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A NOTE ON USING EXCESSIVE PERKS TO RESTRAIN THE HIDDEN SAVING PROBLEM

YiLi Chien
Federal Reserve Bank of St. Louis

Joon Song
Sungkyunkwan University

We offer an explanation for why perks are overprovided to high-profile CEOs. Hidden saving by an agent makes it difficult for a principal to control the agent's moral hazard problem. However, an agent typically cannot save perks; for example, a CEO who owns the right to use a private jet for personal use cannot bank the unused airplane hours. Thus, the principal may oversupply the agent perks to avoid the hidden saving problem. When the agent can *both* exert lower effort *and* save wage income, i.e., in the presence of the *double deviation problem*, we show that the principal supplies more perks than the agent would have purchased on his own (i.e., *excessive* perks).

Keywords: Hidden Saving, Moral Hazard Problem, Double Deviation, Perks

1. INTRODUCTION

Employers often *oversupply* perks to their employees, especially to high-profile CEOs.[1] The question thus arises: Why does an employer want her employees to consume more perks than the employees would purchase on their own? A possible clue lies in the fact that many such perks are products that the employee may find difficult to put on sale, to save, or to postpone consuming. In other words, the employer can easily monitor the employee's consumption of perks, in contrast to his consumption of other goods (which we henceforth call money[2]). We consider a principal–agent framework in which the agent has a hidden saving technology for money but not for perk goods. With the hidden saving technology, the agent can deviate from the contract by exerting less effort *and* saving money at the same

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time. This phenomenon is called the *double deviation problem*.[3] We demonstrate that the principal may supply perk goods excessively (in the sense that for the amount supplied, the marginal rate of substitution between the perk good and money is smaller than the price ratio of the two goods) to mitigate the double deviation problem.

Before considering a compensation scheme including perks, we provide a benchmark model where compensation comes solely from monetary payments in the presence of hidden saving or borrowing. In the first period, the agent receives income from the principal and exerts effort. A stochastic outcome is realized, and the agent's income in the second period (given by the principal) depends on the outcome. The agent may save or borrow in the first period. In solving the benchmark model, the first-order approach may be invalid because the agent's decision problem may not be globally concave in effort and money consumption.[4] Ábrahám and Pavoni (2008) and Ábrahám et al. (2011) characterize a sufficient condition for global concavity in consumption and effort for the agent's problem, under which the first-order approach is valid. The sufficient condition for global concavity requires that the gain from double deviation be sufficiently smaller than the loss of deviation from the optimal consumption or from effort level alone.[5]

We take a different route in order to investigate the consequence of the double deviation problem. Instead of assuming global concavity and using the first-order approach in terms of effort, we assume discrete effort levels and consider the agent's optimal saving decision at each effort level.

Although abandoning the first-order approach means more complex calculation and more difficult extension to infinite-horizon problems, our approach allows us to analyze the issue of double deviation simply. First, our approach makes it possible to measure exactly how much the agent wants to save when he deviates from the contracted effort. Second, our approach does not require the assumption of global concavity.[6] Our setup of discrete effort levels makes it possible to avoid the issue of global concavity and to better focus on the issue of double deviation. Third, we generalize a result of Ábrahám et al. (2011): we show the existence of the hidden saving problem without assuming the monotone likelihood ratio property or nonincreasing absolute risk aversion. Finally, to make an analogy, our approach is to Ábrahám and Pavoni (2008) and Ábrahám et al. (2011) as Grossman and Hart (1983) is to the classical principal–agent models using the first-order approach.[7]

In the benchmark model, we characterize the agent's optimal saving choices when he chooses high effort and when he chooses low effort. If the agent's choice of saving in the first period at his low effort is smaller than the choice at high effort, then we say that *the principal faces the hidden saving problem*.[8] If the agent's choice of saving at high effort is lower than his saving at low effort, we say that the principal faces *the hidden borrowing problem*.

We show that the principal always faces the hidden saving problem: whenever the agent deviates from the contracted effort, he always saves. We prove this without assuming the monotone likelihood ratio property or nonincreasing absolute risk aversion of the agent's utility. Then we show that the double deviation problem causes intertemporal distortion, which makes it more costly for the principal to implement high effort. Finally we show that with nonincreasing absolute risk aversion and the monotone likelihood ratio property, the wage increases in outcome.

After analyzing the benchmark model, we add a perk good into this framework and explain why the principal may oversupply the perk good. We consider perks as goods that the agent cannot save because perk consumptions can be monitored at low cost by the principal, in contrast to money. For example, a CEO who owns the right to use a private jet for personal use cannot bank the unused airplane hours, yet the CEO could set up a saving account for wage income.

Because the agent's saving insures the agent against future risk, the more the agent saves, the more difficult it becomes for the principal to implement high effort. However, the principal may be able to (partially) avoid this problem by providing perks.[9] We show that the principal faces the hidden saving problem and that the second-best compensation provides more perks than the agent would have purchased on his own; that is to say, at the allocated level, the per-dollar marginal utility of money is larger than the per-dollar marginal utility of the perk good (or equivalently, the marginal rate of substitution between the perk good and money is higher than the price ratio between them). Intuitively, the difference between them depends on the severity of the moral hazard problem and how much the agent wants to save when he deviates from the contracted effort. The severity of the moral hazard problem is measured by the shadow value of the incentive compatibility constraint. The more severe the double deviation problem is, the more perks the principal wants to provide. The different saving technologies for perks and for money are the driving force of our results. We further show that the principal can make better use of perks when the perks are more complementary to money. Giving more perks increases the agent's marginal utility in money for today; thus, perks will weaken the agent's willingness to save for tomorrow.

From the aforementioned findings, we derive two testable implications. First, we expect to observe more perks when monitoring of an agent's effort is more difficult. Second, we expect that perk goods are those that are more complementary to wage income (then the other goods are).

Scholars have studied the compensation of high-profile CEOs empirically, e.g., Jensen and Murphy (1990), Murphy (1999), Yermack (1995), and Kole (1997). Others have approached this research agenda in a dynamic framework, e.g., Wang (1997), Hopenhayn and Jarque (2010), and Lustig et al. (2011), or in a matching framework, e.g., Gabaix and Landier (2008) and Edmans et al. (2009). The main focus was on answering why CEOs are paid so much. Despite the large amount of research on CEO compensation, studies on perks are very limited.

There have been two views on perks in the literature.[10] Marino and Zábojník (2008) mainly consider perks as the consumption of productive goods. Oyer (2005) considers perks that have complementarities with effort and production. The first considers perks as nonproductive goods. The principal cannot monitor whether the agent abuses them or not; thus, a moral hazard problem is present. The second view considers perks as productive goods. Specifically, Alchian and Demsetz (1972) consider perks as a remedy for a moral hazard problem rather than a source of the problem. When the members of a profit-sharing firm have to purchase input factors personally, an underinvestment problem emerges, or, equivalently, a free-rider problem occurs because each member does not fully appropriate the profit from his or her investments. If the problem is severe, it could be more efficient to give the input factors as perks even under the risk of possible abuse.

Despite the difference between these two views, they share the same assumption that an employer cannot monitor the use of perks. However, an employer is quite capable of monitoring the use of many expensive perks. For example, an employer would have very little difficulty in checking whether a private jet was used for business or for personal reasons. The monitoring cost will be insignificant compared to the cost of flying the jet. In fact, it is often a legal requirement to report such expensive perks to the public.[11] If the use of perks is observable, it should be explicitly contractible.

One might argue that perks reduce the cost of production or the cost of employees' efforts, and that an agent and a principal can save on taxes by including perks in a compensation scheme. However, many perks do not seem to help production or reduce the agent's cost of effort. For instance, corporate retreats involving horseback riding in Santa Fe, volleyball in Bari, or sailing in Greece may be useful for "team building," but more frugal destinations and activities might be equally useful.[12] Thus, we do not assume that perks reduce the cost of effort: we assume no complementarities between perks and effort, nor do we assume that perks have a productive use. Also, a principal could hypothetically report perks as a cost of production, receive a tax deduction, and therefore provide the perks at a lower cost than the agent would pay privately. However, many perks are now fully subject to tax.[13] As a result, we do not assume that a principal and an agent can exclude perks in their taxes.

Bennardo et al. (2010) assume that an agent's utility depends on effort and consumptions in a nonseparable way. They also assume that the consumption of both perks and money is monitored. When the cross derivatives between effort and monetary income and between effort and a perk good are different, they find that the principal oversupplies perks in the presence of a moral hazard problem. In the present paper, we show that excessive perks can also appear because of different hidden saving technologies for different commodities, even when the cross derivatives are identical. The agent can save money for the purpose of consumption smoothing against uncertainty in the future, but he cannot maintain perks into the next period. Therefore, the oversupply of the perk good can glean the efficiency loss from the hidden saving problem.

In Section 2, we provide a benchmark model without perks as well as an extended model with perks. We conclude in Section 3. Proofs are in the Appendix.

2. MODEL

We demonstrate the double deviation problem in our benchmark model. A principal minimizes the cost of implementing an agent's high effort, given that the agent has a hidden saving technology. We then extend the model to include a perk good.

2.1. Benchmark Model

We consider a two-period principal–agent model. The agent's consumption in periods 1 and 2 is denoted by c and w. The principal awards the agent consumption c; then the agent makes an effort, e, in the first period. There is no effort choice in the second period. This effort is the agent's private information and determines the distribution of the outcome in the second period. There are two effort levels, e_H and e_L, where $e_H > e_L$. Outcome $y \in Y \subset \mathbf{R}$ is realized at the beginning of the second period with probability $P(y|e)$ when the agent chooses effort e, where $e \in \{e_H, e_L\}$. The set of outcomes, Y, is finite. In the second period, the principal awards the agent contingent payment $w(y)$, and the agent consumes it. We assume that the principal's desired effort level is e_H. A contract is a vector $(c, (w(y))_{y\in Y})$. We also assume that there is no commitment issue in the contract.

The agent has a hidden saving/borrowing technology; i.e., the agent can transfer the first period's consumption into the second period without the principal detecting, and vice versa. (However, we will show later that the agent never wants to borrow.) Let s_k be the agent's optimal saving or dissaving when the agent makes effort e_k, $k \in \{H, L\}$. We assume that the agent faces a zero interest rate both for saving and for borrowing—a nonzero interest rate would not change our results qualitatively. Given contract $(c, (w(y))_{y\in Y})$, the agent's maximized utility is

$$\max_{s,e}\left[u(c-s)+\sum_{y}U(w(y)+s)P(y|e)-e\right],$$

where $u(\cdot)$ and $U(\cdot)$ are temporal utility functions for periods 1 and 2, respectively. Temporal utility functions $u(\cdot)$ and $U(\cdot)$ could be identical, as in the most of traditional economic models. However, we stick to the different notations to distinguish the first period and the second period utilities more conveniently. Note that there is no discount between periods 1 and 2—this simplification does not change our results qualitatively.

The principal wants to induce the agent's participation, implement high effort e_H at the lowest cost, and prevent deviation to low effort. Hence, the principal's maximization problem is

$$\max_{c,w(y)} \Big[-c - \sum_y w(y) P(y|e_H) \Big]$$

$$\text{s.t.} \Big[u(c - s_H) + \sum_y U(w(y) + s_H) P(y|e_H) - e_H \Big] \geq \bar{V} \tag{1}$$

$$(s_H, e_H) = \operatorname*{argmax}_{s,e} \Big[u(c - s) + \sum_y U(w(y) + s) P(y|e) - e \Big]. \tag{2}$$

Constraint (1) is an individual rationality constraint. The principal must guarantee the agent some minimum expected utility $\bar{V}$ to get the agent to sign the contract. We assume that the agent cannot opt out of a contract once the contract starts; thus, there is an individual rationality constraint only for period 1. The cost for $(c, (w(y))_{y \in Y})$ is identical to the cost for $(c - s, (w_H(y) + s)_{y \in Y})$ for any $s \in \mathbf{R}$, as both the agent and the principal face the same market price and interest rate. Thus, we can assume without loss of generality that the principal would award $(c, (w(y))_{y \in Y})$ such that the optimal saving was $s_H = 0$. So the individual rationality constraint becomes the following:

$$u(c) + \sum_y U(w(y)) P(y|e_H) - e_H \geq \bar{V}. \tag{3}$$

Constraint (2) is the incentive compatibility constraint. This constraint is potentially complicated because the agent can *both* exert lower effort *and* save his wage; i.e., the double deviation problem arises. However, the discrete levels of effort make it possible to simplify the constraint.

Note that the following two solutions are different in general:

$$s_H := \operatorname*{argmax}_{\tilde{s}_H} \Big[u(c - \tilde{s}_H) + \sum_y U(w(y) + \tilde{s}_H) P(y|e_H) - e_H \Big],$$

$$s_L := \operatorname*{argmax}_{\tilde{s}_L} \Big[u(c - \tilde{s}_L) + \sum_y U(w(y) + \tilde{s}_L) P(y|e_L) - e_L \Big].$$

Because we set $s_H = 0$ without loss of generality, the first-order conditions for the two problems are

$$u'(c) = \sum_y U'(w_H(y)) P(y|e_H), \tag{4}$$

$$u'(c - s_L) = \sum_y U'(w_L(y) + s_L) P(y|e_L). \tag{5}$$

The two conditions are Euler equations at effort e_H and e_L.

Using the solution s_L of the equation (5), we can write the incentive compatibility constraint into the following:

$$u(c) + \sum_y U(w(y))P(y|e_H) - e_H \geq u(c - s_L)$$
$$+ \sum_y U(w(y) + s_L)P(y|e_L) - e_L. \tag{6}$$

Instead of defining s_L as a function of $(c, (w(y))_{y \in Y})$ from equation (5) and then plugging it into constraint (6), we can use the Euler equation (5) as a constraint on the principal *as if* the principal chooses s_L as well. Thus the principal's problem is converted into

$$\max_{\{c, s_L, (w(y))_{y \in Y}\}} \left[-c - \sum w(y)P(y|e_H) \right] \text{ subject to } (3), (4), (5), \text{ and } (6).$$

Considering the envelope condition on the problem of the agent, we conjecture that constraint (5) is redundant. We confirm our conjecture by deriving equation (5) in the following maximization problem that is without constraint (5):

$$\max_{\{c, s_L, (w(y))_{y \in Y}\}} \left[-c - \sum w(y)P(y|e_H) \right] \text{ subject to } (3), (4), \text{ and } (6).$$

Let ρ, η_H, and γ be the Lagrangean multipliers for constraints (3), (4), and (6), respectively. The first order conditions with respect to $w(y)$, c, and s_L are

$$-P(y|e_H) + \rho U'(w(y))P(y|e_H) \tag{7}$$
$$+ \gamma \left[U'(w(y))P(y|e_H) - U'(w(y) + s_L)P(y|e_L)\right]$$
$$+ \eta_H \left[-U''(w(y))P(y|e_H)\right] = 0,$$

$$-1 + \rho u'(c) + \gamma \left[u'(c) - \sum U'(w(y) + s_L)P(y|e_L)\right] + \eta_H u''(c) = 0, \tag{8}$$

$$\gamma \left[-u'(c - s_L) + \sum U'(w(y) + s_L)P(y|e_L)\right] = 0. \tag{9}$$

First, we show that the shadow value of the the incentive compatibility constraint (6) is positive; thus, the constraint is binding. In other words, the incentive compatibility constraint has an impact on the principal's maximization problem.

LEMMA 1. $\gamma > 0$.

Note that we confirm our conjecture that equation (5) is redundant by applying Lemma 1 to equation (9). Thus, we can use equation (5) from now on. Using this, we prove that the shadow value of constraint (4) is also zero.

LEMMA 2. $\eta_H = 0$.

This result is not so surprising: given that the principal wants to rewards the agent when he makes effort e_H, the principal should want to maintain the Euler equation at high effort.

Now we derive the following key equations from equations (7) and (8) by applying the results of Lemma 2 to the first-order conditions:

$$\frac{1}{u'(c)} = \rho + \gamma \left[1 - \frac{u'(c - s_L)}{u'(c)} \right] \tag{10}$$

$$\frac{1}{U'(w(y))} = \rho + \gamma \left[1 - \frac{U'(w(y) + s_L)}{U'(w(y))} \frac{P(y|e_L)}{P(y|e_H)} \right]. \tag{11}$$

We next prove that the individual rationality constraint has a positive shadow value; thus, the constraint is binding. In other words, the individual rationality constraint has an impact on the principal's maximization problem.

LEMMA 3. $\rho > 0$.

Equations (10) and (11) describe how the principal balances the marginal benefits and costs in the presence of the individual rationality constraint, the moral hazard problem, and the hidden saving/borrowing problem. To illustrate this balance, consider increasing the agent's utility. There are two methods for doing this: to increase the first period consumption by $1/u'(c)$ units, and to increase the second period consumption in each output state y by $\frac{1}{U'(w(y))}$.

Using the first method, the cost of the increase is $1/u'(c)$ because the price of c is assumed to be one. This cost is represented by the left-hand side of equation (10). The first benefit of the increase comes from the relaxation of the individual rationality constraint, the benefit of which is its shadow value ρ on the right-hand side of equation (10). The second benefit of the increase is the relaxation of the incentive compatibility constraint, the benefit of which is denoted by γ. However, the second benefit comes with a cost: the agent will save some of the increased first-period consumption, which will tighten the incentive compatibility constraint, the cost of which is denoted by $\gamma \frac{u'(c-s_L)}{u'(c)}$. Thus, the second benefit net of the cost is $\gamma[1 - \frac{u'(c-s_L)}{u'(c)}]$. This net effect is negative if there is a hidden saving problem, $s_L > 0$.

To illustrate the net effect of the second method of increasing the agent's utility, we multiply the probability $P(y|e_H)$ and equation (11) and sum over all $y \in Y$. Thus we derive

$$\sum_y \frac{1}{U'(w(y))} P(y|e_H) = \rho + \gamma \left[1 - \sum_y \frac{U'(w(y) + s_L)}{U'(w(y))} P(y|e_L) \right]. \tag{12}$$

The left-hand side of the equation represents the marginal cost of the second method. The first term on the right-hand side, ρ, is the marginal benefit due to the relaxation of the individual rationality constraint. The second term on the right-hand side, $\gamma[1 - \sum_y \frac{U'(w(y)+s_L)}{U'(w(y))} P(y|e_L)]$, represents the net benefit from the relaxation of the incentive compatibility constraint. If the principal faces a hidden saving problem, the increase of the second-period consumption helps to mitigate the hidden saving problem; thus, the net effect is positive. Mathematically, $s_L > 0$

implies a positive value of the second term. In summary, these two different methods have different net effects on the principal's profit, because of the double deviation problem.

Finally, we prove that the hidden saving problem always exists.

PROPOSITION 4. *The hidden saving problem always exists; i.e.,* $s_L > 0$.

We derive the following from (10) and (12) because $s_L > 0$:

$$\frac{1}{u'(c)} < \rho < \sum_y \frac{1}{U'(w(y))} P(y|e_H). \tag{13}$$

These inequalities show that there is a difference between the net effects of providing an extra unit of utility through the first-period or the second-period consumption: the net marginal benefit of providing one extra unit of utility through the first period consumption is less than the shadow value of the individual rationality constraint, ρ, whereas the marginal benefit through the second-period consumption is greater than the shadow value. From this illustration, we can see that the hidden saving problem has an important effect on the principal's maximization problem.

Let $Y = \{1, \ldots, n\}$ be the set of outcomes. The *monotone likelihood ratio property* (MLRP) holds if: $\frac{P(y|e_H)}{P(y|e_L)}$ decreases in y, i.e., $\frac{P(y+1|e_L)}{P(y+1|e_H)} < \frac{P(y|e_L)}{P(y|e_H)}$ for all $y \in \{1, \ldots, n-1\}$. We show that $w(y)$ increases in y with MLRP and nonincreasing absolute risk aversion.

PROPOSITION 5. *Assume MLRP and that* $U(\cdot)$ *exhibits nonincreasing absolute risk aversion (NIARA). Then the optimal wage* $w(y)$ *increases in the outcome.*

Our model with discrete effort levels is complementary to Ábrahám et al. (2011). First, Proposition 4 extends a result of Ábrahám et al. (2011) to show that hidden saving exists even without the assumption of MLRP or nonincreasing absolute risk aversion. Second, we characterize the agent's maximization problems for all effort levels, and we do not need an additional condition for the validity of our approach. Third, although the wage might not increase in y with increasing absolute risk aversion, our result remains unchanged even if the monotonicity of $w(y)$ is imposed on the principal's problem.[14]

2.2. Extended Model with Perks

In this section, we show that the hidden saving problem implies the oversupply of perks. We introduce a perk good, which is denoted by d. The key difference between the monetary compensation c and the perk good d is that the agent can save c but not d. For semantic convenience, we call c "money" and $w(y)$ "wage" (or "wage scheme"). We consider this money as a composite good excluding the perk good. We normalize the price of c to be unity and define p as the price of d. A contract is $(c, d, (w(y))_{y \in Y})$.

We assume additive separability of the agent's utility function between the consumption of money and the perk good, and we denote the agent's temporal utility function by $u(c) + v(d)$. This allows us to ignore the issue of substitutability/complementarity between the perk good and money, and focus on our main insight. At then end of this section, we relax this assumption, and we show that the principal can make better use of perks when the perks are more complementary to money.

For simplicity, we assume that the principal pays only money at the end of the contract, and that the agent's second-period utility depends only on the consumption of money.[15]

Similarly to the previous section, the principal faces the following individual rationality constraint and the Euler equation when the agent chooses high effort e_H:

$$u(c) + v(d) + \sum_y U(w(y))P(y|e_H) - e_H \geq \bar{V}, \tag{14}$$

$$u'(c) - \sum_y U'(w(y))P(y|e_H) = 0. \tag{15}$$

The principal also faces the following incentive compatibility constraint:

$$\begin{aligned} u(c) + v(d) + \sum_y U(w(y))P(y|e_H) - e_H &\geq u(c - s_L) + v(d) \\ &+ \sum_y U(w(y) + s_L)P(y|e_L) - e_L, \end{aligned} \tag{16}$$

where s_L is defined by

$$u'(c - s_L) - \sum_y U'(w(y) + s_L)P(y|e_L) = 0. \tag{17}$$

Thus, the principal's problem is

$$\max_{\{c,d,w(y),s_L\}} -\sum w(y)P(y|e_H) - c - pd \text{ subject to } (14), (15), (16), \text{ and } (17). \tag{18}$$

As in the benchmark model, we can show that constraint (17) is redundant. The first-order conditions of the maximization problem (18) without constraint (17) are

$$\begin{aligned} &- P(y|e_H) + \rho U'(w(y))P(y|e_H) \\ &+ \gamma \left[U'(w(y))P(y|e_H) - U'(w(y) + s_L)P(y|e_L)\right] \\ &+ \eta_H \left[-U''(w(y))P(y|e_H)\right] = 0, \end{aligned}$$

$$- 1 + \rho u'(c) + \gamma \left[u'(c) - \sum U'(w(y) + s_L) P(y|e_L) \right] + \eta_H u''(c) = 0,$$

$$- p + \rho v'(d) = 0,$$

$$\gamma \left[-u'(c - s_L) + \sum U'(w(y) + s_L) P(y|e_L) \right] = 0.$$

Similarly to the results of the benchmark model, we derive the following lemma.

LEMMA 6. *(i)* $u'(c - s_L) = \sum_y U'(w(y) + s_L) P(y|e_L)$, *(ii)* $\rho > 0$, $\gamma > 0$, *(iii)* $\eta_H = 0$, *and (iv) the hidden saving exists, i.e.,* $s_L > 0$.

By applying the results of Lemma 6 to the first-order conditions, we derive the following two key equations:

$$\frac{p}{v'(d)} = \rho \text{ and } \frac{1}{u'(c)} + \gamma \left[\frac{u'(c - s_L)}{u'(c)} - 1 \right] = \rho. \qquad \textbf{(19)}$$

Equations (19) show that the principal balances the marginal cost and the marginal benefit of giving one extra unit of utility to the agent. The principal has two methods of increasing the agent's utility in period 1: by adding $\frac{1}{u'(d)}$ units of the perk good or by adding $\frac{1}{u'(c)}$ units of money. On one hand, the marginal benefit of either of these is the relaxed individual rationality condition, which is represented by the shadow value of the individual rationality condition, ρ, on the right-hand sides of the two equations. On the other hand, there is a difference in the marginal costs of the two different methods. First, giving one unit of utility to the agent through the perk good costs $p \times \frac{1}{u'(d)}$ units of money to the principal. Second, giving one unit of utility to the agent by giving him money *not only* costs $\frac{1}{u'(c)}$ units of money, *but also* costs $\gamma[\frac{u'(c-s_L)}{u'(c)} - 1]$ because of the hidden saving problem. The agent can save the increased monetary payment against the uncertainty in the future, and this reduced uncertainty makes it more costly for the principal to implement higher effort. This marginal cost is higher when the moral hazard problem is more severe (larger $\gamma > 0$) and/or when the hidden saving problem is more severe (larger $\frac{u'(c-s_L)}{u'(c)} > 1$, i.e., larger s_L).

From equation (19), we derive

$$\frac{1}{u'(c)} - \frac{p}{v'(d)} = \gamma \left[1 - \frac{u'(c - s_L)}{u'(c)} \right]$$

$$\Rightarrow MRS := \frac{v'(d)}{u'(c)} = \frac{p}{1 + \gamma(u'(c - s_L) - u'(c))} > p.$$

Because $u'(c - s_L) > u'(c)$, the marginal rate of substitution is lower than the price ratio p (note that the price of money is normalized to be 1). This means that, *if* the agent were allowed to sell the perk good, d, at the market price p, the agent would choose to sell some of his perks. In other words, the principal provides perks excessively.

Note that the difference between the marginal rate of substitution and the perk good's price p is larger with a larger shadow value of the incentive compatibility constraint (more severe moral hazard problem) in the presence of the hidden saving problem. From this finding, we derive a testable implication: we expect to observe fewer perks with less severe moral hazard problem. For example, it is easy to compare a fund manager's performance with other fund managers,' so that it is relatively easier for a principal to detect a fund manager's effort; hence, we expect that fund managers receive fewer perks than the other employees in other industries. In Appendix A.4, we relax the assumption of additive separability of the agent's utility function between money and the perk good, and we show that the principal can make better use of perks when perks are more complementary to money. From this finding, we derive another testable implication: we expect that a principal will provide the goods that are more complementary to money (than the other goods are) as perks.[16]

The following main proposition summarizes the main findings.

PROPOSITION 7. *For any price of the perk good (p), the principal provides the agent with more perks than the agent would have chosen if the agent were given only money. Moreover, if MLRP hold and the agent's utility function exhibits NIARA, $w(y)$ increases in y.*

3. CONCLUSION

We develop a principal–agent model with the hidden saving problem. A principal faces the hidden saving problem when the agent deviates from the optimal contract by simultaneously saving more and working less. Instead of using the first-order approach in terms of effort, we assume discrete effort levels and calculate an agent's saving/borrowing choice at each effort level. This approach allows us to measure exactly how much the agent wants to save when the agent deviates from the contracted effort. We find that the hidden saving problem always exists.

To avoid the (shadow) cost caused by the hidden saving problem, the principal may want to increase the agent's consumption of goods that the agent cannot save. We extend the developed model to explain why perks may exist. We find that the principal calculates the number of perks for the agent by measuring how much the agent wants to save when the agent deviates from the contracted effort. We also provide two testable implications of our paper. First, we expect to observe more excessive perks in an industry where monitoring is more difficult for the principal. Second, we expect that perk goods are more complementary to money than the other other goods are.

NOTES

1. For example, many people would agree that if high-profile CEOs were given more money—instead of a private jet—they would fly first class instead of renting a private jet (even at the wage that

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they receive). Our definition of being "excessive" is not that the absolute amount of perk good (given by a principal) is large, but that the amount is larger than an agent would have purchased on his own.

2. We do not assume that an employee actually consumes money. This money can be a composite good (excluding the perk goods).

3. This is different from assuming that an agent can exert less effort *or* can save/borrow money. The consideration of the simultaneous deviation makes this problem unique. For example, Farhi and Werning (2009) analyze the optimal saving distortion necessary for constrained efficiency when an agent can freely save in a risk-free asset market, and Edmans et al. (2009) study optimal executive compensation when a CEO can undo the contract by privately saving and can also temporarily inflate stock price; however, they do not consider the simultaneous deviation.

4. The first-order approach considers the agent's first-order condition (with respect to the agent's effort) as an incentive compatibility constraint. This approach essentially assumes that the agent would (locally) deviate only from the implemented effort. In this sense, the constraint is (weakly) weaker than the canonical incentive compatibility constraint, under which the agent can deviate *both* from the implemented effort *and* from the implemented consumption. Kocherlakota (2004) shows that the first-order approach is indeed invalid in a context of dynamic unemployment insurance.

5. To be precise, they assume that the distribution of output is log-convex in effort. This assumption—coupled with the monotone likelihood ratio property and nonincreasing absolute risk aversion—guarantees the condition for global concavity.

6. Kocherlakota (2004) provides a two-period model (Section 3.2 of his paper) in which global concavity is not satisfied (hence; the first-order approach is not valid). Our benchmark model is identical to this model except that the effort levels are discretized.

7. For example, Mirrlees (1976), Harris and Raviv (1979), Holmstrom (1979), Shavell (1979a, 1979b), Rogerson (1985a), and Jewitt (1988) employ and/or justify the first-order approach. On the other hand, Grossman and Hart (1983) do away with the first-order approach and assume discrete effort levels.

8. Our definition of the *hidden saving problem* is conceptually similar to the one noted by Rogerson (1985b). However, there is a subtle difference. Rogerson's terminology means the agent's incentive to save even when the agent chooses implemented effort. To avoid this problem, the principal needs to satisfy the Euler equation balancing today's marginal utility and tomorrow's (expected) marginal utility at the implemented effort. Later literature considering the double deviation problem more explicitly [such as Kocherlakota (2004), Ábrahám and Pavoni (2008), and Ábrahám et al. (2011)] uses the term in a slightly different way: even if the agent's consumption schedule already satisfies the Euler equation at the recommended effort, it may not satisfy the Euler equation at the deviated effort. Our terminology means the latter. Thus, the agent might save and borrow, at the same time while making lower effort. Formally, let $\bar{c}$ be the consumption in period 1 in the model where the principal can monitor and deter the agent's saving, c be the agent's consumption in period 1 in our model, and c_L be the agent's optimal consumption when he deviates to low effort in our model. Our hidden saving problem means $c > c_L$, but not $\bar{c} > c$.

9. However, this does not necessary mean that the principal will supply *only* perks. Providing only perks will be an extremely inefficient way to ensure the agent's participation, i.e., the individual rationality condition.

10. Yermack (2006) uses this term for the consumption of nonproductive goods and services. Jensen and Meckling (1976) and Rajan and Wulf (2006) distinguish productive and nonproductive perks.

11. For example, new rules by the Securities and Exchange Commission [SEC (2006)] require public companies to list all perks over $10,000.

12. Other examples include fancy company cars, a "training program" on a Mediterranean island, a car service home in a Lincoln town car, and a lavish corporate holiday party.

13. Because many perks are listed to the public, they are taxed. For example, Meg Whitman (eBay) was invited to use corporate planes for up to 200 hours of personal travel annually. That added up to more than $773,000, plus nearly $231,000 more to cover her tax bills for the perk.

14. We rarely observe nonmonotone contracts in the real world. There could be many reasons. For example, the principal might be afraid of the agent destroying output ex post. (Note that this is different from putting in low effort. The effort choice is ex ante whereas destroying output is ex post.) Whatever the reason is, we can think of an exogenous increasing wage constraint $w(y+1) \geq w(y)$ for $y \in \{1, \ldots, n-1\}$. This additional constraint alters only the first FOC with respect to $w(y)$, and we still can derive all the results.

15. Alternatively, we can assume that the agent needs to purchase perks good from the market in the second period. Then we can interpret $U(\cdot)$ as an indirect utility function, i.e., $U(w(y)) := \max_{c,d}[u(c) + v(d)]$ s.t. $w(y) = c + pd$.

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APPENDIX

A.1. PROOF FOR LEMMAS 1, 2, AND 3

Proof of Lemma 1. Suppose $\gamma = 0$. Then equations (7) and (8) become the following:

$$-P(y|e_H) + \rho U'(w(y))P(y|e_H) + \eta_H\left[-U''(w(y))P(y|e_H)\right] = 0, \qquad \textbf{(A.1)}$$

$$-1 + \rho u'(c) + \eta_H u''(c) = 0. \qquad \textbf{(A.2)}$$

Summing up equation (A.1) with respect to y and applying (4), we derive

$$-1 + \rho u'(c) + \eta_H\left[-\sum_y U''(w(y))P(y|e_H)\right] = 0.$$

Comparing it with equation (A.2), we conclude that $\eta_H = 0$, because $u'' < 0$ and $U'' < 0$. Plugging this back into equation (A.1), we derive that $w(y)$ is constant in y. Clearly, the enforcement of e_H will be impossible with constant $w(y)$. Thus, $\gamma = 0$ cannot be true. ■

Proof of Lemma 2. Summing up equation (7) with respect to y, subtracting equation (8), and applying equations (4) and (5), we derive $\eta_H[-\sum_y U''(w(y))P(y|e_H) - u''(c)] = 0$. Thus, we conclude that $\eta_H = 0$ because $U'' < 0$ and $u'' < 0$. ■

Proof of Lemma 3. Suppose $\rho = 0$. If $s_L \geq 0$, we derive $u'(c - s_L) \geq u'(c)$, which means that $\frac{1}{u'(c)} \leq 0$ from equation (10). However, this is impossible. If $s_L < 0$, $\frac{U'(w(y)+s_L)}{U'(w(y))} > 1$ for all $y \in Y$. Also, $\frac{P(y|e_L)}{P(y|e_H)} > 1$ for at least one y. These two facts imply that $\frac{1}{U'(w(y))} \leq 0$ for at least one y from equation (11). This is again impossible. ■

A.2. PROOF OF PROPOSITION 4

Suppose $s_L \leq 0$. Then we derive the following:

$$\frac{1}{u'(c)} \geq \rho \geq \sum_y \frac{1}{U'(w(y))} P(y|e_H) = E(\frac{1}{U'(w(y))}) > \frac{1}{\sum_y U'(w(y))P(y|e_H)}.$$

The first inequality is from (10), and the second is from (12). Clearly $w(y)$ is not constant in y (if it is, the implementation of e_H is not possible). Thus, the last strict inequality follows from Jensen's inequality, and we derive $\sum_y U'(w(y))P(y|e_H) > u'(c)$, which is a contradiction to equation (4).

A.3. PROOF FOR PROPOSITION 5

Note the following:

$$\frac{d}{dw(y)}\left[\frac{U'(w(y)+s_L)}{U'(w(y))}\right] = \frac{U'(w(y)+s_L)}{U'(w(y))}\left[\left(-\frac{U''(w(y))}{U'(w(y))}\right) - \left(-\frac{U''(w(y)+s_L)}{U'(w(y)+s_L)}\right)\right].$$

Thus, $\frac{d}{dw(y)}\left[\frac{U'(w(y)+s_L)}{U'(w(y))}\right] \geq 0$ because $s_L > 0$ and NIARA. Suppose $w(y) \geq w(y+1)$; then $\frac{U'(w(y)+s_L)}{U'(w(y))} \geq \frac{U'(w(y+1)+s_L)}{U'(w(y+1))}$. Also, $\frac{P(y|e_L)}{P(y|e_H)} > \frac{P(y+1|e_L)}{P(y+1|e_H)}$, by MLRP. These two facts imply that the right-hand side of equation (11) is increasing in y, which implies that $w(y+1) > w(y)$. This is a contradiction to the supposition. Thus, we conclude that $w(y+1) > w(y)$.

A.4. DIFFERENT UTILITY FUNCTIONS

We consider a general utility function $u(c, d)$ and characterize a condition required for the provision of excessive perks.

With this specification, we derive

$$\frac{p}{u_d(c,d)} = \rho + \left[1 - \frac{u_d(c - s_L, d)}{u_d(c,d)}\right] \text{ and } \frac{1}{u_c(c,d)} = \rho + \left[1 - \frac{u_c(c - s_L, d)}{u_c(c,d)}\right].$$

Combining the two equalities, we can derive

$$\text{MRS} := \frac{u_d(c,d)}{u_c(c,d)} = \frac{p + \gamma(u_d(c - s_L, d) - u_d(c,d))}{1 + \gamma(u_c(c - s_L, d) - u_c(c,d))}. \quad \textbf{(A.3)}$$

where $u_c(\cdot)$ denotes the partial differentiation of the utility function with respect to c, and $u_d(\cdot)$ with respect to d.

Consider the case in which the principal faces the hidden saving problem, i.e., $s_L > 0$. Then $(u_c(c - s_L, d) - u_c(c, d))$ in the denominator of equation (A.3) is approximately $-u_{cc}$; thus, it is positive. On one hand, suppose there is a complementarity between c and d. Because $s_L > 0$, $(u_d(c - s_L, d) - u_d(c, d))$ is approximately $-u_{cd}$; thus, it is negative. In this case, we derive the condition MRS $< p$. On the other hand, suppose $(u_d(c - s_L, d) - u_d(c, d))$ in the numerator is positive, i.e., the perk good d and the money good c are substitutes. Unless $(u_d(c - s_L, d) - u_d(c, d))$ is large enough, we still derive MRS $< p$. In summary, our conclusion of excessive perks remains valid unless $(u_d(c - s_L, d) - u_d(c, d)) \gg 0$.

In fact, high substitutability alone does not necessarily invalidate our result. For example, suppose the money good c and the the perk good d are perfect substitutes, i.e., the utility function is $u(c + d)$. Also, assume that the prices of the perk good and the money good are identical. In other words, the agent's utility function treats the perk good and the money good identically, and so does the principal's cost. In the presence of the hidden saving problem, the only difference is that the agent can save money good but not the perk good. Thus, the principal will provide only the perk good. This example, albeit an extreme one, shows that the basic intuition behind our result in general.