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Abstract

Public service motivation is often considered as an argument for low-powered incentive schemes in the public sector. In this paper, we characterize the optimal contract between a public regulator and an altruistic agent according to the degree α of public service motivation, when the type of the public service consumer is privately observed. We show that the requested effort is non decreasing with α and can be higher than the first best level. Moreover we show that the agent is put on a high powered contract when some customers are served but that this contract is associated with different types of consumers according to α. In contrast, the agent is never put on a cost-plus contract. Finally, we show that the first best allocation can be achieved under budget balance for a degree of altruism higher than a threshold that we characterize.

JEL classification: D2, D8, L3.

Keywords: altruism; power of incentive schemes; regulation; countervailing incentives; public organization.

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1. Introduction

Optimal incentive structures in the public sector generally differ from those in the private sector. Economic theory suggests many arguments against the use of high-powered incentive schemes in public organizations. Multi-tasking, multiple principals, lack of competition, measurement problems, team-based rewards and intrinsic motivation involve that low-powered incentive mechanisms may be appropriate in such organizations. Among these arguments, intrinsic motivation plays a key role. People who choose to work in public-service delivery have preferences different from those who choose to work in the private sector (see Grout and Stevens (2003)). Public service motivated agents care about their output and share to some extent the same objective function as the principal. For instance, they are motivated to serve the interests of the state because they share some idealistic or ethical purpose served by the government[1]. Hence the provision of public services is often viewed as "mission oriented" (Wilson (1989)). When the goals of the agent are aligned with the principal's mission, civil servants' social concern can motivate their performance without the need of financial incentives. Thus, Besley and Ghatak ((2003), (2005)) consider that the public sector incentives are likely to be more low-powered than in the private sector.

When the agent gets disutility from the effort he exerts and utility from the task, there is an *altruistic effect*. This effect is well-known in health economics. According to the Hippocratic Oath, physicians have to do everything possible to care patients. Thus, a great number of papers on the design of optimal payment systems for health services[2] assume that hospitals are partially benevolent and trade off their benefit and the benefit of their patients. This issue is particularly important when the hospital is paid a fixed price per patient treated when the fixed price for a given DRG[3] is calculated on the basis of the average cost incurred for that DRG nationally. If the hospital can observe patients' severity, there is a scope for dumping or cream-skimming when a hospital with a low degree of benevolence faces an excessively costly patient. In contrast, hospitals with a high degree of benevolence may invest in an effort level greater than the socially optimal

[1] See Dixit (2003). Le Grand (2003) reviews the empirical evidence concerning the existence of altruistic motivations in individuals working in the public sector. See also the references on pro-social motivation given by Francois and Vlassopoulos (2008).

[2] Chalkley and Malcomson (1998), Ellis and McGuire (1986), Ma (2004), Ma and McGuire (1997).

[3] Under the Diagnosis related group (DRG) system, patients are classified according to their principal diagnosis.

effort when treating a high cost patient and then may incur some financial losses. The same problem can arise between a doctor and a hospital administration.

This phenomenon arises in situations in which civil servants are concerned about the quality of the public sector's output and consequently are willing to donate labour. It can appear in many cases when public agencies or not-for-profit organizations are involved in the provision of public services directly to the public (such as health care services, education, job training or social services) and when the type of the beneficiaries of these services is privately observed by the supplier. Altruistic agents may care about the sickest patients in hospitals, about the least well-off in job training organizations or the least able pupils in schools. However, these workers can reduce the performance of their agency. For instance, hospitals may incur some financial losses or get a bad recovery record. In the same way, a job training center can realize a bad placement record and a school a poor average performance in standardized tests[4]. Hence the balance of the self-interested and altruistic motivations of the civil servants appears as a special feature that could explain that incentives are generally weaker in the public sector. This is the argument developed by Francois (2000) that shows that there is no need for high-powered incentives schemes when the agents care about the level of services supplied by their organization, provided there is no residual claimant.

Assume that the cost of provision of services to a consumer θ is increasing with θ (for instance the patient's severity or the pupil's unability) and decreasing with the effort level (as in the standard Laffont and Tirole's model (1986)) and that a principal can neither observe θ nor monitor the effort level. This principal can be the government, a public regulator or a government agency. Under this asymmetric information, a trade-off between efficiency and rent extraction arises when the principal designs a contract. If the agent is self interested, his incentive is always to overstate his cost i.e., the type θ of the consumer. For instance, a doctor can say to the hospital administration that it is very costly to treat a patient and that a high compensation is needed. To obtain this compensation, he has an incentive to overstate the severity. To reduce the rent of the agent, the principal must reduce the effort level requested from the agent below the first best level for all values of θ except the lowest. If the agent cares about the utility

[4] According to Heckmann et al. (1996), though job training centers receive a reward based on the employment level and wage rates attained by graduates of the JTPA programme, people with lower expected gains are more likely to be accepted. This suggests preferences of the job training agency for helping the least employable applicants.

$V(\theta)$ of the consumers, with $V(\theta)$ increasing in θ, the trade-off may be reversed and the principal faces a countervailing incentives problem[5]. Indeed, the agent may wish to understate his private information when θ is high to convince the principal that the altruistic component $V(\theta)$ of his utility function is really low and that greater compensation is needed. In our previous example, the doctor may wish to say to the hospital administration that he gets a low altruistic utility when treating a patient. So he has to be paid a lot to do it. To mitigate this incentive to understate θ, the principal should request an effort level higher than the first best level for all θ except the highest.

When countervailing incentives exist, the agent's incentive to overstate (resp. understate) θ dominates his incentive to understate (resp. overstate) θ for any realizations θ for a low (resp. high) degree α of altruism, α being the weight attached to $V(\theta)$ in the agent's utility function. For some intermediate degree of altruism, the dominant incentive will depend on the realization of θ. In this case, which of the two countervailing incentives dominates determine the nature of the distortions and the form of the contract depends on the shape of the utility function. These insights hold in the absence of budget constraint. When the agent has to balance his expected budget, the optimal contract is modified because agents trade off their expected profit and their utility differently. When the degree of altruism is low, the principal must leave an expected monetary rent to the agent if she wants all consumers to be served. When this degree is high, the budget constraint is binding and the agent agrees losses on high cost consumers being offset by gains on low cost consumers as long as the budget is balanced.

In this paper, we analyze cost reduction incentives when agents are public service motivated. In the absence of budget constraint, we completely characterize the optimal fully separating contract that a utilitarian principal can design according to the level of altruism of the agent when the social cost of public funds is taken into account. We show how *public service motivation does not change the nature of optimal contracts but involves special features.* Hence, the agent is put on a high-powered incentive scheme for different types of consumer according to his degree of altruism. Moreover, we show how *the requested effort is non decreasing with the degree of public service motivation* and that total payment can be negative. Then we consider the influence of an *expected budget balance constraint.* We show that the principal can use this instrument to achieve *the first best level of effort* for any degree of altruism greater than a cut-off value that we characterize.

[5]On countervaining incentives, see Lewis and Sappington (1991), Maggi and Rodriguez-Clare (1995), Jullien (2000).

Thus, whereas the optimal contract is fully separating in the absence of budget constraint, it involves pooling when the agent must break even. Furthermore, we show that the expected welfare is always higher under budget balance. Hence expected budget balance is a means to increase social welfare whatever the value of α and to achieve the first best allocation when agents' intrinsic motivation is sufficiently high.

The paper is organized as follows. The model is presented in section 2. The optimal mechanism is characterized in section 3 in the absence of budget constraint and in section 4 when the agent balances his expected budget. Section 5 draws some conclusions.

2. The model

We consider an agent (a civil servant for instance) that provides services to the public. We assume that the cost of this service depends on the type θ of the consumer and on the cost-reduction effort e exerted by the agent. When the agent provides the service to a consumer (or a beneficiary of the public service) θ, his cost is $C(\theta, e) = c + \theta - e$, where c is a common knowledge cost common to all consumers. When the agent exerts effort level e, he incurs a disutility $\varphi(e)$ in monetary unit, increasing with effort at an increasing rate. To obtain closed-form solutions[6], we assume that $\varphi(e) = \frac{e^2}{2d}$, where d, $d > 0$, is a measure of moral hazard.

We assume that the agent provides services to a whole population of beneficiaries. He can observe privately the type θ of each consumer, but the principal only knows its distribution function. The principal's uncertainty about θ is represented by a common knowledge distribution function $F(\theta)$ and an associated density function $f(\theta) > 0$ on a support $\left[\underline{\theta}, \overline{\theta}\right]$, with $\frac{F(\theta)}{f(\theta)}$ non decreasing in θ and $\frac{1-F(\theta)}{f(\theta)}$ non increasing in θ. If the realized cost is observable ex post, the principal can reimburse C and compensate the agent by an additional payment t. Then the profit of the agent when serving a consumer θ with a cost-reduction effort e is $\Pi(e, t) = t - \varphi(e)$. Let us consider that the principal attaches a social benefit $V(\theta)$ to having services provided to consumer θ, with $V'(\theta) > 0$ and $V''(\theta) \leq 0$. If the agent is public service motivated, he partially shares the same benefit function as the principal.

[6] However, our insights carry over to more general settings with an increasing and convex function $\varphi(e)$.

Then, his utility function can be written

$$U(\theta, e, t) = t - \varphi(e) + \alpha V(\theta) \tag{1}$$

where α, $\alpha \in [0, 1]$, represents the degree to which the agent takes the consumer's interest (or the social goal) $V(\theta)$ into account. In the following, we assume that α is common knowledge. However, the altruistic component of the utility function is uncertain for the principal who does not observe θ.

The principal is assumed to be utilitarian and to take the social cost of public funds λ, caused by distortionary taxation, into account, with $\lambda > 0$. As the agent is altruistic, there is an issue about how to treat $\alpha V(\theta)$ in the social welfare W. In our context, including $\alpha V(\theta)$ in W would involve double counting. As it is noted by Chalkley and Malcomson (1998), benevolence represents a desire to do what is in the social interest and should have no role in determining what the social interest is. Then the altruistic component should be excluded to avoid double counting[7]. Under complete information, when a consumer θ is served, social welfare can then be written, [8]

$$\begin{aligned} W(\theta) &= V(\theta) - (1+\lambda)(c + \theta - e + t) + \Pi \\ &= (1 + \alpha\lambda)V(\theta) - (1+\lambda)(c + \theta - e + \frac{e^2}{2d}) - \lambda U \end{aligned}$$

In this case, the first best allocation is such that $e = d$ and $U(\theta) = 0$, $\forall\theta$.

Under incomplete information, the principal has to design a contract to maximize expected welfare subject to the constraints imposed by its lack of information about θ. According to the revelation principle, we look for a direct revealing mechanism. Let us firstly consider the realizable mechanisms.

2.1. Realizable mechanisms

Assume that the principal designs a contract $\{t(\theta'), e(\theta')\}$ or equivalently $\{t(\theta'), C(\theta')\}$ where $t(\theta')$ is the net transfer received by the agent, $e(\theta')$ the effort level and $C(\theta')$

[7] See also Hammond (1987). Note that this approach differs from the theory of charitable giving which considers charity as a privately provided public goods. For instance Andreoni (1989, 1990) considers that an agent can be either altruistic (his utility depends on the level of public good) or impurely altruistic (his utility depends on the act of giving per se). In the first case, double counting must be avoided while there is no double counting problem in the second case (the "warm glow" case). In our model, we are not in a public good context in which other agents could produce the service.

[8] In the following, we assume that $V(\theta)$ is high enough relative to the cost for all θ so that it is always worth serving all consumers.

the cost level that the agent must realize when he announces θ'. Three types of constraints must be considered.

i) *Participation constraints* (or *no dumping constraints*) that ensure that all consumers are served:

$$U(\theta, e(\theta), t(\theta)) = t(\theta) - \varphi(e(\theta)) + \alpha V(\theta) \geq 0 \ \forall \theta \tag{2}$$

when the reservation utility is equal to zero.

ii) *Incentive compatibility constraints* that ensure that the agent reveals the type of the consumer:

$$\theta = \underset{\theta'}{\text{argmax}} \ t(\theta') - \varphi(e(\theta'/\theta)) + \alpha V(\theta) \ \forall \theta, \forall \theta' \tag{3}$$

with $e(\theta'/\theta) = \theta - \theta' + e(\theta')$.

Standard arguments imply that the necessary and sufficient conditions for incentive compatibility are given by the local optimality condition:

$$\dot{U}(\theta) = -\varphi'(e(\theta)) + \alpha V'(\theta) = -e(\theta)/d + \alpha V'(\theta) \tag{4}$$

and the monotonicity condition

$$\dot{e}(\theta) \leq 1 \tag{5}$$

iii) *Budget balance constraint*

As a public service motivated agent is willing to donate labour, he can accept to make losses when serving a high cost consumer. For instance, organizations producing public services may have endowments and then wealth they are prepared to commit to the project. When they are highly altruistic, they can accept losses because mission's arguments and monetary rewards are substitutes. In contrast, a self interested agent can accept to serve all consumers only if he gets a positive profit on each consumer. As a whole population of consumers θ is served, the principal can impose that the agent's expected revenue must cover his expected cost, including managerial compensation t. Taking the definition of the agent's utility into account, the expected budget constraint can be written

$$\int_{\underline{\theta}}^{\overline{\theta}} (U(\theta) - \alpha V(\theta)) f(\theta) d(\theta) \geq 0 \tag{6}$$

When the agent is self interested, imposing a budget constraint is not socially costly because he does not produce when he does not break even. When the agent is highly altruistic, he is willing to produce even when his revenue does not cover his cost. Then the shadow price of the budget constraint increases with the degree of altruism α. Consequently, budget balance can change the nature of the optimal contract.

2.2. Public service motivation and rent extraction-efficiency trade-off

Assume firstly that there is no budget constraint. To understand the nature of the optimal contract between the principal and the agent, we can consider how the rent extraction-efficiency trade-off changes when the degree of public service motivation α changes. According to the local incentive compatibility condition (4), the information rent changes with θ and its slope depends on the degree of altruism because $U'(\theta)$ can be positive or negative for any θ or change sign on $\left[\underline{\theta}, \overline{\theta}\right]$. If we assume $\alpha = 0$, the agent has an incentive to overstate the type θ of the consumer for all θ. To reduce the informational rent of the agent, the principal must distort the level of effort downward for all θ except $\underline{\theta}$. In this case, the effort level requested from the agent is the standard Laffont and Tirole's level of effort $e_L(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)}$ and the informational rent is decreasing in θ. When $\alpha > 0$, the agent has also an incentive to understate his private information to convince the principal that the altruistic component of its utility function is low so as to obtain a greater payment. When the dominating incentive for all θ is to understate θ, i.e., when the degree of public service motivation α is sufficiently high, the principal must distort upward the level of effort for all θ except $\overline{\theta}$ to reduce informational rents. In this case, straighforward arguments show that the optimal effort level requested from the agent is $e_H(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)-1}{f(\theta)}$ and that the informational rent is increasing in θ.

For an intermediate level of public service motivation, $U'(\theta)$ may change sign. Then the principal faces "countervailing incentives" and the analysis of the optimal regulation of an altruistic agent is close to the analysis of the optimal contract in the case of adverse selection with a type-dependent reservation utility (Maggi and Rodriguez-Clare (1995), Jullien (2000)). As $\alpha V(\theta)$ is concave, two cases are possible. Whereas a non-degenerate interval of types earn zero rent when $\alpha V(\theta)$ is weakly concave, the rent can be equal to zero for $\underline{\theta}$ and $\overline{\theta}$ when $\alpha V(\theta)$ is highly concave, but the allocation of effort is fully separating in both cases.

As an altruistic agent may obtain a non negative utility but either a monetary loss or a monetary gain according to the type of the consumer, the nature of the optimal contract changes when the expected budget constraint is taken into account. Then we must consider the optimal mechanism in both cases.

3. Optimal mechanism without budget constraint

To find the optimal mechanism, we can solve the relaxed program in which (5) is ignored and check ex post that it is satisfied. In solving this relaxed program, the usual procedure involves replacing (3) with (4) assuming that (2) binds only at one extreme and converting the program to one of pointwise maximization. However, as shown by Maggi and Rodriguez-Clare (1995), the solution given by this procedure can violate the participation constraint because the sign of $U'(\theta)$ may change when the principal faces countervailing incentives.

Introducing (2) explicitly into the problem involves using control theory tools. However, a Hamiltonian cannot be used when comparing expected welfare. As we want to focus on the influence of public service motivation on the optimal contract, we base our analysis on pointwise maximization after taking the results of Maggi and Rodriguez-Clare (1995) and Jullien (2000) into account. When $\alpha V'(\theta)$ is sufficiently low, the agent has always an incentive to overstate θ. In the contrary, when $\alpha V'(\theta)$ is sufficiently high, the agent has always an incentive to understate θ. For intermediate values of $\alpha V'(\theta)$, $\alpha V'(\theta)$ may intersect $e_L(\theta)/d$, $e_H(\theta)/d$ or both in the support of θ and the dominating incentive depends on the slope of $\alpha V'(\theta)$. When $\alpha V'(\theta)$ decreases at a slow rate, the agent has an incentive to overstate (resp. understate) θ when θ is close to $\underline{\theta}$ (resp. $\overline{\theta}$) whereas when $\alpha V'(\theta)$ decreases at a fast rate, the incentive is to understate (resp. overstate) θ when types are close to $\underline{\theta}$ (resp. $\overline{\theta}$). Let us consider these two cases which correspond respectively to $\alpha V(\theta)$ weakly and highly concave.

3.1. Weak concavity

When $\alpha V'(\theta)$ decreases at a rate lower than $e_L(\theta)/d$ and $e_H(\theta)/d$, $\alpha V'(\theta)$ is lower (resp. higher) than $e_L(\theta)/d$ and $e_H(\theta)/d$ for the low (resp. high) values of θ. Then utility is decreasing (resp. increasing) for the low (resp. high) values of θ. When the standard solution effort $e_L(\theta)$ associated with $U(\overline{\theta})$ is a candidate solution, this implies that $U(\theta)$ is negative for the high values of θ, which violates the participation constraint. When the standard solution effort $e_H(\theta)$ associated with $U(\underline{\theta})$ is a candidate solution, it implies that the participation constraint is violated for the low values of θ. Then, to satisfy the no dumping constraint, it is optimal to impose $U(\theta) = 0$ on a single interval $\left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$ [9]. Consequently, the optimal mechanism is characterized by the requested effort functions $e_1(\theta)$, $e_2(\theta)$ and $e_3(\theta)$ in the intervals $\left[\underline{\theta}, \widetilde{\theta}\right]$, $\left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$ and $\left[\widetilde{\widetilde{\theta}}, \overline{\theta}\right]$. From (4), $e_2(\theta) = \alpha d V'(\theta)$. If we assume that $\underline{\theta} \leq \widetilde{\theta} < \widetilde{\widetilde{\theta}} \leq \overline{\theta}$, and if we denote respectively $U_1(\theta)$, $U_2(\theta)$ and $U_3(\theta)$ the corresponding utilities, the expected welfare can be written

$$\begin{aligned} EW = & \int_{\underline{\theta}}^{\overline{\theta}} (1+\alpha\lambda) V(\theta) f(\theta) d\theta \\ & - \int_{\underline{\theta}}^{\widetilde{\theta}} \{(1+\lambda)(c+\theta-e_1(\theta)+\frac{e_1^2(\theta)}{2d}) + \lambda U_1(\theta)\} f(\theta) d\theta \\ & - \int_{\widetilde{\theta}}^{\widetilde{\widetilde{\theta}}} \{(1+\lambda)(c+\theta-e_2(\theta)+\frac{e_2^2(\theta)}{2d}) + \lambda U_2(\theta)\} f(\theta) d\theta \\ & - \int_{\widetilde{\widetilde{\theta}}}^{\overline{\theta}} \{(1+\lambda)(c+\theta-e_3(\theta)+\frac{e_3^2(\theta)}{2d}) + \lambda U_3(\theta)\} f(\theta) d\theta \end{aligned} \tag{7}$$

In this case, the optimal mechanism is characterized by Proposition 1 (see the proof in Appendix 6.1)

Proposition 2. *When* $d(1+\lambda)[\alpha(V"(\theta)f(\theta) + V'(\theta)f'(\theta)) - f'(\theta)] + \lambda f(\theta) > 0$ *for* $\theta \in \left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$, *the optimal regulated effort level is given by*

$e_1(\theta) = e_L(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)}$ *for* $\theta < \widetilde{\theta}$ *and* $U(\widetilde{\theta}) = 0$

$e_2(\theta) = d\alpha V'(\theta)$ *and* $U(\theta) = 0$ *for* $\widetilde{\theta} \leq \theta \leq \widetilde{\widetilde{\theta}}$

$e_3(\theta) = e_H(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)-1}{f(\theta)}$ *for* $\theta > \widetilde{\widetilde{\theta}}$ *and* $U(\widetilde{\widetilde{\theta}}) = 0$

with $\widetilde{\theta}$ *and* $\widetilde{\widetilde{\theta}}$ *respectively solutions of (8) and (9)*

$$d(1+\lambda)(\alpha V'(\widetilde{\theta}) - 1) f(\widetilde{\theta}) + \lambda F(\widetilde{\theta}) = 0 \tag{8}$$

$$d(1+\lambda)(\alpha V'(\widetilde{\widetilde{\theta}}) - 1) f(\widetilde{\widetilde{\theta}}) + \lambda (F(\widetilde{\widetilde{\theta}}) - 1) = 0 \tag{9}$$

Firstly, we can remark that in the absence of distributional concern ($\lambda = 0$), the first best level of effort ($e = d$) is attained because there is no trade-off between

[9] See Maggi and Rodriguez-Clare (1995), lemma 2 and Jullien (2000), Proposition 3.

rent extraction and efficiency. When the social cost of public funds is strictly positive, the optimal regulated effort level can be greater or lower than the first best level depending on the value of θ. The thresholds $\widetilde{\theta}$ and $\widetilde{\widetilde{\theta}}$ are decreasing in α and such that $e_L(\widetilde{\theta}) = \alpha d V'(\widetilde{\theta})$ and $e_H(\widetilde{\widetilde{\theta}}) = \alpha d V'(\widetilde{\widetilde{\theta}})$. Then we can characterize the optimal contract according to the degree of altruism of the agent. From (8) and (9), we obtain:

$$\begin{aligned}
\widetilde{\theta} &= \underline{\theta} \text{ when } \alpha = \widehat{\alpha} = \frac{1}{V'(\underline{\theta})} \text{ and } \widetilde{\theta} = \overline{\theta} \text{ when } \alpha = \overline{\alpha} = \frac{d(1+\lambda)f(\overline{\theta}) - \lambda}{V'(\overline{\theta})d(1+\lambda)f(\overline{\theta})} < \widehat{\alpha} \\
\widetilde{\widetilde{\theta}} &= \underline{\theta} \text{ when } \alpha = \overline{\overline{\alpha}} = \frac{d(1+\lambda)f(\underline{\theta}) + \lambda}{V'(\underline{\theta})d(1+\lambda)f(\underline{\theta})} \text{ and } \widetilde{\widetilde{\theta}} = \overline{\theta} \text{ when } \alpha = \widehat{\widehat{\alpha}} = \frac{1}{V'(\overline{\theta})} < \overline{\overline{\alpha}}
\end{aligned}$$

Then $\widetilde{\theta} \in [\underline{\theta}, \overline{\theta}]$ when $\alpha \leq \widehat{\alpha}$ and $\widetilde{\widetilde{\theta}} \in [\underline{\theta}, \overline{\theta}]$ when $\alpha \geq \widehat{\widehat{\alpha}}$. As $V'(\theta)$ is decreasing, $\widehat{\alpha} < \widehat{\widehat{\alpha}}$ and there is no α such that $\widetilde{\theta}$ and $\widetilde{\widetilde{\theta}} \in [\underline{\theta}, \overline{\theta}]$ simultaneously. Taking the different values of the thresholds into account, the optimal contract is characterized by Corollary 2.

Corollary 3. *The optimal contract has the following features:*

i) when $0 \leq \alpha \leq \overline{\alpha}$, *i.e., for a very low degree of altruism,* $\widetilde{\theta} = \overline{\theta}$ *and* $e = e_L(\theta)$ $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$

ii) when $\overline{\alpha} \leq \alpha \leq \widehat{\alpha}$, *i.e., for a low degree of altruism,* $\widetilde{\theta} \in \left]\underline{\theta}, \overline{\theta}\right[$, $\widetilde{\widetilde{\theta}} = \overline{\theta}$, $e = e_L(\theta)$ *when* $\theta \in \left[\underline{\theta}, \widetilde{\theta}\right[$ *and* $e = \alpha d V'(\theta)$ *when* $\theta \in \left[\widetilde{\theta}, \overline{\theta}\right]$

iii) when $\widehat{\alpha} \leq \alpha \leq \widehat{\widehat{\alpha}}$, *i.e., for an intermediate degree of altruism,* $\widetilde{\theta} = \underline{\theta}$, $\widetilde{\widetilde{\theta}} = \overline{\theta}$ *and* $e = d\alpha V'(\theta)$ $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$

iv) when $\widehat{\widehat{\alpha}} \leq \alpha \leq \overline{\overline{\alpha}}$, *i.e., for a high degree of altruism,* $\widetilde{\theta} = \underline{\theta}$, $\widetilde{\widetilde{\theta}} \in \left]\underline{\theta}, \overline{\theta}\right[$, $e = \alpha d V'(\theta)$ *when* $\theta \in \left[\underline{\theta}, \widetilde{\widetilde{\theta}}\right]$ *and* $e = e_H(\theta)$ *when* $\theta \in \left]\widetilde{\widetilde{\theta}}, \overline{\theta}\right]$

v) when $\overline{\overline{\alpha}} \leq \alpha \leq 1$, *i.e., for a very high degree of altruism,* $\widetilde{\widetilde{\theta}} = \underline{\theta}$ *and* $e = e_H(\theta)$ $\forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$

One can check that the monotonicity condition is satisfied by this mechanism under our assumptions on the hazard rates. We show in Appendix 6.1 that these results hold when $d(1+\lambda)[\alpha(V"(\theta)f(\theta) + V'(\theta)f'(\theta)) - f'(\theta)] + \lambda f(\theta) > 0$, i.e., in the case of a *low degree of concavity of* $\alpha V(\theta)$. Corollary 2 implies that the effort requested for a consumer θ (and then the cost that the agent must realize) does not vary with the degree of altruism when α is lower than a value $\alpha(\theta = \widetilde{\theta})$ such that (8) is satisfied when $\theta = \widetilde{\theta}$. It increases linearly with the degree of altruism between $\alpha(\theta = \widetilde{\theta})$ and $\alpha(\theta = \widetilde{\widetilde{\theta}})$ and is constant for a higher degree of altruism. Moreover, the optimal contract is fully separating and the agent earns no information rent for all consumer types between $\widetilde{\theta}$ and $\widetilde{\widetilde{\theta}}$. This occurs for all types when the agent has an *intermediate degree of altruism*, for high types when the agent has a *low degree of altruism* and for low types when the agent has a *high degree of altruism*. When the agent has a *very low degree of altruism*, he earns no information rent for a consumer's type equal to $\overline{\theta}$ whereas he earns no information rent for a consumer's type equal to $\underline{\theta}$ when *the degree of altruism is very high*. Figure 1 summarizes these results.

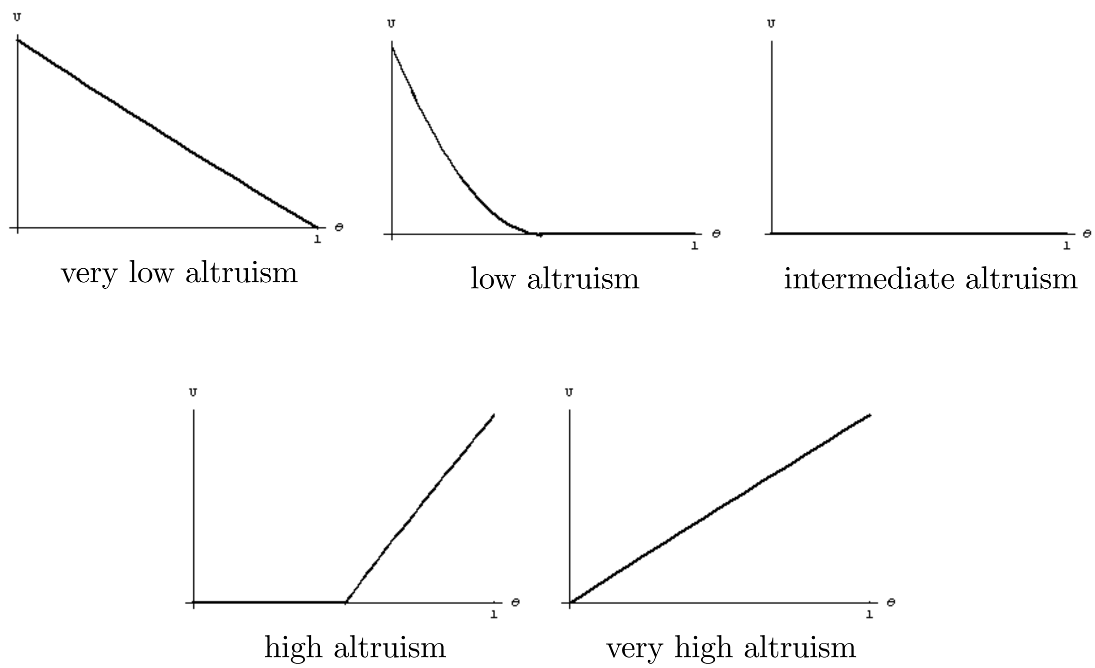


Figure 1: Agent's utility in the weak concavity case

The *first best level of effort* ($e^* = d$) is obtained for $\theta = \underline{\theta}$ when the agent's altruism is low or very low whereas it is obtained for $\theta = \overline{\theta}$ when the altruism is high or very high. For an intermediate degree of altruism ($\alpha \in \left[\widehat{\alpha}, \widehat{\widehat{\alpha}}\right]$), this first best level of effort is obtained for a value of θ such that $\alpha V'(\theta) = 1$. Moreover, to reduce information rent, the requested effort is always distorted downward (resp. upward) when the agent's altruism is very low (resp. very high). For all the intermediate degrees of altruism, the effort can be distorted downward or upward according to the value of θ. Hence *the trade-off between efficiency and rent extraction depends crucially on the degree of altruism.*

3.2. High concavity

When $d(1+\lambda)[\alpha(V"(\theta)f(\theta) + V'(\theta)f'(\theta)) - f'(\theta)] + \lambda f(\theta) < 0$ for $\theta \in \left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$, the previous solution cannot be an optimal solution. As $\alpha V'(\theta)$ decreases at a rate faster than $e_L(\theta)/d$ and $e_H(\theta)/d$, $\alpha V'(\theta)$ is higher (resp. lower) than $e_L(\theta)/d$ and $e_H(\theta)/d$ for the low (resp. high) values of θ. Then the utility function obtained with the standard solutions is increasing (resp. decreasing) for the low (resp. high) values of θ and the participation constraint is not violated as soon as $U(\underline{\theta})$ or $U(\overline{\theta})$ are non negative. Following the approach of Maggi and Rodriguez-Clare (1995), we have to look for a solution involving the same effort function for any θ. It could be $e_L(\theta)$, or $e_H(\theta)$ or an intermediate function such that the marginal utility changes sign for a unique value $\widehat{\theta} \in \left]\underline{\theta}, \overline{\theta}\right[$, according to the value of α. To elicit the different cases ($U(\overline{\theta}) < U(\underline{\theta})$, $U(\overline{\theta}) > U(\underline{\theta})$ or $U(\overline{\theta}) = U(\underline{\theta})$), let us split the expected welfare in two parts, i.e., for $\theta \in [\underline{\theta}, \theta^*]$ and for $\theta \in \left[\theta^*, \overline{\theta}\right]$. EW can be rewritten

$$
\begin{aligned}
EW &= \int_{\underline{\theta}}^{\theta^*} \{(1+\alpha\lambda)V(\theta) - (1+\lambda)(c+\theta-e(\theta)+\frac{e(\theta)^2}{2d}) - \lambda U(\theta)\} f(\theta)d\theta \\
&\quad + \int_{\theta^*}^{\overline{\theta}} \{(1+\alpha\lambda)V(\theta) - (1+\lambda)(c+\theta-e(\theta)+\frac{e(\theta)^2}{2d}) - \lambda U(\theta)\} f(\theta)d\theta
\end{aligned}
$$

with $U(\theta) = \underline{U} + \int_{\underline{\theta}}^{\theta}(-e(s)/d + \alpha V'(s))ds$ on $[\underline{\theta}, \theta^*]$ and $U(\theta) = \overline{U} - \int_{\theta}^{\overline{\theta}}(-e(s)/d + \alpha V'(s))ds$ on $\left[\theta^*, \overline{\theta}\right]$. In this case, the optimal mechanism is characterized by Proposition 3 (whose proof is in Appendix 6.2):

Proposition 4. *When* $d(1+\lambda)[\alpha(V"(\theta)f(\theta) + V'(\theta)f'(\theta)) - f'(\theta)] + \lambda f(\theta) < 0$ *for* $\theta \in \left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$, *the optimal mechanism is such that* *i) when* $0 \leq \alpha < \alpha^* = \frac{\int_{\underline{\theta}}^{\overline{\theta}} e_L(\theta)d\theta}{V(\overline{\theta})-V(\underline{\theta})}$, $e(\theta) = e_L(\theta) \quad \forall\theta \in [\underline{\theta}, \overline{\theta}]$ *and* $U(\overline{\theta}) = 0$*. If* $\alpha < \widehat{\alpha} < \alpha^*$, $U(\theta)$ *is decreasing in* θ *and if* $\widehat{\alpha} < \alpha < \alpha^*$, $U(\theta)$ *has an interior maximum in* $\widehat{\theta}$ *solution of* $-e_L(\widehat{\theta}) + d\alpha V'(\widehat{\theta}) = 0$

ii) when $1 \geq \alpha > \alpha^{**} = \frac{\int_{\underline{\theta}}^{\overline{\theta}} e_H(\theta)d\theta}{V(\overline{\theta})-V(\underline{\theta})}$, $e(\theta) = e_H(\theta) \quad \forall\theta \in [\underline{\theta}, \overline{\theta}]$ *and* $U(\underline{\theta}) = 0$*. If* $\alpha^{**} < \alpha < \widehat{\widehat{\alpha}}$, $U(\theta)$ *has an interior maximum in* $\widehat{\theta}$ *solution of* $-e_H(\widehat{\theta}) + d\alpha V'(\widehat{\theta}) = 0$ *and if* $\widehat{\widehat{\alpha}} < \alpha \leq 1$, $U(\theta)$ *is increasing in* θ

iii) when $\alpha^* \leq \alpha \leq \alpha^{**}$, $e(\theta) = e_{\theta^*}(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)-F(\theta^*)}{f(\theta)} \quad \forall\theta \in [\underline{\theta}, \overline{\theta}]$ *and* $U(\underline{\theta}) = U(\overline{\theta}) = 0$*.* $F(\theta^*)$ *is solution of* $U(\overline{\theta}) - U(\underline{\theta}) = \int_{\underline{\theta}}^{\overline{\theta}}(-e_{\theta^*}(\theta) + d\alpha V'(\theta))d\theta = 0$ *and* $U(\theta)$ *has an interior maximum in* $\widehat{\theta}$ *solution of* $-e_{\theta^*}(\widehat{\theta}) + d\alpha V'(\widehat{\theta}) = 0$

Under the assumption of high concavity, the optimal mechanism is fully separating and satisfies the monotonicity condition. Corollary 4 shows how it depends on the degree of altruism (see Figure 2):

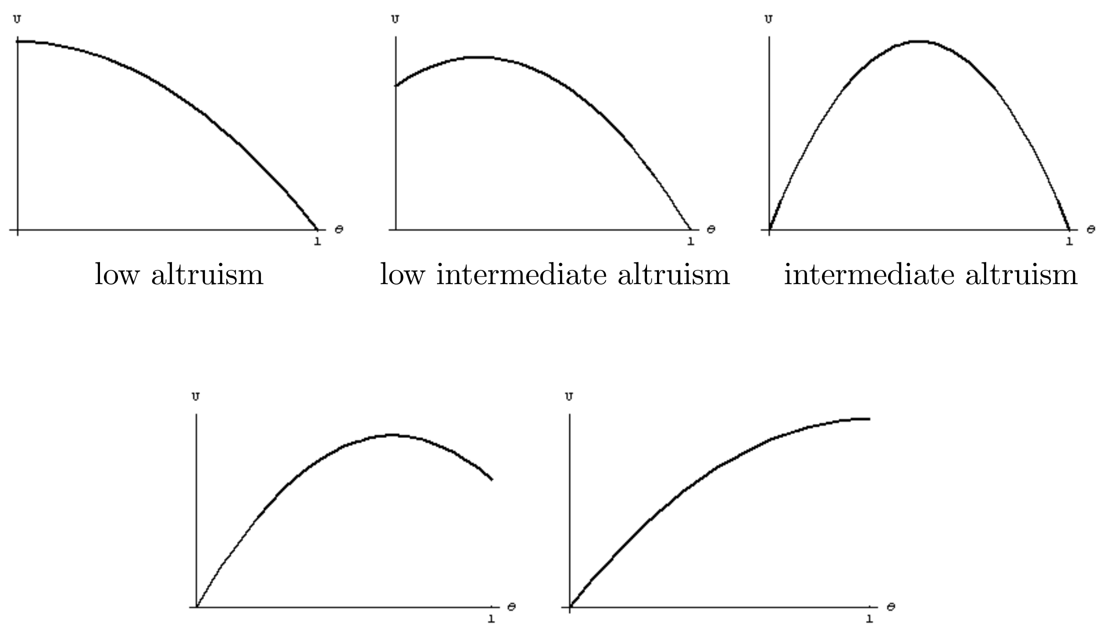


Figure 2: Agent's utility in the high concavity case

Corollary 5. *In the high concavity case, the optimal contract has the following features:*

i) When the agent's altruism is low ($\alpha < \widehat{\alpha}$)*, the incentives to overstate dominate. The optimal effort is downward distorted for all* θ *except* $\underline{\theta}$ *and the agent utility is decreasing with* θ*.*

ii) When the agent's altruism has a "low" intermediate value ($\widehat{\alpha} < \alpha < \alpha^*$)*, the incentives to overstate still dominate and the optimal effort is downward distorted for all* θ *except* $\underline{\theta}$ *but the agent utility has a maximum for* $\widehat{\theta}$ *such that* $-e_L(\widehat{\theta}) + d\alpha V'(\widehat{\theta}) = 0$*.*

iii) When the agent's altruism has an intermediate value ($\alpha^* \leq \alpha \leq \alpha^{**}$)*, countervailing incentives are balanced. The first best effort is obtained for* $\theta^*(\alpha)$ *varying with the degree of altruism. For all types* $\theta < \theta^*$*, the optimal effort is downward distorted whereas it is upward distorted for all types* $\theta > \theta^*$[10]*. The agent's utility is increasing in* θ *for* $\theta < \widehat{\theta}$ *and decreasing in* θ *for* $\theta > \widehat{\theta}$*.*

iv) When the agent's altruism has a "high" intermediate value ($\alpha^{**} < \alpha < \widehat{\widehat{\alpha}}$)*, the incentives to understate dominate. The optimal effort is upward distorted for all* θ *except* $\overline{\theta}$ *and the agent utility has a maximum for* $\widehat{\theta}$ *such that* $-e_H(\widehat{\theta}) + d\alpha V'(\widehat{\theta}) = 0$*.*

v) When the agent's altruism is high ($\alpha > \widehat{\widehat{\alpha}}$)*, the incentives to overstate still dominate. The optimal effort is upward distorted for all* θ *except* $\overline{\theta}$ *and the agent's utility is increasing in* θ*.*

In this mechanism, the first best level of effort is achieved for $\theta = \underline{\theta}$ when the altruism is low, for $\theta = \theta^*$ when the agent's altruism has an intermediate value and for $\theta = \overline{\theta}$ when the altruism is high. As $F(\theta^*)$ is increasing in α, the effort requested for a type θ increases (and then the cost that the agent must realize decreases) with the degree of altruism when $\alpha^* \leq \alpha \leq \alpha^{**}$ whereas it is a constant function of α when $\alpha < \alpha^*$ and when $\alpha > \alpha^{**}$.

3.3. Properties of the optimal contract

In this section, we have shown how the form of the contract depends crucially on the shape of the altruistic component of the agent's utility function. For simplicity, assume that $F(\theta)$ is uniform on [0,1] and that $d = 1$. The concavity condition implies that $\alpha V''(\theta)$ is lower (resp. greater) than the Ramsey number

[10] This mechanism is similar to the mechanism obtained by Maggi and Rodriguez-Clare (1995) in the case of high convexity of the agent's reservation utility.

$\frac{\lambda}{1+\lambda}$ in the weak (resp. high) concavity case. Then it depends on the value of the shadow cost of public funds. According to this shape, incentives to misrepresent θ change. We have also shown how the optimal policy can be characterized according to the degree of altruism of the agent. Figures 1 and 2 indicate how the trade-off between efficiency and rent extraction and consequently the rent obtained by the civil servant vary with his public service motivation.

It is now possible to characterize the *properties of the optimal contracts*. First, we can note that the requested effort $e(\theta)$ is non decreasing with α for any θ in the high and weak concavity cases. This implies that the realized cost must be non increasing with the degree of public service motivation. Second, we can consider the *payment rule* of the optimal mechanism in both cases. From the no dumping constraint, the optimal payment is $t^*(\theta) = U(\theta) + \varphi(e(\theta)) - \alpha V(\theta)$. This optimal mechanism can be implemented by a menu of linear contracts[11] $t(\theta, C) = a(\theta) - b(\theta)C$ where the share of cost borne by the agent is $b(\theta) = e(\theta)/d$, the fixed payment is $a(\theta) = t^*(\theta) + C^*(\theta)e(\theta)/d$ and $C^*(\theta)$ is the level of cost when the agent exerts the requested effort. This menu of linear contracts can be written

$$\begin{aligned}
t(\theta, C) &= -\alpha V(\overline{\theta}) + \frac{e_L(\theta)}{2d}[2c + 2\theta - e_L(\theta)] + \int_\theta^{\overline{\theta}} \frac{e_L(\theta)}{d} d\theta - \frac{e_L(\theta)}{d} C \text{ when } e = e_L(\theta) \\
t(\theta, C) &= \alpha V(\theta) + \frac{\alpha V'(\theta)}{2d}[2c + 2\theta - \alpha V'(\theta)] - \alpha V'(\theta) C \text{ when } e = d\alpha V'(\theta) \\
t(\theta, C) &= -\alpha V(\underline{\theta}) + \frac{e_H(\theta)}{2d}[2c + 2\theta - e_H(\theta)] - \int_{\underline{\theta}}^{\theta} \frac{e_H(\theta)}{d} d\theta - \frac{e_H(\theta)}{d} C \text{ when } e = e_H(\theta) \\
t(\theta, C) &= -\alpha V(\underline{\theta}) + \frac{e_{\theta^*}(\theta)}{2d}[2c + 2\theta - e(\theta)] - \int_{\underline{\theta}}^{\theta} \frac{e_{\theta^*}(\theta)}{d} d\theta - \frac{e_{\theta^*}(\theta)}{d} C \text{ when } e = e_{\theta^*}(\theta)
\end{aligned}$$

In each case, the *optimal contract is a fixed-price contract for a peculiar value of* θ : $\overline{\theta}$ when $e = e_H(\theta)$, $\underline{\theta}$ when $e = e_L(\theta)$, $\widehat{\theta}$ such that $\alpha V'(\widehat{\theta}) = 1$ when $e = d\alpha V'(\theta)$ and θ^* when $e = e_{\theta^*}(\theta)$. On the one hand, whatever the degree of public service motivation, there is always a type of consumer for which the agent faces a fixed-price contract. However, the residual claimant for cost savings is not associated with the same type of consumer according to the degree of public service motivation and according to the slope of $\alpha V(\theta)$. On the other hand, all the other types are given incentive contracts whose general form is $a(\theta) - b(\theta)C$ with $b(\theta) \neq 1$.

[11] As in Laffont and Tirole (1986).

Hence, the differences between optimal contracts with self-interested and altruistic agents are not matters of kind. However, these contracts have *specific features depending on the degree of altruism*. On the one hand, the fixed payment may be negative when α is sufficiently high. On the other hand, the share of cost borne by the agent may be greater than 1 when α is high. Thus, when the degree of altruism is high, $b(\theta) = e_H(\theta) > d$ and total payment $T(\theta, C) = t(\theta, C)) + C = a(\theta) + (1 - b(\theta))C$ with $(1 - b(\theta)) < 0$ if $d > 1$. Note that $a(\underline{\theta}) < 0$ if $\alpha > e_H(\underline{\theta})[2c + 2\underline{\theta} - e_H(\underline{\theta})]/2dV(\underline{\theta})$ and $a(\overline{\theta}) < 0$ when $\alpha > [2c - d + 2\underline{\theta}]/2V(\underline{\theta})$. When the degree of public service motivation is sufficiently high, civil servants volunteer their services for free. Then the principal can lower the payment to these agents and can even ask a payment to the agent getting utility from his action and still obtain the optimal level of effort.

As *missions' alignments and monetary reward are substitutes*, the principal can choose a menu of contracts with a negative fixed payment and a negative share of the cost, but the general form of this menu is the same as in the case of a self-interested agent. *Then intrinsic motivation cannot be considered as an argument for low-powered contracts*. As in the standard *false moral hazard* models, the agent is put on a high-powered incentive scheme when some customers are served ($\underline{\theta}, \overline{\theta}, \theta^*$ or $\widehat{\theta}$ according to the value of α). Is he on a low-powered incentive scheme when some other customers are served? The answer depends on the meaning of the *power of incentives*. As noted by Lazear (2000), there is a confusion in the literature. If the use of the terms *high power* and *low power* incentives connote difference in the ability to elicit agent effort, the agent is put on a low-powered incentive scheme for some customer's types ($\overline{\theta}$ when α is low or $\underline{\theta}$ when α is is high) when the agent exerts the level of effort the most distant from the first best. In contrast, if a low-powered incentive scheme is considered as akin to a cost-plus contract (Laffont and Martimort (2002)), the agent is never put on a low-powered incentive scheme when α is high because he over provides effort and gets a part of his managerial effort greater than 1. As C is reimbursed, the agent must pay an additional part of the cost $((1 - b(\theta)) < 0)$ to the principal and the contract is never cost plus.

4. Optimal mechanism under budget balance

If the agent must balance his expected budget, the principal takes (6) into account in its program. Under this assumption, we firstly characterize the optimal contract. Then we show that imposing a budget constraint is welfare-improving.

4.1. Optimal contracts

Let us denote γ the Kuhn and Tucker multiplier associated with this constraint. In the case of *high concavity*, the expected Lagrangian can be written:

$$EL = \int_{\underline{\theta}}^{\overline{\theta}} \{(1+\alpha(\lambda-\gamma))V(\theta) - (1+\lambda)(c+\theta-e(\theta)+\frac{e(\theta)^2}{2d})$$

$$+(\lambda-\gamma)(-e(\theta)/d+\alpha V'(\theta))\frac{F(\theta)-F(\theta^*)}{f(\theta)}\}f(\theta)d\theta-(\lambda-\gamma)(\underline{U}F(\theta^*)+\overline{U}(1-F(\theta^*)))$$

Note that the optimal value of γ is increasing in α but cannot be strictly greater than λ. Assume $\lambda > \gamma$ in the three cases previously considered.

i) If $\overline{U} > \underline{U}$, the optimal mechanism is characterized by

$$e(\theta) = d - \frac{\lambda-\gamma}{1+\lambda}\frac{F(\theta)-1}{f(\theta)} \quad \text{and } \underline{U} = 0 \tag{10}$$

The expected profit can be rewritten

$$E\Pi = -\alpha V(\underline{\theta}) + \int_{\underline{\theta}}^{\overline{\theta}} \frac{e(\theta)}{d}(F(\theta)-1)d\theta < 0$$

Then the budget constraint cannot be satisfied when $\lambda > \gamma$. Consequently, $\lambda = \gamma$ and $e(\theta) = d$ for any θ.

ii) If $\overline{U} = \underline{U}$, the optimal mechanism is characterized by

$$e(\theta) = d - \frac{\lambda-\gamma}{1+\lambda}\frac{F(\theta)-F(\theta^*)}{f(\theta)} \quad \text{and} \quad \int_{\underline{\theta}}^{\overline{\theta}} (-e(\theta)+d\alpha V'(\theta))d\theta = 0 \tag{11}$$

Then $\int_{\underline{\theta}}^{\overline{\theta}} e(\theta)d\theta = d\alpha(V(\overline{\theta})-V(\underline{\theta}))$. If the budget is balanced, we have $\int_{\underline{\theta}}^{\overline{\theta}} e(\theta)F(\theta)d\theta = d\alpha V(\overline{\theta})$. Taking these conditions together involves that

$$\int_{\underline{\theta}}^{\overline{\theta}} \frac{e(\theta)}{d}(1-F(\theta))d\theta = -\alpha V(\underline{\theta})$$

As this is impossible, we must have $\lambda = \gamma$ and $e(\theta) = d$ for any θ.

iii) If $\underline{U} > \overline{U}$, the optimal mechanism is such that

$$e(\theta) = d - \frac{\lambda-\gamma}{1+\lambda}\frac{F(\theta)}{f(\theta)} \quad \text{and } \overline{U} = 0 \tag{12}$$

The expected profit can be rewritten

$$E\Pi = -\alpha V(\overline{\theta}) + \int_{\underline{\theta}}^{\overline{\theta}} (1 - \frac{\lambda - \gamma}{d(1+\lambda)} \frac{F(\theta)}{f(\theta)}) F(\theta) d\theta$$

$E\Pi > 0$ if $\alpha \leq \alpha_o = \frac{\int_{\underline{\theta}}^{\overline{\theta}} e_L(\theta) F(\theta) d\theta}{dV(\overline{\theta})}$ and the expected budget is balanced for a value $\overline{\gamma}$ of the multiplier

$$\overline{\gamma} = \left[d\alpha(1+\lambda)V(\overline{\theta}) - \int_{\underline{\theta}}^{\overline{\theta}} (f(\theta)(1+\lambda)d - \lambda F(\theta)) \frac{F(\theta)}{f(\theta)} d\theta \right] / \int_{\underline{\theta}}^{\overline{\theta}} \frac{F(\theta)^2}{f(\theta)} d\theta \quad (13)$$

$\overline{\gamma}$ is positive when $\alpha > \alpha_o$ and lower than λ when $\alpha < \alpha_1 = \frac{\int_{\underline{\theta}}^{\overline{\theta}} F(\theta) d\theta}{V(\overline{\theta})} = \frac{\overline{\theta} - E\theta}{V(\overline{\theta})}$.

In the case of *weak concavity*, the same reasoning applies. When $e(\theta)$ is given by (10), the expected budget cannot be balanced for $\lambda > \gamma$ when $\alpha > 0$. When $e(\theta) = d\alpha V'(\theta)$, $E\Pi < 0$ when $\lambda > \gamma$ and when $e(\theta)$ is given by (12), $\gamma = 0$ and $E\Pi > 0$ when $\alpha \leq \alpha_o$ and $E\Pi = 0$ and $\lambda > \gamma$ when $\alpha \leq \alpha_1$. Consequently, the difference between the optimal mechanisms in the high concavity and weak concavity cases vanishes. In both cases, the optimal mechanism is characterized by the following proposition:

Proposition 6. *When the agent must balance his expected budget, the optimal mechanism is characterized by*

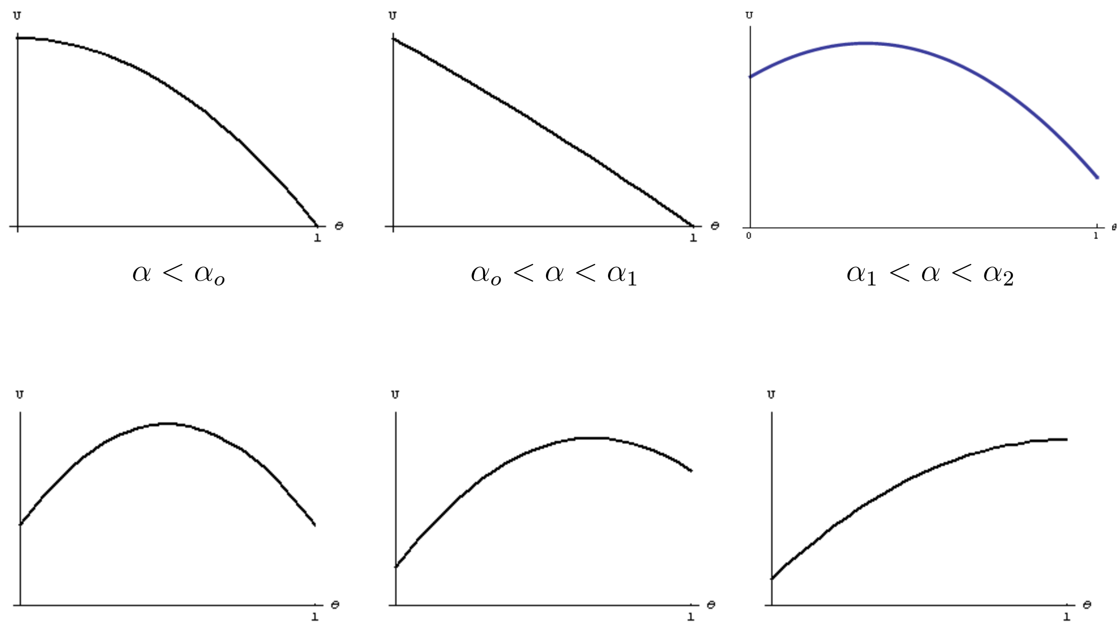
$e(\theta) = e_L(\theta) = d - \frac{\lambda}{1+\lambda} \frac{F(\theta)}{f(\theta)}$, $\overline{U} = 0$ *and* $E\Pi > 0$ *when* $\alpha \leq \alpha_o = \frac{\int_{\underline{\theta}}^{\overline{\theta}} e_L(\theta) F(\theta) d\theta}{dV(\overline{\theta})}$

$e(\theta) = e_{\overline{\gamma}}(\theta) = d - \frac{\lambda - \overline{\gamma}}{1+\lambda} \frac{F(\theta)}{f(\theta)}$, $\overline{U} = 0$ *and* $E\Pi = 0$ *when* $\alpha_o < \alpha \leq \alpha_1 = \frac{\overline{\theta} - E\theta}{V(\overline{\theta})}$, *with* $\overline{\gamma}$ *given by (13)*

$e(\theta) = d \; \forall \theta$ *and* $E\Pi = 0$ *when* $\alpha > \alpha_1$

This mechanism is the standard Laffont and Tirole's mechanism for $\alpha \leq \alpha_o$ and a modified Laffont and Tirole's mechanism for $\alpha_o < \alpha \leq \alpha_1$. When $\alpha > \alpha_1$, the requested effort is the *first best effort* for any level of θ. The effort requested for a type θ does not depend on the degree of altruism when $\alpha \leq \alpha_0$ and $\alpha \geq \alpha_1$. It increases with α when $\alpha_0 \leq \alpha \leq \alpha_1$. This mechanism involves *pooling for all types when the degree of altruism is greater than* α_1. In this case, $\overline{U} - \underline{U} = \alpha(V(\overline{\theta}) - V(\underline{\theta})) - (\overline{\theta} - \underline{\theta})$ and can be positive, negative or null according to α.

$\overline{U} \underset{>}{\overset{\leq}{=}} \underline{U}$ if $\alpha \underset{>}{\overset{\leq}{=}} \alpha_2 = \frac{\overline{\theta}-\underline{\theta}}{V(\overline{\theta})-V(\underline{\theta})}$. Moreover $U(\theta) = \underline{U} + \underline{\theta} - \alpha V(\underline{\theta}) - \theta + \alpha V(\theta)$ and $E\Pi = \underline{U} + \underline{\theta} - \alpha V(\underline{\theta}) - E\theta = 0$. Then $\underline{U} = \alpha V(\underline{\theta}) - \underline{\theta} + E\theta$ depends on α and is always positive. In the same way, $\overline{U} = \alpha V(\overline{\theta}) - \overline{\theta} + E\theta$ is also always positive. Consequently, the principal must leave information rents $U(\theta) = \alpha V(\theta) - \theta + E\theta$ for all consumer's types when the expected budget is balanced and the agent's degree of altruism greater than α_1. Figure 3 summarizes these results.



$\alpha < \alpha_o$ $\alpha_o < \alpha < \alpha_1$ $\alpha_1 < \alpha < \alpha_2$

$\alpha = \alpha_2$ $\alpha > \alpha_2$ $\alpha > \alpha_2$

Figure 3: Agent's utility under budget constraint

These results deserve some comments. When the agent is required to break even and when his degree of public service motivation is sufficiently high, the *complete information level of effort can be achieved*. The main reason is that the budget constraint is an ex ante constraint while no dumping constraints are interim constraints. When the principal commits to a mechanism imposing an expected balanced budget constraint, he contracts under conditions of symmetric information with a risk neutral agent. Then *all monetary rents for the agent can be eliminated without distorting effort decisions.* This incurs for a degree of public service motivation such that the no dumping constraints are not binding. *Public service motivation reduces the agent's willingness to dump high cost consumers even if he is not reimbursed for their cost provided budget is balanced.* In this case, insuring participation of the agent for all θ is socially costless. As the principal can extract the expected monetary rent, high cost consumers are subsidized by low cost consumers. The only rent earned by the agent is a non monetary rent. Hence, rent extraction is not a concern and productive efficiency is the only goal of the principal. For a lower degree of altruism, the allocation must be distorted because the no dumping constraints are active.

Consequently, the optimal mechanism is characterized by a *downward distortion of the requested effort* and no information rent at the top for the agents with a degree of altruism lower than α_1 and by the first best level of effort, information rents for all θ but no monetary rents for the agents with a degree of altruism greater than α_1. Hence, *imposing a break-even constraint is a means to achieve a first best allocation* when the degree of public service motivation is higher than α_1.

As the optimal contract induces a first best level of effort when $\alpha \geq \alpha_1$, the agent faces a *fixed-price contract for all the consumer's types.* As $U(\theta) = \alpha V(\theta) - \theta + E\theta$, $t^*(\theta) = E\theta - \theta + d/2$ when $e = d$. Therefore, total payment $t(\theta) + C(\theta)$ is equal to $c + E\theta - d/2$, i.e. the *mean value of the cost* $C(\theta) + \varphi(d)$. Under this fixed-price contract, the agent is residual claimant for his cost savings. When $\alpha < \alpha_1$, the optimal menu of contract is such as the agent faces a fixed price only when $\underline{\theta}$ is served.

4.2. Expected welfare comparison

One may wonder if it is in the interest of the principal to impose a budget constraint to the agent. Let us compare expected welfare in both cases. Under a budget constraint, the expected welfare can be written

$$EW^B(d) = (1 + \alpha\lambda)EV(\theta) - (1 + \lambda)(c + E\theta - d/2)$$

when $\alpha > \alpha_1$ and $e = d$ and

$$EW^B(\overline{\gamma}) = (1 + \alpha\lambda)EV(\theta) - (1 + \lambda)(c + E\theta) + (\lambda - \overline{\gamma}) \int_{\underline{\theta}}^{\overline{\theta}} (\alpha V'(\theta) - \frac{e_{\overline{\gamma}}(\theta)}{d})F(\theta)d(\theta)$$

$$-\frac{1+\lambda}{2d} \int_{\underline{\theta}}^{\overline{\theta}} (e_{\overline{\gamma}}(\theta)^2 - 2de_{\overline{\gamma}}(\theta))f(\theta)d(\theta)$$

when $\alpha_0 < \alpha < \alpha_1$. In the absence of a budget constraint, the expected welfare depends on the requested effort level according to the degree of public service motivation. We prove in Appendix 6.3 the following Proposition:

Proposition 7. *When the degree of public service motivation is higher than α_0, expected welfare is always greater when the agent must break even whereas the same level of expected welfare is achieved when $\alpha < \alpha_0$.*

Thus, *imposing a break-even constraint is welfare-improving*. The intuition of this result can be found by considering the different levels of effort. When $\alpha > \alpha_1$, as the first best level of effort is achieved instead of either an insufficient or an excessive effort, expected welfare is higher under budget balance. When $\alpha_0 < \alpha < \alpha_1$, the downward distortion of effort is lower under budget balance whereas the same expected welfare is achieved when $\alpha < \alpha_0$. Then the break-even constraint is an instrument that the principal can use to achieve the first best allocation when the agent is sufficiently altruistic but also to increase social welfare for any degree of public service motivation.

These results could explain why governments do not want to exploit the public service motivated civil servants by getting them to work for less than their alternative wage. This would be analogous to obtaining a negative payment and violating the balanced budget constraint. As social welfare is greater under budget balance, that could explain why individuals working in the public sector do not seem to be "paying" for the privilege of doing so by obtaining lower wages than reservation[12].

5. Conclusion

In this paper, we have considered a principal-agent setting in which the agent shares some purpose served by a public regulator. In this public service motivation framework, we have shown how the principal faces a countervailing incentives problem when the agent is sufficiently altruistic. We have characterized the optimal contract without budget balance and under budget balance as a function of the degree of altruism. When there is no budget constraint, we show that the difference between optimal contracts with a self-interested agent and an altruistic agent is not matter of kind though these contracts have special features. First, the requested effort is non decreasing when the degree of public service motivation

[12]We thank an anonymous referee for emphasing this point.

increases and can be higher than the first best level. Second, the agent faces a fixed-price contract when some customers are served but this high-powered incentive contract is associated with different types of consumers according to the degree of altruism. Third, the fixed payment can be negative and the share of cost borne by the agent can be greater than 1 when the degree of altruism is high. Then, if a low-powered incentives scheme is akin a cost-plus contract, the altruistic agent is never put on such a scheme. As public service motivated agents receives satisfaction from providing services to the beneficiaries of the public service, they can accept a lower payment. As they volunteer their services for free, the principal can ask a payment to agents getting utility from their action. Thus, though these contracts have special features, public service motivation cannot be considered as an argument for low-powered incentives schemes in the public sector. Under expected budget balance, the principal can achieve the first best allocation for a degree of altruism higher than a threshold that we characterize. Moreover, we show that expected welfare is always higher than in the absence of budget constraint.

Our analysis shows how the choice of an optimal policy depends on the degree to which civil servants take the customer's interests into account. It shows that the degree of altruism matters when defining the optimal policy. However this degree is likely to vary across agents and is private information. Jack (2005) has considered a model in which there is asymmetric information about altruism but he does not assume that the cost parameter is private information. Then our analysis could be extended by considering simultaneously that the principal does not observe θ and α. We would have to deal with multidimensional adverse selection problem. Another extension could consider the case of agents with different degrees of public service motivation competing to supply the service in the line of the works of Delgaauw and Dur (2009). These issues will be considered in further research.

6. Appendix

6.1. Proof of Proposition 1

On $\left[\underline{\theta}, \widetilde{\theta}\right[$, $\widetilde{U} - U_1(\theta) = \int_{\theta}^{\widetilde{\theta}} U_1'(s)ds$, with $\widetilde{U} \equiv U(\widetilde{\theta})$. In the same way, on $\left]\widetilde{\widetilde{\theta}}, \overline{\theta}\right]$, $U_3(\theta) - \widetilde{\widetilde{U}} = \int_{\widetilde{\widetilde{\theta}}}^{\theta} U_3'(s)ds$, with $\widetilde{\widetilde{U}} \equiv U(\widetilde{\widetilde{\theta}})$. On $\left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$, $U_2(\theta) = \widetilde{U} = \widetilde{\widetilde{U}}$ and $U_2'(\theta) = 0$.

Replacing $U_i(\theta)$ in (7) and integrating by parts, we obtain

$$EW = \int_{\underline{\theta}}^{\overline{\theta}} (1+\alpha\lambda)V(\theta)f(\theta)d\theta$$
$$+ \int_{\underline{\theta}}^{\widetilde{\theta}} \{-(1+\lambda)(c+\theta-e_1(\theta)+\frac{e_1^2(\theta)}{2d}) + \lambda U_1'(\theta)\frac{F(\theta)}{f(\theta)}\}f(\theta)d\theta$$
$$+ \int_{\widetilde{\theta}}^{\widetilde{\widetilde{\theta}}} \{-(1+\lambda)(c+\theta-e_2(\theta)+\frac{e_2^2(\theta)}{2d})\}f(\theta)d\theta$$
$$+ \int_{\widetilde{\widetilde{\theta}}}^{\overline{\theta}} \{-(1+\lambda)(c+\theta-e_3(\theta)+\frac{e_3^2(\theta)}{2d}) + \lambda U_3'(\theta)\frac{F(\theta)-1}{f(\theta)}\}f(\theta)d\theta - \lambda A$$

with $A = [\widetilde{U}F(\widetilde{\theta}) + \widetilde{U}(F(\widetilde{\widetilde{\theta}}) - F(\widetilde{\theta})) + \widetilde{\widetilde{U}}(1-F(\widetilde{\widetilde{\theta}}))] = \widetilde{U} = \widetilde{\widetilde{U}}$, $U_1'(\theta) = -e_1(\theta)/d + \alpha V'(\theta)$ and $U_3'(\theta) = -e_3(\theta)/d + \alpha V'(\theta)$ from (4). After pointwise maximization of EW with respect to e_1 and e_3, we obtain

$$e_1 = e_L(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)} \text{ and } e_3 = e_H(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)-1}{f(\theta)}$$

As $U_2'(\theta) = 0\ \forall\theta \in \left[\widetilde{\theta}, \widetilde{\widetilde{\theta}}\right]$, $e_2(\theta) = d\alpha V'(\theta)$.

Maximizing EW with respect to $\widetilde{\theta}$ and replacing e_1 and e_2, we obtain $\widetilde{\theta}$ solution of

$$K(\widetilde{\theta}) = d(1+\lambda)(\alpha V'(\widetilde{\theta}) - 1)f(\widetilde{\theta}) + \lambda F(\widetilde{\theta}) = 0 \tag{A1}$$

In the same way, maximizing EW with respect to $\widetilde{\widetilde{\theta}}$ and replacing e_3 and e_2, we obtain $\widetilde{\widetilde{\theta}}$ solution of

$$K(\widetilde{\widetilde{\theta}}) = d(1+\lambda)(\alpha V'(\widetilde{\widetilde{\theta}}) - 1)f(\widetilde{\widetilde{\theta}}) + \lambda F(\widetilde{\widetilde{\theta}}) = \lambda \tag{A2}$$

As $\widetilde{\theta} < \widetilde{\widetilde{\theta}}$ and $\lambda > 0$, $K(\theta) = d(1+\lambda)(\alpha V'(\theta) - 1)f(\theta) + \lambda F(\theta)$ must be increasing in θ, which implies

$$K'(.) = d(1+\lambda)[\alpha(V"(\theta)f(\theta) + V'(\theta)f'(\theta)) - f'(\theta)] + \lambda f(\theta) > 0 \tag{A3}$$

From (A1), (A3) and the implicit function theorem, it can be shown that $\frac{d\widetilde{\theta}}{d\alpha} < 0$. The same result is obtained from (A2) and (A3): $\frac{d\widetilde{\widetilde{\theta}}}{d\alpha} < 0$.

6.2. Proof of Proposition 2.

On $[\underline{\theta}, \theta^*]$, $U(\theta) = \underline{U} + \int_{\underline{\theta}}^{\theta}(-e(s)/d + \alpha V'(s))ds$, with $\underline{U} \equiv U(\underline{\theta})$. In the same way, on $\left[\theta^*, \overline{\theta}\right]$, $U(\theta) = \overline{U} - \int_{\theta}^{\overline{\theta}}(-e(s)/d + \alpha V'(s))ds$, with $\overline{U} \equiv U(\overline{\theta})$. Replacing $U(\theta)$ in EW, we obtain

$$
\begin{aligned}
EW &= \int_{\underline{\theta}}^{\overline{\theta}}(1+\alpha\lambda)V(\theta)f(\theta)d\theta \\
&- \int_{\underline{\theta}}^{\theta^*}\{(1+\lambda)(c+\theta-e(\theta)+\frac{e^2(\theta)}{2d})+\lambda(-\frac{e(\theta)}{d}+\alpha V'(\theta))\frac{F(\theta^*)-F(\theta)}{f(\theta)}\}f(\theta)d\theta \\
&- \int_{\theta^*}^{\overline{\theta}}\{(1+\lambda)(c+\theta-e(\theta)+\frac{e^2(\theta)}{2d})+\lambda(-\frac{e(\theta)}{d}+\alpha V'(\theta))\frac{F(\theta^*)-F(\theta)}{f(\theta)}\}f(\theta)d\theta \\
&-\lambda(\underline{U}F(\theta^*)+\overline{U}(1-F(\theta^*))
\end{aligned}
$$

After pointwise maximization of EW with respect to e on $[\underline{\theta}, \theta^*]$ and $\left[\theta^*, \overline{\theta}\right]$, we obtain

$$
e(\theta) = e_{\theta^*}(\theta) = d - \frac{\lambda}{1+\lambda}\frac{F(\theta)-F(\theta^*)}{f(\theta)}
$$

and EW can be rewritten

$$
\begin{aligned}
EW &= \int_{\underline{\theta}}^{\overline{\theta}}(1+\alpha\lambda)V(\theta)f(\theta)d\theta \\
&- \int_{\underline{\theta}}^{\overline{\theta}}\{(1+\lambda)(c+\theta-e(\theta)+\frac{e^2(\theta)}{2d})+\lambda(\frac{e(\theta)}{d}+\alpha V'(\theta))\frac{F(\theta^*)-F(\theta)}{f(\theta)}\}f(\theta)d\theta \\
&-\lambda(\underline{U}F(\theta^*)+\overline{U}(1-F(\theta^*)))
\end{aligned}
$$

Three cases must be considered to elicit $F(\theta^*)$:

i) If $\overline{U} > \underline{U}$, as $\overline{U} - \underline{U} = \int_{\underline{\theta}}^{\overline{\theta}}(-e(\theta)/d + \alpha V'(\theta))d\theta$, $-\lambda(\underline{U}F(\theta^*) + \overline{U}(1-F(\theta^*))) = -\lambda[\underline{U} + (1-F(\theta^*)) \int_{\underline{\theta}}^{\overline{\theta}}(-e(\theta)/d + \alpha V'(\theta))d\theta]$, we obtain

$$
\begin{aligned}
EW &= \int_{\underline{\theta}}^{\overline{\theta}}(1+\alpha\lambda)V(\theta)f(\theta)d\theta \\
&+ \int_{\underline{\theta}}^{\overline{\theta}}\{-(1+\lambda)(c+\theta-e(\theta)+\frac{e^2(\theta)}{2d})+\lambda[(-\frac{e(\theta)}{d}+\alpha V'(\theta))\frac{F(\theta)-1}{f(\theta)}]\}f(\theta)d\theta - \lambda\underline{U}
\end{aligned}
$$

Then, EW is maximized for $\underline{U} = 0$ and $e = e_H(\theta)$. Moreover $\overline{U} > 0$ when $\alpha > \alpha^{**} = \frac{\int_{\underline{\theta}}^{\overline{\theta}} 1 - \frac{\lambda}{1+\lambda}\frac{F(\theta)-1}{f(\theta)} d\theta}{d(V(\overline{\theta}) - V(\underline{\theta}))}$ and $\widehat{\theta}$ is solution of

$$-1 + \frac{\lambda}{d(1+\lambda)} \frac{F(\widehat{\theta}) - 1}{f(\widehat{\theta})} + \alpha V'(\widehat{\theta}) = 0$$

ii) If $\underline{U} > \overline{U}$, EW can be rewritten

$$EW = \int_{\underline{\theta}}^{\overline{\theta}} (1 + \alpha\lambda) V(\theta) f(\theta) d\theta$$

$$\int_{\underline{\theta}}^{\overline{\theta}} -(1+\lambda)(c + \theta - e(\theta) + \frac{e^2(\theta)}{2d}) + \lambda[(-\frac{e(\theta)}{d} + \alpha V'(\theta))\frac{F(\theta)}{f(\theta)}]\} f(\theta) d\theta - \lambda \overline{U}$$

Then, EW is maximized for $\overline{U} = 0$ and $e(\theta) = e_L(\theta)$. Moreover $\underline{U} > 0$ when $\alpha < \alpha^{*} = \frac{\int_{\underline{\theta}}^{\overline{\theta}} 1 - \frac{\lambda}{1+\lambda}\frac{F(\theta)}{f(\theta)} d\theta}{d(V(\overline{\theta}) - V(\underline{\theta}))}$ and $\widehat{\theta}$ is solution of

$$-1 + \frac{\lambda}{d(1+\lambda)} \frac{F(\widehat{\theta})}{f(\widehat{\theta})} + \alpha V'(\widehat{\theta}) = 0$$

iii) If $\overline{U} = \underline{U}$, EW is maximized for $\overline{U} = \underline{U} = 0$. Then $-\lambda(\underline{U}F(\theta^*) + \overline{U}(1 - F(\theta^*))) = 0$ and $e(\theta) = e_{\theta^*}(\theta)$, with $F(\theta^*)$ such that the utility differential between $\underline{\theta}$ and $\overline{\theta}$ is equal to zero, i. e.,

$$\int_{\underline{\theta}}^{\overline{\theta}} (-1 + \frac{\lambda}{d(1+\lambda)} \frac{F(\theta) - F(\theta^*)}{f(\theta)} + \alpha V'(\theta)) d\theta = 0$$

This occurs when $\alpha^* < \alpha < \alpha^{**}$.

6.3. Proof of Proposition 3.

In the absence of budget constraint, the requested level of effort can be e_L, e_2, e_H or e_{θ^*}. Let us compare the expected welfare in these different cases with $EW^B(d)$.

When $e(\theta) = e_H(\theta)$,

$$EW^B(d) - EW(e_H(\theta)) = \lambda \int_{\underline{\theta}}^{\overline{\theta}} (1 - F(\theta))[\alpha V'(\theta) - \frac{e_H(\theta)}{d} + \frac{\lambda(1 - F(\theta))}{2d(1+\lambda) f(\theta)}] d\theta \geq 0$$

When $e(\theta) = d\alpha V'(\theta)$,

$$EW^B(d) - EW(d\alpha V'(\theta)) = \frac{1+\lambda}{2}\int_{\underline{\theta}}^{\overline{\theta}} d(\alpha V'(\theta) - 1)^2 f(\theta)d\theta > 0$$

When $e(\theta) = e_L(\theta)$,

$$\begin{aligned} EW^B(d) - EW(e_L(\theta)) &= \frac{1+\lambda}{2}\int_{\underline{\theta}}^{\overline{\theta}} d(e_L(\theta) - 1)^2 f(\theta)d\theta - \lambda\int_{\underline{\theta}}^{\overline{\theta}} (\alpha V'(\theta) - \frac{e_L(\theta)}{d})F(\theta)d\theta \\ &= \frac{1+\lambda}{2}\int_{\underline{\theta}}^{\overline{\theta}} d(e_L(\theta) - 1)^2 f(\theta)d\theta + \lambda\int_{\underline{\theta}}^{\overline{\theta}} U(\theta)f(\theta)d\theta > 0 \end{aligned}$$

When $e(\theta) = e_{\theta^*}(\theta)$,

$$EW^B(d) - EW(e_{\theta^*}(\theta)) = \lambda\int_{\underline{\theta}}^{\overline{\theta}} \frac{(F(\theta) - F(\theta^*))^2}{2d(1+\lambda)f(\theta)}d\theta + \lambda\int_{\underline{\theta}}^{\overline{\theta}} U(\theta)f(\theta)d\theta > 0$$

In the same way, we can show that $EW^B(e_{\overline{\gamma}}(\theta)) > EW(e_{\theta^*}(\theta))$, $EW^B(e_{\overline{\gamma}}(\theta)) > EW(e_2(\theta))$ and $EW^B(e_{\overline{\gamma}}(\theta)) > EW(e_L(\theta))$.

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