MANAGERIAL WORKAHOLISM, COMPETITION AND INCENTIVES

by

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ABSTRACT

Managerial Workaholism, Competition and Incentives

(Under the supervision of Sérgio O. Parreiras)

The dissertation has two chapters. In "Managerial Workaholism and Incentives" I examine the implications of managerial workaholism in the case of a monopoly. There are two types of managers, workaholic and normal. 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. If both types of managers participate, 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. If only the workaholic participates, he has the same utility in either society. In case the principal is a social planner, the firm has an expected profit at least as big in a society with a larger probability of workaholism compared to a society with a lower probability of workaholism. In case both manager types participate, both a workaholic and a normal in a higher probability of workaholism society are strictly worse off than their correspondents in a society with a lower probability of workaholism. In case only the workaholic participates, he gets the same utility in either society.

In “Managerial Workaholism and Competitive Markets” I analyze managerial workaholism under competition a la Rothschild and Stiglitz [1976]. There exist separating Nash equilibria where either both types of managers participate, or, if the reservation utility is large enough, only workaholics participate. Firms make zero expected profit from either type of manager. The workaholics are assigned no vacation time by firms and put more effective hours worked, produce more output and are overall paid more. There exists no pooling Nash equilibrium due to “cream skimming” (Rothschild and Stiglitz [1976]). There are two types of Wilson equilibria: the separating one above and the zero expected profit incentive compatible pooling contract most preferred by the normals. The pooling equilibrium’s transfer is in between the separating transfers of the two types and the pooling equilibrium vacation time is the same as the separating vacation time of the normals. There exists only a Riley (reactive) equilibrium identical to the separating equilibrium described above.

To my family

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Chapter I. Literature Review

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 my second essay paper, 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 scenario for the case of two-worker

partnerships. In each such partnership, there is Nash bargaining over the distribution of total work hours between the two complementary owners (partners), a workaholic and a normal. They ask the question of the effects of workaholism on the co-worker (partner), on family and 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 on the contracts offered by firms to managers, on profits, welfare and on competition. In my setup, the workaholic is the manager and not the owner of the firm or a consumer. Moreover, my framework of managerial 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. Also, my dissertation work is based on the "trait theory" (Clark, 1993) of workaholism, differently than Hamermesh and Slemrod [2008]. 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.

My second essay paper also relates to the extensive literature on insurance markets under adverse selection stemming from the work of Rothschild and Stiglitz [1976], Riley [1979] and Wilson [1977]. Moreover, my dissertation 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. 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]. DellaVigna and Malmendier [2004] 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 cos

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. The next section analyzes managerial workaholism in case of a monopoly.

Chapter II. Managerial Workaholism and Incentives

1. Introduction

This paper is the first, to my knowledge, to examine in the Economics literature the implications for firms and for individuals of managerial workaholism in the case of a monopoly firm. 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 is the over-achievers: "productive, happy, have a high self-esteem and is 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].

2. 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**".** A brief description of this theory is found in Chapter I of the dissertation.

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 $\psi^W < 0$[1] 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 marginal product function $q(t) = \frac{\partial Q(t)}{\partial t}$, assumed to be a continously 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: $q(0) \geq \psi^N$.

[1] 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 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:

$$U(N) = T(N) - \psi^N (1 - v(N)) \tag{3}$$

The following section analyzes the equilibrium of this game under adverse selection with regard to the type of the manager and derives the welfare effects of workaholism in this setting.

3. 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:

$$T(W) - \psi^W \geq u^R \quad (5\text{ w})$$

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

The incentive compatibility constraints of each type of manager are:

$$T(W) - \psi^W \geq T(N) - \psi^W \quad (6\text{ w})$$

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

The time constraints restricting vacation times are:

$$0 \leq v(W) \leq 1 \quad (7\text{ w})$$

$$0 \leq v(N) \leq 1 \quad (7\text{ n})$$

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:

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

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:

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

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 A

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 explores the effects of workaholism on firms and on individuals.

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 A

According to (i), a firm in society A (with a larger probability of workaholism) has a higher expected profit than a 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 a 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.

4. 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:

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

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

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 A

Under the optimal contract for the social planner, 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.

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 the same in both societies if both types of managers participate and is larger in society A if only the workaholics participate.

ii). The equilibrium utility of a workaholic is smaller in society A if both types of managers participate. In case only the workaholic participates, he earns the same utility in either society.

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

Proof: Appendix A

Under the social planner's optimal contract, a firm from either society gets zero expected profit when both types of managers participate. In case only the workaholics participate, they get extracted their entire surplus which explains why the society A with the higher probability of workaholism has a larger expected profit in this case.

In terms of utilities, when both types of managers participate, 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. A larger probability of workaholism society will have a firm that pays the workaholic less than a lower probability of workaholism society due to the lower opportunity cost of working of this type of manager. In case only the workaholics participate, they are extracted their entire surplus so they have the same utility in both societies. 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

Following up on example 2, 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. Next I present conclusions and directions of future work.

5. Conclusions

This paper examines, in a monopoly framework, managerial workaholism and its effects on firms 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. 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 more with a social planner than with a for profit principal. 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 better off with the social planner. In contrast, the firm makes zero expected profit with a social planner principal. Depending on the size of the reservation utility, either both types of managers are hired or only the workaholic is hired.

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. In case both types of managers participate, 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. Essentially this is due to the lower transfer received in society A following the lower opportunity cost of the workaholic versus the normal. In case only the workaholic participates, he is extracted his entire surplus and has the same utility in either society. Also, a firm has at least as big of an expected profit in a society with a larger probability of workaholism compared to a society with a lower probability of workaholism.

I plan to extend this analysis in several directions in the near future. First, I want to look into the dynamic game (in progress), both in terms of lack of commitment and respectively commitment and renegotiation. Second, I plan to analyze the effects of managerial workaholism on the financial policy of the firm. Third, I am interested in looking at the case of oligopolistic competition among firms for managers whose types can be workaholic or normal.

Chapter III. Managerial Workaholism and Competitive Markets

1. Introduction

This paper is examining the implications of managerial workaholism for competitive markets. I consider a labor market setting a la Rothschild and Stiglitz [1976] and characterize the equilibrium given that the manager's type (private information) can be workaholic or normal. A workaholic manager, unlike a normal one, works during his unpaid vacation time. The firms compete for managers by offering contracts consisting of vacation times and transfers. I focus on three types of equilibria: Nash, Wilson and Riley and I look into the existence of both pooling and separating equilibria. 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 2 presents the model, section 3 analyzes the Nash equilibrium, sections 4 and 5 examine the Wilson and Riley equilibrium respectively while section 6 presents the conclusions.

2. The model

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**".** A description of this theory is found in the Chapter I of the dissertation.

Let there be a competitive labor market with adverse selection a la Rothschild and Stiglitz [1976]. In this market, firms hire managers to oversee the production process. Both firms and managers are risk neutral. The managers can be of two types, similarly to Ranca [2008]. With a probability $p \in (0,1)$ a 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, the workaholics are individuals "who devote long hours and *personal time* to work*"*. A workaholic manager has the disutility of working per unit of time $\psi^W < 0$ 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 of a firm flows over a period of length 1. Let the production be $Q(t)$, with the marginal product function $q(t) = \frac{\partial Q(t)}{\partial t}$ 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 such managers to be possible in the production process. A sufficient condition is: $q(0) \geq \psi^N$.

The timing of the model is the following. *First*, nature selects the type, workaholic (W) or normal (N) of each manager. I am assuming that the managers are aware of their types before going on the job market but the firms (potential employers) are not. *Second*, each firm j simultaneously offers managers 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 a firm j consist of a managerial compensation $T^j(i)$ and a vacation time $v^j(i)$ where $i \in \{ W, N \}$ is the type declared by the manager. *Third*, the managers decide which firm's contract (if any) to accept. After a manager accepts, vacation time v and managerial payment T are assigned according to the contract and output occurs at each unit of working time.

If a manager rejects all contracts, he is unemployed and receives the corresponding reservation utility u^R. 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 benefit received by the manager which is assumed to be the same for both the workaholic and the normal.

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

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

A workaholic manager is risk neutral and if he accepts contract from firm j gets the payment T^j (W) and spends all vacation time working and the disutility of working per unit

of time is $\psi^W < 0$. His payoff if he accepts the contract offered by firm j and designed for his type is:

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

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

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

3. Nash Equilibrium Results

The equilibrium concept, like in Rothschild-Stiglitz [1976], "is a set of contracts such that, when consumers [managers in my setup] maximize expected utility, (i) no contract in the equilibrium set makes negative expected profits and (ii) there is no contract outside the equilibrium set that, if offered, will make a non-negative profit".

Proposition I. There exist no pooling equilibria for the competitive labor market described in section I under adverse selection.

The proof of this result follows. For an equilibrium of the perfectly competitive market, all firms must make zero expected profit. Next, the non-existence of a pooling equilibrium, like in the original Rothschild-Stiglitz [1976] paper is based on the "cream-skimming" argument.

I will show a firm can profitably deviate and attract only the workaholics by using a contract menu given all the rivals pool. The proof is by contradiction. Suppose there exists a pooling equilibrium. In this equilibrium, any firm j makes zero expected profit and offers a contract consisting of managerial compensation T and of vacation time v. Let there be a separating deviation menu offered by a firm with two contracts, one designed for workaholics ($T+e_1$, $v+e_2$) and another designed for normals ($T+e_3$, $v+e_4$). One example of a profitable deviation, for which workaholics are paid more than with the pooling contract, normals are paid the same and both types of managers are offered less vacation time than with the pooling contract is:

i) $0<e_1<Q(1)-T$ *ii*) $e_3=0$

iii) $0>e_4>e_2+\frac{e_1}{\psi^N}$ *iv*) $e_2<-\frac{e_1}{\psi^N}$

These properties guarantee that the deviation is profitable for firm j, the incentive compatibility constraints hold, workaholics are attracted, normals are not attracted:

$T+e_1-\psi^W>T+e_3-\psi^W$ (incentive compatibility constraint of workaholics holds)

$T+e_3-\psi^N(1-(v+e_4))>T+e_1-\psi^N(1-(v+e_2))$ (incentive compatibility constraint of normals holds)

$T+e_1-\psi^W\geq T-\psi^W$ (workaholics participate)

$T+e_3-\psi^N(1-(v+e_4))<T-\psi^N(1-v))$ (normals don't participate)

$Q(1)-T-e_1>0$ (firm makes profit from workaholics)

Next I analyze the case of separating equilibrium.

Proposition II. There exists a separating equilibrium where all firms offer the same contracts such that:

i) If the reservation utility is smaller than or equal to the threshold in (4) below both types of managers (workaholics and normals) are hired :

$$u^R \le pQ(1) + (1-p)Q(q^{-1}(\psi^N)) + (1-p)\psi^N(1-q^{-1}(\psi^N)) - \psi^N \qquad (4)$$

The equilibrium contracts of firm j are:

Workaholics:

$v^j(W) = 0$ $\qquad$ $T^j(W) = pQ(1) + (1-p)Q(q^{-1}(\psi^N)) + (1-p)\psi^N(1-q^{-1}(\psi^N))$

Normals:

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

ii) If the reservation utility is in between the range in (5) below only workaholics are hired and the equilibrium contracts are like above:

$$pQ(1) + (1-p)Q(q^{-1}(\psi^N)) + (1-p)\psi^N(1-q^{-1}(\psi^N)) - \psi^N < u^R \le pQ(1) + (1-p)Q(q^{-1}(\psi^N)) + (1-p)\psi^N(1-q^{-1}(\psi^N)) - \psi^W \qquad (5)$$

iii). If the reservation utility is larger than the upper bound in (5) above then there exist no type of manager that is hired (labor market breaks down)

The proof of this Proposition is in appendix B. Workaholics are the "good type" (Rothschild and Stiglitz, [1976]) in the sense they don't want to deviate and pretend to be normals. Moreover, workaholics have a lower opportunity cost of working than normals. Thus, the firms compete primarily for workaholics by maximizing their utility while making non-negative profits. In a sense, the workaholics are the less costly to hire skilled labor input. In equilibrium, due to competition, all firms make zero profit from either type of manager. The workaholics receive a larger transfer than the normal managers because they work more

hours and produce more output. Compared to the monopoly case[2], under competition both types of managers receive larger equilibrium transfers. Also, under competition normals' hours worked are longer than with the monopoly while workaholics work all the time either way.

Depending on whether the reservation utility is small, intermediate or large (the bounds are given in the proposition), either both types of managers are hired, only workaholics are hired or no type is hired. The larger is the utility of working of the workaholics, the easier will be for them to be hired because they become relatively less costly. Similarly, the higher is the disutility of working of the normal managers, the harder will be for them to be hired. Moreover, the workaholics are easier hired in a society that has a larger probability of workaholism than in a society that has a lower probability of workaholism. The rent of the workaholics is larger than that of the normals, given the above and since both types have the same reservation utility. While the workaholics receive rents due to competition, the normals receive information rents to stay true to their type.

Workaholics are assigned no vacation time by firms since hiring them during office time is less costly compared to the normals and because of competition among firms. Not surprisingly, the workaholics overall put in more effective hours worked than the normals. This is because the normals are spending all vacation time as leisure. The normals' vacation time v is longer the larger is their disutility of working ψ^N because they become relatively more costly compared to workaholics in terms of paid work and consequently they are assigned less office time (1-v). A larger probability p of workaholism increases the transfer of both types of managers because the expected output of the firm is larger.

[2] Presented in the "Managerial Workaholism and Incentives" chapter

Example 3.

Let the production process be represented by the marginal products:

$q(t) = 10,000 - 10,000t$

In this example the following parameter values have been selected:

p=0.8, $\psi^N = 3,000, \psi^W = -2,000, q(0) = 10,000$

There are three cases summarized below, depending on how large the reservation utility is.

Figure 1 Separating equilibrium type for different reservation utility values

0_____1180_____3180_____

Both workaholics and normals **Only workaholics** **No type of manager**

Case 1. Both workaholics and normals are hired (u^R<=1180)

Table 1 Equilibrium outputs, vacation times and transfers

Q (W)	Q(N)	v(N)	v(W)	T(W)	T(N)
5000	1050	0.3	0	4180	3280

While the workaholic is paid with 27% more, he generates an output with 376% larger than the normal manager. This is because he has more office time spent than the normal manager and the normal manager spends the entire vacation time (0.3) as leisure**.**

As expected from Proposition II, the rent of the workaholics is larger than the rent of the normals for a given reservation utility.

Case 2. Only workaholics participate (1180< u^R<=3180)

In this intermediate range, the utilities of workaholics are still larger than the reservation utility and they participate. In contrast, the normals are better off by being unemployed. The contract of the workaholics is like in table 3 above.

Case 3. No type of manager is hired (u^R>3180)

If the reservation utility is larger than what they get by being hired, workaholics choose unemployment. The normals will also choose unemployment since their utilities are smaller than the workaholics' utilities. In this case, the labor market breaks down and there are no new managers hired by firms. The next section examines the Wilson equilibria of the game.

4. Wilson Equilibrium Results[3]

In the context of a competitive market under adverse selection, Wilson [1977] introduced a new equilibrium concept that differs from the standard Nash equilibrium (used in Rothschild and Stiglitz [1976]) in terms of what happens after a firm deviates (say to a separating contract for instance) given all other firms keep their initial contracts (say pooling for instance). The main point is: do the other firms remain passive and stick to their initial contracts or rather react in response to the new offer of the rival? In the standard Nash equilibrium, all the other firms stay with their initial contracts even if it may be better perhaps to react to the new contract of the rival. Consequently, like showed by Rothschild and Stiglitz [1976] there exists no Nash pooling equilibrium due to "cream skimming" deviations where a firm gets only the type of agent that brings profit. In the case of Wilson equilibrium, following the deviation of one firm (say) to an updated (separating) contract, the other firms react by withdrawing the old (say pooling) contracts. This makes it more difficult for the deviating firm to make a profit because it implies the other firms respond after the deviation.

Formally, the Wilson [1977] equilibrium "is a set of contracts such that no firm has a profitable deviation that remains profitable once existing contracts that lose money after this deviation are withdrawn". (Mas Collel A, Whinston M, Green J [2005], p 466)

The following result (Proposition III) characterizes the Wilson equilibrium set of the competitive labor market under adverse selection.

[3] I thank R. Vijay Krishna for suggesting to find Wilson and Riley equilibrium of the model. I have consulted Mas Collel, Whinston and Green [1995] Chapter 13

Proposition III. There exist two Wilson equilibria of the competitive labor market:

i) The separating equilibrium of Proposition II

ii) A pooling equilibrium with the following contracts for any firm j:

$$v^j = 1 - q^{-1}(\psi^N)$$

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

Proof: Appendix B

The separating equilibrium of proposition II is a Wilson [1977] equilibrium because it survives any deviations to a pooling or separating contract even if the other firms don't react to the updated contract offered by a rival. This will also be an equilibrium if we allow (a la Wilson [1977]) for the other firms to withdraw their initial contracts following the deviation by the rival. (please refer to proof of Proposition III to see the largest possible deviation expected profit is 0).

There exists also a pooling Wilson equilibrium. In this equilibrium, firms make zero expected profit. Also, this is the best zero expected profit pooling contract from the perspective of the normals. The pooling equilibrium transfer is in between the separating equilibrium transfers of the workaholics and normals. The pooling equilibrium vacation time is the same as the separating equilibrium vacation time of normals and also the same as the complete information one. Since transfer and vacation time are the same for both types of managers and given the above, the effective hours worked are longer for the workaholics because they spend their vacation time working while the office time is the same for both

types. The effective hours worked by normals decrease in the disutility of working ψ^N for the same reasons like above (see Proposition II).

Next I explain why this Wilson pooling equilibrium exists. There cannot be a profitable deviation to another pooling contract that is attractive to the managers because the normals are already given their best contract conditional on the firms making zero expected profit. Moreover, there exists no profitable deviation to a separating contract. Indeed, given all other firms offer the initial pooling contracts, suppose one firm considers a separating contract deviation to attract only workaholics. Since the other firms would react by withdrawing their contracts, the deviation separating contract will attract both normals and workaholics. The deviating firm thus makes a loss from normals and a profit from workaholics but I find that overall its expected profit is negative due to the information rents paid to normals (the costs of separating types).

5. Riley Equilibrium Results

In 1979 Riley introduced a new equilibrium concept that in a way is the opposite of the Wilson equilibrium in terms of the reactions to a deviation. The Riley (or reactive) equilibrium is based on the idea of adding contracts (rather than withdrawing old contracts like is the case of Wilson) following the deviation by one firm from the initial contract. In order for a set of contracts to form a Riley equilibrium, it must survive deviations to added contracts. The definition provided by the author says that "a set of offers is a reactive equilibrium if for any additional offer which generates an expected gain for the agent making the offer there is another which yields a gain to the second agent and losses to the first.

Moreover, no further addition to the set of offers generates losses to the second agent" (Riley, [1979], page 350)

Proposition IV. There exists no pooling Riley equilibrium of the competitive labor market.

The proof is by contradiction and follows. First, note there cannot be a pooling Riley equilibrium whereby firms make strictly positive expected profits. If that was the case, there would exist three successively added pooling contracts by different firms, each contract with a smaller positive profit than the preceding and than the initial contract such that the managers would be profitably attracted in turn by each deviating firm.

Suppose now there exists a zero expected profit pooling Riley equilibrium (v, T). Let there exist a new profitable "cream skimming" contract added by a deviating firm j to attract only workaholics. This deviation contract offers better terms to workaholics and worse terms to normals than the initial pooling contracts. Let the separating deviation menu be given by two contracts, one designed for workaholics ($T+e_1$, $v+e_2$) and another designed for normals ($T+e_3$, $v+e_4$). By Proposition I, a profitable deviation has the following properties:

i) $0 < e_3 < e_1 \leq Q(1) - T$

ii) $e_2 < e_4 < 0$

iii) $0 > e_3 + \psi^N e_4 \geq e_1 + \psi^N e_2$

In response to firm j's added contract, another firm i offers a "cream skimming" contract constructed like above that offers better terms to workaholics and the same or worse terms to the normals than firm j's and still makes positive expected profit from workaholics. Firm i attracts all workaholics and makes positive expected profit while firm j has zero expected profit because it does not attract any manager. However, there will similarly exist a third firm k that offers a separating contract with better terms to workaholics than firm i and makes positive (albeit smaller) positive expected profit. But this contradicts, by definition, the hypothesis the zero expected profit pooling contract is Riley equilibrium. q.e.d.

Next I characterize in Proposition V the separating Riley equilibrium of the competitive labor market.

Proposition V. There exists only one separating Riley equilibrium identical to the one in Proposition II.

The proof is as follows. The Proposition II separating contract is obviously Riley equilibrium since there exists no profitable deviation from it. Suppose now there exists another separating Riley equilibrium. Like above, this equilibrium cannot have strictly positive expected profit because there always exist three successive profitable deviations to separating contracts, each offering better terms to managers and making smaller (but strictly positive) expected profit than the preceding one. Now, suppose there exists another zero expected profit separating equilibrium. One firm could then deviate and attract the managers by playing the strategies in Proposition II. However, we know there exists no further deviation that is profitable once this first deviation occurs. This contradicts the definition of

Riley equilibrium. By all of the above the Proposition II contracts constitute the unique Riley separating equilibrium of the game. q.e.d. The next section contains conclusions and directions of future work.

6. Conclusions

This paper examines the equilibrium of a competitive labor market under adverse selection. I look at three types of equilibria: Nash (a la Rothschild-Stiglitz, [1976]), Wilson [1977] and Riley [1979]. In this market, firms compete for managers, who can be either workaholics or normals. Firms offer managers contracts consisting of a vacation time and a transfer. Workaholism is modeled based on the psychological "trait theory" of Clark [1993]) according to which "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). These authors also note on the same page 82, that "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". In my setting, the workaholics are individuals who work all of their vacation time while normals spend vacation on leisure activities.

In terms of Nash equilibrium, there exist only separating equilibria. Pooling equilibria do not exist due to "cream skimming" (Rothschild and Stiglitz, [1976]) profitable deviations whereby a firm attracts only workaholics. In the separating equilibrium, due to competition, all firms make zero profit from either type of manager. The workaholics receive a larger

transfer than the normal managers because they work more and produce more output. Depending on whether the reservation utility is small, intermediate or large (the bounds are given in the proposition), either both types of managers are hired, only workaholics are hired or no type is hired. Workaholics are assigned no vacation time by firms because they are the less costly to hire skilled labor input and because of competition among firms. Not surprisingly, the workaholics overall put in more effective hours worked than the normals. This is because normals are spending all vacation time as leisure and moreover normals spend less time in the office than workaholics.

In terms of Wilson [1977] and Riley [1979] equilibria, there exist two Wilson equilibria (the separating Nash equilibrium and the zero expected profit pooling contract most preferred by the normals) and one Riley equilibrium (the separating Nash equilibrium). The two types of equilibria differ in terms of the reaction of firms if a rival deviates and introduces a new contract. In case of Wilson equilibrium, the other firms may respond by withdrawing their old contracts while in case of Riley equilibrium the other firms may add new contracts of their own.

The separating Nash equilibrium is Wilson equilibrium. It survives Nash deviations to pooling or separating contracts. These separating contracts are also a Wilson equilibrium because if the other firms withdraw the old contracts, the firm that deviates attracts both types of managers and makes at most zero expected profit. Also, this is a Riley equilibrium because, by Proposition II, it does not allow for profitable pooling or separating deviations stemming from adding new contracts.

The zero expected profit pooling contract most preferred by the normals is Wilson equilibrium because in case there is a deviation say to a "cream skimming" separating

contract then all other firms withdraw their old pooling contracts which renders the deviation unprofitable (the loss due to normals is larger than the profit due to workaholics). Also, since the normals already get the best pooling contract under perfect competition (zero expected profit for all firms) there is no pooling deviation that is more attractive to both types and that makes a positive profit. There cannot exist a pooling Riley equilibrium. First, it is obvious no contract that yields strictly positive expected profit to the firm can be a Riley equilibrium because there are three successive pooling contracts each with better terms to the managers and lower expected profit than the preceding one. Second, there cannot be a zero expected profit pooling Riley equilibrium because I show there exist three successive separating deviations that profitably attract (each in turn) only workaholics.

I plan to extend the project in two directions. First, the case of positive transaction costs and economies of scale, following the insurance study of Allard, Cresta and Rochet [1997] appears like an interesting extension. Second, I want to consider dynamics (a two period model) whereby the firms learn in the second period about the type of manager after observing the first period's strategies.

Appendix A (Proofs pertaining to Chapter II)

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 [4] 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:

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

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

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:

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

Plugging the optimal managerial transfers (4) 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 (6) into (4):

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

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, condition (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:

$$T(W)=T(N)+\psi^{N}(v(N)-v(W)) \qquad (9)$$

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

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

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:

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

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:

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

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

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

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

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

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

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:

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

The participation constraint of the firm must hold:

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

The participation constraints of each type of manager must hold:

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

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

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

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

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

The time constraints restricting vacation times must hold:

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

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

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:

$$p(Q(1)-T(W))+(1-p)(Q(1-v(N))-T(N))=0 \qquad (8)$$

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

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

$$T(N)=p(Q(1)+(1-p)(Q(1-v(N))-p\psi^N(v(N)-v(W)) \qquad (9)$$

The objective function of the firm becomes (once we consider (9) and (2)):

$$\max_{v(N)} p(Q(1)+(1-p)(Q(1-v(N))-p\psi^{W}-(1-p)\psi^{N}(1-v(N)) \qquad (10)$$

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

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

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

Also, the time constraint of the workaholic binds: v(W)=0 (11)

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:

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

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

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

Combined to (4n), this implies that:

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

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

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

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

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:

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

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

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

i). By Proposition III above, the firm has an expected profit of 0 when both types of managers are hired. When only workaholics are hired, they are extracted their entire surplus thus in this case the expected profit is larger in society A (with a larger probability of workaholism).

ii) In case both types of managers participate, 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:

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

In case only the workaholic participates, he is extracted his entire surplus, hence his utility is the same in society A and society B.

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

Appendix B (Proofs pertaining to Chapter III)

Proof of Proposition II

I will construct in what follows the separating equilibrium and I will show: i). that the utility of workaholics is maximized (subject to the participation, compatibility and time constraints for vacation) and ii) there exists no profitable deviation to either a pooling or a separating contract

i) .

$$\max_{T(i),v(i),\; i\in\{W,N\}} \quad T(W)-\psi^{W}$$

subject to:
Participation constraint of the firm:

$$pQ((1)+(1\text{-}p)Q((1-v(N))-pT(W)-(1-p)T(N)\geq 0 \qquad (1)$$

Participation constraints of both types of managers:

$$T(W)-\psi^{W}\geq u^{R} \qquad (2)$$
$$T(N)-\psi^{N}(1-v(N))\geq u^{R} \qquad (3)$$

Incentive compatibility constraints of both types of managers:

$$T(W)-\psi^{W}\geq T(N)-\psi^{W} \qquad (4)$$
$$T(N)-\psi^{N}(1-v(N))\geq T(W)-\psi^{N}(1-v(W)) \qquad (5)$$

Vacation time constraints:

$$0\leq v(W)\leq 1 \qquad (6)$$
$$0\leq v(N)\leq 1 \qquad (7)$$

Due to perfect competition, the participation constraint of the firm (1) binds. Also, from the two IC constraints (4) and (5) it results for existence of optimal contract the normals must be assigned at least as much vacation time as the workaholics:

$$T(N)+\psi^{N}(v(N)-v(W))\geq T(W)\geq T(N) \qquad (8)$$

There are two possible cases.

Case 1. If the IC of the normal manager binds and the IC of the workaholic does not bind

From (8) this leads to:

$$T(N)+\psi^{N}(v(N)-v(W))=T(W)>T(N) \qquad (9)$$

Thus the transfer of the normal manager is:

$$T(N)=T(W)+\psi^{N}(v(W)-v(N)) \qquad (10)$$

Plugging this into (1) the transfer of the workaholic is:

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

The objective function of the firm, once we plug in this transfer is:

$$\max_{v(i),\ i\in\{W,N\}} pQ(1)+(1-p)Q(1-v(N))+(1-p)\psi^{N}(v(N)-v(W))-\psi^{W} \qquad (12)$$

From the first order conditions:

$$\frac{\partial U}{\partial v(W)} \leq 0 \Rightarrow v(W) = 0 \qquad \text{(corner solution)}$$

$$\frac{\partial U}{\partial v(N)} \leq 0 \Rightarrow -(1-p)q(1-v(N)) + (1-p)\psi^N = 0 \Rightarrow v(N) = 1 - q^{-1}(\psi^N) \tag{14}$$

Note also the second order conditions for a maximum are satisfied since:

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

Plugging the vacation times into (10) and (11) gives us the managerial transfers:

$$T(W) = pQ(1) + (1-p)Q(q^{-1}(\psi^N)) + (1-p)\psi^N(1 - q^{-1}(\psi^N))$$
$$T(N) = pQ(1) + (1-p)Q(q^{-1}(\psi^N)) - p\psi^N(1 - q^{-1}(\psi^N)) \tag{15}$$

For the existence of the contract I must check the participation constraints and time constraints of both types of managers are satisfied. Time constraints hold. In terms of participation constraints, note the utility of the workaholic is strictly larger than that of the normal. Hence, if the reservation utility is lower than or equal to the utility of the normal (given by (5) in Proposition II) both types participate. If the reservation utility is strictly larger than the utility of the normals and lower than or equal to the utility of workaholics (bounds given by (6) in Proposition II based on the contract above) only workaholics participate. If the reservation utility is strictly larger than the utility of the workaholics in the contract above, no type of manager participates in the labor market.

Case 2. If the IC of workaholic binds and IC of normal does not bind

By (8) the transfers of the two types are the same. Moreover, plugging in the transfers (given (1) zero profit condition) one can show the vacation time of the normal manager is 0. However, this does not satisfy the IC constraint of the normal manager because in order for that to happen the vacation time of the workaholic should be less (negative) which is not possible.

Case 3. If both IC constraints bind. This leads to a pooling contract which cannot be an equilibrium by Proposition I.

ii) Proof there exists no profitable deviation from the separating contract menu given by transfers (15) and vacation times (14) above

There are three types of potential deviations: a) deviation to a pooling contract, b) deviation to a separating contract to attract only workaholics and c) deviation to a separating contract to attract only normals.

ii a) Deviation to a pooling contract

Let's assume such a profitable deviation pooling contract, T^P, v^P does exist. Then the best pooling contract maximizes the expected profit of the firm while making both types of managers equally well off compared to the separating strategies denoted in what follows T* and v* and given by (3) and (4) of the rival firms:

$$\max \quad p(\mathrm{Q}(1)+(1-p)(\mathrm{Q}(1\text{-}v^P))-T^P$$
$$T^P, v^P$$
subject to:

$$U^P(W)=T^P-\psi^W=T\ (\mathrm{W})\text{-}\psi^W$$

$$U^P(N)=T^P-\psi^N((1-v^P)=T(N)-\psi^N((1-v(\mathrm{N}))$$

It results the contract is the same as the separating contract designed for workaholics:

$$\mathrm{T}^P=T(W) \text{ and } \mathrm{v}^P=v(W)$$

The second order condition for a maximum is satisfied since: $\frac{\partial^2\Pi}{\partial(v^P)^2}=-(1-p)\frac{\partial q(1-v^P)}{\partial v^P}<0$

However this solution leads to zero expected profit to the deviating firm. Basically, the same expected profit is achieved like with the separating contract designed for workaholics. Because of perfect competition, that expected profit is zero. Hence, this deviation is not profitable

ii b. Deviation to a separating contract that attracts only workaholics.

The best such contract for the firm maximizes its expected profit subject to the workaholics getting the same utility like under the separating contract:

$$\max \quad \mathrm{p}(\mathrm{Q}(1)-T)$$
$$T(i,dev), v(i,dev)$$
$$i\in\{W,N\}$$

subject to:

$$T(W,dev)-\psi^W=T(W)-\psi^W \Rightarrow T(W,dev)=T(W)$$
$$T(N,dev)-\psi^N(1-v(N,dev))<T(N)-\psi^N(1-v(N))$$

Thus the largest expected profit in this deviation is zero, so it is not profitable.

ii c. Deviation to a separating contract that attracts only normals.

The best such contract for the firm maximizes its expected profit subject to the normals getting the same utility like under the separating contract and the workaholics getting a strictly lower utility.

$$\max_{T(i,dev),v(i,dev)} (1-p)(Q(1-v(N.dev)) - T(N,dev))$$
$$i \in \{W,N\}$$

subject to:

$$T(W,dev) - \psi^W < T(W) - \psi^W$$

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

This deviation leads to zero expected profit (at most) because in the best case for the deviating firm the transfer and vacation time are the same like in the case of the separating contract

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Proof of Proposition III

I prove there exist two Wilson equilibria

i). The separating equilibrium of proposition II is a Wilson (1980) equilibrium. If all firms initially offer the separating contracts in the proposition above, suppose one firm deviates by introducing a new contract. In response, all other firms withdraw their initial contracts. I will show this makes the deviation unprofitable. There are three types of deviations: pooling, separating that attracts only workaholics and separating that attracts only normals.

i a) Pooling deviation:

If all other firms withdraw contracts, similar to Proposition 2, the firm makes at most zero expected profit

i b) Separating deviation to attract only workaholics

If all other firms withdraw contracts the firm that deviates attracts both types of managers rather than only workaholics. Moreover, by proof of Proposition II (page 76) we know the expected profit from workaholics is at most zero. The expected profit from normals has to be negative. If this was not the case, then the firm would want to attract normals in the first place. Hence, by the above, the overall expected profit of the firm is negative given all other firms withdraw their contracts.

i c) Separating deviation to attract only normals

The best such deviation contract maximizes the expected profit of the firm subject to attracting normals, not attracting workaholics, the compatibility constraints holding, deviating firm making a profit from normals and a loss from workaholics and time constraints holding:

max (1-p) (Q(1-v(N, dev)) $- T(N, dev)$)

subject to:

$T(N, dev) - \psi^N$ (1-v(N, dev)) $\geq T(N) - \psi^N$ (1-v(N))
$T(W, dev) - \psi^W < T(W) - \psi^W$
$T(N, dev) - \psi^N$ (1-v(N, dev)) $\geq T(W, dev) - \psi^N$ (1-v(W, dev))
$T(W, dev) - \psi^W \geq T(N, dev) - \psi^W$
Q(1-v(N, dev)) $- T(N, dev) \geq 0$
Q(1) $- T(W, dev) < 0$
$0 \leq$ v(W, dev) ≤ 1
$0 \leq$ v(N, dev) ≤ 1

In the best case for the deviating firm, the normals receive the same utility like under the existing separating contracts (the first constraint above binds). This leads to the same expected profit (zero) from normals like in the case of Proposition II. Moreover, the expected profit from workaholics is negative (else the deviating firm would want to attract them in the first place). By all of the above, given all other firms withdraw their contracts, this deviation is not profitable.

ii).

I will show the following pooling contracts (v,T) form a Wilson equilibrium. The contracts have the properties that: 1. All firms make zero expected profit; 2. The contract is the best from the perspective of the normals among all zero expected profit pooling contracts; 3. The participation constraint of each type of manager holds. This is the most attractive pooling contract for both types and firms make zero expected profit with it hence no deviation to another pooling contract will be profitable and attract managers. This is because it cannot attract normals with another zero expected profit pooling contract. It can attract normals with

an unprofitable contract that either offers more vacation time and the same transfer, a larger transfer and the same vacation time or both more vacation time and a larger transfer.

I will next check that there exists no profitable deviation to a separating contract menu that using "cream skimming" attracts the workaholics (the profitable type of agents in case of pooling contract above). Suppose such a deviation contract exists. This maximizes the expected profit of the firm subject to: the firm making profit from workaholics and loss from normals; the IC constraints of both types holding; the workaholics being at least as well off and the normals' being worse off than with the pooling contract; the pooling contract has zero expected profit for the firm:

$$\max_{T(i),v(i)} \; p\left(Q(1)-T(W)\right)$$
$$with \; i \in \{W,N\}$$

subject to:

$$Q(1)-T(W)>0 \quad (1)$$
$$Q(1-v(N))-T(N)<0 \quad (2)$$
$$T(W)-\psi_W \geq T(N)-\psi_W \quad (3)$$
$$T(N)-\psi_N(1-v(N)) \geq T(W)-\psi_N(1-v(W)) \quad (4)$$
$$T(W)-\psi_W \geq T-\psi_W \quad (5)$$
$$T(N)-\psi_N(1-v(N)) < T-\psi_N(1-v) \quad (6)$$
$$p(Q(1))+(1-p)Q(1-v)-T=0 \quad (7)$$
$$0 \leq v(W) \leq 1 \quad (8)$$
$$0 \leq v(N) \leq 1 \quad (9)$$

I will show that the separating contract above leads to an expected loss for the deviating firm if all other firms withdraw their pooling contracts. In that case the deviating firm unprofitably attracts both types of managers (it's the only one that still offers jobs). This means the

pooling contract is Wilson equilibrium. I must prove that, given all of the above, the overall profit from both types of the deviating firm is negative:

$$pQ(1)+(1-p)Q(1-v(N))-pT(W)-(1-p)T(N)<0 \qquad (10)$$

Like in Proposition II, the IC of normals (4) binds. Moreover, the firm offers workaholics the lowest transfer such they are still attracted so (5) binds also. Plugging in the transfers from these two constraints into (10) leads to:

$$pQ(1)+(1-p)Q(1-v(N))-pT-(1-p)(T-\psi_N(v(N)-v(W))<0 \qquad (11)$$

Taking into account (7) (the pooling contract makes firms get zero expected profit), (11) becomes:

$$(1-p)Q(1-v(N)-Q(1-v))+(1-p)\psi_N(v(N)-v(W))<0 \qquad (12)$$

Rearranging terms in (12) I must prove that:

$$Q(1-v(N))-\psi_N(1-v(N))<Q(1-v))-\psi_N(1-v(W))<0 \qquad (14)$$

Adding and subtracting T to the right hand side it is sufficient to show that:

$$Q(1-v(N))-\psi_N(1-v(N))<T-\psi_N(1-v(W))<0 \qquad (15)$$

Considering (4) and rewriting right hand side of (15):

$$Q(1-v(N))-\psi_N(1-v(N))<T(W)-\psi_N(1-v(W))=T(N)-\psi_N(1-v(N)<0 \qquad (16)$$

Now, adding and subtracting T(N) on the left hand side and simplifying (16) leads to:

$$Q(1-v(N))-T(N)<0 \tag{17}$$

Note (17) is true given (2) above. Hence, if all other firms withdraw the old pooling contracts the "cream skimming" deviations are not profitable. Given all of the above, the pooling contracts presented in this part are a Wilson equilibrium. For existence of Wilson pooling equilibrium, both types of managers must participate. Note for participation of both types of managers it is sufficient if (2) holds so normals accept the contract. (3) is then automatically satisfied because workaholics get more utility than normals due to their negative disutility from working and since transfers are the same. Plugging from (1) into objective function one can solve for the vacation time and transfer:

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

For both types of managers to be hired it is sufficient that (2) is satisfied:

$$pQ(1)+(1-p)Q(q^{-1}(\psi^N))-\psi^N(1-q^{-1}(\psi^N))\geq u^R \tag{18}$$

Also, only workaholics are hired if:

$$pQ(1)+(1-p)Q(q^{-1}(\psi^N))-\psi^N(1-q^{-1}(\psi^N))<u^R\leq pQ(1)+(1-p)Q(q^{-1}(\psi^N))-\psi^W \tag{19}$$

Moreover, no type of manager is hired if:

$$u^R > pQ(1) + (1-p)Q(q^{-1}(\psi^N)) - \psi^W \quad (20)$$

Note also it is trivial to show that the deviating firm does find it profitable to attract normals using a separating contract since this type of manager causes a loss in the pooling contract above. Indeed, in the best case for the deviating firm (when normals are as well off as under the pooling contract in Proposition III), the profit from normals is zero (since they are offered the same contract like under the Proposition II). Also, profit from workaholics must be negative (else deviating firm would want them in the first place).

By all of the above, the pooling contract in Proposition III is Wilson equilibrium. Indeed given all other firms offer the initial pooling contracts, one firm considers a separating contract deviation (say) to attract only workaholics. Since the other firms would react by withdrawing their contracts, the deviating firm ends up attracting both workaholics and normals. In a Wilson type setting the best a firm can hope for when deviating from the pooling contract and trying to attract all workaholics is to make zero expected profit due to (updated) competition from the other firms. So, these deviations are not profitable. Therefore the initial pooling contracts form a Wilson equilibrium.

Also, note these are the only Wilson equilibria of the game because:

a) There is no equilibrium where firms makes strictly positive profits. Suppose not; then, conditional on the other firms offers, a firm could find a profitable deviation that is slightly better for managers than the existing contracts and that makes positive expected profit overall by attracting both types of managers. This deviation woould remain profitable even if all other firms withdraw their contracts.

b) There exists no other zero expected profit pooling equlibrium. Suppose not; then, conditional on the other firms' offers, a firm could profitable deviate to the pooling Wilson equilibrium in Proposition III and attract both types of managers. This deviation remains profitable even if all other firms withdraw their contracts

c) There exists no other zero expected profit separating equlibrium. Suppose not; then, conditional on the other firms' offers, a firm could profiably deviate to the separating equilibrium in Proposition II and attract both types of managers. This deviation remains profitable even if all other firms withdraw their contracts

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