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When high-powered incentive contracts reduce performance: Choking under pressure as a screening device

Christina E. Bannier*and Eberhard Feess†

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Abstract

Empirical and experimental papers find that high-powered incentives may reduce performance rather than improve it; a phenomenon referred to as "choking under pressure". We show that competition for high ability workers nevertheless leads firms to offer high bonus payments, thereby deliberately accepting pressure-induced performance reductions. Bonus payments allow for a separating equilibrium in which only high ability workers choose high-powered incentive contracts. Low ability workers receive fixed payments and produce their maximum output which, however, is still below the reduced output of high ability workers. Bonus payments lead to a social loss which is increasing in the degree of competition. Our paper helps to explain why steep incentive schemes are persistent in highly-competitive in-

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dustries such as investment banking, and why the observed performance sensitivity of CEO compensation is largely heterogeneous.

JEL Classification: D86, J31, J33

Keywords: Performance-related pay, screening, choking under pressure, competition

1 Introduction

Performance-related pay is common in many industries and among various layers of business hierarchies. Payment schemes in upper management typically feature a strong "bonus" component, as do - traditionally - those in sales departments or in investment banking. While performance-based pay has clearly been introduced to motivate individuals to increase their effort and improve performance, recent experimental work has shown that providing high incentives may lead to lower performance (Ariely et al., 2009). Such *choking under pressure* (Baumeister, 1984) may be explained by increased arousal beyond an optimal level of motivation, by shifting behavior from "automatic" to "controlled", or by a simple pre-occupation of the laborer with the reward itself. According to psychological research, pressure-induced performance decrements are strongly triggered by monetary incentives, but also by peer pressure or via public evaluation (Beilock and DeCaro, 2007; Beilock, 2008). The choking phenomenon is also well-known in professional sports where the percentage of missed penalties or the frequency of wrong decisions made by referees, for instance, is increasing in the importance of the event (Dohmen, 2008).

Performance-related pay schemes became increasingly popular in the 1980s and 1990s. While initially reserved for the professional-level employee, they have lately also been introduced at lower hierarchy levels. However, CEO remuneration has been particularly boosted by bonuses in the last two decades (Kaplan and Rauh, 2007; Gabaix and Landier, 2008). In 2008, average CEOs in large U.S. companies received more than 75% of their overall compensation in the form of performance-related pay (The Economist, September 17, 2009). Given these extremely high-powered incentive schemes, there is clearly a risk of the positive impact on effort being outweighed by choking under pressure. If this is the case, however, why would firms then deliberately offer such contracts

resulting in lower performance? Our paper provides a rationale: we show that high-powered monetary incentives can be used as a screening device in competitive markets. In our model, there are high ability and low ability workers whose types are private information. Both types are susceptible to choking under pressure which is common knowledge. Then, firms will screen potential employees by offering a menu of fixed and output-related payments such that only high ability types will pick high-powered incentive contracts. This reduces the output of high ability types, but their performance will still be above those of low ability types. Such a separating equilibrium exists under plausible conditions, and despite the inefficiency caused by the bonus payments, no firm will deviate as it would otherwise only attract low ability types. Still, the equilibrium is inefficient from a social point of view as bonuses reduce performance, and the only incentive to offer them in our model is to "steal" high ability workers from competitors.

Whereas the early literature on performance-based pay has mainly focused on the productivity-increasing effects of incentive provision (Holmstrom and Milgrom, 1987; Gibbons, 1987; Baker, 1992) and on problems of its implementation, in particular regarding performance measurement (Prendergast, 1999), our paper is related to the theory that considers variable payments as screening devices to attract workers with higher unobservable abilities (Lazear, 1986). This literature usually assumes uncertain output and risk averse workers (Balmaceda, 2004; Moen and Rosen, 2005; Lazear, 2005), and self-selection of highly productive workers into pay-for-performance jobs is then shown to occur either because they have stronger incentives to pay the higher monitoring costs required by output-based pay, or because it is cheaper for them to bear the higher compensation risk if output is uncertain. Recently, theoretical work on executive compensation shifted to particular industries such as investment banking and their specific moral hazard problems (Axelson and Bond, 2009) or to so-called superstars economics and the question whether CEOs are paid based on talent or rather on

power (Baranchuk, MacDonald and Yang, 2007; Falato, 2007).

In the theoretical literature just described, variable payments unambiguously increase output, but the empirical evidence is less clear (Jensen and Murphy, 1990; Haubrich, 1994; Garen, 1994; Booth and Frank, 1999; Lazear, 2000). Most empirical studies find only a mild average sensitivity of CEO pay to firm performance, and sensitivities vary greatly with industry and firm size. Still, most economists agree upon the benefits of bonus payments (Murphy, 1999; Hall and Liebman, 1998; Cole and Mehran, 2008), but the huge increases in salaries in the financial industry due to performance pay (Kaplan and Rauh, 2007) and the onset of the financial crisis have triggered heated debates about pay structures, particularly in investment banking (Narayanan, 2009). Note that our model does *not* contradict the empirical consent that variable payments and performance are positively correlated as long as it is impossible to control perfectly for ability: In our model, high ability types get higher variable wages *and* produce higher output than low ability workers, but they produce lower output than they would with lower variable payments.

In contrast to economists, social scientists often favour the view that high-powered incentives do not unambiguously lead to better performance (Beilock and Carr, 2005; Smithey Fulmer, 2009). Recently, the phenomenon has been analyzed experimentally by economists, and they find that choking under pressure is likely to occur if variable payments exceed a critical threshold (Ariely et al., 2009). But then, why should firms offer performance-reducing variable payments in equilibrium?

Our paper contributes to this question in several ways. The *first* and most fundamental result is that firms may have incentives to deliberately design high-powered incentive schemes leading to lower performance of high ability workers in order to reduce the information rent of low ability workers. Hence, self-selection occurs even without resorting to monitoring costs or risk aversion. Rather, high ability workers choose

steeply-incentivized contracts because they prefer enduring the choking phenomenon to being mistaken for (and paid like) low ability employees.

Second, we are interested in how competition between principals affects this socially inefficient incentive. We model this in the simplest manner by assuming two principals competing for an agent, and by allowing agents to have different productivity when working for the two principals. We find that excessive incentives are maximum when firms are identical (Bertrand competition), and that the efficiency loss is lower when monopolistic power is higher. Moreover, the socially efficient pooling equilibrium without excessive incentives arises with a monopolistic principal. It follows that, in our setting, competition has a detrimental impact on incentives and performance. This result corresponds to recent findings by Leslie and Oyer (2009) who report that managers in private equity (PE)-owned companies are offered much steeper incentives than in comparable public firms, since the PE industry has become significantly more competitive in the late 1990s and early 2000s. Still, they find little evidence that PE firms display higher profitability than public companies.

Third, we analyze how the equilibrium configuration changes when high and low ability workers are differently susceptible to choking under pressure. We find that the variable payment decreases in the high ability type's sensitivity to the choking phenomenon, but increases in the low ability type's sensitivity. While the latter decreases social welfare, the high-type's sensitivity effect on welfare is ambiguous.

The paper is organized as follows: Section 2 presents the model. In section 3, we characterize the separating equilibrium where high-powered incentive schemes reduce the performance of high ability individuals. Section 4 analyzes the detrimental impact of competition between principals. Section 5 discusses how the equilibrium configuration changes when high and low ability workers are differently affected by choking under pressure, and section 6 compares separating and pooling equilibria. We conclude in

section 7.

2 The model

In our model, there are two principals $k = A, B$ competing for an agent. The agent's type $i = H, L$ is private information, and is high (H) with probability α and low (L) with probability $1 - \alpha$. The agent's reservation level of utility is normalized to 0 regardless of her type. The output produced by type i depends on the variable wage $w \geq 0$ per unit of output and is denoted by $Y_i^k(w)$. We assume $\frac{dY_i^k(w)}{dw} < 0$ and $\frac{d^2Y_i^k(w)}{dw^2} \leq 0$ to capture the negative impact of variable payments discussed in the introduction. When the variable payment is the same for both types, then the high type produces higher output, i.e. $Y_H^k(w) > Y_L^k(w)\ \forall w$. For notational convenience, let $Y_i^k(0) \equiv \overline{Y}_i^k$.

Principals compete for the agent by simultaneously offering take-it-or-leave-it contracts $\Omega^k = (F^k, w^k)$, where F^k represents fixed wages. We denote the set of different contracts proposed by principal k as $\mathbf{\Omega}^k$. If type i accepts contract Ω, her utility is

$$U_i^k(\Omega) = F + wY_i^k(w).$$

We define $\widehat{U}_i^k$ as the maximum utility agent i can get from principal k, and each type will choose the contract that maximizes $\widehat{U}_i^k$, $k = A, B$. To simplify the exposition, we introduce without loss of generality the tie-breaking rule that both types accept principal A's offer if $\widehat{U}_i^A = \widehat{U}_i^B$.

To analyze the impact of competition between principals, we assume $Y_i^B(w) = \beta Y_i^A(w)\ \forall w$ where $\beta \leq 1$. Thus, each agent reaches her highest productivity when working for principal A, and the higher β, the higher is the competition with principal B. $\beta = 1$ represents Bertrand-competition for the agent, and $\beta \to 0$ expresses a monopolistic principal A. In this sense, the degree of competition endogenizes the

agent's exit option from principal A's point of view, and we will see that the degree of competition captured by β has interesting and clear-cut consequences on the equilibrium contracts offered by principal A.

With two types of agents, each principal will suggest at most two contracts, and we denote by $\Omega_i^k = (F_i^k, w_i^k)$ the contract principal k wants agent i to accept.

The sequence of the game is as follows:

- *Stage 0*: Nature chooses the agent's type. This becomes private information.
- *Stage 1*: Principals simultaneously offer contracts to the agent.
- *Stage 2*: Depending on her type, the agent chooses her utility-maximizing contract.
- *Stage 3*: Output and payments are realized.

3 Equilibrium analysis

In this section, we analyze the properties of a separating equilibrium in which principal A attracts the two types with different contracts. In this regard, assume that principal B offers a set of contracts which yields $\widehat{U}_H^B > \widehat{U}_L^B$, i.e. the maximum utility the high type can obtain from the contracts offered by principal B is higher than the low type's. This assumption is intuitive as the high type has higher productivity, and principal B will hence be willing to offer higher salaries. We will prove later on that $\widehat{U}_H^B > \widehat{U}_L^B$ indeed holds in the subgame perfect equilibrium if a separating equilibrium exists.

When both agent types accept contracts offered by principal A, then A's expected profit is

$$\Pi^A(\cdot) = \alpha\left[\left(1-w_H^A\right)Y_H^A\left(w_H^A\right) - F_H^A\right] + (1-\alpha)\left[\left(1-w_L^A\right)Y_L^A\left(w_L^A\right) - F_L^A\right]. \quad (1)$$

The incentive compatibility constraints *(ICC)* and participation constraints *(PC)* principal A must observe are[1]

$$\begin{aligned} \text{(ICCH)} \quad &: \quad F_H^A + w_H^A Y_H(w_H^A) \geq F_L^A + w_L^A Y_H(w_L^A) \\ \text{(PCH)} \quad &: \quad F_H^A + w_H^A Y_H(w_H^A) \geq \widehat{U}_H^B \end{aligned}$$

and

$$\begin{aligned} \text{(ICCL)} \quad &: \quad F_L^A + w_L^A Y_L(w_L^A) \geq F_H^A + w_H^A Y_L(w_H^A) \\ \text{(PCL)} \quad &: \quad F_L^A + w_L^A Y_L(w_L^A) \geq \widehat{U}_L^B \ , \end{aligned}$$

where the first (last) two restrictions refer to the high (low) type. We will then make use of the following Lemma:

Lemma 1 *In the optimal menu of contracts in a separating equilibrium,* (i) *the wage for the low type is zero,* $w_L^A = 0$*;* (ii) *the high type's incentive compatibility constraint* (ICCH) *is non-binding:* $F_H^A + w_H^A Y_H(w_H^A) > F_L^A + w_L^A Y_H(w_L^A)$*;* (iii) *the high type's participation constraint* (PCH) *is binding:* $F_H^A + w_H^A Y_H(w_H^A) = \widehat{U}_H^B$.

Proof: See Appendix.

[1] With slight abuse of terminology, we refer to the condition that type i chooses the contract offered by principal A as *participation constraint.*

For an intuition, note that the variable wage is the only screening device available as the low type's marginal rate of substitution between variable wages and fixed wages is higher than the high type's due to her lower productivity. Hence, the variable wage offered to the high type needs to be positive although this reduces productivity, but there is no reason to offer a positive variable wage to the low type. This can also be seen from the fact that only the *sum* of $F_L^A + w_L^A Y_L(w_L^A)$ enters both *(ICCL)* and *(PCL)* and explains *part (i)*.

Part (ii) mirrors the standard feature of screening equilibria that the high type has no incentive to imitate the low type. Hence, the high type's incentive compatibility constraint *(ICCH)* is slack, and it follows immediately that the principal will reduce her fixed wage (F_H^A) until the participation constraint *(PCH)* becomes binding. This explains *part (iii)*.

Following Lemma 1, we set $w_L^A = 0$, we ignore *(ICCH)* and we make use of $F_H^A + w_H^A Y_H(w_H^A) = \widehat{U}_H^B$ as *(PCH)* is binding. Then, principal A's simplified maximization problem can be written as

$$\begin{aligned} \max_{w_H^A, F_L^A} \quad & \Big[\alpha \left(Y_H\left(w_H^A\right) - \widehat{U}_H^B\right) + (1-\alpha)\left(\overline{Y}_L - F_L^A\right) + \lambda_{PCL}\left(F_L^A - \hat{U}_L^B\right) \\ & + \lambda_{ICCL}\left(F_L^A - \widehat{U}_H^B + w_H^A\left[Y_H(w_H^A) - Y_L(w_H^A)\right]\right)\Big]. \end{aligned} \tag{2}$$

Next, let us define $\Delta\widehat{U}^B \equiv \widehat{U}_H^B - \widehat{U}_L^B$ as the difference in the utilities the two agent types could get when signing contracts offered by principal B. The following Proposition states that the variable wage principal A designs for the high type depends crucially on $\Delta\widehat{U}^B$:

Proposition 1 *Suppose a separating equilibrium exists. Then, the variable wage in the contract designed for the high type depends on $\Delta\widehat{U}^B$, and two regions can be distinguished:*

Region (1): If $\Delta\widehat{U}^B \geq c$, then the low type's participation constraint (PCL) is non-binding in equilibrium, and the high type's variable wage $w_H^A = w_H^{FOC}$ is implicitly defined by

$$\alpha \frac{dY_H^A}{dw_H^{FOC}} + (1-\alpha)\left(Y_H^A\left(w_H^{FOC}\right) - Y_L^A\left(w_H^{FOC}\right) + w_H^{FOC}\left(\frac{dY_H^A}{dw_H^{FOC}} - \frac{dY_L^A}{dw_H^{FOC}}\right)\right) = 0. \tag{3}$$

Region (2): If $\Delta\widehat{U}^B < c$, then the low type's participation constraint (PCL) is binding in equilibrium, and the high type's variable wage $w_H^A = \widehat{w}_H$ is implicitly defined by

$$\widehat{w}_H\left(Y_H^A(\widehat{w}_H) - Y_L^A(\widehat{w}_H)\right) = \Delta\widehat{U}^B. \tag{4}$$

The variable wage in region 2 is strictly smaller than in region 1, but strictly increasing in the utility difference the two types can get from principal B, i.e. $\widehat{w}_H < w_H^{FOC}$ and $\frac{d\widehat{w}_H}{d\left(\Delta\widehat{U}^B\right)} > 0$.

Proof: See Appendix.

Before we turn to the explanation why the utility difference $\Delta\widehat{U}^B$ determines whether or not the low type's participation constraint *(PCL)* is binding in equilibrium, let us first consider the two regions in turn. In region 1, *(PCL)* is non-binding which means that the low type receives a positive information rent, i.e. $F_L^A - \widehat{U}_L^B > 0$. When principal A designs the contract for the high type, he then faces the typical trade-off known from screening contracts with competition:[2] On the one hand, a higher variable wage offered to the high type reduces the high type's performance, and thereby also the principal's profit when actually contracting with the high type. The corresponding expected marginal loss from higher variable wages is represented by the term $\alpha\frac{dY_H^A}{dw_H^{FOC}}$

[2]In our case, competition means that, from principal A's point of view, the two agent types have different exit options.

in equation (3). On the other hand, higher variable wages in the contract designed for the high type reduce the low type's imitation incentive for any given *total* salary for the high type. The associated reduction in the marginal information rent is expressed in the remainder term of equation (3). Note that in region 1, $\widehat{U}_H^B$ and $\widehat{U}_L^B$ do not influence the variable wage w_H^{FOC} designed for the high type: If $\widehat{U}_H^B$ increases, then principal A will satisfy the high type's participation constraint by increasing the *fixed* wage, which is cheaper than increasing the *variable* wage beyond w_H^{FOC}. And if $\widehat{U}_L^B$ increases, this has no impact at all since the low type's participation constraint is non-binding by definition of region 1.

However, increasing the variable wage offered to the high type is only sensible for principal A if it allows to reduce the fixed payment to the low type (F_L^A), and thus her information rent. When the low type's participation constraint is binding, though, then the exit option to sign a contract with principal B sets a lower bound on this fixed payment given by $F_L^A = \widehat{U}_L^B$. As a consequence, principal A will only increase the variable wage for the high type up to the point where *(PCL)* becomes binding as it is useless to increase w_H^A further without being able to reduce F_L^A. Summing up, the marginal trade-off expressed by equation (3) determines the variable wage w_H^A only as long as *(PCL)* is non-binding. But as soon as *(PCL)* is binding, the variable wage is given by $\widehat{w}_H$. This explains why the variable wage for the high type is strictly higher in region 1, i.e. when *(PCL)* is non-binding.

It remains to be explained why the low type's participation constraint *(PCL)* is binding in equilibrium if and only if $\Delta\widehat{U}^B$ is *below* some critical threshold denoted by c in Proposition 1. Recalling that $\Delta\widehat{U}^B \equiv \widehat{U}_H^B - \widehat{U}_L^B$, this means that *(PCL)* is likely to be binding when $\widehat{U}_H^B$ is low and when $\widehat{U}_L^B$ is high. The impact of $\widehat{U}_L^B$ is straightforward: if $\widehat{U}_L^B$ is high, then it is ceteris paribus less likely that $F_L^A > \widehat{U}_L^B$ so that *(PCL)* were slack. It would then not make much sense to further increase w_H^A in order to decrease

F_L^A which is bounded below by a (high) exit option $\widehat{U}_L^B$. Proposition 1, however, shows that the high type's exit option expressed by $\widehat{U}_H^B$ is equally important: If $\widehat{U}_H^B$ is high, then, for any w_H^A given, principal A needs to offer a higher fixed payment to the high type (F_H^A) in order to ensure the high type's participation constraint. And the higher F_H^A, the higher must ceteris paribus be the fixed payment for the low type (F_L^A) to satisfy her incentive compatibility constraint, *(ICCL)*: $F_L^A \geq F_H^A + w_L^A(w_H^A)$. Hence, higher $\widehat{U}_H^B$ leads to higher F_L^A in the optimal screening contract, and this reduces the probability that the low type's participation constraint *(PCL)* is binding. This explains why the division of the two regions depends on the *difference* in the utilities the two agent types could obtain from principal B.

Finally, Proposition 1 states that in region 2 the variable wage is increasing in the utility difference, i.e. $\frac{d\widehat{w}_H}{d\left(\Delta\widehat{U}^B\right)} > 0$. This follows directly from the explanation above: The higher $\Delta\widehat{U}^B$, the less restrictive is the low type's participation constraint *(PCL)*, and the higher the variable wage for the high type which still allows for reductions in the fixed payment for the low type, F_L^A (and hence for reductions in her information rent).

4 The impact of competition

Based on the equilibrium analysis in section 3, we can now easily extend our arguments to the impact of competition on the separating equilibrium. Consider first the following Lemma:

Lemma 2 *The utility difference the two agent types may receive from principal B is increasing in the degree of competition β:* $\frac{\partial\left(\Delta\widehat{U}^B\right)}{\partial\beta} > 0$.

Proof: See Appendix.

For an intuition of Lemma 2, note first that principal A will always outbid principal B, so that there cannot be an equilibrium in which one or both agent types sign a contract with principal B. Still, in equilibrium principal B must do his best to attract the agent as long as he earns non-negative profits. Otherwise, principal A would offer contracts that could be outperformed by principal B. In equilibrium, principal B therefore promises both types of agents their total output so that the contracts he offers hence yield utilities of $\widehat{U}_L^B = F_L^B = \beta \overline{Y}_L^A$ and $\widehat{U}_H^B = F_H^B + w_H^B \beta Y_H^A\left(w_H^B\right) = \beta Y_H^A\left(w_H^B\right)$.[3] It then follows straightforwardly that

$$\Delta \widehat{U}^B \equiv \widehat{U}_H^B - \widehat{U}_L^B = \beta\left(Y_H^A\left(w_H^B\right) - \overline{Y}_L^A\right)$$

is increasing in β as the high type will always produce strictly higher output than the low type.

Combining Proposition 1 and Lemma 2 immediately yields our main result:

Proposition 2 *Suppose a separating equilibrium exists. Then, the variable wage in the contract designed for the high type depends on the degree of competition, β: (i) If $\beta \geq \overline{\beta}$, region 1 is reached and the optimal variable wage is given by w_H^{FOC}. If $\beta < \overline{\beta}$, region 2 is reached and the optimal variable wage is given by $\widehat{w}_H < w_H^{FOC}$. (ii) Social welfare in region 1 is independent of β, and lower than in region 2. Social welfare in region 2 is strictly decreasing in β.*

Proof: See Appendix.

At first glance, Proposition 2 may appear surprising: Fiercer competition (higher β) leads to a higher utility the low type can get from principal B, which might implicate that her participation constraint *(PCL)* is more likely to be binding in the contract

[3] Of course, principal B will also adopt a screening mechanism to implement these utilities.

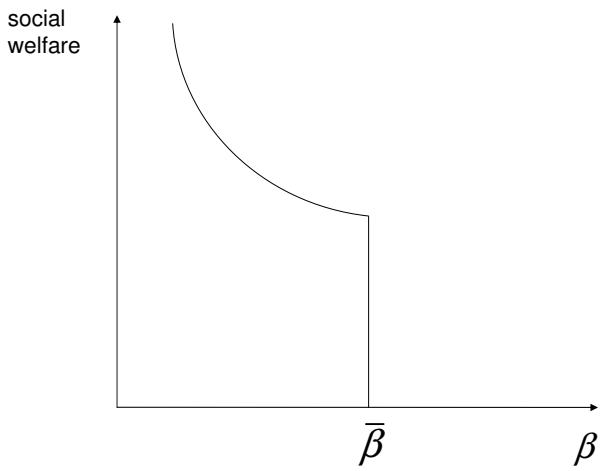
offered by principal A. This, in turn, should cap the variable wage offered to the high type. However, Proposition 1 emphasizes that the *difference* in the utilities the two agent types can get from principal B, $\Delta\widehat{U}^B$, determines whether or not *(PCL)* is binding. Given the clear-cut result that a higher degree of competition captured by β increases $\Delta\widehat{U}^B$, Proposition 2 follows immediately.

Let us now summarize the impact of competition on the separating equilibrium and on social welfare: Whenever β is below some critical threshold expressed by $\overline{\beta}$ in Proposition 2, then *(PCL)* becomes binding even *before* the wage w_H^{FOC}, which balances the marginal output reduction for the high type with the marginal rent reduction for the low type (see equation (3)), is reached. For low levels of competition, the optimal variable wage is therefore given by $\widehat{w}_H$, which is strictly increasing in β. For higher levels of competition, i.e. for $\beta \geq \overline{\beta}$, in contrast, *(PCL)* is always non-binding, and the wage is then - independently of β - given by the trade-off expressed in equation (3).

The impact on social welfare follows straightforwardly as in our model social welfare is strictly decreasing in the variable wage. Admittedly, this is a stylized assumption to capture the choking under pressure phenomenon. The crucial point, however, is that the output reduction that principal A must accept in a separating equilibrium is strictly increasing in the degree of competition. In other words, variable wages come with no social benefits: They are only used to reduce the low type's information rent. As this feature becomes more important when competition increases, the degree of competition has a detrimental effect on social welfare as depicted in Figure 1.

Despite the extreme simplicity of representing competition in our model solely by parameter β, we believe this modelling to be adequate. Its particular contribution is to endogenize the exit options of the two agent types from principal A's point of view. We believe that this is indeed the main characteristic of competition for workers: high productivity workers can only gain high wages if they can credibly threaten to

Figure 1: The effect of competition on social welfare



switch employers; otherwise they are not able to benefit from their high productivity as they have no negotiation power. Hence, β conveniently expresses the competitive threat principal B puts on principal A. It is exactly this competitive threat for the *high* type which makes the *low* type's participation constraint non-binding and leads to the socially inefficiently high variable wage in the screening contract for the high type.

5 The impact of the sensitivity of the two types

A natural question following the equilibrium analysis is how the variable wage in the contract designed for the high type is affected by the sensitivity of the two agent types to the choking under pressure-problem. To perform the comparative statics analysis in a treatable way, we consider the more specific output function

$$Y_i^A = \overline{\theta}_i - \phi_i \theta_i \left(w_i^A\right) \ , \tag{5}$$

where the maximum output when variable wages are zero is denoted by $\overline{\theta}_i$. Furthermore, we assume $\frac{d\theta_i^k\left(w_i^A\right)}{dw_i^A} > 0$, $\frac{d\left(\theta_i^k\left(w_i^A\right)\right)^2}{d\left(w_i^A\right)^2} \geq 0$, and $\overline{\theta}_H > \overline{\theta}_L$, which resembles our assumptions for the general output function used before. The higher the parameter ϕ_i, the more is type i susceptible to choking under pressure. We therefore run the comparative statics analysis with respect to ϕ_i. Our results are summarized in Proposition 3:

Proposition 3 *Suppose the high type's variable wage is given by w_H^{FOC} as defined in equation (3). Then,* (i) *the variable wage is decreasing (increasing) in the sensitivity of the high type (low type), i.e. $\frac{dw_H^{FOC}}{d\phi_H} < 0$ and $\frac{dw_H^{FOC}}{d\phi_L} > 0$.* (ii) *Social welfare is decreasing in the sensitivity of the low type, while the effect of the high type's sensitivity is ambiguous.*

Proof: See Appendix.

Part (i) shows that the exposure of the two types to the choking under pressure problem affects the trade-off between output reduction and rent reduction in an intuitive way. A higher sensitivity of the high type implies that the output reduction caused by variable wages increases. As ϕ_H has no impact on the low types's incentive to imitate, there is no countervailing effect, so that higher ϕ_H induces lower w_H^{FOC}. The opposite holds for ϕ_L, as a higher sensitivity of the low type increases the marginal rent reduction from higher variable wages, and as ϕ_L has no impact on the high type's output reduction, there is again no countervailing effect.

For *part (ii)*, recall that social welfare in a separating equilibrium is strictly decreasing in the high type's variable wage. For the specific output function defined in (5), it is given by

$$SW = \alpha \left[\overline{\theta}_H - \phi_H \theta_H \left(w_H^{FOC}\left(\phi_H, \phi_L\right)\right)\right] + (1-\alpha)\,\overline{\theta}_L.$$

A higher sensitivity of the low type increases the variable payment w_H^{FOC}, and as there is no countervailing effect, social welfare is decreasing. The reason is that the marginal rent reduction from higher variable wages is now higher, so that the principal implements higher variable wages. For ϕ_H, there are opposing effects, though. The direct effect of a higher sensitivity ϕ_H is a welfare reduction as the high type produces lower output for any positive variable wage given. However, this induces the principal to offer lower variable wages and thus induces a countervailing indirect effect. The overall impact is ambiguous and depends on the specific functional form of $\theta_H\left(w_H^A\right)$. Finally, note that Proposition 3 refers only to the case where the low type's participation constraint *(PCL)* is non-binding. Yet, extending the analysis to the case where the variable wage is given by $\widehat{w}_H$ is straightforward and adds nothing.

6 Separating vs. pooling equilibrium

So far, we have restricted our attention to separating equilibria. In the only possible pooling equilibrium, principal A offers zero variable wages as he could otherwise provide identical utilities for both agent types with higher outputs and hence higher profits. His profits in a pooling equilibrium are therefore given by

$$\Pi_P^A = \alpha\left(\overline{Y}_H - \widehat{U}_H^B\right) + (1-\alpha)\left(\overline{Y}_L - \widehat{U}_H^B\right).$$

Note that in this pooling equilibrium he needs to ensure that the high type accepts his offer, which requires $F_P^A = \widehat{U}_H^B$.[4] To see that principal A's profits in a pooling equilibrium may well be above profits in a separating equilibrium, recall first that profits in the latter case are

$$\Pi^A(\cdot) = \alpha\left(\left(1-w_H^A\right)Y_H\left(w_H^A\right) - F_H^A\right) + (1-\alpha)\left(\overline{Y}_L - F_L^A\right)$$

and that $F_H^A + w_H^A Y_H\left(w_H^A\right) = \widehat{U}_H^B$ since the high type's participation constraint *(PCH)* is binding. For simplicity, let us restrict attention this time to the case in which $\beta < \overline{\beta}$, i.e. to region 2 where *(PCL)* is binding.[5] As $F_L^A = \widehat{U}_L^B$ in region 2, profits in the separating equilibrium in region 2 are

$$\Pi_{\beta<\overline{\beta}}^A = \alpha\left(Y_H\left(w_H^A\right) - \widehat{U}_H^B\right) + (1-\alpha)\left(\overline{Y}_L - \widehat{U}_L^B\right).$$

The difference in profits from the separating vis-à-vis the pooling equilibrium is thus

[4] Subscript "P" represents a pooling equilibrium. Note that we do not have to differentiate between the salaries for the high and for the low type by definition of a pooling equilibrium.

[5] Extending to region 1 is straightforward, but considering region 2 is slightly more intuitive as it allows to substitute the endogenous variable F_L^A by the (from principal A's point of view) exogenous variable $\widehat{U}_L^B$.

$$\Delta\Pi = \Pi^A_{\beta<\overline{\beta}} - \Pi^A_P = (1-\alpha)\left(\widehat{U}^B_H - \widehat{U}^B_L\right) - \alpha\left(\overline{Y}_H - Y_H\left(w^A_H\right)\right). \tag{6}$$

According to equation (6), the principal saves $\widehat{U}^B_H - \widehat{U}^B_L$ for $\beta < \overline{\beta}$ when he meets a low type, but loses the output difference $\overline{Y}_H - Y_H\left(w^A_H\right)$ whenever he meets a high type. Hence, $\Delta\Pi$ may either be positive or negative, depending on the sensitivities of the two types to the choking under pressure-problem and on the degree of competition expressed by β. Of course, the pooling equilibrium is Pareto efficient as both types produce their maximum output, and because welfare is strictly decreasing in w^A_H. An important point to note is that pooling and separating equilibria cannot coexist in our setting, so that the equilibrium will be unique: The reason is that in stage 1 of the game, principal A will either suggest one contract (pooling equilibrium) or two contracts (separating equilibrium), depending on what will yield higher profits. In other words, *only* the pooling equilibrium or the separating equilibrium can be subgame perfect except for the non-generic case in which they yield identical profits for principal A. Note that, if principal A suggests just one contract because he prefers the pooling equilibrium, this equilibrium cannot be destroyed by principal B by offering two (screening-) contracts because this would yield negative profits.

Since we are mainly interested in characterizing the separating equilibrium, we do not wish to fully analyze the conditions under which a separating or a pooling equilibrium arise at this point. The exercise is formally tedious and does not add much to the core results of the paper. We do want to add a few remarks, though. From equation (6), it follows immediately that for $\beta \to 0$, the equilibrium is always a pooling equilibrium, as under this parameter restriction $\widehat{U}^B_H = \widehat{U}^B_L = 0$ and hence $\Delta\Pi < 0$. Clearly, the fixed wage the principal needs to pay converges to zero for both types of agents if they have no exit option, and there is hence no reason to deliberately reduce output by

offering variable wages. As a consequence, the problem of socially inefficient screening via choking under pressure can only arise with competition between principals. For $\beta > 0$, however, it can easily be shown in simulations that the impact of β on the choice of equilibrium type depends on the underlying functional forms as both $\widehat{U}_H^B - \widehat{U}_L^B$ *and* w_H^A are increasing in β. As the loss from screening contracts when meeting high types depends on $Y_H\left(w_H^A\right)$, there is no clear-cut result.[6]

7 Conclusion

In a recent paper, Ariely et al. (2009) have shown experimentally that "large stakes" may lead to "big mistakes"; a phenomenon well known by psychologists that is referred to as *choking under pressure*. Sometimes, large stakes are implied by the situation itself (and hence cannot be avoided), and most readers will remember opportunities in their personal life they have spoiled due to choking under pressure. For economists, however, a more challenging question is whether we might observe performance-reducing large stakes, in particular in the form of bonus payments, even in cases where firms can freely design the contracts offered to their (potential) employees. Our model shows that competition for high ability employees may induce firms to offer steep incentives despite their performance-reducing impacts. Assuming two types of agents, we show that a separating equilibrium arises in which high ability workers choose high-powered incentive contracts and hence endure the subsequent performance decrements, in order to avoid being mistaken for low ability agents. Both the incentive to offer bonus payments and the generated social loss increase in the degree of competition. Interestingly, the problem becomes even more pronounced when low ability workers are particularly sensitive to the choking problem as this allows for higher rent reductions through variable

[6] Of course, a pooling equilibrium becomes more likely when the percentage of high types, α, increases as this increases the expected loss from variable wages.

payments. Our results may be helpful in explaining why highly competitive industries such as investment banking or Private Equity firms offer steep bonus systems, while at the same time displaying only weakly higher profitability than comparable firms in less competitive markets (Kaplan and Rauh, 2007; Leslie and Oyer, 2009).

Some remarks regarding our assumptions are in order. We followed many papers on screening contracts by assuming that both types of agents are employed,[7] and we ignored that variable payments might be required to reduce shirking incentives. Both assumptions neglect potential advantages of bonus payments, but adding them into the model would drive the analysis convoluted without adding much to the existing literature. Furthermore, we have assumed a deterministic output function, but stochastic output and risk-aversion would obviously not affect our results in a qualitative way.

A natural question is whether our results can be tested. As for this, recall first that our model does not predict a negative correlation between variable payments and performance, but rather a positive one as the selection effect must necessarily outweigh the choking under presssure-effect in a separating equilibrium. Hence, an econometric analysis would require to control adequately for worker heterogeneity, and this seems hardly possible. We do believe, however, that our result could be tested experimentally in extending the Ariely et al. (2009)-paper by distinguishing between two settings: one resembling the original experiment, and one with an additional stage where different contracts are offered to the participants who would then, according to our model, self-select to different combinations of fixed and variable payments. We should then observe that participants who are more successful in the original experiment choose high powered incentive contracts, and that their reduced performance is still above the one of those choosing lower variable payments.

[7]For instance, in most papers on price discrimination, it is assumed that the firm wants to sell to both types of consumers.

Finally, we wish to mention other lines of research our analysis might shed light on. In our model, the negative effect of high variable payments arises through choking under pressure, but an other (and potentially even more important) channel could be excessive risk-taking. In a model similar to ours, it may then well be expected that a screening equilibrium arises where firms offer high-powered incentive contracts even though they know that this induces agents to select more risky, and unwarranted activities. While highly relevant for compensation systems, particularly in investment banking, we left these questions for future research.

Next, aspects of corporate governance may also be related to our results. Recently, economists have argued that managerial rents provided via bonus systems in competitive markets, may be driven by weak corporate governance systems (Fahlenbrach, 2009; Acharya and Volpin, 2009). In this literature, CEO compensation is seen a substitute for corporate governance, and weak corporate governance leads to high outside options for managers (re-)negotiating their contracts. In our model, high exit options arise from competition modelled simply by the parameter β, but our result that bonus payments for high ability workers are increasing in exit options is independent of where these outside opportunities come from.

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Appendix

Proof of Lemma 1

Principal A maximizes his profits

$$\Pi^A(\cdot) = \alpha\left(\left(1-w_H^A\right)Y_H^A\left(w_H^A\right) - F_H^A\right) + (1-\alpha)\left(\left(1-w_L^A\right)Y_L^A\left(w_L^A\right) - F_L^A\right) \quad (7)$$

s.t. the following incentive compatibility constraints *(ICC)* and participation constraints *(PC)*:

$$\begin{aligned} \text{(ICCH)} \quad &: \quad F_H^A + w_H^A Y_H(w_H^A) \geq F_L^A + w_L^A Y_H(w_L^A) \\ \text{(PCH)} \quad &: \quad F_H^A + w_H^A Y_H(w_H^A) \geq \widehat{U}_H^B \end{aligned}$$

and

$$\begin{aligned} \text{(ICCL)} \quad &: \quad F_L^A + w_L^A Y_L(w_L^A) \geq F_H^A + w_H^A Y_L(w_H^A) \\ \text{(PCL)} \quad &: \quad F_L^A + w_L^A Y_L(w_L^A) \geq \widehat{U}_L^B \ . \end{aligned}$$

Part (i). Define $X = \max\left(F_H^A + w_H^A Y_L(w_H^A),\ \widehat{U}_L^B\right)$. Principal A would then have to set $F_L^A + w_L^A Y_L(w_L^A) = X$ to satisfy both (ICCL) and (PCL). Substituting $F_L^A = X - w_L^A Y_L(w_L^A)$ in (7) yields

$$\Pi^A(\cdot) = \alpha\left(\left(1-w_H^A\right)Y_H^A\left(w_H^A\right) - F_H^A\right) + (1-\alpha)\left(Y_L^A\left(w_L^A\right) - X\right) \quad (8)$$

and thus

$$\frac{\partial \Pi^A(\cdot)}{\partial w_L^A} = (1-\alpha)\frac{\partial Y_L^A\left(w_L^A\right)}{\partial w_L^A} < 0. \tag{9}$$

Part (ii). Note that at most *(ICCL) or (PCL)* can be slack, but not both of them. Suppose first that *(ICCL)* is binding. Then, making use of $w_L^A = 0$, we have

$$F_L^A = F_H^A + w_H^A Y_L^A(w_H^A) < F_H^A + w_H^A Y_H^A(w_H^A)$$

as $Y_L^k(w) < Y_H^k(w)\ \forall w$. If, instead, *(PCL)* is binding, then,

$$F_L^A = \widehat{U}_L^B < \widehat{U}_H^B \leq F_H^A + w_H^A Y_H^A(w_H^A).$$

It follows that *(ICCH)* holds with strict inequality in both cases.

Part (iii). Given that *(ICCH)* will always be slack and that F_H^A enters the constraints for the low type only on the right-hand-side of *(ICCL)*, it follows immediately that the principal's profit is strictly decreasing in F_H^A, which will hence be set so that *(PCH)* holds with strict equality.

Proof of Proposition 1

Principal A's simplified maximization problem

$$\begin{aligned} L \;=\; & \alpha\left(Y_H^A\left(w_H^A\right) - \widehat{U}_H^B\right) + (1-\alpha)\left(\overline{Y}_L^A - F_L^A\right) + \lambda_{PCL}\left(F_L^A - \hat{U}_L^B\right) \\ & + \lambda_{ICCL}\left(F_L^A - \widehat{U}_H^B + w_H^A\left[Y_H^A(w_H^A) - Y_L(w_H^A)\right]\right) \end{aligned} \tag{10}$$

yields the first-order conditions

$$\frac{\partial L}{\partial w_H^A} = \alpha \frac{dY_H^A}{dw_H^A} + \lambda_{ICCL} \left(Y_H^A(w_H^A) - Y_L^A(w_H^A) + w_H^A \left(\frac{dY_H^A}{dw_H^A} - \frac{dY_L^A}{dw_H^A} \right) \right) = 0 \qquad (11)$$

and

$$\frac{\partial L}{\partial F_L^A} = -(1-\alpha) + \lambda_{PCL} + \lambda_{ICCL} = 0\,. \qquad (12)$$

The existence of a separating equilibrium requires that

$$\frac{\partial^2 L}{\partial (w_H^A)^2} = \alpha \frac{\partial^2 Y_H^A(w_H^A)}{\partial (w_H^A)^2} + \lambda_{ICCL} \cdot \Big[2 \Big(\frac{\partial Y_H^A(w_H^A)}{\partial w_H^A} - \frac{\partial Y_L^A(w_H^A)}{\partial w_H^A} \Big) + w_H^A \Big(\frac{\partial^2 Y_H^A(w_H^A)}{\partial (w_H^A)^2} - \frac{\partial^2 Y_L^A(w_H^A)}{\partial (w_H^A)^2} \Big) \Big] < 0,$$

We assume that $\frac{\partial^2 L}{\partial (w_H^A)^2} < 0$ holds; otherwise no separating equilibrium exists and principal A sets $w_H^A = w_L^A$.

Region 1: PCL is non-binding

If $\frac{\partial^2 L}{\partial (w_H^A)^2} < 0$ holds, two cases need to be distinguished. Suppose first that (PCL) is non-binding, i.e. $\lambda_{PCL} = 0$. Then, it follows from (12) that $\lambda_{ICCL} = (1-\alpha)$. Substituting for λ_{ICCL} in (11) then yields

$$\alpha \frac{dY_H^A}{dw_H^A} + (1-\alpha) \left(\left(Y_H^A\left(w_H^A\right) - Y_L^A\left(w_H^A\right) \right) + w_H^A \left(\frac{dY_H^A}{dw_H^A} - \frac{dY_L^A}{dw_H^A} \right) \right) = 0. \qquad (13)$$

Define w_H^{FOC} as the high type's variable wage which solves Equation (13).

Region 2: PCL is binding

If *(PCL)* is binding, then $F_L^A = \hat{U}_L^B$ (as we know from Lemma 1 that $w_L^A = 0$). Substituting in *(ICCL)* yields

$$\hat{U}_L^B \geq F_H^A + w_H^A Y_L^A(w_H^A) \tag{14}$$

Furthermore, we know already that *(PCH)* is binding. Therefore, we can substitute $F_H^A = \hat{U}_H^B - w_H^A Y_H(w_H^A)$ to re-write the low type's incentive compatibility constraint as

$$\textit{(ICCL)}\text{: } w_H^A \left[Y_H^A(w_H^A) - Y_L^A(w_H^A)\right] \geq \hat{U}_H^B - \hat{U}_L^B \tag{15}$$

As this is the only constraint left and because principal A's profit is decreasing in w_H^A, he will choose the minimum feasible w_H^A, i.e. *(ICCL)* will be binding. Defining $\widehat{w}_H$ as the respective wage, we get

$$\widehat{w}_H \left[Y_H^A(\widehat{w}_H) - Y_L^A(\widehat{w}_H)\right] = \hat{U}_H^B - \hat{U}_L^B$$

as stated in Proposition 1. Finally, if $\widehat{w}_H < w^{FOC}$, then $\frac{d\Pi_A(\cdot)}{dw_H^A} < 0$ for all $w_H^A > \widehat{w}_H$ as $F_L^A = \widehat{U}_L^B$ by definition of the case considered, so that increasing w_H^A reduces the high type's output without reducing the low type's information rent. It follows that $\left(w_H^A\right)^* = \min\left(\widehat{w}_H, w^{FOC}\right)$: if *(PCL)* is non-binding, the marginal-trade off between output reduction and rent reduction expressed by equation (3) determines $\left(w_H^A\right)^*$. Otherwise, *(PCL)* sets an upper bound on $\left(w_H^A\right)^*$.

To prove that $\frac{\partial \widehat{w}_H}{\partial\left(\Delta \widehat{U}^B\right)} > 0$, define

$$V = \widehat{w}_H \left(Y_H^A(\widehat{w}_H) - Y_L^A(\widehat{w}_H)\right) - \Delta \widehat{U}^B = 0.$$

From the implicit function theorem

$$\frac{d\widehat{w}_H}{d(\Delta\widehat{U}^B)} = -\frac{\frac{\partial V}{\partial(\Delta\widehat{U}^B)}}{\frac{\partial V}{\partial\widehat{w}_H}} = -\frac{-1}{\left(Y_H^A(\widehat{w}_H) - Y_L^A(\widehat{w}_H)\right) + \widehat{w}_H\left(\frac{dY_H^A(\widehat{w}_H)}{d\widehat{w}_H} - \frac{dY_H^L(\widehat{w}_H)}{d\widehat{w}_H}\right)}.$$

The sign depends on the denominator D, so that $\frac{d\widehat{w}_H}{d\Delta\widehat{U}^B} > 0$ if $D > 0$. Note that D is just the marginal rent reduction for the low type (see equation (3)). Hence, $D > 0$ is a necessary condition for the existence of a separating equilibrium because $\frac{\partial\Pi_A(\cdot)}{\partial w_H^A}$ will be negative throughout if $\frac{\partial F_L^A}{\partial w_H^A} < 0$ is violated. Hence, if a separating equilibrium exists at all, $\frac{d\widehat{w}_H}{d(\Delta\widehat{U}^B)} > 0$. ■

Proof of Lemma 2

Suppose first that principal B offers $\widehat{U}_L^B = F_L^B = \beta\overline{Y}_L^A$ and $\widehat{U}_H^B = F_H^B + w_H^B\beta Y_H^A\left(w_H^B\right) = \beta Y_H^A\left(w_H^B\right)$. Then, $\Delta U^B = \beta\left(Y_H^A\left(w_H^B\right) - \overline{Y}_L^A\right)$ and $\frac{\partial\Delta U^B}{\partial\beta} = \left(Y_H^A\left(w_H^B\right) - \overline{Y}_L^A\right) > 0$. Given the contracts offered by principal A captured in Proposition 1, the contracts just described constitute an equilibrium: Principal A cannot deviate as at least one agent would otherwise sign a contract with principal B. And principal B cannot deviate as he would earn negative profits by offering more. To see that the equilibrium is unique (given that the equilibrium is separating at all), suppose principal B offers lower utilities. Then, principal A would also offer lower utilities as he could still attract both types, thereby earning higher profits. But this cannot be an equilibrium as principal B could then outbid principal A without earning negative profits. ■

Proof of Proposition 2

We already know that the variable wage is independent of $\Delta\widehat{U}^B$, and hence independent of β, in region 1. In region 2, we know that $\frac{d\widehat{w}_H}{d\beta} = \frac{\partial\widehat{w}_H}{\partial\left(\Delta\widehat{U}^B\right)}\frac{\partial\left(\Delta\widehat{U}^B\right)}{\partial\Delta\beta} > 0$ as both terms are positive. It remains to be shown that social welfare in a separating equilibrium is

decreasing in w_H^A. We have

$$SW = \alpha Y_H^A\left(w_H^A\right) + (1-\alpha)\,\beta \overline{Y}_L^A$$

and hence $\frac{\partial SW}{\partial w_H^A} = \alpha \frac{\partial Y_H^A}{\partial w_H^A} < 0$. ■

Proof of Proposition 3

Part (i). Given the specific output function (5), the first-order condition is

$$Z \equiv \frac{\partial L}{\partial w} = -\alpha\phi_H \frac{d\theta_H(w)}{dw} + (1-\alpha)\left(\left(Y_H^A(w) - Y_L^A(w)\right) - w\left(\phi_H \frac{d\theta_H(w)}{dw} - \phi_L \frac{d\theta_L(w)}{dw}\right)\right) = 0\,.$$

From the implicit function theorem, $\frac{dw_H^{FOC}}{d\phi_i} = -\frac{\frac{\partial Z}{\partial \phi_i}}{\frac{\partial Z}{\partial w_H^{FOC}}}$ where

$$\frac{\partial Z}{\partial \phi_H} = -\alpha \frac{d\theta_H(w_H^A)}{dw_H^A} - (1-\alpha)\left([\theta_H(w_H^A) + w\frac{d\theta_H(w_H^A)}{dw_H^A}\right) < 0,$$

$$\frac{\partial Z}{\partial \phi_L} = (1-\alpha)\left([\theta_L(w_H^A) + w\frac{d\theta_L(w_H^A)}{dw_H^A}\right) > 0$$

and where $\frac{\partial Z}{\partial w_H^{FOC}} = \frac{\partial^2 L}{\partial \left(w_H^A\right)^2} < 0$ whenever an interior solution for w_H^A exists at all. Hence, $\frac{dw_H^A}{d\phi_H} < 0$ and $\frac{dw_H^A}{d\phi_L} > 0$.

Part (ii) Recall from the text that

$$SW = \alpha\left[\overline{\theta}_H - \phi_H \theta_H\left(w_H^{FOC}(\phi_H, \phi_L)\right)\right] + (1-\alpha)\,\overline{\theta}_L.$$

Hence, $\frac{\partial(SW)}{\partial \phi_L} = -\phi_H \frac{\partial \theta_H}{\partial w_H^{FOC}} \frac{\partial w_H^{FOC}}{\partial \phi_L} < 0$ as $\phi_H \frac{\partial \theta_H}{\partial w_H^{FOC}} > 0$ and $\frac{\partial w_H^{FOC}}{\partial \phi_L} > 0$. Furthermore, $\frac{\partial(SW)}{\partial \phi_H} = -\theta_H\left(w_H^{FOC}(\phi_H, \phi_L)\right) - \phi_H \frac{\partial \theta_H}{\partial w_H^{FOC}} \frac{\partial w_H^{FOC}}{\partial \phi_H}$ where $-\theta_H\left(w_H^{FOC}(\phi_H, \phi_L)\right) < 0$, but $-\phi_H \frac{\partial \theta_H}{\partial w_H^{FOC}} \frac{\partial w_H^{FOC}}{\partial \phi_H} > 0$ as $\phi_H \frac{\partial \theta_H}{\partial w_H^{FOC}} > 0$ and $\frac{\partial w_H^{FOC}}{\partial \phi_H} < 0$. ■