

Pay Structure, Employment Risk and Capital Structure

Jason Allen	James R. Thompson*
Bank of Canada	University of Waterloo
jallen@bankofcanada.ca	james@uwaterloo.ca

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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, e.g, agency. 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 broker-dealer industry, which contains information on variable pay across firms, we find support for our model, most notably, that capital structure can be more important than agency in determining the use of variable pay.

Keywords: Worker compensation; Job tenure; Leverage; Financial institutions

JEL: G32, G24, J33

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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? When there is an agency problem, i.e., hidden information or action related to the worker, variable pay can be used to help correct the inefficiency. Absence an agency problem, standard theory says that fixed pay is optimal. We re-visit this question and show that, when the firm's capital structure problem is incorporated, variable pay can arise endogenously, even in the absence of agency costs.

To understand why the interaction of the worker compensation and firm financing decisions is important, consider the following. First, given a subsidization to debt and bankruptcy costs, there exists an optimal overall firm leverage. Second, variable pay can be used as a means to reduce operating leverage. Finally, operating leverage and financial leverage can be substitutes. Our model incorporates these features and asks: what should happen to operating and financial leverage when project risk increases? Clearly, overall leverage should not increase; however, one might think that there should be a reduction in both operating and financial leverage. We show that to the contrary, due to a worker compensation effect, operating leverage increases. Thus, financial leverage needs to decrease by more than one may expect. Firms with riskier projects have workers who face greater employment uncertainty, more fixed pay, and lower financial leverage.

The intuition behind our theoretical results is as follows. Consider workers with risky projects that can either have a high or low return but with no capital for implementation. A firm exogenously matches with workers who possess the same project, and can pay them a fixed wage plus a variable wage conditional on a high return. For simplicity assume that workers are terminated if the return is low; the worker incurs a cost of termination. In this standard environment, it is clearly 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. Risk aversion implies that the worker receives more utility from fixed wages, allowing the firm to minimize its wage bill.

Now consider a firm that needs to raise money for projects and does so through debt and equity. Assuming that debt is subsidized relative to equity, in the presence of bankruptcy costs, the firm opts to take on as much debt as possible while avoiding the possibility of bankruptcy in the low state. 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 to 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 the bankruptcy costs). Firms with

projects having a higher probability of success will pay workers with more variable pay. 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, our model makes the novel prediction that firms with less employment uncertainty will have more variable pay and higher financial leverage.

Next, we embed a standard agency problem into the model to create a wedge between worker and firm preferences: workers may now shirk and take a private benefit; however, doing so will cause the project to fail with certainty. To control this problem, the firm uses variable pay, which allows the worker to experience the project upside potential. The results are the opposite of our capital structure mechanism: workers with high unemployment risk need incentive not to shirk. Thus, in this case unemployment and variable pay are positively correlated. Looking at both the capital structure channel and agency mechanisms together, to determine which one dominates requires a comparison between two key variables: the amount by which debt is subsidized versus the severity of the worker agency problem. This then becomes an empirical question to which we bring to the data and show evidence of the importance of our capital structure channel.

Our model produces clear testable implications; however, there is little data available that could identify variable pay across firms and over time. We use detailed firm-level data on variable wages for Canadian financial institutions as well as information on their balance sheets, income statements, and employment numbers. We therefore examine our model in the context of banks, which tend to have subsidized debt (e.g. the survey by Gorton and Winton (2003)) and lower unemployment costs relative to workers at non-banks (Jacobson et al. (1994) and Morissette et al. (2007)). When debt is cheaper, firms have an incentive to use more of it and do so by increasing the amount of variable pay. 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 predictions of the model: high variable pay (Lemieux et al. (2009)) and high leverage (Gornall and Strebulaev (2013)).

Using panel data on Canadian broker-dealers, we test the relationships predicted in the model. We do this by constructing a measure of firm-specific unemployment risk based on turnover and show how variation in unemployment risk across firms has implications for the composition of wages and ultimately leverage. In particular, we show that unemployment risk and variable wage are negatively correlated and therefore consistent with our model of

capital structure and inconsistent with a model of agency. We first show this by estimating a system of seemingly unrelated regressions with wages and leverage as our variables of interest. Given the concern that leverage and wages are endogenous, we then use an approach that combines traditional instrumental variables estimation with the use of generated instruments (Lewbel (2012)). The reason for this approach is that leverage is jointly determined by fixed and variable wages and these are both determined by unemployment risk. Generated instruments allow us to (over-)identify the model and test its validity. In contrast to a model with agency problems, we show that when capital structure is taken into account, low unemployment risk is correlated with high variable pay and high leverage.

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 endogenize 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 heterogeneous workers and explicitly consider the capital structure problem. As such, we are able to obtain predictions on what types of firms should have more/less variable wages and higher/lower 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. The empirical evidence is mixed, however, on the trade-off between risk and incentives implied by the standard agency model (Prendergast (1999)). Partly due to data limitations, much of the agency literature has focused on management compensation. It is impossible to do justice to this literature; however, three prominent examples include Jensen and Murphy (1990), Hall and Liebman (1998), and Milbourn (2003). By focusing only on management, a seemingly important piece of the compensation puzzle is missed. Aon Hewitt report that over 90% of the companies they surveyed in 2015 had some form of variable compensation and now comprises 12.7% of payrolls, accounting for almost all of the observed increase in total

wages paid to workers.^{1,2} Furthermore, Lemieux et al. (2009) report, using the PSID, that 41.6% of non-management workers receive variable compensation, going as high as 75% for non-management professionals. Our theory therefore focuses on variable pay for all workers.

Recently, 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 sans renegotiation. See also Himmelberg and Hubbard (2000) and Lustig et al. (2011) for the use of variable pay for retention purposes. 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 as in the previous literature.

Finally, our paper contributes to the debate about unemployment risk and financial leverage. Understanding the mechanism that drives this relationship has important implications for labor policies as well as financial regulation. Simintzi et al. (2014) 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. Workers who face lower unemployment risk require lower pay, which allows firms to increase debt. These papers all use exogenous changes in the cost of firing to identify a relationship between job risk and financial leverage. The different mechanisms, however, lead to different implications for leverage. We take the cost of firing as fixed but focus instead on unemployment risk. Our model can be seen as providing theoretical underpinnings to the empirical analysis of Agrawal and Matsa (2013). That paper shows that if the cost of being fired decreases for a worker, the firm can pay less wages and thus take on more leverage.

The remainder of the paper is as follows. Section 2 presents the model of workers and firms. Section 3 provides the main comparative statics. Section 4 extends the model to include an agency problem. In Section 5 we present the data and the empirical tests of the model. Section 6 contains two extensions of the baseline model. Section 7 concludes.

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

²A well known example of a construction company that has adopted pay-at-risk schemes is Caterpillar. See <http://www.reuters.com/article/us-usa-workers-pay-analysis-idUSBRE98005N20130901>.

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 in period t , which is given by:

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

where C_t is consumption in period t and α is the coefficient of absolute risk aversion. 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.

A worker is penniless but can implement 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*). Clearly it makes sense to allow r_H and r_L to be a function of p , since different projects should have both different risk and returns; however, 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 make this assumption going forward, 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 $t = 1$. If the low state occurs, then we assume that the investment returns nothing at $t = 2$. Thus, it is obvious that if the investment is in the low state at $t = 1$, it will be optimal for the firm to terminate the worker, which we assume comes with a cost ϕ to that worker.³ For reasons of tractability, we assume that, if

³In 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

the investment is in the high state at $t = 1$, the worker suffers no cost of being fired; however, this is not crucial.⁴ 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 normal-

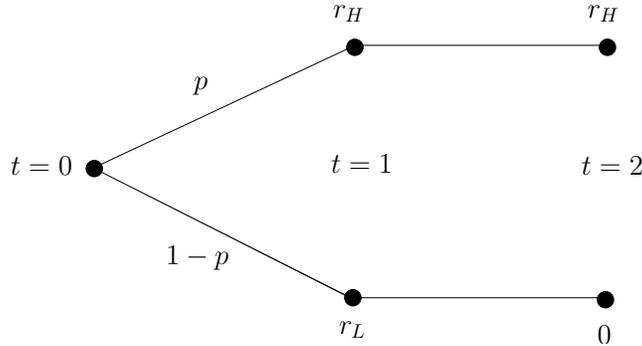


Figure 1: **Timing and payoffs of the investment**

ized to one at both $t = 0$ and $t = 1$. The firm provides the funding for the workers and so the firm is the project owner. Workers have an outside option, for example, other employment opportunities, that 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 $t = 1$.⁵ 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 created a model where the second period solution is relatively straightforward. In Section

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 have cutting 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.

⁴One can imagine that this arises from an (un-modelled) information environment in which worker type is revealed to the market as being high when the state of the world is high, and low when the state of the world is low. If the worker does have a cost of being fired in the high state, then this would complicate the firm problem (to be outlined below) 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.

⁵With 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.

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 when analyzing the problem between $t = 0, 1$. Thus, for expositional purposes, we begin by analyzing the model at $t = 0$.

First, we rule out two cases which merit discussion. One, firms do not offer 2-period contracts wherein they commit to never terminate 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, one could imagine this arising. However, this is not dynamically consistent since a worker in the low state produces nothing at $t = 2$ and the firm would always terminate (shown formally in Section 3.3). If, on the other hand, contracts could be written wherein the firm could legally commit to not terminating 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.⁶ The second case which we rule out is the firm pre-committing to paying ϕ for the worker. This too, however, is not dynamically consistent. There are, however, real-world examples of firms offsetting some worker expenses. 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, reputation, etc.⁷

Since workers do not own the equity in the project, they do not receive the proceeds of the investment directly; however, 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 whether the state of the world is L or H (the return is r_L or r_H), and V as variable wages since these are contingent on state H . 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

$$p [u_1(V + F)] + (1 - p) [u_1(F - \phi)]. \quad (3)$$

⁶If 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.

⁷All of our main results to come will obtain even in the case in which $\phi = 0$, which is equivalent to 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 for their empirical analysis that workers must bear some cost when fired, i.e., $\phi > 0$ in the context of our model.

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 have 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 only complicate our analysis without offering us insight into the mechanism which we study. 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. In other words, 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 raises an amount of funds normalized to 1.⁸ 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 induce the worker to invest in the project. We assume that firms 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 for simplicity, we also assume that debt holders are risk neutral, 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 literature driven largely by a perceived tax advantage of debt over equity (see, for example, Graham (2000) and references therein and in particular Gorton and Winton (2003) for financial institutions). To this end, we let the cost of debt, from the perspective of the firm, be subsidized by a factor of $1 - \eta$.⁹

In Assumption 2 we will restrict the parameter space to that which yields the firm positive profit in equilibrium and as a consequence, the firm does not fail in the high state. Consequently, the stark set-up of the model implies that there are two key regions to analyze:

⁸The 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.

⁹In essence, we are analyzing 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.

the one in which the firm succeeds in the low state, and the one in which it fails. If the firm chooses a sufficiently small 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 $r'_E(D) \geq 0$.¹⁰ 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 from the firms perspective. Note that the rate of return on equity is an expected return and so is not necessarily the rate that they will actually receive. Conversely, the rate of return on debt is an interest rate, not an expected rate of return. Conversely, 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 assumption on the bankruptcy cost B : it wipes out all stakeholders.¹¹

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, $D > \frac{r_L - F}{(1 - \eta)r_f}$. The firm's payoff for a given $\{V, F, D\}$ is given by

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

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

¹⁰Since 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.

¹¹It should be noted that this assumption isn't necessary. Without it, there will be a recovery value that, upon bankruptcy, must be shared between debt holders and workers according to some rule.

$\eta r_f D$. The second term represents the return 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

$$p[r_H - V - D(1 - \eta)\widetilde{r}_D]. \quad (5)$$

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—it is restricted to using variable wages. We now consider the constrained optimization problem of the firm both when it can and cannot fail. Consider first the case in which it cannot fail, $D \leq \frac{r_L - F}{(1 - \eta)r_f}$ (note that in this case, both the interest rate on debt, and the expected return on equity is r_f).

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

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 and so only variable pay is possible.

$$\begin{aligned} \max_{V, D} \Pi &= p[r_H - V - D(1 - \eta)\widetilde{r}_D] + (1 - p)[0] - \widetilde{r}_E(1 - D) \quad (7) \\ &\text{subject to } p u_1(V) + (1 - p) u_1(-\phi) \geq \underline{u}, \\ &\quad \Pi \geq 0. \end{aligned}$$

Where, as discussed above, $\widetilde{r}_D = \frac{r_f}{p}$ and $\widetilde{r}_E = r_f$. As a consequence of Assumption 1 and the fact that debt is subsidized at a rate η , the firm has two choices. First, it can choose the highest level of debt that will still maintain its solvency in all states. Alternatively, it can finance the investment exclusively with debt and face the bankruptcy cost in the low state.

The following lemma summarizes these two choices.

Lemma 1 *The firm sets 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 the amount of debt, D^* , which just ensures it remains solvent. Conditional on bankruptcy, the firm chooses to raise funds completely with debt. We will 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.¹² We can now rewrite the firm optimization problem given $D^* = \frac{r_L - F}{(1-\eta)r_f}$ from Lemma 1.

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

3 Equilibrium and Comparative Statics

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

To begin, we consider results in the absence of variable pay, $V \equiv 0$. Importantly, this case is distinct from the case 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 then allow us to see the incremental effect of our proposed mechanism. Setting $V = 0$ in (8), it is obvious 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’.

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

¹²It 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.

Using the assumption that utility is exponential yields the following:

$$F_{NV}^* = \frac{\log(p + (1-p)\exp(\phi))}{\alpha} + \underline{C}. \quad (10)$$

We can now perform comparative statics. In order to easily refer to it below when we consider variable pay, 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) $\frac{dD}{dp}\Big|_{NV} > 0$

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 $D^* = \frac{r_L - F}{(1-\eta)r_f}$ from Lemma 1, 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. We exclude the non-negativity constraint on the expected payoff of the firm, and consider it in Lemma 3. After obtaining the first-order conditions, and using the fact that utility is exponential, we have the following solutions:

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

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

We now restrict the parameter space to implement the $\Pi \geq 0$ restriction 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 $F^* > 0$).¹³ The following result derives the necessary

¹³The 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, $V^* > 0$.

and sufficient conditions under which $\Pi \geq 0$, $V^* > 0$, $F^* > 0$ and shows that parameters exist that satisfy these conditions.

Lemma 3

- i.* 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).
- ii.* If $\frac{1-p(1-\eta)}{(1-p)(1-\eta)} > \exp(\alpha\phi) > \frac{1-p(1-\eta)}{(1-p)\exp(\alpha\underline{C})}$, then $V^* > 0$ and $F^* > 0$.

There exist parameters under which these conditions hold simultaneously.

Proof. See Appendix.

The proof shows that one set of parameters that satisfies the two conditions are \underline{C} and r_H sufficiently high and ϕ sufficiently small. The first condition is relatively straightforward. The higher r_H , the larger the payoff to the firm in the high state. Clearly, a sufficiently large r_H can be chosen to ensure that the firm makes non-negative profits since r_H is exogenous. Note that this condition also ensures that the firm does not fail in the high state. To understand the second condition, consider that, when the cost of job termination (ϕ) is high, fixed pay is favored since it hedges the state in which the worker is terminated. Alternatively, when the cost of job termination is low, the firm favors variable pay. It is this second case that is most interesting, since in standard 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, which, if sufficiently subsidized, is desirable.

Given V^* and F^* defined in (11) and (12), we can now show a simple condition under which the firm always chooses a level of debt D^* such that they never default. 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 fail 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 will still exist values for η such that the firm chooses never to default. To maintain focus, we now consider 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 riskiness of the projects that the workers of a given firm possess (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 with variable pay. 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 every exogenous variable that affects both the amount of debt and the 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. Note that there is one exogenous variable, r_L , that affects only the amount of debt. 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 the firm can sustain. Thus, if the relative amount of fixed pay decreases (due to a change in an exogenous parameter of our model), the firm can take on more financial debt. If the amount of variable pay increases (due to a change in an exogenous parameter of our model), then debt increases due to a corresponding decrease in F . It is worth highlighting the relationship between the cost of job termination (ϕ), and leverage. In the proof we show that as the cost of job termination increases, variable wages decrease, fixed wages increase and so leverage decreases. This is consistent with Agrawal and Matsa (2013) who show that as the cost of workers being terminated decreases, firms will increase financial leverage.

From part (ii) Lemma 2, it is clear that even absent variable pay, p is related to leverage. Importantly however, variable pay and fixed pay act as substitutes, so affect the relationship between employment risk and leverage. 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 affect 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 is found easily by considering 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 shows 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 an 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 relative that a firm has, relative to the payoff in the low state.

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

Plugging D^* into (14) yields the result that overall leverage is constant and equal to 1. This follows easily from the fact that all firms choose the amount of debt such that they do not default. This better illuminates the mechanism behind our result: 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. 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 at both time periods, 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 , $r_D^2 = (1 - \eta)r_f$ as the required rate of return to debt, and $r_E^2 = r_f$ as the required rate of return to equity. If the investment is in the high state, then it returns r_H with certainty. Given debt is assumed to be subsidized, the firm optimally sets the amount of debt to 1 since it cannot go bankrupt.¹⁴ The firm problem becomes

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

It is straightforward to show that the choice between fixed and variable pay is irrelevant since variable pay is not actually variable. 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.¹⁵

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 $t = 1$). If we relaxed the assumption that the worker does not discount utility over the three periods, it will have no effect on 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. The purpose, however, is different. Variable pay in this case is used to align preferences between workers and the

¹⁴Given the subsidy to debt, it is simplest to assume that profits earned between $t = 0$ and $t = 1$ are paid out as a dividend at $t = 1$, since they would not be used for re-investment. 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).

¹⁵Note that a worker still receives the outside option \underline{C} when fired; however, it is not received from the firm in question.

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.

In the preceding results, we assumed that a worker had only a choice between accepting the wage contract they were offered, or taking an outside option. We now relax 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 . If the worker does not shirk, we assume that the project is identical to Section 2. If they do shirk however, 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. 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 a worker can receive V only if they do not shirk.

We have opted for such a simple agency setup since the analysis with agency 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:

$$pu_1(V + F) + (1 - p)u_1(F - \phi) \geq u_1(F - \phi + s). \quad (16)$$

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.*

Lemma 7 says that the agency problem can only affect the optimal wage contract when the project is sufficiently risky (p is low). The reason for this is that 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 (project risk) 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. In that case, 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, the firm need not provide any additional incentives to prevent shirking, as long as the project is not too risky. 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 $p < \hat{p}$ then variable pay relative to fixed pay is increasing in the probability of job termination.*

The intuition behind this result is best gleaned by considering the new constraint (16). When a firm needs to induce a worker not to shirk, it provides 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 (s is high) 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: a testable implication of the model as to which mechanism is responsible for variable wages, 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.

5 Empirical Implications

Our theoretical model generates testable comparative statics. Most importantly, we show theoretically that when a firm jointly determines its wage and capital structure, and workers face unemployment risk, the probability of job separation and variable wages are negatively correlated. On the other hand, if agency problems exist, variable wages and the probability of job separation are positively correlated. We therefore have our first testable hypothesis, which corresponds to Proposition 2:

H1: Variable wages 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. Otherwise, leverage and the probability of job separation would be positively correlated (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 (for which broker-dealers are a member), 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 show that a lower cost of job termination (ϕ) leads to more variable wages and higher leverage. In addition, we show that a higher debt subsidy (η) also leads to more variable wages and higher leverage. Therefore, given the existence of relatively high variable wages 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).¹⁶ 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.¹⁷

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.

Table I presents summary statistics on the cross-section of firms for the main variables

¹⁶The blank report schedules are publicly available. <http://tinyurl.com/11st4v4>.

¹⁷Many small firms first start off trading only mutual funds and are 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.

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 (although we cannot distinguish the exact amount) and therefore closer to equity than debt.¹⁸

Our results are qualitatively similar when non-industry-subordinated debt is included; however, leverage is substantially higher in some cases.¹⁹ 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 might be due to a number of regulatory and structural factors (Ratnovski and Huang (2009)). It is more likely, however, stemming from the substantial heterogeneity in the set of broker-dealers in our sample relative to the typical set of bank holding companies studied in the literature. More than two-thirds of the broker-dealers with leverage below 50 are small retail firms. These firms are in the bottom decile of firm size, both in terms of assets and number of employees, and rely on retained earnings. The benefit of having a wide cross-section of firms is being able to compare the compensation structures of vastly different capital structures, even within the same industry.

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.²⁰ 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

¹⁸To 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.

¹⁹Average 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 our data was collected, while at the same time experimenting with the possibility that non-industry-subordinated debt might be miss-classified.

²⁰For robustness, we also look at 7.5% and 10% and have qualitatively similar results. The idea is to capture firms with significant turnover.

Table I: **Summary statistics**

The sample is from 1992 to 2010 and on average 179 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. $I(\text{dividend})$ is an indicator variable equal to 1 if the firm issued a dividend and 0 otherwise. $I(\text{trading income})$ is an indicator variable equal to one if a bank generated trading revenue. Non-allowable assets are those 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
$I(\text{dividend})$ (%)	30	32			
$I(\text{trading income})$ (%)	81	34			
Non-allowable assets/assets (%)	11	14	1	6	26

firms.^{21,22}

Wages are decomposed into three segments.²³ First is fixed wages (FW). Fixed wages

²¹Alternatively we could average over the observed turnover rate regardless of size. We want to capture relatively large movements in unemployment which is why we average over the indicator variable.

²²Note that, in the data, we cannot separately identify firing from voluntary departures. There are a number of reasons why job termination in this industry, however, might not be considered voluntary. First, almost all firms have a no-competitor clause which introduces important switching costs. In addition, bonuses are often deferred, especially any stock options, which can further lead to large switching costs (Morris and Wilhelm (2007)) and reduce turnover (Aldatmaz et al. (2014)).

²³Wages are based on average wages for all non-executive broker-dealers in the firm, irrespective of hierarchy. Efung et al. (2014) do not find that the correlation between variable pay and trading volume/volatility is overly sensitive to whether or not wages are equally weighted or weighted by hierarchy within their set

are included in total operating expenses. For 12 financial institutions we have the breakdown of operating expenses into fixed wages and other operating expenses through access to the confidential Canadian tri-agency database managed by the Bank of Canada, the Office of the Superintendent of Financial Institutions, and the Canada Deposit Insurance Corporation. Total operating expenses include fixed wages and costs related to buildings and equipment. Wages are consistently 50% of operating expenses (standard deviation of 1.3%); therefore, we apply this rule for all financial institutions. In addition to fixed wages, there are two types of bonuses. 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. Importantly, these are payouts only to registered representatives and institutional and professional trading personnel. Bonuses to management are excluded, both discretionary and contractual. Importantly, the theoretical model relates leverage and job separation to variable pay, and therefore we need variable pay to be correctly measured.

Total wages is the sum of its three components. In Canadian dollars (deflated using 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. On average, total wages are similar to those reported in the introduction for analysts and specialists.

The average return on assets is an impressive 5.5, but with substantial variation (The median ROA is 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. Each employee, on average, 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

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. Note also that we use wages to denote labor earnings since we do not have data on hours.

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 aim to present evidence consistent with $H1$ and $H2$, which are simply Proposition 2 and 1, respectively. 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 some insight into the correlations predicted by the model and allows for correlated errors. Although informative, it does not provide for a complete test of the model or allow for endogeneity. In our second approach, therefore, 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. We also include group fixed effects (small/large interacted with retail/institutional). We include size as a control for several reasons but largely 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. The dividend indicator variable potentially captures 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.²⁴ 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 $\beta > 0$

²⁴Although our theory model in its current form cannot 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.

if agency problems are first-order.

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

where the explanatory variables, X , are highlighted above. 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 II 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 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. Larger firms tend to offer wage contracts that are skewed towards fixed wages, which is consistent with Michelacci and Quadrini (2008). We also find variable compensation and dividend pay-outs are positively correlated and document a negative correlation between variable wages and non-allowable assets (illiquidity). The more illiquid a banks' portfolio the higher the fraction of pay that is fixed. Finally, we point out that both the correlation of variables 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 obvious 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 regression and the leverage regression (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 reasons we do not control for.

Table II: SUR estimation

The dependent variable in columns (1) and (4) is total variable wage, defined as discretionary bonuses plus contractual bonuses. The dependent variable in columns (2) and (5) is 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 calculated using the bootstrap. 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*** (0.163)	0.180*** (0.0273)	-0.0430*** (0.0112)	-0.535*** (0.163)	0.180*** (0.0273)	-0.0525*** (0.0106)
log(size)	-0.0444 (0.0276)	0.0406*** (0.00462)	0.0644*** (0.00189)	-0.0444 (0.0276)	0.0406*** (0.00462)	0.0653*** (0.00179)
Nonallowable assets	-3.970*** (0.543)	0.663*** (0.0910)	-0.934*** (0.0373)	-3.970*** (0.543)	0.663*** (0.0910)	-1.054*** (0.0353)
log(rev/employee)	0.475*** (0.0902)	0.712*** (0.0151)	-0.0590*** (0.00620)	0.475*** (0.0902)	0.712*** (0.0151)	-0.0599*** (0.00586)
I(dividend)	0.290** (0.140)	-0.131*** (0.0234)	-0.0207** (0.00959)	0.290** (0.140)	-0.131*** (0.0234)	-0.00138 (0.00907)
I(trading income)	1.349*** (0.183)	-0.154*** (0.0307)	-0.0442*** (0.0126)	1.349*** (0.183)	-0.154*** (0.0307)	-0.0378*** (0.0119)
Constant	4.738*** (1.022)	1.488*** (0.171)	0.415*** (0.0702)	4.738*** (1.022)	1.488*** (0.171)	0.390*** (0.0664)

One reason could be cash flow risk. The model is constructed such that workers with riskier projects are more likely to be terminated. Thus, we should expect to see a positive relationship in the data between project (cash flow) risk and employment uncertainty. If we include cash flow risk—proxied by volatility of revenue, however, the negative correlation falls from (0.25 and 0.2) to (0.24 and 0.19), which is not significant.²⁵

There are two potential concerns with the SUR regressions. First, if our mechanism is correct, the probability of job termination affects leverage via wages. Therefore the direct effect captured in Table II is not a complete test of the model. Second, leverage is endogenous to wages. We should therefore take this into account in our estimation. Thus we use an instrumental variables approach. The assumption is that the probability of job

²⁵Results available upon request.

termination is exogenous to wages and wages are endogenous to leverage. In our system of equations, however, we only have one exogenous variable—job termination—and two endogenous variables—variable and fixed wages. We therefore generate regressors in a manner outlined in Lewbel (2012). 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. The higher the degree of heteroscedasticity in the errors, the higher the correlation between the generated instruments and the included endogenous variables. The sufficient conditions for identification, therefore, are that $E[X\epsilon] = 0$ and $cov[Z, \epsilon] = 0$ and that at least some of the Z exhibit heteroscedasticity. To achieve this we include in Z our one valid instrument ($\text{pr}(\text{job termination})$) and the demeaned regressors multiplied by the residuals: $(X_j - \bar{X})\epsilon$. Note that the regressors are, in this case, not the X 's but the demeaned X 's (except in the case where the regressor is binary). Table III 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 qualitatively similar to those using SUR. 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. Focusing therefore on columns (4) and (6) we observe first from the J-test that the model specification cannot be rejected. Unfortunately the generated instruments are somewhat weak, with an F-test of about 10. This is because the residuals are not too close to being homoscedastic. With weak identification the coefficients are biased towards the ols coefficients. Using the probability of job termination in addition to the generated instruments, however, greatly improves identification. That is, it is the differences across firms in unemployment risk are crucial to the model.

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. Recalling Proposition 1, this result suggests that variable pay is a key mechanism for explaining variation in financial

leverage. In addition, we have the same qualitative results as in Table II for the exogenous regressors. Leverage is increasing in firm size, but decreasing in illiquidity, dividends and trading activity. Non-allowable assets work against operating leverage because they are similar to fixed pay whereas for dividends it is well known that they are sticky, and therefore behave similar to debt.

Table III: Instrumental variable estimation

All variables except the wages and 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. Variable wages (TVW) is total variable wage, 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 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)	-0.338*** (0.130)	0.166*** (0.026)				
log(TVW)			0.0249*** (0.00483)	0.0233*** (0.00469)	0.0139*** (0.0036)	0.0133*** (0.0035)
log(F)			-0.01472 (0.059)	-0.0505 (0.0492)	-0.0535 (0.0502)	-0.130*** (0.0432)
log(size)	-0.0249 (0.025)	0.0413*** (0.0045)	0.0663*** (0.00582)	0.0677*** (0.00585)	0.0689*** (0.0055)	0.0704*** (0.00567)
nonallowable assets	-3.776*** (0.564)	0.716*** (0.0967)	-0.8461*** (0.102)	-0.8257*** (0.102)	-0.961*** (0.0939)	-0.938*** (0.0913)
log(rev/employee)	0.718*** (0.0675)	0.701*** (0.018)	-0.0585 (0.0488)	-0.0325 (0.0415)	-0.0226 (0.0415)	.00713 (0.0366)
I(trading income)	1.345*** (0.160)	-0.135*** (0.0256)	-.07249*** (0.0265)	-0.077*** (0.0267)	-.0643*** (0.0244)	-.0694*** (0.0253)
I(dividend)	0.257** (0.1304)	-0.123*** (0.024)	-0.0273 (0.0215)	-0.0319 (0.0207)	-0.0121 (0.0212)	-0.0174 (0.0205)
Constant	10.72*** (0.058)	10.99*** (0.012)	0.6342 (0.718)	1.037* (0.612)	1.206** (0.584)	1.666*** (0.523)
J-test			16.4	15.0	17.3	15.4
pvalue			(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, the optimal 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 it is again noteworthy that operating leverage actually 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 as a result, 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:

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

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 $p_H \widetilde{r}_D + (1 - p_H + p_L) \widetilde{r}_D = r_f$:

$$\widetilde{r}_D = \frac{r_f}{1 - p_L}. \quad (21)$$

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

$$p_H(r_H - V - r_M) - \widetilde{r}_E \left(1 - \frac{r_M - F}{\widetilde{r}_D(1-\eta)} \right). \quad (22)$$

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 the solution to $p_H \widehat{r}_D = r_f$:

$$\widehat{r}_D = \frac{r_f}{p_H}. \quad (23)$$

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

$$p_H(r_H - V - F - \widehat{r}_D(1-\eta)). \quad (24)$$

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 projects with risk 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. There are two main testable implications, for which we find empirical support using a novel data set composed of Canadian investment broker-dealers. We show that firms that are less likely to dismiss workers pay more variable wages. This is despite there being no agency problems. Once we take into account the firm's capital structure decision, variable pay arises endogenously. In contrast, if agency costs were severe, variable pay would be increasing in job risk. In addition, we find that firms paying more variable wages have higher leverage, and so firms that are more likely to dismiss workers have lower leverage. In the context of financial institutions we provide a new justification for why they may be highly levered, and why their wage structure may be skewed toward variable pay relative to non-financial institutions. What drives these results is the fact that banks tend to have lower costs of debt, and lower costs to workers of being unemployed. As data becomes available, it would be interesting to test the model implications for other industries. In industries with large agency problems, firms will have to use more variable pay to control the problem, and therefore the correlation between unemployment risk and pay structure could be driven by the agency problem as opposed to the capital structure channel we propose.

We do not in this paper explicitly model stock options – another form of variable pay. A future direction, therefore, is to consider stock options versus variable pay. Although stock options may be relegated to management in many organizations, there are firms, such as financial firms, that pay workers partly with 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. Interestingly, if our model was relaxed to allow heterogeneity among workers, the payoff of stock options could, for example, be high at the same time a worker's project is in the L state. In that case, stock options would actually be a hedge against the state in which the worker is dismissed, thus performing the same function as fixed pay. In any case, the operating flexibility that stock options would create could allow more debt through the same mechanism explored in this paper.

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8 Appendix

Proof of Lemma 2

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

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

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

Proof of Lemma 3

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

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

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, there Assumption 1 implies that the workers receive nothing, therefore, only variable wages is possible. Given workers must be paid the outside option \underline{C} , define V_{Def} as the variable wage which must satisfy (recalling that utility is exponential):

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

Solving for V_{Def} yields:

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

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:

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

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

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

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 can now obtain the condition under which a firm will choose not to default, $\pi_{ND} - \pi_{Def} \geq 0$.

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

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

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

The first term is negative since $(1-\eta)(1-p)$. 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 $\eta > 0$.

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

where again the inequality follows from $\eta > 0$. 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 the condition and simplifying yields:

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

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

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

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

Proof of Lemma 6

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

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

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

where the inequality in (35) follows since $\frac{1-p}{1-p(1-\eta)} < 1$, and the inequality in (36) follows since $\frac{1-p(1-\eta)}{(1-p)(1-\eta)} > 1$. 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 is negatively correlated with leverage and variable pay is positively correlated with leverage. ■

Proof of Proposition 1

Part (i):

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

where the inequality follows from Lemma 5 and Lemma 6. 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 . Note that no fix wage is possible in this case. Comparing (22) with (20) and (22) with (24) yields the following two conditions under which a firm chooses to default only in state L :

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

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

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

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

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

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

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 $\eta \rightarrow 0$ and r_M sufficiently small. ■