlated with project risk) and leverage. This suggests that, although often overlooked, pay structure throughout an organization should be considered when conducting future research into the relationship of project risk and leverage. In fact, although we modeled job termination risk because of data considerations, one could derive similar results where the risk to the worker comes not as the risk of being terminated, but simply as the risk of not receiving variable pay.

In this paper we do not explicitly model stock options—another form of variable pay that can relax a borrower’s total leverage constraint (Babenko and Tserlukevich (2009)). Although stock options may be relegated to management in many organizations, there are firms that also pay workers such options. In the context of our model, if stock options are granted ex ante with an exercise price such that they pay off in the H state but not in the L state, then the results will be qualitatively similar to what we have presented. If stock options are granted ex post, then we would need to consider additional periods to capture how the option value evolves.

Another interesting direction that introduces wage flexibility are hourly wages. One could imagine a model wherein the variable pay that we consider is used ex ante in the presence of uncertainty, whereas hourly wages are used ex post in response to a bad outcome (the firm can make do with less labor input). One could also imagine the firm pre-committing to job stability; namely, some firms may be quicker to terminate workers based on similar conditions than others. All these forms of flexibility could interact with one another in potentially interesting ways.

7 Appendix

Proof of Lemma 2

Part (i). Taking $\frac{dF_{NV}^*}{dp}$ yields:

$$\frac{dF_{NV}^*}{dp} = \frac{1 - \exp(\phi)}{\alpha(p + (1-p)\exp(\phi))} < 0, \quad (25)$$

which holds since $\exp(\phi) > 1$. Since $D^* = \frac{r_L - F}{(1-\eta)r_f}$, $\frac{dF_{NV}^*}{dp} < 0$ implies part (ii). ■

Proof of Lemma 3

Condition 1. (Profit) is derived by substituting $D^* = \frac{r_L - F}{(1-\eta)r_f}$ into the objective function (7), and

showing when it's weakly positive. Condition 2. (Leverage) is obtained by restricting

$D^* = \frac{r_L - F}{(1-\eta)r_f}$ to be in the interior, i.e., between zero and one. Condition 3. (Wages) is obtained

by setting (10) and (11) greater than zero. To show that parameters exist satisfying all three conditions, we use the following parameterizations: let $\phi \rightarrow 0$ so that $\exp(\alpha\phi) \rightarrow 1$. Next, let

$r_L = F^* + \epsilon$ for ϵ small and positive. Given these, the left hand inequality of condition 3. (Wages)

is satisfied since $\frac{1-p(1-\eta)}{(1-p)(1-\eta)} = \frac{1-p(1-\eta)}{1-p(1-\eta)-\eta} > 1$. The right hand inequality condition 3.

(Wages) is then satisfied whenever:

$$\exp(\alpha\underline{C}) \geq \frac{1-p(1-\eta)}{(1-p)}, \quad (26)$$

where the right hand side of (26) is finite. Thus, there exists a \underline{C} sufficiently large such that (26)

is satisfied. Now consider condition 2. (Leverage). Since $r_L = F^* + \epsilon$, the right hand and left hand

inequalities are satisfied. Finally, noting that (10) and (11) are finite whenever $\alpha \neq 0$, it follows

that the right hand side of condition 1 must be finite whenever $\alpha \neq 0$. Since the right hand side of

condition 1. (Profit) is independent of r_H (and \underline{C}), r_H can be chosen sufficiently large to

ensure that the profit condition holds. ■

Proof of Lemma 4

Define $V_{ND} = V^*$ as the variable wage when the firm does not default as given in (10), and

$F_{ND} = F^*$ as the fixed wage when the firm does not default as given in (11). When the firm defaults, Assumption 1 implies that workers receive nothing, therefore, only variable pay is possible. Given \underline{C} , define V_{Def} as the variable wage which must satisfy:

$$-p \exp(-\alpha V_{Def}) - (1-p) \exp(\alpha \phi) = -\exp(-\alpha \underline{C}). \quad (27)$$

Solving for V_{Def} yields:

$$V_{Def} = \frac{-\log\left(\frac{\exp(-\alpha \underline{C}) - (1-p) \exp(\alpha \phi)}{p}\right)}{\alpha}. \quad (28)$$

With no default, $D_{ND} = \frac{r_L - F_{ND}}{r_f(1-\eta)}$, and the corresponding payoff denoted π_{ND} is given by:

$$\pi_{ND} = p(r_H - V_{ND} - F_{ND} - (1-\eta)r_f D_{ND}) + (1-p)(r_L - F_{ND} - (1-\eta)r_f D_{ND}) - r_f(1 - D_{ND})$$

With default in state L , $D_{Def} = 1$, and the corresponding payoff denoted π_D is given by (recall that in default, equity holders clearly cannot receive anything since debtholders and workers do not receive anything due to Assumption 1):

$$\pi_{Def} = p(r_H - V_{Def} - (1-\eta)r_D D_{Def}) - r_f(1 - D_{Def}). \quad (29)$$

Using the fact that interest rate on debt is $r_D = \frac{r_f}{p}$, and plugging in D_{Def} and D_{ND} , we obtain the condition under which a firm will choose not to default, $\pi_{ND} - \pi_{Def} \geq 0$.

$$p(V_{Def} - V_{ND} - F_{ND}) + (r_L - F_{ND})\left(\frac{1}{1-\eta} - p\right) - r_f \eta \geq 0. \quad (30)$$

The second term is positive since $1-\eta < 1$ and $p < 1$, while the third term is negative. To obtain a sufficient condition for the above to be satisfied, we plug in for V_{def} , V_{ND} and F_{ND} and simplify what is in the brackets in the first term.

$$V_{Def} - V_{ND} - F_{ND} = \log((1-\eta)(1-p)) + \phi + \underline{C}. \quad (31)$$

The first term on the right hand side is negative since $(1-\eta)(1-p) < 1$. Clearly, the right hand side can be made as large and positive as we want by choosing \underline{C} sufficiently large. Thus there must exist a \hat{C} such that, for any $\underline{C} \geq \hat{C}$, (30) is satisfied. From (26), it follows that \underline{C} can be chosen sufficiently large so that all three conditions of Lemma 3 are satisfied. ■

Proof of Proposition 1

$$\frac{dF^*}{dp} = -\frac{\eta}{\alpha(1-p)(1-p(1-\eta))} < 0,$$

where the inequality follows since $\eta > 0$. The same inequality implies:

$$\frac{dV^*}{dp} = \frac{\eta}{\alpha(1-p)(1-p(1-\eta))} > 0.$$

We can now expand and simplify the condition under which fixed pay decreases faster with variable pay versus the case when variable pay is not allowed: $-\frac{dF^*}{dp} > -\frac{dF_{NV}^*}{dp}$, where $\frac{dF_{NV}^*}{dp}$ is given in (25). Expanding and simplifying this condition yields:

$$\exp(\phi) < \frac{\eta p}{(1-p)^2(1-\eta)} + \frac{1-p(1-\eta)}{(1-p)(1-\eta)} \quad (32)$$

By Assumption 2, condition (ii) of Lemma 3 is satisfied and so we know the following holds:

$$\exp(\phi) < \frac{1-p(1-\eta)}{(1-p)(1-\eta)}. \quad (33)$$

Therefore, (32) must hold since $\frac{\eta p}{(1-p)^2(1-\eta)} > 0$. ■

Proof of Lemma 5

We consider how F^* , V^* , and D^* change with all parameters. $\frac{dV^*}{d\phi} = -1 < 0$, $\frac{dF^*}{d\phi} = 1 > 0$,

$\frac{dD^*}{d\phi} = -\frac{dF^*}{d\phi} \left(\frac{1}{r_f(1-\eta)} \right) < 0$. It is straightforward to show that $\frac{dV^*}{d\eta} > 0$, $\frac{dF^*}{d\eta} < 0$. $\frac{dD^*}{d\eta}$ yields:

$$\frac{dD^*}{d\eta} = \frac{-\frac{dF^*}{d\eta}}{r_f(1-\eta)} + \frac{(r_L - F)r_f}{(r_f(1-\eta))^2} > 0. \quad (34)$$

The proof to Proposition 1 shows that $\frac{dF^*}{dp} < 0$, and $\frac{dV^*}{dp} > 0$. Since $D^* = \frac{r_L - F^*}{r_f(1-\eta)}$, it follows

that $\frac{dD^*}{dp} > 0$. Next, $\frac{dF^*}{dC} > 0$, $\frac{dV^*}{dC} = 0$ and since $D^* = \frac{r_L - F^*}{r_f(1-\eta)}$, it follows that $\frac{dD^*}{dC} < 0$. Now

consider α :

$$\frac{dF^*}{d\alpha} = \frac{\log\left(\frac{1-p}{1-p(1-\eta)}\right)}{\alpha^2} > 0 \quad (35)$$

$$\frac{dV^*}{d\alpha} = \frac{\log\left(\frac{1-p(1-\eta)}{(1-p)(1-\eta)}\right)}{\alpha^2} < 0, \quad (36)$$

where the inequality in (35) follows from $\frac{1-p}{1-p(1-\eta)} < 1$, and the inequality in (36) follows from

$\frac{1-p(1-\eta)}{(1-p)(1-\eta)} > 1$. Since $D^* = \frac{r_L - F^*}{r_f(1-\eta)}$, it follows that $\frac{dD^*}{d\alpha} < 0$. Finally, F^* and V^* are

independent of r_L and r_f , while D^* is trivially increasing in r_L and r_f . Note that all endogenous variables are independent of r_H . It follows that, for every parameter, when a relationship exists, F^* and D^* change in opposite directions, and V^* and D^* change in the same direction. Thus, fixed pay (variable pay) is negatively (positively) correlated with leverage. ■

Proof of Proposition 2

Part (i): the inequality needed follows from Proposition 1 and Lemma 5

$$\frac{dD^*}{dp} = \frac{dD^*}{dF^*} \frac{dF^*}{dp} > 0. \quad (37)$$

Part (ii): since $\frac{dD^*}{dp} = \frac{dD^*}{dF^*} \frac{dF^*}{dp}$, we need only show that $-\frac{dF^*}{dp} > -\frac{dF_{NV}^*}{dp}$, which follows from

Proposition 1. ■

Proof of Lemma 7

Let V_{ND}^* (F_{ND}^*) represent the solution to the variable (fixed) wage when the firm never defaults, V_{D1}^* (F_{D1}^*) represent the solution to the variable (fixed) wage when the firm defaults only in state L , where the Fixed wage is only paid in states H and M when the firm defaults in state L . Let V_{D2}^* be the variable wage when the firm defaults in both states M and L , thus no fixed wage is

possible. Comparing (18) with (16) and (18) with (20) yields the following two conditions under which a firm chooses to default only in state L :

$$(p_H + p_M)(r_M - r_L) \leq p_H(V_{D1}^* - V_{ND}^*) + r_f \left(1 - \frac{r_L - F_{ND}^*}{r_f(1-\eta)}\right) - r_f \left(1 - \frac{r_M - F_{D1}^*}{r_D(1-\eta)}\right) \quad (38)$$

$$p_H(r_D(1-\eta)) \geq p_H(V_{D1}^* - V_{D2}^* + r_M) + r_f \left(1 - \frac{r_M - F_{D1}^*}{r_D(1-\eta)}\right). \quad (39)$$

To show parameters exist such that (38) and (39) can be satisfied, let $p_L \rightarrow 0$. It is straightforward to show that in equilibrium, $V_{D1}^* \rightarrow V_{ND}^*$ and $V_{D1}^* \rightarrow V_{ND}^*$ since the worker and firm problems converge to the same problems as without default. Condition (38) then becomes:

$$(p_H + p_M)(r_M - r_L) \leq \frac{1}{1-\eta}(r_M - r_L), \quad (40)$$

which is always satisfied since $\eta > 0$ and $p_H + p_M \rightarrow 1$. From (39) we get

$$r_D(1-\eta) \geq V_{D1}^* - V_{D2}^* + r_M + \frac{r_f}{p_H} \left(1 - \frac{r_M - F_{D1}^*}{r_f(1-\eta)}\right), \quad (41)$$

where it can be shown that $V_{D1}^* - V_{D2}^* < 0$ since the worker must be compensated for the default risk. Since $r_D = \frac{r_f}{p_H}$ the condition holds for $\eta \rightarrow 0$ and r_M sufficiently small. ■

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Highlights

- Provide a model that links worker employment risk, pay structure, and firm capital structure.
- A novel mechanism to explain the relationship between the worker and capital structure: composition of wages
- The probability of job termination and leverage are shown to be negatively correlated
- The probability of job termination is shown to be negatively correlated with the amount of variable pay

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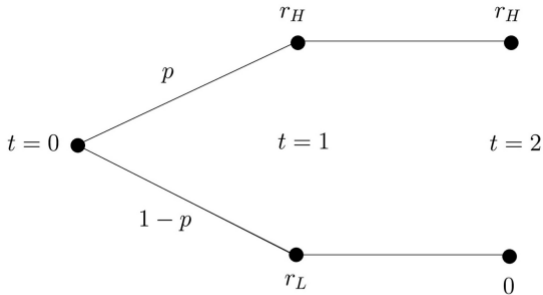


Figure 1