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

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Abstract

We develop a model of variable pay driven by the capital structure problem of the firm, as opposed to a problem related to the worker, on which the prior literature has focused. If workers face low unemployment risk, firms use more variable pay, and more leverage. With an agency problem embedded in the model, we show the opposite relationship between employment risk and variable pay can prevail. Using novel data from the banking industry, which contains information on variable pay across firms, we find support for our model, most notably, that capital structure can be an important motivation for the use of variable pay.

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1 Introduction

When a worker is risk averse and has a risky project, how should a risk-neutral firm pay them? 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 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—the combination of operating leverage and financial leverage. One way that operating leverage can be reduced is by increasing the proportion of variable versus fixed pay. However, if underlying project risk is also correlated with increased unemployment risk to the worker, she may demand more fixed versus variable pay to compensate. We explore this tension and show that financial leverage needs to fall by more than anticipated since operating leverage actually increases 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 (unemployment 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 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 are terminated. Thus, firms with less employment uncertainty will have more variable pay and higher financial leverage.

Next, we embed an agency problem into the model to create a wedge between worker and firm preferences: workers may shirk for private benefit; however, doing so will cause the project to fail with certainty. If this were the only problem the firm faced, it would use variable pay to force the worker to internalize the project upside potential. The result is the opposite of our capital structure mechanism: workers with high unemployment risk need sufficient incentive not to shirk. Thus, unemployment risk and variable pay are positively correlated. Combining the capital structure channel and agency mechanisms, we can then determine which one dominates in the determination of variable pay. The result is a comparison between two key variables: the amount by which debt is subsidized versus the severity of the worker agency problem. We provide empirical evidence that our capital structure channel can be more important than the agency channel in determining variable pay.

To date there has been little data available that can identify variable pay for all workers across firms and over time. We use detailed firm-level panel data on variable wages for Canadian bankers as well as information on their balance sheets, income statements, and employment. Financial institutions tend to have subsidized debt (e.g. the survey by Gorton and Winton (2003)) and lower unemployment costs relative to non-bank workers (Jacobson et al. (1994) and Morissette et al. (2007)). In our model, when debt is cheaper, firms have an incentive to use more of it and accommodate this by increasing the amount of variable pay. Similarly, we show that when the cost of unemployment is low, firms use more variable pay since the benefit of fixed pay, in utility terms, is less. This in turn allows firms to take on more debt. These then combine to support two key features of banks that we observe in the real world, and which make the environment ideal for testing the model's predictions: high variable pay (Lemieux et al. (2009)) and high leverage (Gornall and Strebulaev (2013)).

After constructing a firm-specific unemployment risk measure based on turnover, we show that unemployment risk and variable wage are negatively correlated and therefore consistent with our model of capital structure and inconsistent with the agency model we consider. We first show this by estimating a system of seemingly unrelated regressions with variable pay, fixed pay, and leverage as our variables of interest. An important concern with this approach, however, is that leverage and wages are endogenous. In the model leverage is jointly determined by fixed and variable wages and these are both determined by unemployment risk. Therefore, to re-examine the relationship between leverage and wages, we use an approach that combines traditional instrumental variables estimation with the use of generated instruments (Rigobon (2003) and Lewbel (2012)). The reason for this approach will become clear when we bring the model to the data in Section 5. We find empirical support for our mechanism: low unemployment risk is correlated with high variable pay and high leverage.

Recent papers have examined non-agency mechanisms related to the worker to help explain the prevalence of variable pay. Oyer (2004) 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 and so the interim participation constraint does not imply variable wages. Instead, variable pay arises from the firm's capital structure problem, i.e., it does not arise for reasons related to the worker.

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, and not due to 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. Also related, 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 in our paper; however, we model heterogenous 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 worker compensation and pay-for-performance, which has largely focused on an agency environment to explain issues like risk taking; Lazear and Oyer (2012) provide a summary of this literature. Partly due to data limitations, much of the literature has focused on management compensation. There is strong evidence however, that variable compensation is important beyond management. 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

[1] http://ir.aon.com/about-aon/investor-relations/investor-news/news-release-details/

from Caterpillar, the world's largest maker of mining and construction equipment, which has recently adopted a variable pay plan for all of its non-union employees.[2] Thus, we contend that by focusing only on management, a seemingly important piece of the compensation puzzle is missed. Our theory therefore focuses on variable pay for *all* workers.

Finally, our paper contributes to the debate on the relationship between unemployment risk and financial leverage. Understanding the drivers of this relationship has important implications for labor policies as well as financial regulation. 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. See also Bae et al. (2010). 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 job risk and financial leverage. We take the cost of firing as fixed but focus instead on unemployment risk, and importantly, the role of variable pay.

2 Model

In this section, we first outline the worker's problem and then solve the firm problem. The model has two key empirical predictions that we test in Section 5.2.

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:

$$u_t = -\exp(-\alpha C_t), \tag{1}$$

where α is the coefficient of absolute risk aversion.[3] We assume for simplicity that total (lifetime) utility is additively separable over time and stationary. Without loss of generality (see Section 3.3), we assume that workers do not discount utility over the three periods.

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

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, and p is independent and identically distributed (*iid*). One can think of workers as possessing the skills to implement a specific project characterized by p.[4] 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 the paper can be derived under the simple case in which r_H and r_L are constant. As such, we now make this assumption, and show in Section 6.1 that the results carry through when it is relaxed.

A worker's decision is simple: either engage in the project or take an outside option to be discussed below. We will compare firms that hire workers with different projects. The projects differ in their probability of being in the high state. 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 risk level p, there is a continuum of workers with the same *iid* probability of achieving the high return. 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 $t = 2$. Thus, if the investment is in the low state at $t = 1$, it will be optimal for the firm to fire the worker, which we assume comes with a cost ϕ to that worker.[5] For reasons of tractability, we assume that, if the investment is in the high state at $t = 1$, the worker suffers no cost of being fired.[6] We will maintain this cost as exogenous in the model. The timing and payoffs of the investment are found in Figure 1.

We assume that the investment opportunity requires an amount of funding that is normalized to one 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, for example, other employment, that

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

[5]In practice, one might think it would be less costly for the firm to lower wages than firing them. 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 the model was relaxed to 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 cutting fixed wages. Bewley (1998) documents how wage cuts impact employee morale, in particular productivity and turnover. We could capture these effects by adding another period to the model in which workers can be productive.

[6]This assumption is not crucial. It could arise, for example, from an (un-modelled) learning environment in which worker-type is revealed to the market as being high when the state is high, and low when the state is low. If the worker faced a cost of being fired in the high state, then this would complicate the firm problem at $t = 0$. One could get around this by adding a cost of firing to the firm, in addition to the worker. When the worker has a cost of firing in both the low and high state, then ϕ can also be interpreted as a cost of a worker losing firm-specific human capital.

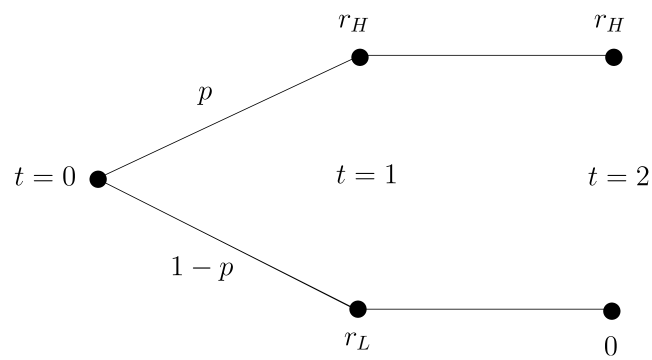

Figure 1: **Timing and payoffs of the investment**

yields (instantaneous) utility $\underline{u}$, which will be a constraint that must be satisfied at both $t = 0$ and $t = 1$. For simplicity, we assume that a worker can be replaced without cost to the firm at $t = 1$.[7] Let the consumption that attains utility $\underline{u}$ be given by $\underline{C}$ such that

$$\underline{u} = -\exp(-\alpha \underline{C}). \tag{2}$$

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 for the problem between $t = 1, 2$ and show that a worker is terminated in the low state at $t = 1$. This is the only result that we require from the $t = 1, 2$ problem to analyze the $t = 0, 1$ problem. Thus, for expositional purposes, we begin by analyzing the model at $t = 0$.

Of note, we rule out two cases which merit discussion. First, firms do not offer 2-period contracts wherein they commit to never firing the worker, and thus eliminate job risk. If this were the case, workers save the cost 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 $t = 2$ and the firm would always fire (shown formally in Section 3.3). If, on the other hand, contracts could be written wherein the firm could legally commit to not firing a worker, then a simple condition on ϕ (sufficiently small) can be derived to rule out this case, and all of the results of the paper carry through.[8] We also rule out the

[7] With a cost of replacement the worker will, not surprisingly, simply receive more compensation in $t = 1$. If there were also compensation adjustment costs variable pay could be used in a similar way to Oyer (2004). Given that the main results would be unaffected, we do not consider this mechanism to maintain focus.

[8] 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.

firm pre-committing to paying ϕ for the worker, as this again is not dynamically consistent.[9]

Since workers do not own the equity in the project, they do not receive the proceeds of the investment directly; instead they receive a compensation contract from the firm 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 the variable pay. Although not necessary, 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 for time $t = 1$ who invests in a project characterized by p is given by

$$p\left[u_1(V+F)\right] + (1-p)\left[u_1(F-\phi)\right]. \tag{3}$$

The first term represents the high state of the investment, which occurs with probability p. In the high state, 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. For simplicity we assume that firms are differentiated by the types of workers that are hired, i.e. firms are differentiated by project riskiness. To this end, we assume that a firm hires a measure 1 of workers, each with identical p, and

[9] 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 funds than non-family firms. In the case in which firms can pre-commit, we interpret ϕ as costs which are not easily quantified and therefore not contractible, e.g., the loss of firm-specific human capital or reputation. All of our main results to come can hold even in the case in which $\phi = 0$, i.e., the unlikely case in which all termination costs are quantifiable and the firm pre-commits to them upon termination. Only Lemma 6, wherein we perform compared statics on ϕ requires that $\phi > 0$. For example, Agrawal and Matsa (2013) implicitly assume that workers must bear some cost when fired, i.e., $\phi > 0$ in the context of our model.

raises an amount of funds normalized to 1.[10] The firm is created at $t = 0$ and owners raise one-period (for simplicity) debt, D, where the remainder, $1 - D$, is provided by the owners, E. The firm chooses F and V so as to provide the worker with at least $\underline{\text{u}}$, the outside option. We assume that firms (equity holders) are risk neutral but are subject to a bankruptcy cost B, which can sensitize the firm to default risk. Given that equity holders are assumed risk neutral we assume the same for debt holders, and let the 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 (c.f. Graham (2000) and Gorton and Winton (2003)). To this end, from the perspective of the firm, we let the cost of debt be subsidized by a factor of η.[11]

In Assumption 2 we will restrict the parameter space to that which yields the firm positive profits in equilibrium and as a consequence, the firm does not fail in the high state. The stark set-up of the model implies that there are two key regions to analyze: the one in which the firm succeeds in the low state, and the one in which it fails. If the firm chooses a sufficiently low level of debt, it will always succeed; thus debt holders will always be paid. In this case, 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 $r'_E(D) \geq 0$.[12] Given the subsidy to debt, and using the fact that debt holders 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. When $D > \frac{r_L - F}{(1-\eta)r_f}$, the firm fails in the low state. For what follows, we wish to analyze a meaningful firm capital structure choice. As such, we consider the case in which the bankruptcy cost is sufficiently large so that the firm does not simply wish to take on debt without bounds. To ease the analysis, we make a stark

[10]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 the projects that they possess. All that is required is a positive correlation between worker and firm performance. This relationship can be justified based on results starting with Griliches (1957), in which firm productivity differences could be explained by differences in input quality.

[11]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; however, the qualitative results will remain unchanged.

[12]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, $r_E = r_f$ so that the required rate of return to equity is also independent of p. We can relax this to allow r_E to decrease in p with risk aversion without impacting our qualitative results; however, they will be needlessly obfuscated.

assumption on the bankruptcy cost B: it wipes out all stakeholders.[13]

Assumption 1 $B = r_L$

Under Assumption 1, when $D > \frac{r_L - F}{(1-\eta)r_f}$, the debt holders receive no payment when the firm fails and so the required interest rate must satisfy $p\widetilde{r_D} + (1-p)(0) = r_f$, thus $\widetilde{r_D} = \frac{r_f}{p} > r_f$. Similarly, the equity holders do not receive a payoff in the failed state, so that the required (expected) rate of return to equity is constant and given by $\widetilde{r_E} = r_f$. 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

$$p\underbrace{\left[r_H - V - F - (1-\eta)r_f D\right]}_{\text{high state return}} + (1-p)\underbrace{\left[r_L - F - (1-\eta)r_f D\right]}_{\text{low state return}} - \underbrace{r_f(1-D)}_{\text{opportunity cost of equity}} \tag{4}$$

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 debt holders, 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

$$p\left[r_H - V - D(1-\eta)\widetilde{r_D}\right] - r_f(1-D). \tag{5}$$

The key difference between (4) and (5) is that when the investment return is low there is no payoff for the firm when it defaults on its debt. In addition, Assumption 1 implies that, upon defaulting, there is nothing left for the workers nor the debt holders. Therefore, the firm cannot offer a fixed wage since it cannot pay in state L. Thus, it is equivalent to the firm being restricted to only 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

[13]It should be noted that this assumption is not necessary. Without it, there will be a recovery value that, upon bankruptcy, must be shared between debt holders and workers according to some rule.

cannot fail, $D \leq \frac{r_L - F}{(1-\eta)r_f}$.

$$\max_{V,F,D} \Pi = p\left[r_H - V - F - (1-\eta)r_f D\right] + (1-p)\left[r_L - F - (1-\eta)r_f D\right] - r_f(1-D) \quad (6)$$

$$\text{subject to} \quad p\, u_1(V+F) + (1-p)\, u_1(F-\phi) \geq \underline{u},$$

$$\Pi \geq 0.$$

The first constraint represents the restriction that workers must earn at least their reservation utility. 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 will only receive it in the high state. Thus, we include only V for worker pay.

$$\max_{V,D} \; \Pi = p\left[r_H - V - D(1-\eta)\widetilde{r_D}\right] + (1-p)\,[0] - r_f(1-D) \quad (7)$$

$$\text{subject to} \quad p\, u_1(V) + (1-p)\, u_1(-\phi) \geq \underline{u},$$

$$\Pi \geq 0,$$

where again, $\widetilde{r_D} = \frac{r_f}{p}$. As a consequence of Assumption 1 and the fact that debt is subsidized ($\eta > 0$), 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, i.e., $D^* = 1$. 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, D^*, which 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. We proceed by considering the case in which the firm chooses never to fail. After, we will confirm that this case prevails within a simple parameter set.[14] Given $D^* = \frac{r_L - F}{(1-\eta) r_f}$ from Lemma 1, we rewrite the firm optimization problem.

$$\max_{V,F} \; \Pi = p\left[r_H - V - F - (1-\eta) r_f D^*\right] - r_f (1 - D^*) \tag{8}$$
$$\text{subject to} \quad p\, u_1(V+F) + (1-p)\, u_1(F-\phi) \geq \underline{u}$$
$$\Pi \geq 0.$$

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 which V cannot be used. This analysis is important since, even in the absence of variable pay, p is related to fixed wage, and consequently, to firm debt. This will allow us to see the incremental effect of our proposed mechanism. Setting $V = 0$ in (8), 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:

$$p u_1(F^*_{NV}) + (1-p)\, u_1(F^*_{NV} - \phi) \geq \underline{u}. \tag{9}$$

Using the assumption that utility is exponential yields the following:

$$F^*_{NV} = \frac{log\left(p + (1-p)\exp(\phi)\right)}{\alpha} + \underline{C}. \tag{10}$$

We can now perform comparative statics. We define $\frac{dD}{dp}\big|_{NV}$ 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 the two key comparative statics.

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

[14]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 6.2, we consider the 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.

Proof. *See Appendix.*

The intuition behind this result is relatively 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

We consider the problem outlined in (8) for the case with variable pay, but exclude the non-negativity constraint on the expected payoff of the firm, and consider it in Lemma 3. After obtaining the first-order conditions, using the fact that utility is exponential, we have the following solutions:

$$V^* = \frac{\log\left(\frac{1-p(1-\eta)}{(1-\eta)\exp(\alpha\phi)(1-p)}\right)}{\alpha}, \tag{11}$$

$$F^* = \frac{\log\left(\frac{(1-p)}{1-p(1-\eta)}\right)}{\alpha} + \phi + \underline{C}. \tag{12}$$

We now restrict the parameter space to implement the $\Pi \geq 0$ constraint in the problem outlined in (8). In addition, we analyze the most interesting case in which the firm uses both variable and fixed pay (i.e., $V^* > 0$ and $F^* > 0$).[15] The following result derives the necessary and sufficient conditions under which $\Pi \geq 0$, $V^* > 0$, $F^* > 0$ and shows that parameters exist that satisfy these conditions.

Lemma 3

1. *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* (11) *and* (12).

2. *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.

[15] The interpretation of $V^* < 0$ is that of variable pay in the L state. In particular, the amount of variable pay in the L state is $|V^*|$ and fixed pay would be $F - |V^*|$. Since we are interested in the most empirically relevant case, we focus on the situation in which total pay is higher in the H state, $V^* > 0$.

Proof. *See Appendix.*

The proof shows that one set of parameters that satisfies the two conditions is $\underline{C}$ and r_H sufficiently large and ϕ sufficiently small. The first condition (i) is relatively straightforward. The higher r_H, the larger the payoff to the firm in the high state. Since r_H is exogenous, clearly it can be made sufficiently large to ensure that the firm makes non-negative profits. Note that this condition also ensures that the firm does not fail in the high state. To understand the second condition (ii), consider that, when the cost of job termination 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 models of worker compensation without agency problems, having a risk-neutral firm and a risk-averse worker implies that the worker will receive full insurance through a fixed wage (e.g. Laffont and Martimort (2002)). To understand how variable pay can be optimal in our setting without an agency problem related to workers, we re-arrange the condition under which $V^* > 0$.

$$\eta > \frac{(1-p)(\exp(\alpha\phi)-1)}{\exp(\alpha\phi)(1-p)+p}. \tag{13}$$

As the subsidy to debt increases (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 will 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.

Given V^* and F^* defined in (11) and (12), we can provide a simple condition under which the firm always chooses a level of debt D^* such that it never defaults. Although we have assumed that bankruptcy costs are large ($B = r_L$), 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 that this can be possible is that debt holders are risk neutral, and thus the firm simply needs to compensate the debt holders for their expected loss due to bankruptcy, which is $(1-p)r_f$. On the other hand, if the firm uses all debt, the overall effective payment to debt holders may be lower when the subsidization to debt is sufficiently high. This of course neglects an important party that must be compensated if the firm fails; the workers. The workers cannot receive a fixed wage since if the firm fails, there is nothing left to pay them due to bankruptcy costs. Thus, we can ensure the firm never wishes to default on its debt if the 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 result summarizes.

Lemma 4 *There exists a* $\hat{C}$ *such that for any* $\underline{C} \geq \hat{C}$*, the firm chooses never to default. Given* $\underline{C} \geq \hat{C}$*, there exists parameters under which conditions (i) and (ii) of Lemma 3 are both satisfied.*

Proof. *See Appendix.*

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. To maintain focus, we consider only the case in which $\underline{C} \geq \hat{C}$. Therefore, to ensure that firms do not fail, and that $V^* > 0$ and $F^* > 0$ we make the following assumption.

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. This represents the first implication of the model, which is explored empirically in Section 5.2.

Lemma 5 *Variable pay is decreasing 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 6 *Debt is negatively correlated with the amount of fixed pay, and positively correlated with the amount of variable pay.*

Proof. *See Appendix.*

We show this result by analyzing the relationship between the two model variables exogenous to debt (r_L and r_H) and debt and worker compensation. In each case, 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, it is illuminating to consider the bankruptcy costs of debt, and the fact that debt is subsidized relative to equity. Given these two 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 increases (due to a change in an exogenous parameter), 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) and more recently Kahl et al. (2014)) 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 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 will 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. The overall implication will be tested empirically in Section 5.2, and in addition, we will also provide empirical support for the incremental contribution of variable pay on the relationship.

Proposition (Empirically Tested) 1 *(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 Lemmas 5 and 6. The higher the probability of job termination, the more fixed pay and the less variable pay that workers will be paid. 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 pay and fixed pay are substitutes. As in Lemma 5, an increase in the probability of job termination causes a decrease in variable pay, and thus fixed pay must increase in response. Since in the model 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 of course 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.

$$OL = \frac{r_f(1-\eta)D + F}{r_L}. \tag{14}$$

Plugging D^* into (14) 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 1: 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. Note that this intuition holds even when r_L is a function of p, which we pursue in Section 6.1.

3.3 The Optimal Decision at $t = 1$

The firm decision between $t = 1$ and $t = 2$ differs based on whether the worker's investment is in the high or low state. Recall that we assumed that a worker is essential, so that 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. Given $\eta > 0$, the firm optimally sets the amount of debt to 1 since it cannot go bankrupt.[16] The firm problem becomes

$$\max_{V_H^2, F_H^2} r_H - V_H^2 - F_H^2 - (1-\eta) r_f \quad \text{subject to:} \quad u_2(V_H^2 + F_H^2) \geq \underline{u}. \tag{15}$$

It is straightforward to show that the choice between fixed and variable pay is irrelevant since variable pay is not actually variable since there is no risk in project outcome from $t = 1$ to $t = 2$. Thus, the solution is simply given by the firm paying the worker $C_2 = \underline{C}$ with certainty. If the investment is in the low state, there is no further payoff for the firm, and thus the budget constraint cannot hold since the firm would lose money by paying $\underline{C}$. Thus, it is optimal to terminate the worker.[17]

It is important to recognize that this decision is made at $t = 1$ and therefore has no bearing on the decision at $t = 0$ (other than the knowledge that workers will be terminated in the low state at $t = 1$). Thus, if we relaxed the assumption that the worker does not discount utility over the three periods, it will not affect the solution at $t = 0$.

4 Agency Problem

Thus far we have shown that even in the absence of an agency problem, variable pay can be optimal once one considers the capital structure decision of the firm simultaneously. If in addition, there are agency problems, variable pay can also be used to align preferences between workers and the firm. In this section we show that introducing an agency problem in our model can lead to different testable implications than those we have outlined thus far. There are of course, many different agency models that one could consider when analyzing the role of incentives to workers. Given that our objective is to test our capital structure model against an agency model, the two must be nested and have clear predictions. Thus, we will consider a natural extension of our model which features the agency problem interacting with our comparative static results in a meaningful way. We provide a further discussion of our fit within the agency literature at the end of this section.

[16]It is simplest to assume (and we do so here) 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 this will be optimal since the firm will prefer to reduce equity and increase debt. 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 the amount of debt is 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 the optimization problem (15).

[17]Note that a worker still receives the outside option when fired, just not from the firm in question.

In the preceding results, we assumed that a worker had a choice only between accepting the wage contract they were offered, or taking an outside option. We now enrich the model in a simple way to allow the worker to choose an action that the firm cannot observe. We assume that upon accepting a wage contract, a worker can choose to shirk and receive a private benefit s.[18] If the worker does not shirk, we assume that the project is identical to that in Section 2. If they do shirk, we assume that the project will be in the low state (returns r_L at $t = 1$ and 0 at $t = 2$) with probability 1.[19] Since shirking is private information, the firm cannot tell whether the project had a low return because the worker shirked, or because the worker was unlucky. This means that a worker will receive F regardless of whether they shirk, whereas they receive V only if they do not shirk.

We have opted for such a simple agency setup since the analysis with this agency problem is identical to without, save for one important difference. The firm now solves the problem outlined in (8), subject to a new constraint which ensures that a worker does not shirk:

$$pu_1(V + F) + (1 - p)\, u_1(F - \phi) \geq u_1(F - \phi + s). \tag{16}$$

The left hand side of (16) represents the utility of a worker that does not shirk. In this case, worker utility does not change from the case in which there is no agency problem. The right hand side of (16) is the utility when the worker shirks. The worker receives the private benefit s, and is terminated with probability 1. Solving the optimization problem with the new constraint yields the following result on when the agency problem will be important for determining wages of a worker.

Lemma 7 *There exists a project risk $\hat{p} = \frac{1-\exp(-\alpha s)}{1-(1-\eta)\exp(-\alpha s)}$ such that for any $p \geq \hat{p}$, V^* and F^* remain unchanged and given by* (11) *and* (12)*, respectively.*

The expression for $\hat{p}$ is found by equating the right hand sides of (16) and the worker outside option constraint in (8) using our exponential utility assumption. Lemma 7 says that the

[18] A model of effort as opposed to shirking would yield the same qualitative results however, a shirking model turns out to be simpler to nest into our capital structure model.

[19] Technically, since a firm employs a measure one of workers, an individual measure-zero worker cannot affect the probability of a project's outcome. As in Thompson (2010), for example, we can imagine a small but positive measure of workers making a collective decision, or we can consider the measure as a whole. In the former case the assumption that the project fails with certainty would clearly be unrealistic if the measure that deviates is small. The results of this section will be qualitatively similar if we assume that instead of causing the project to fail with certainty, shirking simply causes the probability of the low state to increase. In this case we would need a condition to ensure that the probability of the low state increases sufficiently so that, all else equal, the firm prefers to avoid shirking.

agency problem can only affect the optimal wage contract when the project is sufficiently risky (p is low). This is because when the project is very risky, the worker is more likely to be terminated even if they do not shirk, so it makes sense to take the private benefits and shirk. When the risk of job termination is not too high, a worker gives up the potential variable pay (in addition to having to incur the termination costs with certainty) when they shirk. Thus the variable pay offered as a consequence of the subsidization to debt (i.e., our model without an agency problem), is already sufficient to prevent the worker from shirking. In other words, as long as the project is not too risky, the firm need not provide any additional incentives to prevent shirking. Therefore, when $p \geq \hat{p}$, all of the results of our model without an agency problem follow through. The interesting case is that in which $p < \hat{p}$.

Lemma 8 *When $p < \hat{p}$, variable pay is increasing in the probability of job termination.*

The intuition behind this result is best gleaned by considering the new constraint (16). When the variable pay that arises as a solution to our capital structure model does not provide sufficient incentives for the worker not to shirk, the firm must provide the worker with higher utility in the good state (when the return to the project is r_H), which can only be received by not shirking. Variable pay is used to provide this incentive since it is only paid in the high state, whereas a worker receives F regardless of whether they shirk or not. As p increases, the project is more likely to be in the high state, so the firm can decrease the amount of V that it pays, while still ensuring the worker does not shirk. Since p increases, V is set such that the expected utility of the worker remains constant, and thus the firm need not adjust F to ensure that the worker earns the outside option.

It is instructive to look at the capital structure versus agency mechanisms for variable pay by re-arranging and simplifying the $p \geq \hat{p}$ inequality (and substituting in the expression for $\hat{p}$ found in Lemma 7):

$$\eta \geq \exp(\alpha s). \tag{17}$$

The inequality (17) shows that the higher is the benefit to shirking (s), the higher must be the subsidy to debt (η) so that the choice of V is driven by the capital structure problem of the firm, and not the agency problem. If this condition holds, we should expect to uncover the relationship described in Lemma 5. Conversely, if the subsidy to debt is low (or the agency problem is severe so that (17) is not satisfied), the agency problem will dominate and the opposite relationship to Lemma 5, described in Proposition 2 will hold. This leads to the main result: an empirical implication of the model as to which mechanism is responsible for variable pay, either our new capital structure mechanism, or the agency mechanism.

Proposition (Empirically Tested) 2 *If variable pay is decreasing in the probability of job termination, then variable pay is determined by the capital structure problem of the firm. If variable pay is increasing in the probability of job termination, then variable pay is determined by the agency problem.*

The results of this section deserve some discussion in light of the lengthy agency literature, which has produced many results relating risk to worker behavior and pay (some of which are conflicting). A foundational paper in this area is Holmstrom and Milgrom (1987). There the risk of a project is uncorrelated with worker effort. Instead, worker effort can increase output for any given level of risk, and since outcomes are continuous, variable pay is continuous and varies with output level. Higher project risk corresponds to higher wage risk and thus the firm reduces variable pay due to worker risk aversion. Importantly, our theory is built so that it can be contrasted against our capital structure mechanism, and so the problem must interact in a meaningful way with our model so that it can be tested empirically. The key variable in our comparative statics is the probability of job termination and so the agency problem that best lends itself to our environment is one which interacts with this variable. Furthermore, agency problems that compare risk to variable pay (such as Holmstrom and Milgrom (1987)) typically consider a change in risk of the continuous outcome distribution (i.e., a change in *both* the upside and downside), which is not isomorphic to a change in the probability of job termination that we consider (a change in *either* the upside or the downside). An important mechanism from the literature is still present in our model; if a worker shirks, the probability of job termination goes up, and so risk aversion of the worker would imply that the marginal value of fixed pay would increase relative to that of variable pay. However, since in our model, shirking causes the probability of project failure to increase, the firm uses variable pay to prevent the worker from lowering the value of the project through shirking, thereby aligning worker incentives with firm profit.

5 Empirical Implications

Our theoretical model generates testable implications. Most importantly, we show that variable pay may be determined as a solution to an agency problem, in which case the probability of job termination and variable pay will be positively correlated. Conversely, the variable pay may be determined as a solution to a capital structure problem, in which case the probability of job termination and variable pay will be negatively correlated. We therefore have our first testable hypothesis, which corresponds to Proposition 2:

H1: Variable pay and the probability of job separation are negatively correlated if a capital structure channel is of first-order importance in the determination of variable pay and the correlation is positive if agency problems are of first-order importance.

The second implication of the model derives from the first: leverage is negatively correlated with the probability of job separation. This is because variable pay allows flexibility on the operations side of the firm (corresponding to Proposition 1).

H2: Leverage is negatively correlated with the probability of job separation and the mechanism is through variable pay.

In this section we introduce a novel data set that includes variable compensation. We first describe the data, which covers the population of Canadian broker-dealers. We then test our hypotheses. When applied to financial institutions, our model is able to rationalize two key features of these types of firms. First, a typical debt-to-assets ratio is 87% to 95%, which is substantially higher than non-financial firms (Gornall and Strebulaev (2013)). Second, Lemieux et al. (2009) show that on average U.S. financial institutions pay 65% of a worker's salary as variable compensation compared to 33% for non-financial firms. These two features arise endogenously through two key parameters: the cost of job termination and the cost of debt, both of which are lower, on average, in financial institutions versus non-financial firms.

With respect to job termination, Jacobson et al. (1994) report that, in the U.S., the financial sector is among the lowest in terms of future losses to the worker upon job displacement. Morissette et al. (2007) find similar evidence for Canada over the period 1983 to 2002. In terms of the cost of debt, there are a number of reasons why financial firms can enjoy better borrowing rates than those for non-financial firms. Banks that hold deposits receive a subsidy through deposit insurance. Financial institutions also tend to have highly liquid debt and highly liquid assets in case of fire sales.

In the proof to Lemma 6, we showed that a lower cost of job termination (ϕ) leads to more variable pay and higher leverage. In addition, we showed that a higher debt subsidy (η) also leads to more variable pay and higher leverage. Therefore, given the existence of relatively high variable pay throughout the organization, the banking environment represents an ideal testing ground for our theory.

5.1 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 is a self-regulatory organization that oversees investment dealer activity in Canadian debt and equity markets as well as personal and wholesale investing. In addition to enforcing prudential regulation, IIROC is the market-conduct regulator, monitoring dealer behavior, and ensures members follow a set of Market Integrity Practices that govern issues like front-running and client priority.[20] Income and balance sheet data are reported monthly although we aggregate annually; bonuses are accrued monthly but paid annually, and what is accrued might not actually be awarded. Therefore using monthly data would not be appropriate for analyzing questions related to compensation. 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.[21]

Table 1 presents summary statistics on the cross-section of firms for the main variables of interest. Few firms are publicly traded, therefore, we measure leverage as book value of liabilities over assets. In addition, we introduce a second measure of leverage that incorporates a portion of a financial institutions' subordinated debt. Broker-dealers have two types of subordinated debt on their balance sheet: subordinated loans within the industry and subordinated loans from non-industry investors. We treat the latter as debt and the former as equity; the former is often from the parent and therefore closer to equity than debt.[22]

[20]The blank report schedules are here: http://www.iiroc.ca/Rulebook/MemberRules/Form1_en.pdf.

[21]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.

[22]To prevent dealers from taking out subordinated debt and simply depositing unused funds at the provider of the debt, IIROC 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) (IIROC, accessed 2011). By analyzing the capital charges, we determined that within-industry subordinated loans are almost exclusively from the parent.

Table 1: **Summary statistics**

The sample is from 1992 to 2010 and on average 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, which include bonuses payable to shareholders in accordance with share ownership. 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 one if a bank generated trading revenue. Non-allowable assets are those assets deemed illiquid by IIROC. 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
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 results are qualitatively similar when non-industry-subordinated debt is included; however, leverage is substantially higher in some cases.[23] Nevertheless, 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 United States in Gornall and Strebulaev (2013). This likely it stems from the substantial heterogeneity in our sample of broker-dealers relative to the typical set of

[23]Average leverage would be higher still if we included subordinated loans within the industry as debt and not equity. We use our current definitions based on the accounting definitions of capital and debt at the time the data was collected.

bank holding companies studied in the literature. More than two-thirds of the broker-dealers with leverage below 50 are small retail firms. These firms are in the bottom decile of firm size, both in terms of assets and number of employees, and rely on retained earnings.

Our measure of job termination is firm-specific and meant to capture employment uncertainty. A firm is given a 1 if, between two years it laid off at least 5% of its workforce 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. Alternatively, we could average over the observed turnover rate regardless of size. We average over the indicator variable, however, to capture relatively large movements in job loss. The interpretation of our variable is firm-level expected job risk.[24]

Wages are decomposed into three segments.[25] 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 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. Most important for testing our theory is variable pay however, fixed pay is helpful. Thus, finally there is fixed wages (FW), which for most firms are included in total operating expenses (which includes fixed wages and costs related to buildings and equipment) and not reported separately. For 12 financial institutions however, we have the breakdown of operating expenses into fixed wages and other operating expenses. Fixed wages are consistently 50% of operating expenses (standard deviation of 1.3%); therefore, we apply this rule for all financial institutions. It is possible that the proportion of operating expenses that fixed wages represents varies with firm size or type, and that the 12 institutions that we have the breakdown are a non-random. Therefore, we will control for this possibility in the regressions by controlling for size and including group fixed effects (small/large interacted with retail/institutional).

Total wages is the sum of its three components. In Canadian dollars (deflated using

[24]Note that we cannot separately identify firing from voluntary departures. Job termination in banking might be considered involuntary because: (i) almost all firms have a no-competitor clause which introduces important switching costs, (ii) bonuses are often deferred which can lead to large switching costs (Morris and Wilhelm (2007)) and reduce turnover (Aldatmaz et al. (2014)).

[25]Wages are based on average wages for all broker-dealers in the firm, irrespective of hierarchy. Efing et al. (2014) do not find that the correlation between variable pay and trading volume/volatilty 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, which is used because of the lack of information on job titles, is a good approximation to capture the cross-section heterogeneity in firms' wages.

the 2002 consumer price index deflator), the average base (or 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 (approximately $586,098 in 2014 dollars) 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, about 81% of firms are involved in trading.

5.2 Empirical Results

In this section we present evidence consistent with $H1$ (Proposition 2) and $H2$ (Proposition 1). We test the hypotheses based on two approaches. First, we estimate a system of seemingly unrelated regressions (SUR) using variable pay, fixed pay, and leverage as our dependent variables. This provides insight into the correlations predicted by the model and allows for correlated errors. In other words, it provides confirmation of the correlations produced by our capital structure mechanism, and therefore not consistent with the agency problem we model. If one is willing to accept stronger identification assumptions, it is possible to go further, and explore not just the results from our mechanism, but the mechanism itself. One concern is endogeniety. In our context, it would be desirable to allow for endogeniety of wages and leverage. In this way, we can rule out models wherein the mechanism works in the opposite direction but produces the same correlations. Therefore, in our second approach, we use variation across firms in unemployment risk as an exogenous shifter of wages in addition to using generated instruments (described below) to produce causal estimates of the relationships outlined in the model.

Our empirical strategy is to compare firms with varying degrees of unemployment risk and thus variable wages and leverage. Our regression has a vector of 3 dependent variables (y): total variable wages, fixed wages, and finally leverage. For the explanatory variables we include firm size log-assets, 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. In addition to group fixed effects, 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 structure and not on a mechanical relationship between outcomes and realized wages. The dividend indicator variable potentially captures another form of 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.[26] The prediction from $H1$ is that $\beta < 0$ if the capital structure channel is of first-order importance for the determination of variable pay and $\beta > 0$ if the agency problem is first-order.

$$y_{it} = \alpha + \beta \text{pr(job termination)}_i + \gamma X_{it} + \delta_j + \epsilon_{it}, \tag{18}$$

where the explanatory variables, X, are highlighted above and δ_j are group fixed effects as discussed above. We do not include firm fixed effects since we are interested in the cross-sectional variation in unemployment risk, wages, and leverage. We estimate the model using 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. First, firms with high employment uncertainty are less likely to use variable wages and more likely to use fixed wages. This result provides supporting evidence for Proposition 2 and therefore we cannot reject $H1$. That is, the capital structure channel is of first-order importance relative to the agency

[26] 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 the worker output. Currently, the firm can perfectly observe the output of the worker, so that variable pay is only paid in the high state. If instead, jobs differed in how much information on outcome is revealed to the firm, we could capture the idea that some jobs are simply better suited to variable pay than others. This represents an interesting path for future research.

channel for the set of firms examined here. Although a lack of data availability for other industries prevents us from testing our hypotheses with firms outside the financial sector, when better data does become available, this regression can be run for other industries to gauge the importance of our new channel for variable pay.

In addition to the correlation between unemployment 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 also have high variable wages but firms with illiquid assets tend to have more fixed pay. Finally, we point out that both the correlation of variable wages and fixed wages with revenues per employee is positive, although only statistically significant for fixed wages. The reason is, at least in our sample, more productive firms pay employees higher wages.

In columns (3) and (6) we provide evidence consistent with $H2$. Firms with higher probabilities of job termination have lower leverage. Note 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.

In addition to the correlations between unobservables, we also find a strong negative correlation (-0.42) between the residuals in the variable and fixed wage regressions, a strong positive correlation between the residuals in the variable and leverage regressions (0.25 and 0.2), and finally a negative correlation between the residuals in the fixed wage regression and leverage (-0.06 and -0.13). A null hypothesis that the residuals are independent is easily rejected (Breusch-Pagan test of 41.6 and 40.1 for the first and second system, respectively). These correlations suggest that variable wages and fixed wages are substitutes. Also, leverage and unemployment risk negatively co-move for unobservable reasons.

There are two potential concerns with the SUR regressions, in particular the estimated relationship between job termination and leverage. First, if our mechanism is correct, the probability of job termination affects leverage via wages. This is the second part of $H2$. Therefore the direct effect captured in Table 2, although suggestive, is not a strict test of $H2$. Second, leverage is potentially endogenous to wages. Our estimation strategy should therefore take this into account. We use an instrumental variables approach under the assumption that the probability of job termination is exogenous to wages. That is, differences in the probability of job separation across firms lead to different wage structures, which ultimately leads to differences in leverage. Our system of equations, however, only has one exogenous variable—job termination—and two endogenous variables—variable and

Table 2: SUR estimation

The dependent variable in columns (1) and (4) is log of total variable wage, defined as discretionary bonuses plus contractual bonuses. The dependent variable in columns (2) and (5) is lof of fixed wages. The dependent variable in columns (3) is leverage defined as liabilities plus subordinated debt over assets and in column (6) the dependent variable is leverage defined as liabilities over assets. The first system of equations is columns (1)-(3) and the second set is columns (4)-(6). 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 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.

		System 1			System 2	
	log(TVW)	log(F)	(L+SD)/A	log(TVW)	log(F)	L/A
pr(job termination)	-0.535***	0.180***	-0.0430***	-0.535***	0.180***	-0.0525***
	(0.163)	(0.0273)	(0.0112)	(0.163)	(0.0273)	(0.0106)
log(size)	-0.0444	0.0406***	0.0644***	-0.0444	0.0406***	0.0653***
	(0.0276)	(0.00462)	(0.00189)	(0.0276)	(0.00462)	(0.00179)
Nonallowable assets	-3.970***	0.663***	-0.934***	-3.970***	0.663***	-1.054***
	(0.543)	(0.0910)	(0.0373)	(0.543)	(0.0910)	(0.0353)
log(rev/employee)	0.475***	0.712***	-0.0590***	0.475***	0.712***	-0.0599***
	(0.0902)	(0.0151)	(0.00620)	(0.0902)	(0.0151)	(0.00586)
I(dividend)	0.290**	-0.131***	-0.0207**	0.290**	-0.131***	-0.00138
	(0.140)	(0.0234)	(0.00959)	(0.140)	(0.0234)	(0.00907)
I(trading income)	1.349***	-0.154***	-0.0442***	1.349***	-0.154***	-0.0378***
	(0.183)	(0.0307)	(0.0126)	(0.183)	(0.0307)	(0.0119)
Constant	4.738***	1.488***	0.415***	4.738***	1.488***	0.390***
	(1.022)	(0.171)	(0.0702)	(1.022)	(0.171)	(0.0664)

fixed wages. Ideally, we would want to have at least one more plausibly exogenous variable to just-identify the model, and more than one to have over-identification. This is not the case, therefore we will rely more on functional form restrictions. Our approach is to generate regressors in a manner outlined in Lewbel (2012), which is an extension to Rigobon (2003). The idea is to rely on higher moments and restricting the correlation between the regressors, X, and the product of the residuals. Lewbel (2012) shows that in the presence of heteroscedasticity related to at least a sub-set of X we can achieve identification.[27] The higher the degree of heteroscedasticity in the errors, the higher the correlation between the

[27] This identification approach, which relies on a sufficient amount of heteroscedasticity in the residuals from the first stage, has been used in other contexts. For example, Emran and Hou (2013) employ it in the context of studying household consumption, Arcand et al. (2015) in the context of economic growth, and Chaboud et al. (2014) in the context of foreign exchange markets.

generated instruments and the included endogenous variables. The sufficient conditions for identification, therefore, are (i) $E[X\epsilon] = 0$ and (ii) $cov[Z, \epsilon] = 0$, and that at least some of the instruments, Z, exhibit heteroscedasticity. To achieve this we include in Z our one valid instrument (pr(job termination)) and the demeaned regressors multiplied by the residuals: $(X_j - \overline{X})\epsilon$. Note that the binary regressors are not demeaned. Although we do not have an economic interpretation of these instruments, and they are less precise than traditional instruments, they are by construction valid if the first-stage residuals are characterized by a high degree of heteroscedasticity - which we show to be the case in our data. Importantly, it allows us to easily test for weak identification and model specification, and so we are able to show that our instruments are valid and our model is not rejected at standard significance levels.

Table 3 presents results of our model estimated by GMM. We show both the first-stage regression and two sets of results for each definition of leverage. The first-stage results are the same as those using SUR. The information matrix test for heteroscedasticity is reported in columns (1) and (2) and points to substantial heteroscedasticity in the first-stage residuals, ensuring that our approach is valid. The main result is that variable pay is negatively correlated with unemployment risk and fixed pay is positively correlated. From $H1$ (Proposition 2), therefore, we say that the results are consistent with the capital structure channel being of first-order importance for the determination of variable pay.

In columns (3)-(6) we present the second stage results. In columns (3) and (5) we only use the generated regressors and in (4) and (6) we also include the probability of job separation. This is the key mechanism in the theory and therefore crucial. In addition, presenting it this way allows us to see that our exogenous variable provides valuable information beyond the generated regressors for purposes of identification. Focusing therefore on columns (4) and (6) we observe first from the J-test that the model specification cannot be rejected. Using the probability of job termination in addition to the generated instruments improves identification since it is strongly correlated with wages. This is important since the theory model takes this as the key exogenous variable, i.e., unemployment risk differences across firms are crucial to the mechanism behind the theory.

The results from the IV estimation confirm the predictions of a model with a capital structure channel. Higher variable pay allows firms to have more leverage. From column (4) we get that a one standard deviation increase in log-variable wage leads to a 1.2% increase in leverage. In contrast, higher fixed wages leads to lower leverage. This is consistent with Lemma 6. Recalling Proposition 1, this result suggests that variable pay is an important mechanism for explaining variation in financial leverage. In addition, we have the same qualitative results as in Table 2 for the exogenous regressors. Leverage is increasing in firm size, but decreasing in illiquidity (non-allowable assets), dividends and trading activity. Illiquidity raises potential bankruptcy costs and so can lead to less leverage. It is standard that dividends, although weaker than debt due to there being no legal obligation, are sticky nonetheless and so reduce the amount of leverage that can be maintained.

Table 3: Instrumental variable estimation

All variables except wages and the binary variables are demeaned in order to be able to include generated instruments. Firm size is therefore measured as demeaned 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 demeaned by the mean non-allowable assets. I(trading income) is an indicator variable equal to 1 if the firm generates trading income and 0 otherwise. Total variable wages (TVW) is defined as discretionary bonuses plus contractual bonuses and fixed wages (F) is defined as 50% of operating expenses. There are on average 178 firms and therefore 1,783 observations. Standard errors are robust and clustered at the firm level. 'Gen IVs' denotes generated instruments. The IM-test is a test for heteroscedasticity where the null hypothesis is homoscedasticity. The levels of significance are *** p<0.01, ** p<0.05.

Variable	First-stage		Gen. IVs	All IVs	Gen. IVs	All IVs
	log(TVW)	log(F)	(L+SD)/A	(L+SD)/A	L/A	L/A
pr(job termination)	-0.535***	0.180***				
	(0.163)	(0.027)				
log(TVW)			0.0249***	0.0233***	0.0139***	0.0133***
			(0.00483)	(0.00469)	(0.0036)	(0.0035)
log(F)			-0.01472	-0.0505	-0.0535	-0.130***
			(0.059)	(0.0492)	(0.0502)	(0.0432)
log(size)	-0.0444	0.0406***	0.0663***	0.0677***	0.0689***	0.0704***
	(0.028)	(0.0046)	(0.00582)	(0.00585)	(0.0055)	(0.00567)
nonallowable assets	-3.970***	0.663***	-0.8461***	-0.8257***	-0.961***	-0.938***
	(0.544)	(0.0911)	(0.102)	(0.102)	(0.0939)	(0.0913)
log(rev/employee)	0.475***	0.712***	-0.0585	-0.0325	-0.0226	.00713
	(0.090)	(0.015)	(0.0488)	(0.0415)	(0.0415)	(0.0366)
I(trading income)	1.349***	-0.154***	-.07249***	-0.077***	-.0643***	-.0694***
	(0.183)	(0.031)	(0.0265)	(0.0267)	(0.0244)	(0.0253)
I(dividend)	0.290**	-0.131***	-0.0273	-0.0319	-0.0121	-0.0174
	(0.140)	(0.023)	(0.0215)	(0.0207)	(0.0212)	(0.0205)
Constant	9.52***	11.16***	0.6342	1.037*	1.206**	1.666***
	(0.176)	(0.029)	(0.718)	(0.612)	(0.584)	(0.523)
IM (heteroscedasticity)	272	207				
J-test			16.4	15.0	17.3	15.4
pvalue	[0.000]	[0.000]	[0.037]	[0.059]	[0.0273]	[0.051]
Weak identification			10.4	18.2	10.4	18.2

6 Robustness

6.1 Project Returns and p

In this section we consider the case in which r_H and r_L are both functions of p. Similar to the base model in which returns are constant, we assume that if a firm received $r_H(p)$ at $t = 1$, it receives $r_H(p)$ at time $t = 2$; if a firm receives $r_L(p)$ at $t = 1$, it receives nothing at $t = 2$. Clearly, it is reasonable to assume that firms with workers implementing riskier projects should have higher expected returns to those projects. However, as it turns out, to obtain our previous results we do not require any assumptions on $r_H(p)$, and only a minimal assumption on $r_L(p)$. We make the sufficient but not necessary assumption that $r'_L(p) \geq 0$. In other words, firms with safer projects have a (weakly) higher return in the low state. We begin by modifying Assumption 1 to maintain the environment as close as possible.

Assumption 3 $B = \max(r_L(p))$

The optimal amount of debt is determined in similar fashion as in the base model and it is straightforward to obtain a result equivalent to Lemma 4.

Lemma 9 *If the firm remains solvent in both states, it sets* $D^* = \frac{r_L(p)-F}{r_f(1-\eta)}$. *There exists parameters under which the firm chooses to remain solvent in both states.*

Finally, F^* and V^* are unchanged since they are neither a function of r_H nor r_L. We can now consider the three main results of the paper. First, the results of Lemma 5 are similar, since F^* and V^* are unchanged. However, since r_L is now different for each firm, we need to normalize the amount of fixed pay relative to $r_L(p)$. This is because firms with higher r_L can have more fixed wages (or debt) and still remain solvent in the low state. It is straightforward to show that the results of Lemma 5 hold when we consider the relative fixed wage using the assumption that $r'_L(p) \geq 0$. Next, it follows that the results of Lemma 6 hold noting D^* in Lemma 9, and again using the assumption that $r'_L(p) \geq 0$. As in the base model, Proposition 1 then follows as a consequence of the previous 2 lemmas. Importantly, the intuition is unchanged and so operating leverage increases when project risk increases. As in the base model, we define overall leverage (OL) as the amount of fixed pay and interest payments that a firm has; however now it must be relative to the payoff in the low state.

$$OL = \frac{r_f(1-\eta)D + F}{r_L(p)} \tag{19}$$

Plugging D^* into equation (19) again yields the result that overall leverage is constant and equal to 1. Thus, as in the base case, when project risk increases, the firm increases operating leverage, and so must decrease financial leverage to offset the change in overall leverage.

6.2 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 the simplest way possible, 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 debt holders 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:

$$p_H(r_H - V - r_L) + p_M(1-p)(r_M - r_L) - r_E\left(1 - \frac{r_L - F}{r_f(1-\eta)}\right). \tag{20}$$

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

$$\widetilde{r_D} = \frac{r_f}{1 - p_L.} \tag{21}$$

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

$$p_H(r_H - V - r_M) - \widetilde{r_E}\left(1 - \frac{r_M - F}{\widetilde{r_D}(1-\eta)}\right). \tag{22}$$

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

$$\widehat{r_D} = \frac{r_f}{p_H}. \tag{23}$$

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

$$p_H(r_H - V - F - \widehat{r_D}(1-\eta)). \tag{24}$$

The following result shows that (22) can yield the highest payoff for a firm.

Lemma 10 *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 $\frac{r_M - F}{\widetilde{r_D}(1-\eta)}$ 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 the 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 (8), 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.

7 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. On the contrary, when we introduce an agency cost, the firm may actually have to increase variable pay to control it as the probability of job termination increases. 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 support for 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 the organization should be considered when conducting future research into the relationship of project risk and leverage. In fact, although we modeled unemployment 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 the context of financial institutions we provide a new justification for why they may be highly levered and their pay skewed toward variable relative to non-financial institutions: banks tend to have lower costs of debt, and lower costs to workers of being unemployed. Thus, since they are expected to have more variable pay, they are an ideal industry on which to test our model. When better data become available, it will clearly be interesting to test the model implications for other industries.

In this paper we do not explicitly model stock options – another form of variable pay. A future direction is to consider stock options versus variable pay. 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 those from our model. If stock options are granted ex post, then the model would need to consider additional periods to capture how the option value evolves.

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8 Appendix

Proof of Lemma 2

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

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

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 (i) is derived by substituting D^* into the objective function of problem (8), and setting the inequality. Condition (ii) comes directly from setting (11) and (12) greater than zero. To show that parameters exist that satisfy conditions (i) and (ii), let $\phi \to 0$ so that $\exp(\alpha\phi) \to 1$. Consequently, the left hand inequality of condition (ii) 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 of (ii) is then satisfied whenever:

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

where the right hand side of (26) is finite. Let $\underline{C}$ be such that $\exp(\alpha\underline{C}) = \frac{1-p(1-\eta)}{(1-p)} + \epsilon$ for ϵ positive and finite. Therefore, the right hand side of condition (i) is finite and so satisfied. Finally, let r_H be sufficiently large and finite so that condition (i) is satisfied. ■

Proof of Lemma 4

Define $V_{ND} = V^*$ as the variable wage when the firm does not default as given in (11), and $F_{ND} = F^*$ as the fixed wage when the firm does not default as given in (12). 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:

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

Solving for V_{Def} yields:

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

When the firm does not default, it chooses $D_{ND} = \frac{r_L - F_{ND}}{r_f(1-\eta)}$, and the corresponding payoff denoted π_{ND} is given by:

$$\pi_{ND} = p(r_H - V_{ND} - F_{ND} - (1-\eta)r_f D_{ND}) + (1-p)(r_L - F_{ND} - (1-\eta)r_f D_{ND}) - r_f(1 - D_{ND}) \tag{29}$$

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

$$\pi_{Def} = p(r_H - V_{Def} - (1-\eta)\widetilde{r_D}) - r_f(1 - D_{Def}). \tag{30}$$

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

$$p(V_{def} - V_{ND} - F_{ND}) + (r_L - F_{ND})\left(\frac{1}{1-\eta} - p\right) - r_f\eta \geq 0. \tag{31}$$

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.

$$V_{def} - V_{ND} - F_{ND} = log((1-\eta)(1-p)) + \phi + \underline{C}. \tag{32}$$

The first term is negative since $(1-\eta)(1-p) < 0$. Clearly, this term 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 $\underline{C} \geq \hat{C}$, (31) is satisfied. From (26), it follows that $\underline{C}$ can be chosen sufficiently large so that conditions (i) and (ii) of Lemma 3 are satisfied. ■

Proof of Lemma 5

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

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:

$$\exp(\phi) < \frac{\eta p}{(1-p)^2(1-\eta)} + \frac{1-p(1-\eta)}{(1-p)(1-\eta)} \tag{33}$$

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

$$\exp(\phi) < \frac{1-p(1-\eta)}{(1-p)(1-\eta)}. \tag{34}$$

Therefore, (33) must hold since $\frac{\eta p}{(1-p)^2(1-\eta)} > 0$. ■

Proof of Lemma 6

We consider how F^*, V^*, and D^* change with all parameters. $\frac{dV^*}{d\phi} = -1 < 0$, $\frac{dF^*}{d\phi} = 1 > 0$, Lemma 6 implies $\frac{dD^*}{d\phi} = \frac{dD}{dV}\frac{dV}{d\phi} < 0$. It is straightforward to show that $\frac{dV^*}{d\eta} > 0$, $\frac{dF^*}{d\eta} < 0$. Since $D^* = \frac{r_L - F}{r_f(1-\eta)}$, D^* is increasing in η. The proof to Lemma 5 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, $\frac{dF^*}{d\underline{C}} > 0$, $\frac{dV^*}{d\underline{C}} < 0$ are trivial and since $D^* = \frac{r_L - F^*}{r_f(1-\eta)}$, it follows that $\frac{dD^*}{d\underline{C}} < 0$. Now consider α:

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

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

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. It follows that, for every parameter, 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 1

Part (i): the inequality needed follows from Lemma 5 and Lemma 6

$$\frac{dD^*}{dp} = \frac{dD^*}{dF^*}\frac{dF^*}{dp} > 0. \tag{37}$$

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 Lemma 5. ■

Proof of Lemma 10

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 (22) with (20) and (22) with (24) yields the following two conditions under which a firm chooses to default only in state L:

$$(p_H + p_M)(r_M - r_L) \leq p_H(V^*_{D1} - V^*_{ND}) + r_f\left(1 - \frac{r_L - F^*_{ND}}{r_f(1-\eta)}\right) - r_f\left(1 - \frac{r_M - F^*_{D1}}{\widetilde{r_D}(1-\eta)}\right) \tag{38}$$

$$p_H(\widehat{r_D}(1-\eta)) \geq p_H(V^*_{D1} - V^*_{D2} + r_M) + r_f\left(1 - \frac{r_M - F^*_{D1}}{\widetilde{r_D}(1-\eta)}\right). \tag{39}$$

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

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

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

$$\widehat{r_D}(1-\eta) \geq V^*_{D1} - V^*_{D2} + r_M + \frac{r_f}{p_H}\left(1 - \frac{r_M - F^*_{D1}}{r_f(1-\eta)}\right), \tag{41}$$

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