Workaholism and Managerial Incentives (Job Market Paper)

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ABSTRACT

I examine the implications of workaholism for the firm and for the manager in the context of a monopoly. There are two types of managers, workaholic and normal. In the static game, when the principal is a profit maximizing firm, the workaholic is assigned more office time than the normal and spends the entire vacation time working. On average the workaholic is paid less than the normal. The firm either hires both types of managers or, if the reservation utility is large enough, only the workaholic. A firm in a society with a higher probability of workaholism has a bigger expected profit than a firm in a lower probability of workaholism society. A workaholic in a society with a larger probability of workaholism is worse off relative to one in a lower probability of workaholism society while a normal has the same utility in either society. In case the principal is a social planner, both a workaholic and a normal in a higher probability of workaholism society are worse off than their correspondents in a society with a lower probability of workaholism. A firm in a higher probability of workaholism society is at least as well off as a firm in a lower probability of workaholism society. In the dynamic game, the optimal incentive compatible contract can be either separating or pooling in the first period depending on the discount factor. With separation, compared to the static contract, in the second period both types of managers are paid less and the normal manager works more while the workaholic puts the same hours worked. In the first period, the workaholic is paid more than with the static contract and kept full time in the office while the normal manager is assigned fewer hours worked and paid less. With pooling, the second period's contract is similar to the static one. In the first period, the workaholic manager is assigned less office time than with the static contract. Moreover, compared to the separating contract, the workaholic gets paid less and assigned less office time while the normal manager gets paid more and is assigned more office time.

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I. Introduction

This paper is the first, to my knowledge, to examine in the literature the implications of managerial workaholism in the case of a monopoly. My goal is to examine, in a principal-agent theoretical framework, the optimal contract from the perspective of the firm under adverse selection regarding the type of manager, workaholic or normal. In my setup the firm offers the manager contracts consisting of compensation and vacation hours. Given the existence of workaholism, how should the firm set the incentive scheme? Should the transfer designed for the workaholic be larger than the one designed for the normal manager, less or the same? What about the optimal duration of vacation hours? What are the welfare effects of workaholism? These questions are answered both in case of a profit maximizing principal and of a social planner principal. The conclusions section contains the main results of the paper.

The first one to use the term "workaholism" was the psychologist Oates in 1971. He defined it as "an excessive and uncontrollable need to work incessantly that disturbs health, happiness, and relationships". Since Oates' breakthrough contribution there have been many definitions of workaholism but one that stands out due to its high correlation with the results of empirical work is by Brady, Marsh, Mc Millan and O'Driscoll [2001]. According to these authors, workaholism is "a personal reluctance to disengage from work evidenced by the tendency to work (or to think about work) anytime and anywhere".

The following personal confession of a workaholic is from Coombs [2004, p 354]: "When I used to binge, I would take on a project and stay up until three or four in the morning to get finished, just compulsively thinking that morning's not going to come and that if something happened to me, I have to have it done today. That binge would go into 14 and 16 hours, and then I'd have two or three hours of sleep and then go on a roll and do this for two or three more days." Another confession of a workaholic [Coombs, 2004, page 357]: "When the kids were small and we went on picnics, I carried the blanket and picnic basket and my husband carried his briefcase. To everyone else, my husband can do nothing wrong. He denies there's anything wrong and gets hostile if I bring up workaholism".

The psychology literature has identified four different types of workaholics. Obsessive compulsive workaholics find in work the cure for personal problems, the motivation to overcome negative emotions. According to Killinger [1991, page 6], these are "people who gradually become emotionally crippled and addicted to control and power in a compulsive drive to gain approval and success. For these people work is the fix, the drug that frees them from experiencing the emotional pain of anger, hurt, guilt and fear." A different type of workaholics are the over-achievers: "productive, happy, have a high self-esteem and are driven by enjoyment to work" [Scott, Moore and Micelli, 1997, page 289]. Financially-constrained workaholics, Kemeny [2002, page 3] are

"exhausted, emotionally burdened, and suffering from stress and relationship problems because of the disproportionate amount of time and emotional energy they put into their jobs". Finally, corporate-estranged workaholics "fight with isolation and job insecurity and work hard to keep their employment" [Kemeny, 2002, page 4]. The paper proceeds as follows. Section II presents the benchmark static model of a profit maximizing principal, further analyzed in section III. Section IV explores the case of the social planner principal. Section V looks at the dynamic framework extending section III's analysis. Section VI contains the conclusions. The related literature in Economics and other disciplines is presented in section VII. All the proofs are in the appendix.

II. The benchmark model of a profit maximizing principal

My model is based on the psychological "trait theory" [Clark 1993] of workaholism that according to Brady et al [2001, page 83] "appears to be the most adequately supported by the current body of research data**".** According to this theory, "workaholism would be conceptualized as an expression of an underlying trait that became evident in late adolescence, exhibited stability across multiple employment situations and was exacerbated by environmental stimuli such as stress" (Brady et al, [2001], page 82) **.** A detailed description of this theory is found in section VII.

Let there be two risk neutral players, the firm (principal) and the manager (agent). The firm's goal is to maximize its profit and it aims at hiring the manager to oversee the production process. With a probability $p \in (0,1)$ the manager is workaholic (W) and with a probability 1-p he is normal (N). As Feldman, Ng and Sorensen [2007, page 289] note, by definition, a workaholic is an individual "who devotes long hours and *personal time* to work*".* A workaholic manager has the disutility of working per unit of time $\psi^W < 0$[2] and consequently spends all his unpaid vacation time working. A normal manager has the disutility of working per unit of time $\psi^N > 0$ and consequently spends all his vacation time as leisure.

Production time flows over a period of length 1. Let the production function be *Q(t)* with the associated marginal product function *q(t)* assumed to be a continuously differentiable and invertible function with *q(0)*>1, *q(1)*=0 and $\frac{\partial q(t)}{\partial t} < 0$ for all $t \in (0,1)$.

I assume the disutility of working of the normal manager is small enough for a positive social surplus from hiring him to be possible in the production process. A sufficient condition is: $q(0) \geq \psi^N$.

[2] I thank Gary Biglaiser for suggesting to make this disutility negative

The timing of the model is the following. *First*, nature selects the type, workaholic (W) or normal (N) of the manager. I am assuming that the manager is aware of his type but the firm (potential employer) is not. *Second*, the firm offers the manager a take-it-or-leave-it contract. Due to the revelation principle, we can restrict our attention to direct mechanisms where the message of the manager is a type declaration. Let the contract offered by the firm consist of a managerial compensation T (i) and a vacation time v(i) where $i \in \{ W, N \}$ is the type declared by the manager. *Third*, the manager decides whether to accept or not to work for the firm. If he accepts, vacation time v and managerial payment T are assigned according to the contract and output occurs at each unit of working time. If the manager rejects the offer, he is unemployed.

In my model, productive working can occur only inside of a firm, because it must lead to some output, so if unemployed the manager does not work at all. Therefore, I assume the reservation utilities are equal: $u^R(W) = u^R(N) = u^R > 0$. Note if unemployed there is no payment received for working but there may be some kind of unemployment benefit received by the manager which is assumed to be the same for both the workaholic and the normal.

The expected payoff of the firm if the type of manager is private information is:

$$E(\Pi) = p[Q(1)] + (1-p)[(Q(1-v(N))] - p(T(W)) - (1-p)(T(N)) \quad (1)$$

A workaholic manager is risk neutral and if he accepts the contract he gets the payment T (W) and spends all vacation time working. The disutility of working per unit of time is $\psi^W < 0$. Thus, a workaholic manager's payoff if he accepts the contract designed for his type is:

$$U(W) = T(W) - \psi^W \quad (2)$$

A normal manager is risk neutral and if he accepts the contract he gets the payment T(N) and spends all vacation time as leisure. This type of manager only works during office time. The disutility of working per unit of time is $\psi^N > 0$. His payoff if he accepts the contract designed for his type is:

$$U(N) = T(N) - \psi^N (1 - v(N)) \quad (3)$$

III. The profit maximizing principal and managerial workaholism

Following the revelation principle, I focus on direct mechanisms where the message sent by the manager is a type declaration $i \in \{W, N\}$, not necessarily true. The firm chooses the contract (T,v) that maximizes its expected profit:

$$E(\Pi) = pQ(1) + (1-p)Q(1-v(N)) - pT(W) - (1-p)T(N) \quad (1)$$

The participation constraints of each type of manager are:

$$T(W) - \psi^W \geq u^R \quad (5\,w)$$

$$T(N) - \psi^N(1-v(N)) \geq u^R \quad (5\,n)$$

The incentive compatibility constraints of each type of manager are:

$$T(W) - \psi^W \geq T(N) - \psi^W \quad (6\,w)$$

$$T(N) - \psi^N(1-v(N)) \geq T(W) - \psi^N(1-v(W)) \quad (6\,n)$$

The time constraints restricting vacation times are:

$$0 \leq v(W) \leq 1 \quad (7\,w)$$

$$0 \leq v(N) \leq 1 \quad (7\,n)$$

The following result presents the equilibrium set.

Proposition I. The optimal contract under adverse selection in case of a profit maximizing principal has the following properties:

a) Both the workaholic and the normal are hired if the reservation utility is such that:

$$u^R \leq Q(q^{-1}(\frac{\psi^N}{1-p})) - \frac{1}{1-p}(\psi^N q^{-1}(\frac{\psi^N}{1-p}) - p\psi^W) \quad (8)$$

The transfers and vacation times are given by:

$$\text{Workaholic: } T(W)=\psi^N q^{-1}(\frac{\psi^N}{1-p})+u^R,\ 0\leq v(W)<1-q^{-1}(\frac{\psi^N}{1-p})$$

$$\text{Normal: } \quad T(N)=\psi^N q^{-1}(\frac{\psi^N}{1-p})+u^R,\ v(N)=1-q^{-1}(\frac{\psi^N}{1-p})$$

b) Only the workaholic is hired if the reservation utility is such that:

$$Q(q^{-1}(\frac{\psi^N}{1-p})) - \frac{1}{1-p}(\psi^N q^{-1}(\frac{\psi^N}{1-p}) - p\psi^W) < u^R \quad (9)$$

The transfers and vacation times are given by:

$$\text{Workaholic: } T(W)=\psi^W+u^R,\ v(W)=0$$

$$\text{Normal: } \quad T(N)=\psi^W+u^R-\psi^N(1-q^{-1}(\psi^N)),\ v(N)=1-q^{-1}(\psi^N)$$

Proof: Appendix

There are two cases in Proposition I, depending on whether the firm hires only the workaholic or both types of managers. If the disutility of working of the normal manager is large enough or the utility of working of the workaholic is large enough, the firm hires only the workaholic because the normal becomes too expensive in relative terms. Thus, the model predicts that only the workaholic is hired if the reservation utility is large enough, say due to more generous support to the unemployed. Also, a firm in a higher probability of workaholism society will be more prone to hiring only the workaholic rather than both types of managers when compared to a firm in a lower probability of workaholism society.

In case both types of managers are hired, the workaholic spends more hours working than the normal manager because the workaholic puts in more office hours and also works during his unpaid vacation time. The firm keeps the workaholic longer in the office (and thus assigns less vacation to him) due to his lower (in fact negative) disutility of working compared to the normal.

Consequently, the workaholic produces more output than the normal. As expected, an increase in the disutility of working of the normal manager lowers his effective hours worked.

The managerial transfers are the same for the workaholic and the normal in case both types participate. This is just enough for the workaholic to be true to his type, given he works all the time, both in the office and on vacation. Paying the workaholic more than the normal is not optimal while paying less is not incentive compatible. This implies the testable hypothesis the workaholic is paid less on average for each unit worked than the normal manager. The effect of an increase in the normal manager's disutility of working ψ^N on the transfer is not obvious and it depends on two effects. On the one hand, this will decrease the hours worked by the normal manager (which lowers the transfer). On the other hand, it makes the normal manager's cost of working per unit of time larger (which increases the transfer). If ψ^N is large enough the second effect dominates and an increase in the disutility of working of the normal manager increases the transfer. As expected, an increase in the reservation utility increases the managerial transfer.

In case only the workaholic participates, he is extracted the entire surplus by the firm. Moreover, he is assigned no vacation time since the firm takes advantage of the fact the workaholic derives utility from working. Proposition II that follows present a related result.

Proposition II. Let there be two societies, A and B, that differ only in the probability of workaholism, with $p_A > p_B$. In case of a profit maximizing principal, the welfare effects of workaholism are:

i) The equilibrium expected profit of a firm is always larger in society A

ii). The equilibrium utility of a workaholic is smaller in society A in case both types of managers are hired. In contrast, if only the workaholic is hired, the equilibrium utility of such an individual is the same in both societies.

iii). The equilibrium utility of a normal manager is the same in both societies.

Proof: Appendix

According to (i), a firm in society A (with a larger probability of workaholism) has a higher expected profit than another firm in society B. This is because the output gains a firm gets in case of a higher probability of workaholism exceed the increase in managerial transfer. This holds since a workaholic manager, by Proposition I, has a lower cost of working than a normal manager and spends all the unpaid vacation time working and this makes him less expensive to hire.

Interestingly, part (ii) shows that if both types of managers participate, a workaholic manager in society A is worse off compared to another workaholic manager in society B. This is in accordance with the results of empirical work (Kilroy [2007] among others) that also finds a workaholic is negatively affected by a larger degree of workaholism. In my framework, this effect is because in case of society A, with a larger probability of workaholism, a firm will assign fewer hours worked to the normal manager compared to society B. The more likely it is the manager is workaholic, relatively more working time will be assigned to the least costly type (workaholic). This in turn will make the overall transfer of a normal manager in society A lower than in society B. Since the two types' transfers are equal (by Proposition I) in a given society, the transfer of a workaholic will also be lower in society A compared to society B. Thus, a workaholic in society A is overall worse off than a workaholic in society B because he receives a lower transfer while putting the same hours worked. The hours worked are the same in the two societies since regardless of the duration of vacation time, the workaholic works both during office time and during vacation time.

In contrast to the above, in case only the workaholic participates, the monopoly firm extracts his entire surplus hence this type of manager receives the reservation utility in either society.

Part (iii) of the Proposition is due to the fact that a normal manager earns no information rent in equilibrium hence his equilibrium payoff is not affected by a difference in the probability of workaholism between the two societies. Next, I provide an example to illustrate the effects of workaholism.

Example 1.

Let the production process in society A be represented by the marginal product function:
$q(t) = 100,000 - 100,000t$

The following parameter values have been selected:

$p_A = 0.5,\ \psi^N = 10,000,\ \psi^W = -2,000, q(0) = 100,000,\ u^R = 20,000$

Table 1 The optimal contract and output under incomplete information (society A) in case of a profit maximizing principal

Q (W)	Q(N)	v(W)	V(N)	T(W)	T(N)
50,000	48,000	0.05	0.2	28000	28000

The example compares two types of managers, the normal that spends as leisure his 0.2 vacation time and the workaholic that spends his 0.05 vacation time working. Consistent with the results in Proposition I, the workaholic puts more effective hours worked and spends more office time than the normal manager. Consequently, the output of the workaholic is larger, while both types of managers are paid the same. Hence, on average, the workaholic is paid less. Next I explore the welfare effects of workaholism by comparing society A with another society B that differs only in terms of the probability p of workaholism.

Table 2 The welfare effects of workaholism in case of a profit maximizing principal

	Society A (p=0.5)	Society B (p=0.4)
Expected profit of the firm	8,500	8,444
Utility of workaholic	30,000	30,333
Utility of normal	20,000	20,000

A firm in the society with a larger probability of workaholism (society A) has a larger expected profit than a firm in society B. While a normal manager gets the reservation utility in both societies, a workaholic in society A is worse off than a workaholic in society B. The following section studies the social planner case.

IV. The social planner principal and managerial workaholism

The social planner maximizes the expected social welfare, which is the sum of the expected profit of the firm, the utility of the workaholic and the utility of the normal (with utilities weighted by the probabilities of each manager type):

$$\max E(W) = [p(Q(1) - T(W)) + (1-p)Q(1-v(N)) - T(N))] + [p(T(W) - \psi^W)] + [(1-p)(T(N) - \psi^N(1-v(N))] \quad (10)$$

The participation constraint of the firm must hold:

$$E(\Pi) = p(Q(1) - T(W)) + (1-p)(Q(1-v(N)) - T(N)) \geq 0 \quad (11)$$

The participation constraints of each type of manager must hold:

$$T(W) - \psi^W \geq u^R \quad (12\text{ w})$$

$$T(N) - \psi^N(1-v(N)) \geq u^R \quad (12\text{ n})$$

The incentive compatibility constraints of each type of manager must hold:

$$T(W) - \psi^W \geq T(N) - \psi^W \quad (13\text{ w})$$

$$T(N) - \psi^N(1-v(N)) \geq T(W) - \psi^N(1-v(W)) \quad (13\text{ n})$$

The time constraints restricting vacation times must hold:

$$0 \leq v(W) \leq 1 \text{ and } 0 \leq v(N) \leq 1 \quad (14)$$

Proposition III. The optimal contract under adverse selection in case of a social planner principal has the following properties:

a) Both the workaholic and the normal are hired if the reservation utility is such that:

$$u^R \le pQ(1)+(1-p)Q(q^{-1}(\psi^N))+(1\text{-p})\psi^N(q^{-1}(\psi^N))-\psi^N \qquad (15)$$

The transfers and vacation times are given by:

Workaholic: $T(W)=pQ(1)+(1-p)Q(q^{-1}(\psi^N))+(1\text{-p})\psi^N(1\text{-}q^{-1}(\psi^N)),\ v(W)=0$

Normal: $T(N)=pQ(1)+(1-p)Q(q^{-1}(\psi^N))\text{-p}\psi^N(1\text{-}q^{-1}(\psi^N)),\ v(N)=1-q^{-1}(\psi^N)$

b) Only the workaholic is hired if the reservation utility is such that:

$$pQ(1)+(1-p)Q(q^{-1}(\psi^N))+(1\text{-p})\psi^N q^{-1}(\psi^N)-\psi^N<u^R \qquad (16)$$

The transfer and vacation time are given by:

$$T(W)=u^R+\psi^W,\ v(W)=0$$

Proof: Appendix

Under the optimal contract for the social planner, in case both types of managers participate, the firm's expected profit is zero. If this is not true then the planner could increase expected welfare by decreasing the hours worked by the normal manager while having all constraints holding. If the reservation utility is larger than a threshold only the workaholic is hired. The same is true if the disutility of working of the normal manager is large enough. Moreover, a planner in a higher probability of workaholism society will be more inclined to have only the workaholic hired rather than both types of managers when compared to a planner in a lower probability of workaholism society.

The workaholic manager is assigned no vacation time because the planner takes into account this type of manager derives utility from working. However, due to the fact the workaholic works all the time, his hours worked are similar with the for profit principal case. Also, the workaholic is paid more than in case of the for profit principal and consequently his utility is larger.

The social planner, while leaving the firm indifferent between participating and not, will pay a larger rent to the manager. The normal manager is paid more and works more hours than in case of

the for profit principal. This allows him to get more utility since for each hour worked the extra transfer gains are at least as large as the marginal disutility of working. However, from the two types, it is the workaholic who is paid more since he produces more output. When only the workaholic participates, he is extracted his full surplus by the firm.

Proposition IV looks at the welfare effects in case of a social planner principal. I find both a workaholic and a normal individual in society A (with a larger probability of workaholism) are worse off than their corresponding types in the society B. Hence, more workaholism exerts a negative effect on a normal individual, which interestingly is related to the result in the cooperative bargaining model of Hamermesh and Slemrod [2008], although they identify a negative effect in case of a profit maximizing firm.

Proposition IV. Let there be two societies, A and B, that differ only in the probability of workaholism, with $p_A > p_B$. In case of a social planner principal, the welfare effects of workaholism are:

i) The equilibrium expected profit of a firm is at least as large in society A

ii). The equilibrium utility of a workaholic is weakly smaller in society A

iii). The equilibrium utility of a normal manager is strictly smaller in society A

Proof: Appendix

Under the social planner's optimal contract, if both types of managers participate, a firm from either society gets zero expected profit. Moreover, the hours worked by both types of managers are the same in the two societies. This is because there is no reason to distort the normal's complete information hours worked since the workaholic doesn't want to deviate (Laffont and Tirole 1993). Also, the workaholic works all the time. What makes the difference from one society to another is what happens to the managerial transfers. A normal individual in society A (with a larger probability of workaholism) is worse off than a normal individual in society B because the transfer the former receives is smaller. A larger probability of workaholism means lower information rents need to be paid to a normal manager to stay true to his type, thus a normal manager's transfer is lower in society A. Also, a workaholic individual has a lower utility in society A compared to a workaholic in society B because the former's transfer is lower due to the lower opportunity cost of working of this type of manager. If only the workaholic participates, by Proposition III, a firm in society A has a larger expected profit and a workaholic has the same utility compared to their correspondents in society B. The following example illustrates these effects.

Example 2.

Let the production process in society A be represented by the marginal product function:

$q(t) = 100,000 - 100,000t$

The following parameter values have been selected: $p_A = 0.5,\ \psi^N = 20,000,\ \psi^W = -2,000, q(0) = 100,000,\ u^R = 5,000$

Table 3 The optimal contract and output under incomplete information (society A) in case of a social planner principal

Q (W)	Q(N)	v(W)	v(N)	T(W)	T(N)
50,000	48,000	0	0.2	51,000	47,000

In this example both types of managers participate. The workaholic is assigned no vacation time while the normal manager spends the 20% vacation time as leisure. The normal manager ends up with fewer hours worked than the workaholic manager but more than what he would work in case of a for profit principal. The workaholic works all the time which is the same like in the case of the for profit principal. The normal manager produces less output than the workaholic. Also, the transfer of the workaholic is larger than that of the normal manager. The firm makes zero expected profit overall. Next I explore the welfare effects of workaholism for a social planner principal.

Table 4 The welfare effects of workaholism in case of a social planner principal

	Society A (p=0.5)	Society B (p=0.4)
Expected profit of the firm	0	0
Utility of workaholic	53,000	53,400
Utility of workaholic	31,000	31,400

I add society B with a lower probability of workaholism for comparison reasons. Both a workaholic and a normal are worse off in society A versus their corresponding types in society B

V. The dynamic model

In this section I study the equilibrium of the repeated game for a profit maximizing principal with lack of commitment extending the static model of section III and based on Laffont and Tirole (1993). There are two periods and let $\delta>0$ be the discount factor. At the beginning of period 1, nature selects the type of manager, workaholic (W) or normal (N) and I assume the types are fixed and are private information of the manager. Let p be the prior probability the manager's type is workaholic.

At the beginning of each period $t \in (1,2)$, and after the nature's move in case of period 1, the firm offers the manager a short-term contract consisting of compensation T^t (i) and a vacation time v^t (i) where $i \in \{ W, N \}$ is the type declared by the manager. Next, in each period the manager decides whether to accept or not to work for the firm. If he accepts, vacation time and managerial payment are assigned according to the contract and output occurs at each unit of working time. If the manager rejects the offer, he is unemployed.

I am allowing for the manager to randomize between the two contracts in the first period. Let w be the probability the workaholic manager selects the contract (T^1 (W), v^1 (W)) designed for his type in period 1 and similarly let n be the probability the normal manager selects the contract (T^1 (W), v^1 (W)). Depending on the contract selected in period 1 the firm updates its belief regarding the manager's type. Let p_2 be the updated probability the manager is workaholic if contract (T^1 (W), v^1 (W)) was selected. By Bayes rule, this probability is $p_2 = \frac{wp}{wp + (1-p)n}$. Similarly, let p_3 be the updated probability the manager is workaholic if contract (T^1 (N), v^1 (N)) was selected. By Bayes rule, this probability is $p_3 = \frac{(1-w)p}{(1-w)p + (1-p)(1-n)}$.

In period two the firm faces a situation that resembles the static game except the probability of workaholism is updated like above. The second period expected profit is:

$$E(\Pi^2(p_K)) = p_k[Q(1)] + (1-p_k)[(Q(1-v^2(N))] - p_k(T^2(W)) - (1-p_k)(T^2(N)) \qquad (17)$$

where $p_k \in \{p_2, p_3\}$ is the updated probability of workaholism

The second period payoff of a workaholic manager is:

$$U^2(W) = T^2(W) - \psi^W \tag{18}$$

The second period payoff of a normal manager is:

$$U^2(N) = T^2(N) - \psi^N(1 - v^2(N)) \tag{19}$$

In period 1 the firm maximizes the lifetime discounted profit given by:

$$\begin{aligned} E(\Pi^{total}) = & [pw(Q(1) - T^1(W)) + p(1-w)(Q(1) - T^1(N)) + (1-p)n(Q(1 - v^1(\mathrm{W})) - T^1(W)) \\ & + (1-p)(1-n)(Q(1 - v^1(\mathrm{N})) - T^1(N))] + \delta[(pw + (1-p)(1-n))\Pi^2(\mathrm{p}_2) + \\ & (p(1-w) + (1-p)n)\Pi^2(\mathrm{p}_3)] \end{aligned} \tag{20}$$

where $p_k \in \{p_2, p_3\}$ is the updated probability of workaholism in period 2

In period 1 the workaholic manager maximizes his lifetime discounted utility:

$$U^{total}(W) = T^1(W) - \psi^W + \delta(T^2(W, p_2)) - \psi^W$$

where $T^2(W, p_2))$ is the second period transfer of the workaholic if in period 1 contract $(T^1(W), v^1(W))$ was chosen. The corresponding updated probability of workaholism is p_2.

In period 1 the normal manager maximizes his lifetime discounted utility:

$$U^{total}(N) = T^1(N) - \psi^N\left(1 - v^1\left(N\right)\right) + \delta(T^2(N, p_3) - \psi^N\left(1 - v^2\left(N, p_3\right)\right)\right)$$

where $T^2(N, p_3))$ is the second period transfer of the normal if in period 1 contract $(T^1(N), v^1(N))$ was chosen. The corresponding updated probability of workaholism is p_3.

Next I present the analysis of the equilibrium of the dynamic game. Each period the firm maximizes its expected profit (described above) subject to the corresponding incentive compatibility constraints, participation constraints and time constraints. In period two these constraints are similar to the one in the static model in section III.

The participation constraints of each type of manager are:

$$T^2(W)-\psi^W \geq u^R \tag{21}$$

$$T^2(N)-\psi^N(1-v^2(N)) \geq u^R \tag{22}$$

The incentive compatibility constraints of each type of manager are:

$$T^2(W)-\psi^W \geq \ T^2(N)-\psi^W \tag{23}$$

$$T^2(N)-\psi^N(1-v^2(N)) \geq T^2(W)-\psi^N(1-v^2(W)) \tag{24}$$

The time constraints restricting vacation times are:

$$0 \leq v^2(W) \leq 1 \tag{25}$$

$$0 \leq v^2(N) \leq 1 \tag{26}$$

In period 1 the constraints take into account the overall (two-stage) game, taking into account that in the second period the normal manager (similar to Proposition 1) is extracted his entire surplus by the firm.

The participation constraints of each type of manager are:

$$T^1(W)-\psi^W+\delta(T^2(W,p_2)-\psi^W) \geq u^R+\delta u^R \tag{27}$$

$$T^1(N)-\psi^N(1-v^1(N)) \geq u^R \tag{28}$$

The incentive compatibility constraints of each type of manager are:

$$T^1(W)-\psi^W+\delta(T^2(W,p_3)-\psi^W) \geq T^1(N)-\psi^W+\delta(T^2(W,p_4)-\psi^W) \tag{29}$$

$$T^1(N)-\psi^N(1-v^1(N)) \geq T^1(W)-\psi^N(1-v^1(W)) \tag{30}$$

The time constraints restricting vacation times are:

$$0 \le v^1(W) \le 1 \tag{31}$$

$$0 \le v^1(N) \le 1 \tag{32}$$

Since the second period's contract is "conditionally optimal" and given the normal manager (by Proposition I) is extracted his surplus in that period while the workaholic (may) receive an information rent, like in Laffont and Tirole (1993) there are two main cases: only the IC constraint of the workaholic binds in period 1 (case analyzed in Proposition VI) or both IC constraints bind in period 1 (case analyzed in Proposition V). The omitted case (where only the IC of normal binds) leads to a strictly lower overall expected profit than the other two cases. In each situation I characterize the optimal incentive compatible contract from the perspective of the firm (with the corresponding optimal mixing probabilities w and n in period 1).

Proposition V. There exists $\delta^* > 0$ such that the optimal incentive compatible contract of the dynamic game is separating in period 1 if $\delta > \delta^*$. The corresponding managerial transfers and vacation times are:

Period 2

Workaholic: $T^2(W) = \psi^W + u^R,\ v^2(W) = 0$

Normal: $T^2(N) = \psi^N q^{-1}(\psi^N) + u^R,\ v^2(N) = 1 - q^{-1}(\psi^N)$

Period 1

Workaholic: $$T^1(W) = \psi^N q^{-1}\left(\frac{\psi^N}{(1-p)} + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W)\right) + \delta(\psi^N q^{-1}(\psi^N) - \psi^W) + u^R$$

$$v^1(W) = 1 - q^{-1}\left(\frac{\psi^N}{(1-p)}\right)$$

Normal: $$T^1(N) = \psi^N q^{-1}\left(\frac{\psi^N}{(1-p)} + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W)\right) + u^R$$

$$v^1(N) = 1 - q^{-1}\left(\frac{\psi^N}{(1-p)}\right) + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W)$$

Proof: Appendix.

I find that the optimal contract for the firm can either involve separation (Proposition V) or pooling (Proposition VI) in the first period. If both of these are incentive compatible, the pooling contract is better for the firm due to the high costs of separating types in period 1. However (see proof of Proposition VI), the pooling contract is only incentive compatible if the discount factor is smaller than a threshold (δ^*). This explains why the separating contract becomes the best incentive compatible contract if the threshold is exceeded.

Since in Proposition V the first period contract is separating, in the second period both types of managers are extracted their full surplus and the contract is identical to the first best. The larger the discount factor δ is, the lower is the first period's profit of the firm (due to the cost of separating types) and the larger the second period's discounted profit. In the second period, the workaholic, due to his lower disutility from working puts more hours worked than the normal manager in the second period and is also paid less. Compared to the static contract, both types of managers are paid less and the normal manager works more while the workaholic puts the same hours worked.

In period 1 the firm compensates the workaholic to stay true to his type since in case it does its entire surplus is extracted in the second period. Therefore, the managerial transfer paid to the workaholic in period 1 incorporates this foregone rent to make it attractive for the workaholic to choose the contract designed for him. The resulting transfer is larger than in the case of the static contract while the hours worked are the same since the workaholic works all the time, both in the office and on vacation. As expected, the larger is the discount factor δ, the larger will be the transfer paid to the workaholic manager in the first period and the larger will be the rent he receives. Moreover, the workaholic is paid more in period 1 than the normal manager and the pay differential increases in the discount factor δ. The normal manager will be assigned fewer hours worked than the workaholic and is paid less and since he does not want to deviate in the second period it is optimal for the firm to extract his entire surplus in period 1. The vacation time of the workaholic is the same like in case of the static contract. In contrast, in period 1 the normal manager is assigned more vacation time and is paid less compared to the static contract.

Proposition VI (that follows) presents the optimal contract for the firm in other case (when the discount factor is small enough). Since the first period's contract is pooling this implies the second period's contract is identical to the static one in Proposition I because the firm has no new information at the beginning of the second period regarding the type of manager.

Proposition VI. The optimal contract of the dynamic game involves full pooling in period 1 if $\delta < \delta^*$. The corresponding managerial transfers and vacation times are:

Period 2

$$\text{Workaholic: } T^2(W)=T^1(W)=\psi^N q^{-1}\left(\frac{\psi^N}{(1-p)}\right)+u^R,\ v^2(W)=0$$

$$\text{Normal: } \quad T^2(N)=\psi^N q^{-1}\left(\frac{\psi^N}{(1-p)}\right)+u^R,\ v^2(N)=1-q^{-1}\left(\frac{\psi^N}{(1-p)}\right)$$

Period 1

$$T^1(W)=T^1(N)=\psi^N q^{-1}\left(\frac{\psi^N}{1-p}\right)+u^R,\ v^1(W)=v^1(N)=1-q^{-1}\left(\frac{\psi^N}{1-p}\right)$$

Proof: Appendix.

Compared to the separating contract of Proposition V, the second period's expected profit is smaller with pooling due to the incomplete information regarding the type of manager however the first period's expected profit is larger since the managerial costs for this period are smaller and the hours worked are longer. Also, the workaholic manager receives a smaller first period rent than with separation but now he gets some surplus in the second period rather than being extracted out. In the first period, compared to the static contract, the workaholic is assigned less office time while the normal manager is assigned the same office time. Compared to the separating contract, in the first period the workaholic gets paid less while putting the same hours worked while the normal manager is extracted out and gets paid more and is assigned more office time. The following section contains conclusions and directions of future work.

VI. Conclusions

This paper examines, in a monopoly framework, managerial workaholism and its effects on the firm and on individuals, both in case of a profit maximizing principal and of a social planner principal.

In case of a profit maximizing principal, the workaholic works more hours and produces more than the normal. This is because the workaholic has a lower disutility from working than the normal and spends his unpaid vacation working. The firm either hires both types of managers or only the workaholic. The larger is the disutility from working of the normal or the larger the utility of working of the workaholic the more likely it is the firm hires only the workaholic because the normal becomes relatively more costly to hire. Also, if the reservation utility is large enough then only the workaholic is hired.

In terms of the welfare effects of workaholism, when the principal is a for profit firm (Proposition II), I compare two societies, otherwise identical, except society A has a larger probability of workaholism than society B. I find a firm in society A is making a larger expected profit than a firm in society B. Essentially, the expected output gains exceed the increase in expected managerial transfer. This is not surprising given the lower cost of working of a workaholic and the fact he spends the unpaid vacation time working. A normal individual receives only the reservation utility in either society. In contrast, a workaholic in society A is worse off than a workaholic in society B if both types of managers are hired. This is in accordance with the results of empirical work (Kilroy [2007] among others) that also finds a workaholic is negatively affected by a larger degree of workaholism. In my framework, this is because in a larger probability of workaholism society, a firm will assign fewer hours worked to the normal manager. This in turn will lower the transfer of this type of manager. Since in a given society the two types' transfers are equal (by Proposition I) the transfer of a workaholic will also be lower in society A while the hours worked by a workaholic are the same in the two societies. The normal manager has no information rent and hence his utility in society A is the same with his utility in society B. In contrast with the above, in case only the workaholic participates, we know by Proposition I he makes only the reservation utility so it doesn't matter in what society such an individual is.

In case of a social planner principal (Proposition III), the workaholic is kept full time in the office because the planner takes into account he derives utility from working. Either both types of managers participate or, if the reservation utility is large enough, only the workaholic participates. Overall, the hours worked by the workaholic are identical to the for profit firm case since he works all the time. The workaholic is paid at least as much with a social planner than with a for profit principal. Thus the workaholic is at least as well off with the social planner compared to the profit maximizing principal case.

Also, the normal manager gets paid more and puts more hours worked than in case of a for profit principal. The extra gains in terms of transfer exceed the extra costs of working time so overall the normal is strictly better off with the social planner. With a social planner, the firm is at worse off (if both types participate) or equally well off (if only the workaholic participates) compared to a profit maximizing principal.

In terms of the welfare effects of workaholism for a social planner principal (Proposition IV), I compare two societies, otherwise identical, except society A has a larger probability of workaholism than society B. I find a normal individual in society A has a lower utility than a normal individual in society B. This is because the transfer of a normal manager is lower in society A since the information rent needed to be paid is smaller while the hours worked are the same in both societies. Hence, more workaholism exerts a negative effect on a normal individual, which interestingly is related to the result in the cooperative bargaining model of Hamermesh and Slemrod [2008], although they identify a negative effect in case of a profit maximizing firm. Also, a workaholic individual in society A has a lower utility than a workaholic individual in society B due to the lower transfer received.

In case of the dynamic (two-period) model, I find the optimal contract can be either separating or pooling in the first period depending on the discount factor. With separation, the second period exhibits full extraction of surplus from the manager. Compared to the static contract, in the second period both types of managers are paid less and the normal manager works more while the workaholic puts the same hours worked. In the first period the workaholic is paid more than with the static contract because the firm must compensate him for staying true to his type (separating) and being extracted out in the second period, while the hours worked by the workaholic are the same like with the static contract. The firm assigns fewer hours worked to the normal manager and pays him less, extracting his full surplus in the first period. With pooling, the second period's contract is similar to the static one. In contrast, in the first period the workaholic manager is assigned less office time than with the static contract. In the first period, compared to the separating contract, the workaholic gets paid less while putting the same hours worked and he gets a lower rent. The normal manager is extracted out in the first period and gets paid more and is assigned more office time compared to the separating contract.

I plan to extend this analysis in several directions in the near future. First, I plan to analyze the effects of managerial workaholism on the financial policy of the firm. Second, I am interested in looking at the case of oligopolistic competition among firms for managers whose types can be workaholic or normal (in progress). Third, I will study the effects of managerial workaholism under delegation of authority.

VII). LITERATURE REVIEW

The workaholism research in the psychology and other literatures (such as Economics or management) has been focused on three main avenues: a) designing measurement scales of workaholism; b) understanding the causes of workaholism and c) other research on the consequences of workaholism in terms of the individuals, their families, friends, health, workplace, firms and the society as a whole and relationships of workaholism with other concepts such as perfectionism. Next, I will present each of these lines of research on workaholism.

1. Measurements of workaholism (following Brady, Marsh, Mc Millan and O'Driscoll [2001])

There are three main measurement scales of workaholism: the Work Addiction Risk Test (WART) of Robinson [1989]; the The Schedule for Nonadaptive Personality Workaholism Scale (SNAP-Work) of Clark [1993] and The Workaholism Battery (Work Bat) of Spence and Robbins [1992].

The WART scale (Robinson [1989]) is essentially a 25 items survey. Each item has four possible answers: Always (4), Often (3), Sometimes (2) or Never (1). A score larger than 67 out of 100 indicates workaholism. The items are mainly about lifestyle, for instance " "I prefer to do most things rather to ask for help"; "I find myself continuing to work after my co-workers have called it quits" or "I get angry when people don't meet my standards of perfection". This has been used, according to Burke (2000), mainly for students and members of Workaholics Anonymous.

The SNAP-Work scale (Clark [1993]) is an 18 item survey. Each item has two possible answers: true or false. More than WART (where there is only one item in this regard), this scale associates workaholism with an obsessive-compulsive disorder. It has been used (Clark, Mc Ewen, Collard and Hickok, [1993]) with students and full time workers.

The WorkBat scale (Spence and Robbins, [1992]) is a 25 item survey. There are five possible answers on a scale of 1-5 (strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1). The scale has been used with individuals of different nationalities (USA, Canada, Japan, Australia, New Zealand), both students and full time workers, according to Burke [2000]. The scale decomposes workaholism in three characteristics: Drive, Work Enjoyment and Work Involvement.

2. Psychological causes of workaholism (following the survey of Brady, Marsh, Mc Millan and O'Driscoll, [2001])

The psychology literature has focused on three main theories regarding the causes of workaholism: I) the “trait theory” (Clark, [1993]); b) the (rational) addiction theory (Fassel [1992] and Eisenck [1997] in psychology, Becker and Murphy [1988] in Economics) and c) the learning theory (Skinner [1974]).

The "trait theory" (Clark [1993]) says that "workaholism would be conceptualized as an expression of an underlying trait that became evident in late adolescence, exhibited stability across multiple employment situations and was exacerbated by environmental stimuli such as stress" (Brady et al, [2001], page 82). My analysis is based on this theory of workaholism. As Brady et al. note on the same page 82, "a broad range of data produced by psychometrically validated measures supports the trait theory of workaholism, especially with respect to interpersonal correlates such as obsessiveness, nondelegation, perfectionism and hypomania". Further to support this theory, they continue on page 83: "the trait theory appears to be the most adequately supported by the current body of research data". While I do not claim the "trait theory" explains all cases of workaholism, at least based on the results of psychologists noted above it may explain some of them.

The (rational) addiction theory of workaholism is based on the work of Becker and Murphy [1988], Fassel [1990] and Eisenck [1997]. While appealing, the psychology literature (at least based on the survey of Brady et al [2001]) recognizes there are certain issues with the rational addiction theory in the context of workaholism. Working turns out to be a more complex human activity than drinking or smoking and excessive working may not always be explained by addiction. Also, as Brady et al [2001] note on page 80, "Given the dearth of empirical data, it is arguably premature to develop a comprehensive addiction theory of workaholism. Progress is also plagued by methodological difficulties. For instance, biological theories are constrained by the fact that the concept of work as an addictive substance is not as easily measurable or as simple to isolate as the chemicals involved in drug and alcohol addictions. Additionally, fitting workaholism into an addiction model would require us to conceptually substitute the independent variable 'excessive work' for 'addictive substance'. This provokes questions such as: what constitutes work? Should activities such as household chores or gardening be included? Does the compulsiveness of workaholism necessarily equate with biological dependence?". The theory of workaholism as an addiction is (indirectly) tested for in the paper of Hamermesh and Slemrod [2008] in the context of retirement. Their empirical model is not based on the setup of Becker and Murphy [1988], due to problems with finding good instruments for the hours worked in the

previous period in order to generate statistically consistent estimates. Instead, Hamermesh and Slemrod [2008] focuses on an hyperbolic discounting flavored theoretical model of addiction that does not explain endogenously how people become addicted in the first place but rather takes addiction as a fact of life. Addiction occurs in their model by a change in the reservation (retirement) utility of a worker in period two compared to the initial period's expected second period retirement utility.

The "learning theory" (Skinner [1974]) says workaholism is "a relatively durable behavior that is learned via operant conditioning, a form of learning in which a voluntary response comes under the control of its consequences because it earns a desired outcome". One problem with this theory is its lack of empirical support. Brady et al [2001] note on page 82 that "current research designs have not explicitly tested the theory in the context of workaholism" and consequently there is room for more research in this direction.

3. Economics research

The Economics literature on workaholism is small. The closest paper to my research is Sampson [2002]. Like in the case of the second paper of my dissertation (Ranca [2009], he also studies managerial workaholism in competitive markets. There are clear differences between the two papers. While I study workaholism based on the "trait theory", according to which this behavior is explained by a personality trait, he analyzes a different type of workaholics based on the "learning theory". Indeed, in Sampson [2002], managers are workaholics because they learn from the feedback received from co-workers that this leads to a desired outcome: "The reward for such a high provision of effort is usually a higher chance of promotion or a better chance of retaining one's job during bad times" (Sampson, [2002], p 194). Moreover, the contract in his paper is (wage, effort) and he has two types of effort (high, low) while in my paper the contract is (transfer, vacation time) and I have only high effort. In my paper working time is endogenous and continuous on [0,1] while in his paper it is discrete (work/not work). I characterize three types of equilibria: Nash, Wilson and Riley for all cases (when both, one or no type of manager participates), while he characterizes only Nash for the case where all four types (existing in his model) of managers participate. Sampson has two subtypes of ability (bright or dim) for each manager type while I have the same ability for both types. In his paper both types have positive disutility from effort while in my paper the workaholics have negative disutility. Sampson [2002] finds there are, for certain parameter values, three types of Nash equilibrium: one where all four types of managers put high effort, one where the two (workaholic and normal) high ability types put low effort while the low ability put high effort and one where all four types put low effort.

Also, he finds the wage for high effort is larger than the wage for low effort supplied by bright individuals which in turn is larger than the wage for low effort supplied by dim individuals.

Hamermesh and Slemrod [2008] is a primarily empirical paper that focuses on finding evidence of workaholic (addictive) behavior with regard to retirement decisions using data from the Health and Retirement Survey (1969, 1971, 1973,1975). Hamermesh and Slemrod show high income, educated people exhibit workaholic behavior with respect to their retirement. Quoting from Hamermesh and Slemrod [2008], "The main result from the RHS data is that measures that might indicate an addiction to work have some power in predicting retirement beyond that of recent expressed plans for retirement. The estimates suggest that more educated and higher-income respondents simply cannot help themselves: They express an expectation of retirement, but when the time comes they are less likely to be retired. Note that if it were fashionable among more educated or higher paid workers to pooh-pooh the notion of retirement, we would then find that, conditional on expressed retirement expectations, they would be more likely to be retired, not less likely".Hamermesh and Slemrod [2008] also include a theoretical model of workaholism as an addiction. Unlike my setup, they study a complete information case in the case of two-worker partnerships. In each partnership, there is Nash bargaining over the distribution of total work hours between two complementary owners, a workaholic and a normal. They ask the question of the effects of workaholism on co-owner, on family and on the workaholic's future utility. The workaholic exerts a negative externality on the normal worker by lowering his employee's utility via an increase in hours worked. Also, they show in an extension of the model that a workaholic has negative effects on the family. Moreover, in the case of consumer workaholism, they study the optimal income taxation policy of the government. Differently than Hamermesh and Slemrod [2008], the focus of my theoretical analysis is on the implications of managerial workaholism in case of a monopoly. In my setup, the workaholic is the manager and not the owner of the firm or a consumer. Moreover, my framework of workaholism involves a principal-agent model under asymmetric information and in my setup the firm makes take-it-or-leave it offers to the manager who has no bargaining power. Another distinction from their paper is I allow the workaholic to work during the unpaid vacation time on top of the paid hours. Another empirical study that tests for workaholism using structural Econometrics and Belgian data is Dewilde, Dewettink and De Vos [2007].

Benabou and Tirole [2004] use the workaholism term in the context of a behavioral model of endogenous preferences of individuals that set personal rules (so they don't explore the consequences of managerial workaholism for firms). Fields and Mitchell [1984] and Kahn and Lang [1991] mention the word "workaholism "in the context of an empirical model of retirement.

Gerstbach and Haller [2005] analyze the effects of workaholism in two-person households in a general equilibrium model with intra-household externalities between the workaholic and the non-workaholic. They find that when the workaholic has more bargaining power the society is worse off and so is the non-workaholic member of the typical household. Also, they show that a ceiling on the number of hours worked can improve welfare. Drago et al [2006] is an empirical study using Australian data and applying conditional logit. They analyze the demographic characteristics of workaholics. They find that those with high debt and women are more likely to become workaholics. Hodson [2008] uses book length ethnographies of workaholics to understand them better. He finds employees that have job security and those that are well paid are more likely to become workaholics. Burke, Matthiesen and Berge [2004] analyze correlations of work flow with workaholics using Norwegian data. They find evidence this positive correlation exists. Schur [1991] asks the question: why there is less leisure time spent by Americans? She finds job security to be a major factor and she discusses overwork in households and the relationship between capitalism and the number of hours worked. Peters et al [2005] examine correlation between telework and actual time spent working. They find evidence telework can induce workaholism.

Moreover, my paper has connections to an extensive literature on managerial incentives under asymmetric information (Jensen and Meckling [1976], Holstrom and Tirole [1993] among others), excellently summarized in the book length treatment of Bolton and Dewatripont [2005]. This literature does not consider the implications of workaholism. There is also a health literature on rational addictions (Becker and Murphy [1988], Becker, Murphy and Grossman [1994]) that has no strategic interaction (so no equilibrium) but rather an addicted person maximizes lifetime utility by making consumption decisions; addiction is captured by current consumption of the good increasing in the total stock of past consumption. An exception that mentions workaholism in the context of overwork and sets up an empirical rational addiction model to analyze the health consequences of addictive overwork is Ranca [2005]. Also, another related paper is DellaVigna and Malmendier [2004] that analyze the optimal contract for firms whereby consumers have time-inconsistent preferences. They find firms set the price for leisure goods above marginal cost and the price for investment goods below marginal cost.

4. Psychology and other disciplines

The related literature on workaholism consists of both published papers and unpublished dissertation work. There are several topics that these papers are focused on: the relationship between workaholism and health, the relationship between workaholism and family and community life, improvements and additions to measurement scales, improvements in terms of the typology of workaholics, organizations and workaholism, motivations of working hard, leisure and workaholism, telecommuting and workaholism, perfectionism and workaholism, workaholism and passion of working, macroeconomic conditions and workaholism. Excellent reviews are provided by Brady, Marsh, Mc Millan, O'Driscoll [2001], Cunha, Cardoso, Clegg, Rego [2007], Feldman, Ng and Sorensen [2007], Piotrawski and Vodanovich [2008], Zohar [2006].

The relationship between workaholism and health (both physical and psychological) has been found by numerous researchers to be for the most part negative. Workaholism generates stress, anxiety (Andreassen, Eriksen, Ursin [2009], Kilroy [2007], Chamberlin [2001], Bonebright [2001], Haymon [1992], Jackson [1992]). Also, it affects the general well-being of individuals (Taris, Geurts, Schaufelib, Blonk and Lagerveld [2008], Su [2008], Burke, Richardson [2006], Mc Millan [2004], Macholowitz [1978]). Some researchers have found a clear relationship between workaholism and burnout: Andreassen, Eriksen, Ursin [2009], Schafeli, Taris, Van Rhenen [2008], Bonebright [2001]). Interestingly, Macholowitz [1978] also finds a positive health effect because work enjoyment and longevity are correlated. Also, Stearns [1977] finds workaholism useful in healing after emotional losses.

There exists a consensus among researchers workaholism negatively affects family life. There are numerous studies (Beckers, Geurts, Kompier, Schulders, Taris [2009], Bakker [2008], Kilroy [2007], Burke [2000]), Macholowitz [1978]) in this respect. Not only the quality of relationships is affected but also there are more family conflicts (Bakker [2008]). Interestingly, workaholics find comfort in pets that are seen as friends and stress relievers (Damirjon-Santagio [2005]). Also, there are intergenerational effects of workaholism: the strongest correlation is between fathers and daughters both workaholics ([Drake, 2002]).

Several researchers have worked on improving the Spence and Robbins [1992] scale in terms of goodness of fit: Buelens, Peelmans [2004], Aziz [2002], Perez-Prada [1996]. Others have devised some measurements of their own not taken into the mainstream: Haas [1989], Coogley [1982], Stein [1982], Naughton [1987]. Scholtz [2005] improves on the WAB scale.

In terms of organizations, Fassel [1990] shows that work schedules and expectations sometimes beyond reasonable limits generate workaholism among employees. Elder [1991] tests for existence of workaholism in different organizations using MBA graduates data. Cohen and Fry [2009] show that the recruitment and selection process of firms as well as cultural socialization

cause workaholism. Burke [2002] analyzes relationship between organizational values and workaholism. He finds that a strongly work oriented organization will affect the work-life balance of employees. Porter [2006] finds that workaholism is not correlated with business success using data from high tech industries managers.

In terms of motivations of working hard, there are several answers in the literature. Trueman [1995] finds personal identity is important in this regard. Using autoethnographies, Boje and Tyler show job security also matters. Golden [2008] makes an excellent presentation of history of working hours in the USA and shows overwork is due to adaptation to work environment. She suggests improvements in human rights to solve this issue.

Hampton [2008] analyzes the relationship between leisure and downshifting. He finds there are major changes in employees' leisure following this working condition update. Dallis [2001] examines the leisure activities of workaholics and finds gardening, walking and reading to be the top choices. Armington [2007] analyzes the relationship between telecommuting and workaholism, and finds the causality works towards the generation of workaholism by telecommuting. Also, there is an inverted U relationship between the two.

Bousman [2007] studies the relationship between perfectionism and workaholism. She defines and tests for the existence of perfectionist workaholics that want to be in control, are rigid and inflexible and preoccupied with rules. Schibred [2004] examines lifestyles of workaholic pastors and suggests more socialization to help solve this issue. Burke and Fickenbaum [2008] using Canadian data find a strong positive correlation between workaholism and passion for work. The same result is achieved by Snir and Harpaz [2007] using US data. Snir and Zohar [2006] look at demographic characteristics of workaholics. They find religious persons, those with a high level of occupational satisfaction and low level of family centrality are more likely to become workaholics. In a related paper [2008, b] these authors examine workaholism in an international setting using data from Belgium, Israel, Japan, Holland and the US. They find Japanese work the most and also men work more than women, private sector employees more than public sector employees, married men more than unmarried men, unmarried women more than married women. Kanai [2006] finds in recessions there is an increase in workaholism due to a lack of job security.

APPENDIX

Proof of Proposition I

The firm maximizes the expected profit subject to the participation (rationality) constraint of each type of manager, the incentive compatibility constraint and the time constraints.

The program is now:

$$\max_{v,T} E(\Pi) = pQ(1) + (1-p)Q(1-v(N)) - pT(W) - (1-p)T(N) \qquad (1)$$

subject to:

The participation constraints of each type of manager:

$$T(W) - \psi^W \geq u^R \qquad (2\,\text{w})$$

$$T(N) - \psi^N(1-v(N)) \geq u^R \qquad (2\,\text{n})$$

The incentive compatibility constraints of each type of manager:

$$T(W) - \psi^W \geq T(N) - \psi^W \qquad (3\,\text{w})$$

$$T(N) - \psi^N(1-v(N)) \geq T(W) - \psi^N(1-v(W)) \qquad (3\,\text{n})$$

The time constraints restricting vacation times:

$$0 \leq v(W) \leq 1 \qquad (4\,\text{w})$$

$$0 \leq v(N) \leq 1 \qquad (4\,\text{n})$$

Note that by the Mirlees([1971], page 182) single crossing condition [3] only one of the incentive compatibility constraints binds. There are two cases. I first solve for the optimal contract in each case then compare the expected payoff of the firm to get the result.

Case 1. Compatibility constraint (3 w) of the workaholic binds

I solve for the optimal contract under incomplete information by focusing on the program with only the participation constraint of the normal manager (1 n) and the incentive compatibility constraint of the workaholic manager (3 w) binding and then I will show the omitted constraints hold. By standard arguments (for instance Bolton and Dewatripont, 2005, p 55) we can show that the individual rationality constraint (2 n) of the workaholic normal binds at optimum. Suppose that this is not true; then the firm could lower the transfer paid to the normal manager which would result in an increase in expected profit (while the other constraints would still be satisfied).

The firm maximizes its expected profit:

$$\max_{v,T} E(\Pi) = pQ(1) + (1-p)Q(1-v(N)) - pT(W) - (1-p)T(N) \qquad (1)$$

subject to:

The participation constraints of the normal manager:

$$T(N) - \psi^N(1-v(N)) = u^R \qquad (2\text{ n})$$

The incentive compatibility constraint of the workaholic manager:

$$T(W) - \psi^W \geq T(N) - \psi^W \qquad (3\text{ w})$$

From the constraints above the managerial transfers are equal and given by:

$$T(W) = T(N) = \psi^N(1-v(N)) + u^R \qquad (4)$$

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[3] In my setting the single-crossing condition is satisfied since the utility function in my framework is differentiable, concave and : $[\frac{\partial U(N)}{\partial v(N)} / \frac{\partial U(N)}{\partial T(N)} - (\frac{\partial U(W)}{\partial v(W)} / \frac{\partial U(W)}{\partial T(W)}) > 0 \Leftrightarrow \psi^N > 0$

Plugging the optimal managerial transfers (5) into the objective function of the firm allows us to solve for the optimal vacation hours. The corresponding objective function is (after grouping terms and rearranging):

$$\max_{v()} E(\Pi) = pQ(1)+(1-p)Q(1-v(N))-\psi^N(1-v(N))-u^R \qquad (5)$$

The corresponding vacation time of the normal manager is:

$$\frac{\partial E(\Pi)}{\partial v(N)} = -(1-p)q(1-v(N))+\psi^N = 0 \Rightarrow v(N) = 1-q^{-1}\left(\frac{\psi^N}{1-p}\right) \qquad (6)$$

Note the second order condition holds since the production function is concave in v(N):

$$\frac{\partial^2 E(\Pi)}{\partial v(N)^2} = -(1-p)\frac{\partial q(1-v(N))}{\partial v(N)} < 0$$

The transfers are found by plugging vacation time from (7) into (5):

$$T(W) = T(N) = \psi^N\left(q^{-1}\left(\frac{\psi^N}{1-p}\right)\right)+u^R \qquad (7)$$

To complete the proof, I must show the omitted constraints (participation of workaholic manager and incentive compatibility constraint of the normal manager as well as the time constraints) are satisfied. Note that if the participation constraint of the normal (2 n) holds so will the one of the workaholic (not binding) due to the negative disutility of working of the latter type of manager .

The incentive compatibility constraint of the normal manager holds if at the optimum:

$$T(N)-\psi^N(1-v(N)) > T(W)-\psi^N(1-v(W)) \overset{T(W)=T(N)}{\Leftrightarrow} 0 \le v(W) < v(N) \le 1 \qquad (8)$$

Note that under conditions in the Proposition (8) holds true. Also, this guarantees that the time constraints also hold. At the optimum both types of managers are hired. Next I look at the second case and compare them from the perspective of the principal.

Case 2 Compatibility constraint of the Normal manager binds

From this constraint (3 n) we have that:

$$T(W) = T(N) + \psi^N (v(N) - v(W)) \quad (9)$$

Also, note that if the participation constraint of the normal manager binds this leads to a contradiction because it implies:

$$v(W) = 1,\ \text{v(N)=1-q}^{-1}(\psi^N) \quad (10)$$

However, (10) implies the workaholic is paid less which violates the IC of the workaholic (3 w). Hence, the participation of the workaholic must bind:

$$T(W) = \psi^W + \text{u}^R \quad (11)$$

.Also, vacation time of the normal manager is the complete information one since the workaholics don't deviate and vacation time of workaholics is 0. From all of the above, the transfer of normals is:

$$T(N) = \psi^W + \text{u}^R - \psi^N (1 - q^{-1}(\psi^N)) \quad (12)$$

Equilibrium is found by comparing expected profit of the firm in each case:

$$E(\Pi)^{CASE\ 1} = pQ(1) + (1-p)Q(q^{-1}(\frac{\psi_N}{1-p})) - \psi_N q^{-1}(\frac{\psi_N}{1-p}) - u^R$$

$$E(\Pi)^{CASE\ 2} = p(Q(1) - u^R - \psi^W) \quad (14)$$

It results that case 1 (with both types of managers hired) is optimal **if:**

$$u^R \le Q(q^{-1}(\frac{\psi^N}{1-p})) - \frac{1}{1-p}(\psi^N q^{-1}(\frac{\psi^N}{1-p}) - p\psi^W) \quad (15)$$

This completes the proof of Proposition I

Proof of Proposition II

The proof has three parts.

i) First, I show the expected profit of the firm is larger in society A. Following Proposition 1, there are two cases: when both workaholics and normals are hired and respectively when only workaholics are hired. I will show in each case the society that has a larger probability of workaholism (A) has a larger expected profit than the other society (B)

a) *If both workaholics and normals are hired*

$$E(\Pi^A) = p_A(Q(1) - \psi^N q^{-1}(\frac{\psi^N}{1-p_A})) + (1-p_A)(Q(q^{-1}(\frac{\psi^N}{1-p_A})) - \psi^N q^{-1}(\frac{\psi^N}{1-p_A})) - u^R \geq 0$$

$$E(\Pi^B) = p_B(Q(1) - \psi^N q^{-1}(\frac{\psi^N}{1-p_B})) + (1-p_B)(Q(q^{-1}(\frac{\psi^N}{1-p_B})) - \psi^N q^{-1}(\frac{\psi^N}{1-p_B})) - u^R \geq 0$$

Note the profit of the workaholics (first term) is larger than the profit of the normals (second term) and the difference between them is larger in society A. Hence the expected profit of the firm is larger in the society with a higher probability of workaholism (A).

b) If only workaholics are hired

By proof of Proposition I, the expected profit of the firm in each society is:

$E(\Pi^A) = p_A(Q(1) - \psi^W - u^R) \geq 0$ and $E(\Pi^B) = p_B(Q(1) - \psi^W - u^R) \geq 0$

It results the expected profit is larger in society A

ii) In terms of the utility of a workaholic, there are two cases (by Proposition I)

a) If both types of managers are hired

The utilities of a workaholic in both societies are:

$$u_{W}{}^{A} = \psi^N q^{-1}(\frac{\psi^N}{1-p_A})) + u^R - \psi^W \text{ and } u_{W}{}^{B} = \psi^N q^{-1}(\frac{\psi^N}{1-p_B})) + u^R - \psi^W$$

It results society A has a smaller utility of a workaholic

b) If only workaholics are hired

In this case a workaholic receives the reservation utility

iii) In terms of the utility of a normal, this is the same in both societies and equals the reservation utility whether both types of managers or only workaholics are hired

This completes the proof of Proposition II.

Proof of Proposition III.

The social planner, unlike profit seeking firms, maximizes the expected social welfare

and does not observe the true type of the manager, workaholic or normal:

$$\max E(W) = p(Q(1) - \psi^W) + (1-p)Q(1-v(N)) - \psi^N(1-v(N))) \qquad (1)$$

The participation constraint of the firm must hold:

$$E(\Pi) = p(Q(1) - T(W)) + (1-p)(Q(1-v(N)) - T(N)) \geq 0 \qquad (2)$$

The participation constraints of each type of manager must hold:

$$T(W) - \psi^W \geq u^R \qquad (3\,\text{w})$$

$$T(N) - \psi^N(1-v(N)) \geq u^R \qquad (3\,\text{n})$$

The incentive compatibility constraints of each type of manager must hold:

$$T(W)-\psi^W \geq \ T(N)-\psi^W \qquad (4\text{ w})$$

$$T(N)-\psi^N(1-v(N)) \geq T(W)-\psi^N(1-v(W)) \qquad (4\text{ n})$$

The time constraints restricting vacation times must hold:

$$0 \leq v(W) \leq 1 \qquad (5\text{ w})$$

$$0 \leq v(N) \leq 1 \qquad (5\text{ n})$$

There are two main cases analyzed in what follows, depending on which incentive compatibility constraint binds.

Case 1 Incentive Compatibility constraint (4n) of the normal type binds:

$$T(N)-\psi^N(1-v(N)) = T(W)-\psi^N(1-v(W))$$

There are several subcases depending on which participation constraints bind.

A). Only participation constraint of the workaholics binds:

$$T(W) = \psi^W + u^R \qquad (6)$$

The transfer of the normals is (from (6) and (4n)):

$$T(N) = \psi^W + u^R + \psi^N(\text{v(W)-v(N)}) \qquad (7)$$

Note this implies the normals don't participate since their payoff is:

$$\psi^W + u^R - \psi^N(\text{1-v(W)}) < u^R$$

Consequently, only workaholics participate, are extracted their full surplus and the payoff to the social planner is: $p(Q(1)-\psi^W)$

B.) Only participation constraint of the firm binds:

$$p(Q(1)-T(W))+(1-p)(Q(1-v(N))-T(N))=0 \qquad (7)$$

From (7) and (4n) one can find the corresponding transfers:

$$T(W)=p(Q(1)+(1-p)(Q(1-v(N))+(1-p)\psi^N(v(N)-v(W))$$

$$T(N)=p(Q(1)+(1-p)(Q(1-v(N))-p\psi^N(v(N)-v(W)) \qquad (8)$$

The objective function of the firm becomes (once we consider (8) and (2)):

$$\max_{v(N)} p(Q(1)+(1-p)(Q(1-v(N))-p\psi^W-(1-p)\psi^N(1-v(N)) \qquad (9)$$

$$\textit{It results}: \; v(N)=1-q^{-1}(\psi^N).$$

The second order condition holds since the production function is concave in v(N):

$$-(1-p)\frac{\partial q(1-v(N))}{\partial v(N)}<0$$

Also, the time constraint of the workaholic binds: v(W)=0 (10)

The corresponding transfers (considering (8)) are:

$$T(W)=p(Q(1)+(1-p)(Q(1-v(N))+(1-p)\psi^N(1-q^{-1}(\psi^N))$$

$$T(N)=p(Q(1)+(1-p)(Q(1-v(N))-p(1-p)\psi^N(1-q^{-1}(\psi^N)) \qquad (11)$$

This solution satisfies the time constraints as well as the compatibility constraint of the workaholic. For existence it is necessary that the normal participates:

$$u^R \le pQ(1)+(1-p)Q(q^{-1}(\psi^N))+(1-p)\psi^N(q^{-1}(\psi^N)-\psi^N \qquad (12)$$

The payoff to the social planner is: $p(Q(1)-\psi^W))+(1-p)(Q(q^{-1}(\psi^N))-\psi^N q^{-1}(\psi^N))$

C). Only participation constraint of the normal manager binds

$$T(N) = u^R - \psi^N \text{(1-v(N))} \quad (14)$$

Combined to (4n), this implies that:

$$T(W) = u^R - \psi^N \text{(1-v(W))} \quad (15)$$

The program becomes:

$$\max\ p(Q(1) - \psi^W) + (1-p)(Q(1-v(N)) - T(N)) + (1-p)u^R$$

subject to the firm's participation constraint:

$$p(Q(1) + (1-p)(Q(1-v(N)) > T(N) + p\psi^N(v(N) - v(W))$$

Note this solution where the participation constraint of the firm does not bind is not optimal since the planner could decrease T(N) and increase its payoff.

D). Both participation constraint of the normal manager and of the workaholic bind

$$T(N) = u^R - \psi^N \text{(1-v(N))}$$

$$\text{T(W)} = \psi^W + u^R$$

This case leads to a situation similar to case A where only workaholics participate and are extracted their full surplus

E). Both participation constraint of the normal manager and of the firm bind

This leads to:

$$T(N) = u^R - \psi^N \text{(1-v(N))}$$

$$T(W) = u^R - \psi^N \text{(1-v(W))}$$

The payoff in this case is at most equal to the one in case B and is given by:

$$p(\psi^N - \psi^W) + u^R$$

F). Participation of workaholics and participation of firm bind

This leads to a case similar to A where only workaholics participate and are extracted their full surplus

G) All three participation constraints bind

This leads to a social planner payoff equal to the reservation utility

Case 2 Incentive Compatibility constraint (4w) of the workaholic type binds: $T(W) = T(N)$

A) Only participation constraint of the workaholic binds

In this case only workaholics participate. The social planner's payoff is: $p(Q(1) - \psi^W))$

The transfers are: $T(W) = T(N) = u^R + \psi^W$

B). Only participation constraint of the normal manager binds

This leads to an objective function of:

$$\max\ p(Q(1) - \psi^W) + (1-p)(T(N) - \psi^N(1 - v(N)) + (1-p)u^R$$

subject to the firm's participation constraint:

$$p(Q(1) + (1-p)(Q(1 - v(N)) > T(N)$$

Note this is not optimal since the planner could increase transfer and have constraints holding while getting a larger payoff

C) Only participation constraint of the firm holds

This leads to a payoff identical to case 1B. The transfers are:

$$T(W) = T(N) = pQ(1) + (1-p)Q(q^{-1}(\psi^N))$$

For existence it is necessary that normals participate:

$$pQ(1) + (1-p)Q(q^{-1}(\psi^N)) - \psi^N q^{-1}(\psi^N) \geq u^R$$

D) Both the participation of the firm and of the normal bind

The objective function in this case is:

$$p(\psi^N(1 - v(N) - \psi^W) + u^R$$

This implies v(N)=0. This however does not satisfy the compatibility constraint of the normal since it implies v(W) is at least as large as v(N)

E) Both the participation of the workaholic and of the normal bind

$$T(W) = u^R + \psi^W = \psi^N(1 - v(N)) + u^R \Rightarrow v(N) = \frac{\psi^W - \psi^N}{1 - \psi^N} < 0, \text{ contradiction}$$

F) Both participation of workaholic and participation of firm bind

This leads to a case similar to 2A where only workaholics participate and are extracted their full surplus.

G)All three participation constraints bind

This leads to a social planner's payoff equal to the reservation utility.

By all of the above, the optimal contract to the social planner is (1B) where both workaholics and normals are hired if condition (12) holds. Else, the optimal contract is (1A) where only workaholics participate. This completes the proof of Proposition III

Proof of Proposition IV

A) If both types of managers participate

i). By Proposition III above, the firm has an expected profit of 0

ii) A workaholic individual, by Proposition III , gets an utility in each society given by:

$$u_W{}^A = p_A(Q(1)) + (1-p_A)(Q(q^{-1}(\psi^N)) + (1-p_A)\psi^N(1-q^{-1}(\psi^N))) - \psi^W$$

$$u_W{}^B = p_B(Q(1)) + (1-p_B)(Q(q^{-1}(\psi^N)) + (1-p_B)\psi^N(1-q^{-1}(\psi^N))) - \psi^W$$

The difference between the utility in society A and the utility in society B is negative:

$$u_W{}^A - u_W{}^B = (p_A - p_B)((Q(1)) - (Q(q^{-1}(\psi^N)) - q^{-1}(\psi^N))) < 0$$

where the last step comes from observing that the marginal product of the last

unit of work of the normal manager equals the marginal cost hence:

$$Q(1)) - \psi^N < Q(q^{-1}(\psi^N)) - \psi^N q^{-1}(\psi^N)$$

iii). A normal individual gets an utility in each society given by:

$$u_W{}^A = p_A(Q(1)) + (1-p_A)(Q(q^{-1}(\psi^N)) + (1-p_A)\psi^N(1-q^{-1}(\psi^N))) - \psi^N$$

$$u_W{}^B = p_B(Q(1)) + (1-p_B)(Q(q^{-1}(\psi^N)) + (1-p_B)\psi^N(1-q^{-1}(\psi^N))) - \psi^N$$

Hence, similar to (ii) a normal individual is worse off in society A

B) If only the workaholic participates

By Proposition III, the workaholic is extracted so has the same utility in either society. The firm is obviously better in the society with a larger probability of workaholism.

Proof of Proposition V

In the second period, the firm maximizes its profit subject to the participation, incentive compatibility and time constraints of the manager:

$$\max_{v,T} E(\Pi^2(p_K)) = p_k[Q(1)] + (1-p_k)[(Q(1-v^2(N))] - p_k(T^2(W)) - (1-p_k)(T^2(N)) \quad (1)$$

$$\text{where } p_k \in \{p_2 = \frac{pw}{pw+(1-p)n}, p_3 = \frac{p(1-w)}{p(1-w)+(1-p)(1-n)}\} \text{ is the updated probability of workaholism}$$

subject to:

The participation constraints of each type of manager:

$$T^2(W) - \psi^W \geq u^R \quad (2)$$

$$T^2(N) - \psi^N(1-v^2(N)) \geq u^R \quad (3)$$

The incentive compatibility constraints of each type of manager:

$$T^2(W) - \psi^W \geq T^2(N) - \psi^W \quad (4)$$

$$T^2(N) - \psi^N(1-v^2(N)) \geq T^2(W) - \psi^N(1-v^2(W)) \quad (5)$$

The time constraints restricting vacation times:

$$0 \leq v^2(W) \leq 1 \quad (6)$$

$$0 \leq v^2(N) \leq 1 \quad (7)$$

The optimal contract is similar to the static one (given by Proposition I) with the corresponding updated probability of workaholism.

In period 1, the firm maximizes its overall profit:

$$\max_{v,T} E(\Pi^{total}) = [pw(Q(1)-T^1(W)) + p(1-w)(Q(1)-T^1(N)) + (1-p)n(Q(1-v^1(W))-T^1(W)) + (1-p)(1-n)(Q(1-v^1(N))-T^1(N))] + \delta[(pw+(1-p)(1-n))\Pi^2(p_2) + (p(1-w)+(1-p)n)\Pi^2(p_3)] \quad (8)$$

subject to:

The participation constraints of each type of manager:

$$T^1(W) - \psi^W + \delta(T^2(W, p_2) - \psi^W) \geq u^R + \delta u^R \quad (9)$$

$$T^1(N) - \psi^N(1-v^1(N)) \geq u^R \quad (10)$$

The incentive compatibility constraints of each type of manager:

$$T^1(W) - \psi^W + \delta(T^2(W, p_3) - \psi^W) \geq T^1(N) - \psi^W + \delta(T^2(W, p_4) - \psi^W) \quad (11)$$

$$T^1(N) - \psi^N(1-v^1(N)) \geq T^1(W) - \psi^N(1-v^1(W)) \quad (12)$$

The time constraints restricting vacation times:

$$0 \leq v^1(W) \leq 1 \quad (13)$$

$$0 \leq v^1(N) \leq 1 \quad (14)$$

Like in Laffont and Tirole (1993) there are two cases depending on what IC constraints bind in the first period: both IC constraints bind (analyzed here) or only the IC constraint of the workaholic binds (analyzed in Proposition VI). The third case (where only the IC of the normal binds) leads to inferior expected profits compared to the other two cases and is skipped for brevity. The analysis of this case is available from the author upon request.

Since the IC of the workaholic (11), the IC of the normal (12) and the participation constraint of the normal manager (10) bind, the corresponding transfers and vacation time of the workaholic are:

$$T^1(N) = u^R + \psi^N(1 - v^1(N)) \tag{15}$$

$$T^1(W) = u^R + \psi^N(1 - v^1(N)) + \delta(T^2(W, p_4) - T^2(W, p_3)) \tag{16}$$

$$v^1(W) = v^1(N) + \frac{\delta}{\psi^N}(T^2(W, p_3) - T^2(W, p_4)) \tag{17}$$

Plugging these transfers into the profit results in the following first and second order conditions:

$$\frac{\partial \Pi}{\partial v^1(N)} = -(1-p)(1-n)q(1-v^1(N)) - (1-p)nq(1-v^1(N) + \frac{\delta}{\psi^N}(T^2(W,p_4) - T^2(W,p_3)) + \psi^N = 0 \tag{18}$$

$$\frac{\partial^2 \Pi}{\partial v^1(N)^2} = (1-p)(1-n)\frac{\partial q(1-v^1(N))}{\partial(1-v^1(N))} + (1-p)n\frac{\partial q(1-v^1(N) + \frac{\delta}{\psi^N}(T^2(W,p_4) - T^2(W,p_3))}{\partial(1-v^1(N) + \frac{\delta}{\psi^N}(T^2(W,p_4) - T^2(W,p_3))} < 0$$

To complete the proof that separation is optimal in this case I find the best w and n from the perspective of the firm:

$$\frac{\partial \Pi}{\partial w} = ((1-p)n + pw)\psi^N \frac{\partial q(\frac{\psi^N}{1-p_3})}{\partial(\frac{\psi^N}{1-p_3})} \frac{\partial(\frac{\psi^N}{1-p_3})}{\partial p_3}\frac{\partial p_3}{\partial w} +$$

$$((1-p)(1-n) + p(1-w) - 1)\psi^N \frac{\partial q(\frac{\psi^N}{1-p_4})}{\partial(\frac{\psi^N}{1-p_4})} \frac{\partial(\frac{\psi^N}{1-p_4})}{\partial p_4}\frac{\partial p_4}{\partial w} < 0 \Rightarrow w = 0$$

$$\text{where } p_3 = \frac{pw}{pw + (1-p)n} \text{ and } p_4 = \frac{p(1-w)}{p(1-w) + (1-p)(1-n)}$$

$$\frac{\partial \Pi}{\partial n} = ((1-p)n + pw)\psi^N \frac{\partial q(\frac{\psi^N}{1-p_3})}{\partial(\frac{\psi^N}{1-p_3})} \frac{\partial(\frac{\psi^N}{1-p_3})}{\partial p_3} \frac{\partial p_3}{\partial n} +$$

$$((1-p)(1-n) + p(1-w) - 1)\psi^N \frac{\partial q(\frac{\psi^N}{1-p_4})}{\partial(\frac{\psi^N}{1-p_4})} \frac{\partial(\frac{\psi^N}{1-p_4})}{\partial p_4} \frac{\partial p_4}{\partial n}$$

$$+(1-p)(Q(1-v^1(N)) + \frac{\delta}{\psi^N}(T^2(W, p_4) - T^2(W, p_3)) - Q(1-v^1(N)) +$$

$$+\delta(1-p)(Q(q^{-1}(\frac{\psi^N}{1-p_3})) - Q(q^{-1}(\frac{\psi^N}{1-p_4})) > 0 \Rightarrow n = 1$$

Since w=0 and n=1 the corresponding transfers and vacation times are given by:

Workaholic: $T^2(W) = \psi^W + u^R,\ v^2(W) = 0$

Normal: $T^2(N) = \psi^N q^{-1}(\psi^N) + u^R,\ v^2(N) = 1 - q^{-1}(\psi^N)$

Period 1

Workaholic: $T^1(W) = \psi^N q^{-1}(\frac{\psi^N}{(1-p)} + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W) + \delta(\psi^N q^{-1}(\psi^N) - \psi^W) + u^R$

$$v^1(W) = 1 - q^{-1}(\frac{\psi^N}{(1-p)})$$

Normal: $T^1(N) = \psi^N q^{-1}(\frac{\psi^N}{(1-p)} + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W) + u^R$

$$v^1(N) = 1 - q^{-1}(\frac{\psi^N}{(1-p)}) + \frac{\delta}{\psi^N}(\psi^N q^{-1}(\psi^N) - \psi^W)$$

Proof of Proposition VI

In this case only the IC of the workaholic and the participation constraint of the normal bind in period 1:

$$T^1(W)-\psi^W+\delta u^R=T^1(N)-\psi^W+\delta(T^2(W,p_4)-\psi^W) \quad (1)$$
$$T^1(N)-\psi^N(1-v^1(N)=u^R \quad (2)$$

Plugging these the expected profit of the firm is:

$$pQ(1)+(1-p)(1-n)(Q(1-v^1(N))-\psi^N(1-v^1(N)))+(1-p)n(Q(1-v^1(W))-u^R$$
$$-(pw+(1-p)n)\delta(u^R-T^2(W,p_4)+\psi^W)+\delta\Pi^2$$

The first order conditions are:

$$-(1-p)(1-n)q(1-v^1(N))+\psi_N=0\Rightarrow v^1(N)=1-q^{-1}(\frac{\psi_N}{(1-p)(1-n)}),$$
$$-(1-p)nq(1-v^1(W))<0\Rightarrow\ \mathrm{v}^1(W)=0$$

Second order conditions:

$$\frac{\partial^2\Pi}{\partial v^1(N)^2}=(1-p)(1-n)\frac{\partial q(1-v^1(N))}{\partial 1-v^1(N)}<0,\ \frac{\partial^2\Pi}{\partial v^1(W)^2}=(1-p)n\frac{\partial q(1-v^1(W))}{\partial 1-v^1(W)}<0$$
$$\frac{\partial^2\Pi}{\partial v^1(N)\partial v^1(W)}=0$$

Since n=0 (the normal manager does not mix, his IC constraint does not bind) the following must hold for the contract to be incentive compatible:

$$v^1(N)>-\psi^W+\delta(T^2(W,p_4)-\psi^W)$$

Next, I solve for the optimal mixing probability of the workaholic in the first period (w). Collecting terms and considering the optimal vacation times and transfers above, the overall expected profit of the firm (ignoring terms that do not depend on w) can be simplified to:

$$\delta[-\psi^N q^{-1}(\psi^N(1+\frac{(1-w)p}{(1-p)})+(1-p)Q(q^{-1}(\psi^N(1+\frac{(1-w)p}{1-p})))$$

This function can be written as: $\delta[-\psi^N x+(1-p)Q(x)]$ and has a maximum when x= $\frac{\psi^N}{1-p}$

Thus at the maximum: $\frac{\psi^N}{1-p}=\psi^N(1+\frac{(1-w)p}{1-p}) \Leftrightarrow w=0$

Therefore in this case the optimal contract is pooling in period 1 with both types choosing the contract designed for the workaholic. Since in the second period the optimal contract is identical to the static one in period 1 and given the above, the corresponding optimal transfers and vacation times are:

Period 2

Workaholic: $T^2(W)=T^1(W)=\psi^N q^{-1}(\frac{\psi^N}{(1-p)})+u^R,\ v^2(W)=0$

Normal: $T^2(N)=\psi^N q^{-1}(\frac{\psi^N}{(1-p)})+u^R,\ v^2(N)=1-q^{-1}(\frac{\psi^N}{(1-p)})$

Period 1

$T^1(W)=T^1(N)=\psi^N q^{-1}(\frac{\psi^N}{1-p})+u^R,\ v^1(W)=v^1(N)=1-q^{-1}(\frac{\psi^N}{1-p})$

Thus the overall profit of the firm in this case is:

$\Pi^{POOLING}=(1+\delta)\Pi^{SB}$

where $\Pi^{SB}=pQ(1)+(1-p)Q(q^{-1}(\frac{\psi_N}{1-p}))-\psi_N q^{-1}(\frac{\psi_N}{1-p})-u^R$

In contrast, in case of Proposition V (separating) the overall profit of the firm is:

$$\Pi^{SEPARATING} = \Pi_1^{SEPARATING} + \delta\Pi^{FB}$$

where $\Pi_1^{SEPARATING} = pQ(1) + (1-p)Q(q^{-1}(\frac{\psi_N}{1-p} - \frac{\delta}{\psi_N}(\psi_N(q^{-1}(\psi_N) - \psi_W)) -$

$$\psi_N q^{-1}(\frac{\psi_N}{1-p} - \frac{\delta}{\psi_N}(\psi_N(q^{-1}(\psi_N) - \psi_W)) - u^R - p\delta(\psi_N(q^{-1}(\psi_N) - \psi_W)$$

$$\Pi^{FB} = p(Q(1) - \psi_W - u^R) + (1-p)(Q(q^{-1}(\frac{\psi_N}{1-p})) - \psi_N q^{-1}(\frac{\psi_N}{1-p})) - u^R)$$

Note that: $\frac{\partial[\Pi^{SEPARATING}(\delta) - \Pi^{POOLING}(\delta))}{\partial\delta} = \frac{\partial[\Pi_1^{SEPARATING}(\delta) + \delta(\Pi^{FB} - \Pi^{SB}))}{\partial\delta} = -p(\psi_N q^{-1}(\psi_N) - \psi_W) +$

$pQ(1) + (1-p)Q(q^{-1}(\psi_N)) - (1-p)\psi_N q^{-1}(\psi_N) - p\psi_W - u^R - pQ(1) - (1-p)Q(q^{-1}(\frac{\psi_N}{1-p})) +$

$\psi_N q^{-1}(\frac{\psi_N}{1-p}) = [(1-p)(Q(q^{-1}(\psi_N)) - \psi_N q^{-1}(\psi_N)] - [1-p)(Q(q^{-1}(\frac{\psi_N}{1-p})) - \psi_N q^{-1}(\frac{\psi_N}{1-p}) < 0$

Since $\frac{\partial[\Pi_1^{SEPARATING}(\delta) + \delta(\Pi^{FB} - \Pi^{SB}))}{\partial\delta} < 0$ and at $\delta = 0$ $\Pi^{SEPARATING} = \Pi^{POOLING}$ it results that $\Pi^{SEPARATING}(\delta) < \Pi^{POOLING}(\delta)$ for all $\delta > 0$. However, by proof of Proposition V we know the pooling contract is only incentive compatible if $\delta \le \delta^* = \frac{1 - q^{-1}(\frac{\psi^N}{1-p})}{\psi^N q^{-1}(\psi^N) - \psi^W}$.

By the above, when $\delta > \delta^*$ the optimal incentive compatible contract for the firm is separating (as given in Proposition V) and when $\delta \le \delta^*$ the optimal contract for the firm is pooling (as given in Proposition VI) .

This completes the proof of Proposition VI.

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