Optimal Contracting with Endogenous Project Mission

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Abstract

Empirical evidence suggests that workers care about the mission of their job, in addition to their wage. This paper studies how organizations can choose a mission to attract, incentivize and screen their workers. We analyze a model in which a principal offers a contract to an agent for the development of a project and can influence the agent's marginal return of effort through the choice of project mission. The principal's and the agents' mission preferences are misaligned and the agents vary in the intensity of their mission drive. Our main results highlight that how far the organization chooses to move from its preferred mission depends on the contractual environment in which it operates. Missions will be more agent-preferred in environments in which effort is non-contractible. In environments in which agents' drive is unknown, missions will be less agent-preferred and the organization will find it optimal to offer contract menus that may be implemented via scoring auctions when there are competing agents. Our analysis applies to the design and allocation of aid contracts, research funding, and creative jobs.

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1. Introduction

Empirical studies show that workers are often driven by the mission of their projects in addition to financial rewards.[1] The project mission reflects the purpose of the project by identifying the scope of its operations, such as what sort of good or service it provides and its main targeted customers or market. For instance, the mission of a journalistic project will typically consist of the type of topics that are covered and the targeted audience. This paper highlights the importance of viewing the project missions as an organization's choice through which it can attract, incentivize and screen its workers. In fact, if journalists are driven by specific missions, such as promoting a specific political ideology, it may be optimal for a profit-maximizing publisher to move away from its revenue-maximizing mission, for example from the types of topics that sell the most, towards a mission that is closer to the journalist's preferences. In practice, choosing the project mission is equivalent to deciding how much discretion to leave a journalist about the topics to cover and the audience to address. The goal of this paper is to use the tools of optimal contracting to generate predictions about how these mission choices are made.

We analyze a model in which a principal (she) offers a contract to an agent (he) for the development of a project. The agent derives an intrinsic benefit from pursuing a certain (observable) mission, which differs from the principal's preferred mission, that is, the mission that, everything else being equal, would maximize revenues.[2] The closer the project mission is to the agent's preferred mission, the higher the agent's intrinsic marginal return of putting effort into the project. This intrinsic marginal return of effort also depends on the agent's "mission drive," which in our model is a type parameter that is allowed to vary. A higher drive is equivalent to a high intensity with which the agent is motivated by the project mission. Thus, a highly driven agent is an agent whose intrinsic benefit of exerting effort is highly sensitive to the choice of project mission. We address the following main questions:

1. Which project mission will the principal choose if she wants to maximize profits?

2. How is the choice of project mission affected by the contractual environment?

We answer these questions by studying contracting in four settings, in which we vary (i) whether the agent's effort is contractible and (ii) whether the agent's drive is known by the principal. In the last part of the paper we allow for multiple agents to compete for one contract.

[1] See Cassar and Meier (2018) for a recent literature review.

[2] Throughout the paper we refer to the marginal revenue-maximizing mission as the principal's preferred mission, and we refer to the mission that maximizes the agent's marginal return of effort as the agent's preferred mission.

The choice of project mission impacts the principal's profit in four ways. First, choosing a more agent-preferred project mission decreases the principal's marginal revenue, and thus the revenue if we hold the agent's effort fixed. Second, a more agent-preferred mission makes the contract more appealing to the agent, so the organization can attract him at a lower wage. Third, a more agent-preferred project mission increases a driven agent's intrinsic benefit of exerting effort, and therefore motivates effort provision when effort is not contractible. Fourth, highly driven agents disproportionately benefit from more agent-preferred missions, so menus of contracts can be used to screen agents when their drive is not observable by the principal.

Our main findings show that how far the organization chooses to move from its marginal revenue-maximizing mission depends on the contractual environment in which it operates. Missions will be more agent-preferred in environments in which effort is non-contractible. This is because the project mission is used as an incentive device when the principal cannot contract on effort. In environments in which agents' drive is unknown, missions will be less agent-preferred. The intuition is that by moving the project mission away from the agent's preferences, the principal makes the contract for the agents who are less mission-driven less attractive for the highly driven agents and thereby reduces the informational rents she must pay. Furthermore, we show that when there are competing agents, the organization will find it optimal to offer mission menus that may be implemented via scoring auctions.

By emphasizing the importance of treating the project missions as a strategic choice variable in an organization's human resource management, this paper helps explain several patterns in procurement contracting and labor markets that would be hardly understandable in a context with exogenous project missions. First, based on our findings, we would expect to see firms offer menus of contracts that differ both in terms of pay and in terms of project flexibility. This is consistent with what we observe in journalism, where journalists can be employed either as staff, and thus benefit from a higher pay but enjoy less project flexibility, or as freelance workers, who would typically earn less but have more freedom in choosing how to write their articles. Second, our findings suggest that we should observe organizations allocating procurement contracts through the use of scoring auctions in which project design plays a predominant role for the decision about whom to award the contract. This is consistent with the procurement procedures that are typically used in the aid sector. Public and international organizations, such as EuropeAid, USAID, the UK's Department for International Development (DFID), and the World Bank's International Development Association, make extensive use of scoring auctions to allocate services and work contracts. In these auctions, candidates are asked to bid both a proposal for the project design and a price. The procurer then assigns each bidder a score on the project design dimension and a score on the financial dimension. The contract is allocated to the bidder that has achieved the highest total score, which is given by a weighted average of the two scores.[3] Third, based on our model, we should expect the same worker to work on projects that, in terms of the mission, are more closely aligned with his preferences in environments where his drive is known than where it is unknown. This is consistent with observations of the design and allocation of research funding. A given academic researcher will typically have more discretion over the design of a project that is internally funded, that is, where his drive is known, than when the project is funded by an external, less informed body, such as government agencies and private foundations. These external grants typically come with a series of conditions attached regarding the scope of the project, its societal impact, the methods used, and so on. Finally, our model predicts that project missions will be more agent-preferred in environments where workers' effort is non-contractible than where it is contractible. Hence, we should, for example, expect workers to enjoy more autonomy in their projects in those companies and sectors with a strong focus on innovation. As emphasized by previous literature (see e.g., Hellmann and Thiele (2011)), innovation is mainly an unplanned activity, which, contrary to pre-assigned standard tasks, cannot be contracted upon. This helps explain why companies in Silicon Valley – the kingdom of innovation – are renowned for promoting an "entrepreneurship" rather than "stewardship" culture among their employees (Hamel, 1999). Think, for example, of Google, which lets its engineers devote 20 percent of their time to any project of their choice.

This paper contributes to the contract theory literature with motivated agents (Murdock, 2002; Francois, 2003; Benabou and Tirole, 2003, 2006; Besley and Ghatak, 2005; Chau and Huysentruyt, 2006; Delfgaauw and Dur, 2007, 2008; Prendergast, 2007, 2008). Among these studies, only Besley and Ghatak (2005, 2017a) and Chau and Huysentruyt (2006) model mission preferences. Besley and Ghatak (2005) show that a principal can save on monetary incentives if he is matched with an agent who shares his mission preferences. Their setting is, however, very different from the one studied in this paper. First and foremost, the authors assume the project mission to be exogenous and, therefore, contrary to our study, their model cannot shed light on the different trade-offs faced by a principal in choosing the project mission.[4] Second, as their model assumes that principals can use output contingent rewards and that there is full information across parties, it does not provide insights on how the presence of incomplete contracts – namely, the non-contractibility of effort – and of informational asymmetries affects

[3]For instance, in the case of the services contracts procured by Europaid, the score on the project design has a weight of 0.80 and, therefore, is particularly relevant in determining the winner of the contract. See the practical guide of procurement and grants for the European Union external actions at the link *http://ec.europa.eu/europeaid/prag/*

[4]The authors only briefly discuss the possibility of relaxing the assumption of exogenous job mission but leave the detailed analysis for future work.

the contracting outcomes in settings with mission-driven parties. Finally, while we derive the optimal allocation mechanism that can be used by a principal to select an agent and show how this mechanism can be implemented in practice through a scoring auction, Besley and Ghatak (2005) focus on a stable matching analysis. This approach does not generate predictions about the mechanisms through which these principal-agent matches occur in practice in competitive labor markets.

Chau and Huysentruyt (2006) show that a competitive tender for the allocation of public funds between two non-profits leads to an ideological compromise between the missions of the principal and those of the contracted non-profit. However, in their model the agents' effort and, therefore, the motivating effects of the mission are entirely absent. Hence, compared with their study, we enrich the analysis by also taking into account the crucial role of the mission as an incentive device and, in turn, by studying the implications of having different contractual environments, i.e., with or without contractible effort, on the principal's mission choice. Furthermore, the authors do not derive the optimal mechanism to allocate the project but rather compare the outcomes from a given competitive tendering with a cooperative bargaining solution.

Finally, Besley and Ghatak (2017a) take a very different approach by linking the mission choice to the structural form of the organization, namely, to whether the organization takes the form of a for-profit, non-profit, or social enterprise. While for-profits and non-profits have rigid (i.e., exogenous) missions, in social enterprises the trade-off between pursuing profit and the social mission is left to the discretion of the manager. The authors show that the structure of the social enterprise is particularly desirable when both the founders and the managers are *moderately* driven by the social mission, because the flexibility of this structure allows mitigating the trade-off between profit and social mission while at the same time motivating effort provision.

Thus, our analysis is unique in i) explaining the different trade-offs that organizations face when using the job mission as an endogenous strategic HR instrument to maximize profit, and ii) in generating predictions (described above) on how different contractual environments – with or without contractible effort and informational asymmetries — affect these mission choices and their practical implementation.

The remainder of the paper is organized as follows. The next section describes the model. Section 3 characterizes the full information optimum under contractible and non-contractible effort. Section 4 does the same under the assumption of asymmetric information about the agent's drive. Section 5 introduces multiple agents. Section 6 discusses applications in more detail. Section 7 concludes.

2. The Model

There are two risk-neutral parties, a principal (she) and an agent (he). The two parties can sign a contract for the realization of a project in some future period. The principal's and the agent's payoffs from the realization of the project are functions of three endogenous variables: the contractible project mission $m \geq 0$, a contractible lump-sum transfer $p \in \mathbb{R}$, and the effort $e \geq 0$ that the agent puts into the project. Formally, the principal's payoff is given by

$$U^p = M(m)e - p \tag{1}$$

The mission enters the principal's payoff in her marginal revenue $M(m)$, which is a decreasing function of the mission with $M(0) > 0$, $M'(m) < 0$ for $m > 0$, $\lim_{m\to\infty} M'(m) = -\infty$ and $M'(0) = 0$, which means that the principal's preferred mission is equal to 0. In addition, we assume that M is strictly concave.

The agent's payoff is equal to

$$U^a = \theta me - c(e) + p \tag{2}$$

where θ captures the agent's "mission drive," that is, the intensity with which the agent is motivated by the project mission. Hence, a higher θ means a higher mission-driven agent. The type parameter θ is distributed according to the distribution function F, with support on $\Theta = [\underline{\theta}, \overline{\theta}]$, with $\overline{\theta} > \underline{\theta} > 0$, and with density f. We furthermore assume that the distribution satisfies the monotone hazard rate property. More formally, let $\lambda(\theta)$ be the reciprocal of the hazard rate; then the assumption is given by

Assumption 1 $\lambda(\theta) = \frac{1-F(\theta)}{f(\theta)}$ *is strictly decreasing in* θ.

The agent's intrinsic marginal return of effort, θm, is increasing in m, which means that the agent always prefers a higher mission to a lower one. Thus, the principal's and the agent's mission preferences are misaligned. Furthermore, the interaction between θ and m implies that the marginal return of effort of a highly mission-driven agent is more sensitive to the choice of project mission than the marginal return of effort of an agent with a low drive. The cost function $c(e)$ represents the standard disutility of effort, and it is assumed to be quadratic: $c(e) = 1/2e^2$. If the contract is not concluded both the agent and the principal get their outside option, which is normalized to 0. Finally, we impose the following assumption on the principal's marginal revenue $M(m)$:

Assumption 2 *$M(m) > \bar{\theta}m$, for all m for which $|M'(m)| \leq \bar{\theta}$.*[5]

In words, Assumption 2 states that as long as the decrease in the principal's marginal returns to effort following an increase in the mission is smaller than or equal to the agent's corresponding marginal gains, the principal has a higher marginal return of effort than the agent. The main purpose of Assumption 2 is to ensure that the principal's marginal revenue will be non-negative in any solution and, therefore, guarantees regular solutions in all contractual settings.[6]

This paper studies the contracting problem in four settings, in which we vary (i) whether effort is contractible[7] and (ii) whether the agent's drive is known by the principal. To capture these four settings in a single model, let $\sigma \subseteq \{\theta\}$ denote the principal's information, and let $\varphi \subseteq \{e, \hat{\theta}\}$ be a contractible performance measure, where $\hat{\theta}$ is a report made by the agent. If $\theta \in \sigma$, we will say that the agent's drive is observable, and if not, we will say that it is unobservable. If $e \in \varphi$, we will say that effort is contractible, and if not, we will say that effort is non-contractible.[8] The timing is as follows. In period 1, the agent observes θ and the principal observes σ. In period 2, the principal offers a contract consisting of a mission choice m and a payment p as a function of the contractible performance measure φ. In period 3, the agent decides whether to accept the contract. If he accepts the contract, he chooses effort e in period 4, and in period 5, the contract is executed and payoffs are realized. As a final step, this paper extends the analysis of these contractual problems to a competitive environment, that is, when there are n agents in the market competing for a single contract. We will indicate the contracting environment with a pair of superscripts, where the first superscript indicates whether the agent's drive is observable (o) or unobservable (u), and the second superscript denotes whether effort is contractible (c) or non-contractible (n). For example, when the agent's drive is observable and effort contractible, we will denote the optimal mission choice as m^{oc}. All proofs are confined to the appendix.

[5]If, for instance, $M(m) = K - \frac{1}{2}m^2$, Assumption 2 is equivalent to assuming $K - \frac{1}{2}m^2 > \bar{\theta}m$ for all $m \leq \bar{\theta}$. In particular, as M is a decreasing function, the assumption holds if and only if it holds for $m = \bar{\theta}$. Thus, the reduced assumption is then given by $K > \frac{3}{2}\bar{\theta}^2$.

[6]Assumption 2 is sufficient, but not necessary, to ensure that $M(m)$ will be positive in any solution. However, imposing this stronger assumption significantly simplifies the comparative statics with regard to both mission and effort between the contractual settings we consider. It will be made clear from the text when, and to what extent, we rely on this assumption.

[7]We assume that when effort is non-contractible, revenue is non-contractible as well.

[8]Importantly, note that we will only cover sensible combinations of σ and φ. That is, let $\mathcal{P}$ denote the set of combinations of unions of σ and φ that we will cover, then $\mathcal{P} = \{\{\theta, e\}, \{\theta\}, \{\hat{\theta}, e\}, \{\hat{\theta}\}\}$.

3. Full information

3.1. Contractible effort

In this section, we study contracting in a setting in which the agent's effort is contractible, $e \in \varphi$, and his drive is known to the principal, $\theta \in \sigma$. That is, the principal observes the agent's realized type θ in period 1 and in period 2 offers a contract to the agent consisting of a mission and a payment as a function of the agent's effort. Subsequently, in period 3, the agent decides whether to accept the contract. Let $\Pi(m, e, \theta)$ be the social surplus given m, e and a realized θ, that is, $\Pi(m, e, \theta) = (M(m) + \theta m)e - \frac{1}{2}e^2$. Since the agent's participation constraint must bind, the principal's maximization problem is given by

$$\max_{m,e} \Pi(m, e, \theta) \tag{3}$$

Proposition 1 follows

Proposition 1 *When the agent's drive is observable and effort contractible, the optimal mission m^{oc} and effort e^{oc} are given by:*

$$-M'(m^{oc}) = \theta \tag{4}$$

$$e^{oc} = M(m^{oc}) + \theta m^{oc} \tag{5}$$

Proof. See appendix. ■

Hence, the optimal mission m^{oc} with full information and contractible effort equalizes the agent's and the principal's marginal returns of the mission, whereas the optimal effort level e^{oc} equalizes the total marginal returns of effort with the total marginal costs of effort under the project mission m^{oc}. Because the agent's marginal returns are increasing in his drive θ, the optimal mission as well as the optimal effort also increase with θ. In other words, the more mission-driven the agent is, the more agent-preferred the mission and the higher the contracted effort level. This is because more effort can be extracted from highly driven agents by marginally increasing the mission.

3.2. Non-contractible effort

Now suppose that effort is non-contractible. The difference compared with the previous setting is that now, after observing the agent's type, the principal offers a contract (m, p) to the agent consisting only of a mission and a lump-sum transfer, without being able to condition these on the effort of the agent. That is, $\varphi = \emptyset$ and $\theta \in \sigma$. Formally, the principal's maximization problem is given by

$$\max_{m} \Pi(m, e^{on}(m), \theta) \tag{6}$$

where $e^{on}(m)$ is the agent's optimal effort choice following from an incentive compatibility constraint. That is, the principal maximizes the social surplus with her choice of mission, given the agent's optimal effort choice, $e^{on}(m) = \theta m$. Let Π_e^{on} be the partial derivative of the social surplus Π with respect to e evaluated at (m^{on}, e^{on}), and e_m^{on} the derivative of e^{on} with respect to m evaluated at m^{on}. Proposition 2 follows.

Proposition 2 *When the drive is observable and the effort non-contractible, the optimal mission m^{on} and effort e^{on} are given by:*

$$-M'(m^{on}) = \theta + \Pi_e^{on} \frac{e_m^{on}}{e^{on}} \tag{7}$$

$$e^{on}(m) = \theta m^{on} \tag{8}$$

where $\Pi_e^{on} \frac{e_m^{on}}{e^{on}} = \frac{M(m^{on})}{m^{on}}$ is positive by Assumption 2.[9]

Proof. See appendix. ∎

As in the contractible case, it follows that the optimal mission m^{on} characterized in Equation (7) is increasing in the agent's drive θ. On the one hand, the effect of a marginal increase in m on the marginal surplus that can be extracted from the agent is increasing in θ (i.e, $\theta e_\theta^{on} + e^{on} = 2\theta m^{on} > 0$). The more mission-driven an agent is, the higher the intrinsic utility that he derives from a better alignment between the project mission and his preferences. Hence, the minimum payment that makes him accept the contract also decreases with θ. Furthermore, an increase in θ also increases the marginal effect of the mission on the principal's surplus via an increase in effort (i.e., $M(m^{on})e_{m\theta}^{on} = M(m^{on}) > 0$). The more mission-driven an agent is, the higher the increase in effort – and thus in the principal's surplus – that results from an increase in m. On the other hand, the increase in effort generated by the increase in θ also increases the principal's marginal cost of compromising on the project mission (i.e., $M'(m^{on})e_\theta^{on} = M'(m^{on})m^{on} < 0$), which decreases the principal's surplus. Hence, the overall effect of θ on m^{on} depends on the relative size of these counteracting forces. With quadratic costs of effort, it is clearly the case that the marginal effect of the mission on the principal's surplus via the increase in effort along with the higher extractable surplus from the agent

[9] In fact, $\Pi_e^{on} \frac{e_m^{on}}{e^{on}}$ would be positive even if the assumption were weakened to $|M'(m)| \leq \bar{\theta} \Rightarrow M(m) > 0$. To see this, suppose, by contradiction, that $M(m^{on}) < 0$. Then, by (7), we must have $-M'(m^{on}) < \theta$, a contradiction.

dominate the decrease in the principal's surplus due to the higher cost of compromising on the mission. Thus, the optimal mission is increasing in the agent's drive.

Furthermore, note that the right-hand side of Equation (7) in Proposition 2 is larger than the right-hand side of Equation (4) in Proposition 1. Thus, the comparison clearly shows that the optimal mission choice with non-contractible effort, m^{on}, is larger than the optimal mission with contractible effort, m^{oc}, for any given θ. That is, when effort is non-contractible, it is optimal for the principal to distort the project mission towards the agent's preferences compared with the case in which effort is contractible. The intuition behind this result is that the principal uses the project mission as an incentive device to extract more effort from the agent. Indeed, the comparison of equations (5) and (8) suggests that, for any given mission, the agent exerts less effort compared with the case with contractible effort because he does not internalize the preferences of the principal. The principal partially compensates for this lower effort by aligning the mission towards the agent's preferences. This additional "incentive effect" of the mission is captured by the term $\Pi_e^{on} e_m^{on}/e^{on}$, namely the effect of the mission on the social surplus via an increase in effort. In addition, although not as straightforward, it follows from (5) and (8) that, even though the agent faces a more aligned mission in the non-contractible setting, his effort choice will be lower than in the contractible case.[10] Thus, even though the principal will offer a higher mission in the non-contractible case, it is not optimal to offer a mission so high as to match the effort choice between the two settings.

4. Asymmetric information

4.1. Contractible effort

Consider again a setting in which the principal can contract the agent's effort level. But now she cannot observe the agent's mission-drive θ and, instead, perceives the agent's type as being drawn from the distribution function F with properties described in Section 2. Using the revelation principle, the principal offers a mechanism consisting of a mission, lump-sum transfer, and a required effort level, as a function of the agent's report of his type $\hat{\theta}$. That is, $\varphi = \{e, \hat{\theta}\}$ and $\sigma = \emptyset$. Without loss of generality, we restrict our attention to direct and incentive compatible mechanisms that induce a truth-telling Bayesian Nash equilibrium in

[10] Too see this, note that $e^{oc} > e^{on}$ iff $\theta(m^{on} - m^{oc}) < M(m^{oc})$. If one now substitutes in $\theta = -M'(m^{oc})$ we have $0 < M(m^{oc}) + M'(m^{oc})(m^{on} - m^{oc})$, which must hold since the inequality $M(m^{on}) \leq M(m^{oc}) + M'(m^{oc})(m^{on} - m^{oc})$ follows from a standard rooftop theorem of concave functions and $M(m^{on}) > 0$ from Assumption 2.

which $\hat{\theta} = \theta$. The principal's optimization problem is then given by

$$\max_{m(\cdot),p(\cdot),e(\cdot)} \mathbb{E}_\theta \Big[M(m(\theta))e(\theta) - p(\theta) \Big] \tag{9}$$

subject to

$$\theta \in \arg\max_{\hat{\theta}\in\Theta} U^a(\hat{\theta},\theta) \tag{10}$$

$$U^a(\theta) \geq 0, \quad \forall\theta \in \Theta \tag{11}$$

where $U^a(\hat{\theta},\theta)$ is the agent's utility from being type θ and reporting type $\hat{\theta}$ and $U^a(\theta)$ is the equilibrium utility with truthful reporting. Equation (10) is thus an incentive compatibility constraint which imposes that it must be optimal for the agent to report his true type, and Equation (11) is a participation constraint.

Using the envelope theorem, we know that, in any incentive compatible mechanism, the marginal utility of an agent with drive θ is given by $U^{a'}(\theta) = m(\theta)e(\theta)$. Hence, we can rewrite the agent's equilibrium utility as

$$U^a(\theta) = U^a(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} m(\tau)e(\tau)\, d\tau \tag{12}$$

In addition, if the informational rent, $m(\theta)e(\theta)$, is monotonically non-decreasing in θ, then it is straightforward to verify that the envelope condition in (12) is sufficient for incentive compatibility of the mechanism. For now, we will assume that this monotonicity constraint holds and check afterwards that the solution to the relaxed problem does in fact satisfy this assumption. Notice that if the agent's informational rent is non-decreasing, then it follows from Equation (12) that the individual rationality constraint in (11) holds for all types if it holds for the lowest type. That is, we can reduce the participation constraint to $U^a(\underline{\theta}) \geq 0$. Finally, using the agent's equilibrium utility derived by the envelope theorem in (12), we can immediately derive an expression for $p(\theta)$ which we substitute into the principal's objective function and integrate by parts, so that we get to the expected virtual surplus:

$$\mathbb{E}_\theta \Big[\left(M(m(\theta)) + (\theta - \lambda(\theta))m(\theta)\right) e(\theta) - \frac{1}{2}e(\theta)^2 \Big] - U^a(\underline{\theta}) \tag{13}$$

where the term within the expectation is the virtual surplus $V(m,e,\theta)$, i.e., the social surplus $\Pi(m,e,\theta)$ minus the effect of the incentive problem on the social surplus by keeping informational rents non-decreasing. Clearly, it is optimal to set $U^a(\underline{\theta}) = 0$. The expected value of (13) can be maximized point-wise. Naturally, one needs then to verify that the solution indeed satisfies the monotonicity constraint. Proposition 3 follows.

Proposition 3 *When the drive is unobservable and the effort contractible, the optimal mission $m^{uc}(\theta)$ and effort $e^{uc}(\theta)$ satisfy:*

$$-M'(m^{uc}(\theta)) = \max\{\theta - \lambda(\theta), 0\} \tag{14}$$

$$e^{uc}(\theta) = M(m^{uc}(\theta)) + (\theta - \lambda(\theta))m^{uc}(\theta) \tag{15}$$

Proof. See appendix. ■

The term $\theta - \lambda(\theta)$ in Proposition 3 represents the agent's virtual valuation. Hence, the reciprocal of the hazard rate, $\lambda(\theta)$, represents the standard distortion compared with the case with full information. This means that for agents with drive lower than $\overline{\theta}$, the optimal project mission under incomplete information $m^{uc}(\theta)$ in (14) is closer to the principal's preferences than under the case of full information m^{oc} in (4). For agents with sufficiently low mission drive, namely with a negative virtual valuation $\theta - \lambda(\theta) < 0$, the principal would like to set the mission even lower than 0. However, since this is not possible, it is optimal to set the project mission equal to the principal's most preferred one. Similarly, the contracted effort level in (15) is lower than under the case with full information given in (5) for agents with drive lower than $\overline{\theta}$. Since the virtual valuations are increasing in the drive by Assumption 1, the distortion in both the mission and contracted effort decreases with θ, with no distortion at the top. The intuition is that by distorting the project mission towards her own preferences and by contracting a lower effort level, the principal makes the contract for agents with a low drive less attractive to the agents with a higher drive and thereby reduces the rent she has to pay to make them report their type truthfully.

4.2. Non-contractible effort

Suppose now that effort is no longer contractible. The principal offers a schedule consisting of only a mission and lump-sum transfer as a function of the agent's report of his type $\hat{\theta}$, i.e., $\varphi = \{\hat{\theta}\}$ and $\sigma = \emptyset$. In doing so, the principal faces the additional constraint that the agent will choose his optimal effort level in a later period. Again, using the revelation principle, we restrict attention to direct and incentive compatible mechanisms that induce a truth-telling Bayesian Nash equilibrium in which $\hat{\theta} = \theta$. Due to the additional effort-related constraint, the agent's utility as a function of his drive can now be written as $U^a(\theta) = \theta m(\theta) e^{un}(\theta, m(\theta)) - 1/2 e^{un}(\theta, m(\theta))^2$, where $e^{un}(\theta, m(\theta))$ is the optimal effort of an agent with drive θ. As in the preceding subsection, we apply the envelope theorem to rewrite the agent's utility and assume that the mission, $m(\theta)$, is monotonically non-decreasing, implying incentive compatibility of truthful reporting. Once again, it follows that we can reduce the participation constraint to a constraint of non-negative equilibrium utility to the agent of the lowest drive. After applying these steps, the principal's relaxed problem is given by

$$\max_{m(\cdot),p(\cdot)} \mathbb{E}_\theta\Big[M(m(\theta))e^{un}(\theta,m(\theta)) - p(\theta)\Big] \tag{16}$$

subject to

$$U^a(\theta) = U^a(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} m(\tau)e^{un}(\tau,m(\tau))\,d\tau \tag{17}$$

$$U^a(\underline{\theta}) \geq 0, \quad \forall\theta\in\Theta \tag{18}$$

where (17) and (18) are the rewritten incentive compatibility and participation constraint, respectively, after applying the envelope theorem. In addition, notice that the incentive compatibility constraint on effort has already been substituted into the principal's objective, that is, her expected payoff. Applying the same steps as before, we use the agent's equilibrium utility derived by the envelope theorem in (17) to derive an expression for $p(\theta)$, which we substitute into the principal's objective function and integrate by parts to get to the expected virtual surplus:

$$\mathbb{E}_\theta\Big[(M(m(\theta)) + (\theta-\lambda(\theta))m(\theta))\,e^{un}(\theta,m(\theta))) - \frac{1}{2}e^{un}(\theta,m(\theta))^2\Big] - U^a(\underline{\theta}) \tag{19}$$

Let V_e^{un} be the partial derivative of the virtual surplus with respect to e evaluated at the optimal solution. Proposition 4 follows.

Proposition 4 *When the drive is unobservable and the effort non-contractible, the optimal mission $m^{un}(\theta)$ and effort $e^{un}(\theta,m^{un}(\theta))$ satisfy:*

$$-M'(m^{un}(\theta)) = \theta - \lambda(\theta) + V_e^{un}\frac{e_m^{un}}{e^{un}} \tag{20}$$

$$e^{un}(\theta,m^{uc}(\theta)) = \theta m^{un}(\theta) \tag{21}$$

where $V_e^{un}\frac{e_m^{un}}{e^{un}} = \frac{M(m^{un}(\theta))}{m^{un}(\theta)} - \lambda(\theta)$ is positive by Assumption 2.[11]

Proof. See appendix. ■

The implicit characterization of the optimal mission in Equation (20) has an economic interpretation: moving the mission marginally towards the agent's ideal, while holding the agent's effort fixed, reduces the principal's surplus by $-M'(m^{un})e^{un}$, but it increases the obtainable

[11] To see this, suppose that $V_e^{un} = M(m^{un}(\theta)) - \lambda(\theta)m^{un}(\theta) \leq 0$. First, if the virtual valuation is negative, i.e., $\theta < \lambda(\theta)$, we have an immediate contradiction since $M'(m^{un})$ would have to be positive for (20) to hold. Second, if, instead, $\theta \geq \lambda(\theta)$, then from (20) we must have $-M(m^{un}) \leq \theta - \lambda(\theta) \leq \bar{\theta}$. But then from Assumption 2, we have that $M(m^{un}) > \bar{\theta}m^{un} \geq \lambda(\theta)m^{un}$, which leads us again to a contradiction.

surplus of the agent by $(\theta - \lambda(\theta))e^{un}$. It also increases the agent's effort by e_m^{un}, which increases the virtual surplus that the principal captures at the margin, by V_e^{un}.

It follows that the right-hand side of Equation (20) in Proposition 4 is smaller than the right-hand side of Equation (7) in Proposition 2. Thus, the comparison clearly shows that the optimal mission m^{un} in (20) is lower than the optimal mission under full information m^{on} in (7). In other words, private information about θ leads the mission choice to be closer to the principal's ideal. As we saw in the previous subsection, this result also holds when effort is contractible. However, when effort is *not* contractible, the mission has a "double distortion": the first distortion of m, which is also present in equation (14), namely, $\lambda(\theta)$, reduces the payable informational rent by decreasing the agent's marginal return of effort for any given effort level. The second distortion of m, namely, $\lambda(\theta)m$, reduces the payable information rent by inducing a lower effort level from the agent. When effort is contractible, this additional distortion of the mission is absent because the principal can directly distort the contracted effort level. However, when this is not possible, the principal needs to move the project mission even closer to her own preferences in order to induce the agent to exert less effort. Finally, as was the case when comparing the effort level between the contractible and non-contractible settings under full information, the effort level with contractible effort e^{uc} is larger than the effort level with non-contractible effort e^{un}. Thus, even though the distortion on effort through the mission given by V_e^{un} is positive, it is not optimal to increase the mission so much as to match the effort choice between the two settings.

Thus, all together, Propositions 1-4 show that the non-contractibility of effort pushes the project mission towards the agent's preferences, whereas information asymmetries move the project mission towards the principal's preferences. Figure 1 illustrates this result by comparing the optimality conditions in the different contracting and informational environments for an agent with drive θ. As can be seen, the optimal mission is smallest when effort is contractible and θ is not observable, whereas it is highest when effort is non-contractible and θ is observable, that is, $m^{uc} < m^{oc}, m^{un} < m^{on}$. Although we plotted $m^{oc} < m^{un}$, note that the opposite can also be true: whether m^{un} is higher or lower than m^{oc} depends on which of the two effects dominates.

5. Competing agents: Optimal mechanisms

In this section we extend the model to allow for multiple competing agents. The principal now faces the additional problem of having to select one out of $i = 1, ..., n$ mission-driven agents to allocate the project to. That is, in addition to contracting on the mission m_i and p_i as a

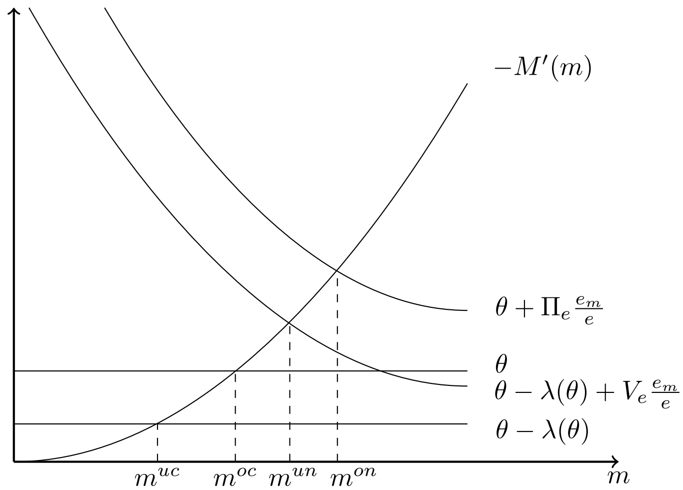

Figure 1: Marginal cost and marginal benefits of increasing the mission in the four different settings, for a given θ. Optimal missions are depicted with dashed vertical lines.

function of the contractible measures, which in the case of asymmetric information includes the agent's report $\hat{\theta}_i$, the principal also specifies, for each agent i, a probability of winning the contract, q_i. It is straightforward to verify that, since the social surplus is increasing in the agent's drive, the principal will always offer the contract to the agent with the highest drive under both cases with full information. In the following subsections, we consider the same setting of competing agents in which the agents' drive is private information. As stated in Section 2, we assume that the agent's types θ_i are independent and identically distributed. For notational ease, let $\theta = (\theta_1, \dots \theta_n)$ where n is the number of competing agents. Further, let $\Theta = \times_{i=1}^{n} \Theta_i$ and $\Theta_{-i} = \Theta \setminus \Theta_i$. Using the revelation principle, we look for a mechanism that specifies for each agent i a probability of winning the project $q_i(\hat{\theta})$, a project mission $m_i(\hat{\theta})$, a payment $p_i(\hat{\theta})$, and, if contractible, an effort level $e_i(\hat{\theta})$ as functions of the agents' reported mission-drive $(\hat{\theta}_1, ..., \hat{\theta}_n) = \hat{\theta}$ that induces a truth-telling Bayesian Nash equilibrium, $\hat{\theta} = \theta$. In the following sections, let $U_i^a(\hat{\theta}_i)$ denote agent i's expected payoff when he reports $\hat{\theta}_i$ and all other agents report truthfully.

5.1. Contractible effort

Let effort be contractible. The principal's optimization problem is given by

$$\max_{q_i(\cdot,\cdot), m_i(\cdot,\cdot), p_i(\cdot,\cdot), e_i(\cdot,\cdot)} \mathbb{E}_\theta \Big[\sum_{i=1}^{n} q_i(\theta_i, \theta_{-i}) \left(M(m_i(\theta_i, \theta_{-i})) e_i(\theta_i, \theta_{-i}) \right) - p_i(\theta_i, \theta_{-i}) \Big] \tag{22}$$

subject to

$$\theta_i \in \arg\max_{\hat{\theta}_i \in \Theta_i} U_i^a(\hat{\theta}_i) \tag{23}$$

$$U_i^a(\theta_i) \geq 0 \tag{24}$$

$$\sum_{i=1}^{n} q_i(\theta_i, \theta_{-i}) \leq 1, \quad q_i(\theta_i, \theta_{-i}) \geq 0, \quad \forall \theta \in \Theta, \forall i = 1, \ldots n \tag{25}$$

where Equation (22) is the principal's expected payoff. As in the setting with one agent, Equation (23) is an incentive compatibility constraint imposed on each agent's report. In particular, it states that it must be optimal for an agent to report his true drive when all other agents do the same. Equation (24) is an individual rationality constraint. In equilibrium, it should not be the case that an agent derives a negative expected utility. The last constraint given in Equation (25) merely states (i) that the sum of probabilities of getting the contract cannot exceed one, and (ii) that the probability of getting the contract, for any agent, cannot be negative.

Once again, we make use of the envelope theorem to derive the marginal expected utility of each agent i, $U_i^{a'}(\theta_i) = \mathbb{E}_{\theta_{-i}}[q_i(\theta_i, \theta_{-i}) m_i(\theta_i, \theta_{-i}) e_i(\theta_i, \theta_{-i})]$, which in turn gives us the expected equilibrium utility of the agent:

$$U_i^a(\theta_i) = U_i^a(\underline{\theta}_i) + \int_{\underline{\theta}_i}^{\theta_i} \mathbb{E}_{\theta_{-i}}[q_i(\tau, \theta_{-i}) m_i(\tau, \theta_{-i}) e_i(\tau, \theta_{-i})] \, d\tau \tag{26}$$

Again, conditional on non-decreasing expected informational rent for every agent, it follows that Equation (26) is sufficient for incentive compatibility of the mechanism. We will assume that this monotonicity constraint holds and check afterwards that the solution to the relaxed problem does in fact satisfy this assumption. The participation constraint is given by $U_i^a(\theta_i) \geq 0$ for all θ_i. Using this assumed monotonicity as well as the rewritten expected equilibrium utility in Equation (26), this participation constraint holds if and only if $U_i^a(\underline{\theta}_i) \geq 0$. We can then use Equation (26) to derive the agent's expected lump-sum transfer $\mathbb{E}_{\theta_{-i}}[p_i(\theta_i, \theta_{-i})]$. As a final step, we take the expectation of this transfer over agent i's drive to get to $\mathbb{E}_\theta[p_i(\theta_i, \theta_{-i})]$, which we in turn integrate by parts and insert in the principal's objective to reduce it to:

$$\mathbb{E}_\theta\Big[\sum_{i=1}^{n} q_i(\theta_i, \theta_{-i}) \left((M(m_i(\theta_i, \theta_{-i}) + (\theta_i - \lambda(\theta_i))\, m_i(\theta_i, \theta_{-i}))\, e_i(\theta_i, \theta_{-i}) - \frac{1}{2} e_i(\theta_i, \theta_{-i})^2 \right)\Big] - U_i^a(\underline{\theta}_i) \tag{27}$$

The principal then chooses the probability, mission and effort schedules which maximize Equation (27) subject to the constraint that the expected utility of the lowest type is non-negative and to the constraints on the probabilities defined in Equation (25). Proposition 5 follows.

Proposition 5 *When the type is unobservable, effort contractible, and the principal must select one agent, the optimal mechanism is such that*

(i) The optimal allocation rule is:

$$q_i^{uc}(\theta) = \begin{cases} 1 & \textit{if } \theta_i > \max_{\forall j \neq i} \theta_j \\ 0 & \textit{otherwise} \end{cases} \tag{28}$$

(ii) The optimal mission and effort are given by $m_i^{uc}(\theta)$ and $e_i^{uc}(\theta)$, respectively, from Proposition (3) for the agent who receives the contract.

Proof. See appendix. ■

It follows from Proposition 5 that the project is *always* allocated to the one agent, among the n competitors, who reports the highest mission drive. This implies non-exclusion – the principal is not better off by excluding agents with low drives from the competition by, for example, imposing a reserve price. In fact, even if agents have negative virtual valuations such that $\theta_i - \lambda(\theta_i) < 0$, by setting the optimal mission to zero and, thus, the optimal effort to $M(0)$, the principal can reduce their informational rents to zero, thereby ensuring a positive virtual surplus.[12]

Finally, note that the contracted mission and effort level of the agent who receives the contract coincide with those specified in Proposition 3. This is the so-called dichotomy property by Laffont and Tirole (1987). To see the intuition for this result, note that the maximization problem with multiple agents is the same as the maximization problem with one agent, with the exception of having to choose the allocation rule $q_i(\theta)$, which is a simple weighting function and therefore does not affect the optimal solution of the mission and effort compared with the model with one agent.

5.2. Non-contractible effort

Suppose now that effort is non-contractible. This means that when agent i decides on his report $\hat{\theta}_i$, he takes into consideration his ex post optimal effort choice, which is given by $\theta_i m_i(\hat{\theta}_i, \theta_{-i})$. However, at the time of the report, θ_{-i} is unknown to agent i, so the agent must choose the report which maximizes his expected utility based on his expected effort choice $\theta_i \mathbb{E}_{\theta_{-i}}[m_i(\hat{\theta}_i, \theta_{-i})]$. This, in turn, implies that the principal faces an additional "effort" constraint when choosing the optimal schedule.

To solve for the optimal schedule, we again make use of the envelope theorem and apply an assumption of non-decreasing expected informational rents, such that incentive compatibility on the report of the agents' drive holds. Following these steps, it follows immediately that the principal's relaxed optimization problem is given by

$$\max_{q_i(\cdot,\cdot), m_i(\cdot,\cdot), p_i(\cdot,\cdot)} \mathbb{E}_\theta \Big[\sum_{i=1}^{n} q_i(\theta_i, \theta_{-i}) \left(M(m_i(\theta_i, \theta_{-i})) e_i^{un}(\theta_i, m(\theta_i, \theta_{-i})) \right) - p_i(\theta_i, \theta_{-i}) \Big] \tag{29}$$

[12] Note that even if we assume that the lowest possible mission choice is larger than 0, the principal always has the option of setting $e = 0$, and therefore does not need to impose any reserve price to exclude low-mission-driven agents from the competition.

subject to

$$U_i^a(\theta) = U_i^a(\underline{\theta}_i) + \int_{\underline{\theta}_i}^{\theta_i} \mathbb{E}_{\theta_{-i}}[q_i(\tau,\theta_{-i})m_i(\tau,\theta_{-i})e_i^{un}(\tau, m(\tau,\theta_{-i}))]\, d\tau \tag{30}$$

$$U^a(\underline{\theta}) \geq 0 \tag{31}$$

$$\sum_{i=1}^{n} q_i(\theta_i,\theta_{-i}) \leq 1, \quad q_i(\theta_i,\theta_{-i}) \geq 0, \quad \forall \theta \in \Theta, \forall i = 1, \ldots n \tag{32}$$

where Equation (30) and Equation (31) are, respectively, the incentive compatibility constraint on the agents' report and the participation constraint after applying the envelope theorem and the monotonicity condition. Equation (32) is the constraint on the probability measure, identical to the previous case.

By applying the same steps as in the previous case, we can reduce the problem even further. That is, we use the envelope theorem to derive the agents' expected lump-sum transfer, integrate by parts, and finally insert it into the principal's objective to get the expected virtual surplus:

$$\mathbb{E}_\theta\Big[\sum_{i=1}^{n} q_i(\theta_i,\theta_{-i}) \left(\left(M(m_i(\theta_i,\theta_{-i}) + (\theta_i - \lambda(\theta_i))\, m_i(\theta_i,\theta_{-i})\right) e_i^{un}(\theta_i, m(\theta_i,\theta_{-i})) - \frac{1}{2} e_i^{un}(\theta_i, m(\theta_i,\theta_{-i}))^2 \right)\Big] - U_i^a(\underline{\theta}) \tag{33}$$

which is maximized point-wise subject to the two constraints given in Equations (31) and (32). Proposition 6 follows.

Proposition 6 *When the type is unobservable, effort non-contractible, and the principal must select one agent, the optimal mechanism is such that*

(i) The optimal allocation rule is:

$$q_i^{un}(\theta) = \begin{cases} 1 & \text{if } \theta_i > \max_{\forall j \neq i} \theta_j \\ 0 & \text{otherwise} \end{cases} \tag{34}$$

(ii) The optimal mission and effort are given by $m_i^{un}(\theta)$ and $e_i^{un}(\theta, m_i^{un}(\theta))$, respectively, from Proposition 4 for the agent who receives the contract.

Proof. See appendix. ■

Proposition 6 shows that, as in the case with contractible effort, the project is always allocated to the one among n agents who has the highest mission drive. So again, the principal is not better off by refusing to contract with low-mission-driven agents. In fact, since the lowest mission is 0, there exists a mission such that $M(m) - \lambda(\theta)m$ is non-negative and Assumption 2 ensures that under the optimal mission $m_i^{un}(\theta)$, the term $M(m) - \lambda(\theta)m$ is always non-negative, which leads to a non-negative virtual surplus for all types. Finally, the dichotomy property holds here as well – the contracted mission and effort level of the winning agent coincide with those specified in Proposition 4

5.3. Implementation

In the following, we show how the optimal mission under asymmetric information, non-contractible effort and competing agents can be implemented through a scoring auction. A scoring auction is an allocation mechanism whereby agents compete by bidding combinations of missions and prices. Bids are evaluated according to a scoring rule S, given by $(m, p) \to S(m, p)$. A scoring rule is quasi-linear, if it can be written as $S(m, p) = \phi(m) - p$ for some function ϕ. If the scoring rule is quasi-linear, we call the scoring auction quasi-linear. The agent whose bid corresponds to the highest score wins. The outcome of the auction is a probability of winning the contract, q_i, as a function of agent i's and all other agents' score; a score to fulfill when the agent wins the contract, t_i^w; and a payment to make when he does not, t_i^l. In a first-score auction, the winner must deliver a contract that generates the value of his winning score; that is, $t_i^w = S(m_i, p_i)$ and $t_i^l = 0$. In a second-score scoring auction, the winner must deliver a contract that generates a score equal to the second highest score submitted, with no constraints attached to the combination of mission-price and $t_i^l = 0$. If the scoring rule is quasi-linear, it can be shown that, under a first- and second-score auction, the agent chooses m that maximizes $U^a + S(m, p) = \theta m e - \frac{1}{2}e^2 + \phi(m)$ (Che, 1993; Asker and Cantillon, 2008). It follows that a scoring rule equal to the principal's payoff is suboptimal. In fact, if $S(m, p) = U^p$, the agent would be induced to provide a mission that is too close to his preferences. The optimal scoring rule thus needs to distort the bidden mission towards the principal's mission preferences. This result is not specific to our setting (see Che, 1993; Nishimura, 2012). Lemma 1 specifies a rule that implements the optimal schedule.

Lemma 1 *Suppose effort is non-contractible. The quasi-linear scoring rule $S(m, p)$ given by*

$$S(m,p) = \begin{cases} M(m)m^{un^{-1}}(m)m - p - \Delta(m) & \text{for } m \in [m^{un}(\underline{\theta}), m^{un}(\overline{\theta})] \\ -\infty & \text{otherwise} \end{cases} \tag{35}$$

where $\Delta(m)$ is given by

$$\Delta(m) = \int_{m^{un}(\underline{\theta})}^{m} M(\tau)[m^{un^{-1}}]'(\tau)\tau + 2\lambda(m^{un^{-1}}(\tau))m^{un^{-1}}(\tau)\tau \, d\tau \tag{36}$$

and where $m^{un}(\theta)$ is the optimal mission in (20), implements the optimal mission under first- and second-score auctions.

Proof. See appendix. ■

The first two terms in the optimal scoring rule are essentially equal to the principal's preferences taking the agent's optimal effort into account. The third term, $\Delta(m)$, implements the distortion in the optimal project mission described in Proposition 4 and, therefore, induces the agents to bid a project mission that is closer to the principal's ideal mission than under the full information optimum with non-contractible effort. It consists of two elements. The first element is the distortion that reduces the agent's intrinsic benefit from effort, holding effort fixed. The second element is the distortion to induce a lower effort level.

6. Applications

The analysis is relevant for a wide set of contracting environments where the mission of the job is part of the compensation package that a principal can use to attract, select and motivate an agent. Below we discuss its application to the design of competitions for aid contracts, research funding, and creative jobs.

6.1. Competition for aid contracts

The model applies to the design and allocation of procurement contracts for the provision of social goods and services. Different actors in the development sector often have different ideological views on how to implement aid projects (Besley and Ghatak, 2001, 2017b), leading to mission conflicts similar to the ones described above. Recall that based on our findings, and in particular Proposition 6 and Lemma 1, we should observe organizations allocating procurement contracts through scoring auctions in which the project design plays a predominant role for the decision about whom to award the contract and in which highly driven agents end up contracting a lower price but a project design that is more aligned with their preferences than agents who are not highly driven. Consistent with this prediction, public and international organizations, such as EuropeAid, USAID, the UK's Department for International Development (DFID), and the World Bank's International Development Association, make extensive use of scoring auctions to allocate aid contracts. In practice, at the launch of the tender, these organizations release the project's "Terms of Reference" (TOR) along with the scoring rule that will be adopted to evaluate each bid. The TOR is a document that describes in detail the ideal project mission from these organizations' point of view. In terms of this model, it means that the principal's mission preferences are common knowledge. Then, each competing candidate bids a price and a proposal on the project's design and characteristics. Finally, the scoring rule assigns a score to the offered price and to each aspect of the proposal, according to the extent to which it corresponds to the specified TOR. The bidder with the highest total score wins.

The study by Huysentruyt (2011) provides empirical evidence on bidding strategies used by for-profits and non-profits in scoring auctions, for the allocation of aid contracts by the

DFID. The author finds that, holding the tender constant, (i) non-profits make bids that score on average 4 to 6 percentage points worse on their compliance with the DFID's terms of reference (TOR) relative to for-profits, and (ii) the overall prices proposed by non-profits are approximately 60 percent cheaper, on average, than the prices proposed by for-profits. These results are consistent with our above-stated prediction if we are willing to assume that workers in non-profit organizations have on average a higher mission drive than workers in for-profit organizations. More-driven agents are willing to sacrifice financial gains in favor of a higher level of control over the project mission. Therefore, they will bid a lower price for developing the project and a project mission that is more biased towards their preferences. On the other hand, agents with a lower mission drive prefer to comply more with the principal's ideal mission in order to receive higher payments. As a consequence, they will bid a higher price for developing the project and will bid a project mission that is closer to the principal's preferences. Overall, more-driven agents are more likely to score lower on the mission dimension and higher on the financial dimension than agents with a low drive.

Finally, this paper contributes to the longstanding debate on the desirability of public-private partnerships for the delivery of social goods by providing insights on whose values are more likely to dictate the provision of these goods and under which circumstances. As discussed in Chau and Huysentruyt (2006), one may be worried that public values, such as laicism, might be undermined by delegating the provision of social services to, for instance, religious organizations. On the other hand, there is the concern that the state may interfere with non-profits' goals and values, as the dependence on public funds is likely to make the non-profits vulnerable to political pressures. This paper shows that non-profits' missions are more likely to be compromised in the presence of informational asymmetries and when output is contractible.

6.2. Competition for research funding

The model also applies to the design and allocation of research grants. Academic researchers and scientists are often motivated by specific research agendas that are targeted toward making academic contributions. External research funding agencies, such as government agencies and private foundations by contrast, are mostly interested in the policy relevance and societal impact of a research project, which sometimes comes at the expense of rigorous and scientific analysis. Such misalignment in research interests, along with the fact that there is heterogeneity in researchers' drive that is usually not observable by an external funding agency, generates trade-offs similar to the one described in this paper.[13] Recall that our findings and, in particular,

[13] Just recently, the Centre for Economic Policy Research (CEPR) under the cooperative action "Cooperation for European Research in Economics" (COEURE), financed by the European Commission, has launched a called

the comparisons between Propositions 1 and 3 and between Propositions 2 and 4, predict that informational asymmetry should lead to more principal-preferred mission choices. This helps explain why research projects that are funded by external bodies, who typically know less about the mission drive of the applicants, will usually have more conditions attached regarding their scope and methods than projects that are funded internally within an academic's own department.

6.3. Creative jobs

More generally, this analysis applies to the design of contracts for jobs that involve a certain level of creativity from the agent, such as journalism, photography, architecture, software development, culinary arts and so on. Workers in these professions usually care about the level of discretion they are given in solving their tasks. Journalists, for example, may be motivated to cover specific types of stories, they may have specific political orientations, or they may want to use specific writing styles. These preferences usually do not perfectly coincide with those of the owners, who may simply want to maximize revenue. Furthermore, the extent to which each worker cares about having discretion in designing a project is heterogeneous and unobservable by the employer. Hence, the contracting problem of these types of jobs is analogous to the model with unobservable types.

Recall that our findings, and in particular Propositions 3 and 4 suggest that we should observe employers offering menus of contracts with different combinations of wage and discretion (and effort, when contractible) and workers self-selecting into one of these contracts based on their mission drive. In practice, offering such menus of contracts can be interpreted as offering the choice between freelancing and staff positions. Highly driven workers will prefer the contracts designed for freelancers, which are usually less attractive financially but offer more flexibility in pursuing one's personal passion and interests. For example, in the Freelance industry report of 2012, 83 percent of people list a non-monetary argument as the main benefit of being a freelancer, such as being able to choose on which projects to work, greater flexibility and creative freedom, whereas only 7.5 percent of people gave a financial reason, such as higher income potential or higher income security.[14]

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for tender for the analysis of "research funding agencies in Europe, how research agendas are set; how priorities are decided; and what is the balance between top down and bottom up initiatives, between academic criteria and policy relevance/societal impact." The main goal of this project is to "suggest ways in which funding mechanisms might evolve in the future to more effectively support frontier research." For more information visit *http://www.coeure.eu/call-for-interest/*

[14]For more information visit *https://s3.amazonaws.com/ifdconference/2012report/FreelanceIndustryReport2012.pdf*

7. Conclusion

This paper highlights the importance of treating project missions as a strategic instrument available to organizations for attracting, screening and motivating their employees. With our novel model, we analyze an optimal contracting problem in which the agents are driven not by financial rewards but by the project mission. The principal's and the agents' mission preferences are misaligned, and the agents vary in the intensity of their mission drive. We investigate when and to what extent it is optimal for a profit-maximizing principal to deviate from the marginal revenue-maximizing mission towards a more agent-preferred mission. We find that the contractual environment plays a crucial role. Because of its motivating effect, a mission will be more agent-preferred in environments in which effort is non-contractible than when it is contractible. On the other hand, a mission will be more principal-preferred in environments in which the agents' drive is unknown to the principal, and the latter will find it optimal to offer menus of contracts that may be implemented via scoring auctions when there are competing agents.

In practice, choosing the project mission is equivalent to deciding how much discretion to leave a worker in designing the project. Hence, our model points to a new "cost of control," which arises not from the perception that the lack of discretion is a signal of the principal's distrust but simply from the fact that workers have direct preferences for how to design their projects and these preferences are not always aligned with those of their employers. Our findings help explain several observed patterns in procurement contracting and labor markets, including the co-existence of freelance contracts and staff positions within the same firm, the wide use of scoring auctions to allocate aid contracts, the different characteristics of external versus internal research funding, and the strong entrepreneurial culture of the workforce in Silicon Valley.

Appendix

A-1. Proof of Proposition 1

Proof. To prove optimality of m^{oc} and e^{oc}, we need to show that the characterizations given in (4) and (5) characterize a global maximum of the maximization problem specified in (3). We have the following local first order conditions (FOCs):

$$(M'(m) + \theta)e = 0 \tag{A-1}$$

$$M(m) + \theta m - e = 0 \tag{A-2}$$

Notice that $M'(m) < 0$ for all $m > 0$, $\lim_{m\to\infty} M'(m) = -\infty$ and $M'(0) = 0$, together with $\theta > 0$ implies that (A-1) exists for some $m^* > 0$ when $e > 0$. Furthermore, since the left hand side of (A-1) is strictly decreasing in m when $e > 0$, m^* is unique. On the other hand, existence of $e^* \geq 0$ satisfying (A-2) holds if and only if $M(m) + \theta m \geq 0$. Conditional on existence, however, uniqueness of e^* follows immediately.

In the interior of the domain, it follows that the unique critical point is characterized by (4) and (5). To see this, note that since $-M'(m^*) = \theta \leq \overline{\theta}$, we have $M(m^*) > 0$ by Assumption 2. To show that these constitute a local maximum, it suffices to show that

$$\begin{aligned} M''(m^*)e^* &< 0 \\ -1 &< 0 \\ -M''(m^*)e^* - [M'(m^*) + \theta]^2 &> 0 \end{aligned}$$

since $e^* > 0$, $M''(m^*) < 0$ and $-M'(m^*) = \theta$, all conditions hold. Thus, (4) and (5) characterizes the unique local maximum in the interior. To ensure global optimality, we need to show that

(i) $\Pi(m^*, e^*, \theta) \geq \lim_{e\to\infty} \Pi(m, e, \theta), \forall m$,

(ii) $\Pi(m^*, e^*, \theta) \geq \Pi(m, 0, \theta), \forall m$,

(iii) $\Pi(m^*, e^*, \theta) \geq \lim_{m\to\infty} \Pi(m, e, \theta), \forall e$, and

(iv) $\Pi(m^*, e^*, \theta) \geq \Pi(0, e, \theta), \forall e$.

It follows immediately that $\lim_{e\to\infty} \Pi(m, e, \theta) = -\infty, \Pi(m, 0, \theta) = 0, \forall m$, and $\lim_{m\to\infty} \Pi(m, e, \theta) \leq 0, \forall e$, so it suffices to show that $\Pi(m^*, e^*, \theta) \geq 0$, that is,

$$(M(m^*) + \theta m^*)e^* - \frac{1}{2}e^{*^2} \geq 0 \iff e^{*^2} \geq 0$$

where the last inequality follows after substituting in e^*. Thus, (i)-(iii) holds.

Suppose now $m = 0$ as in (iv). It follows that the optimal effort is given by $e^{**} = M(0)$. Thus, (iv) holds if

$$\begin{aligned}
&(M(m^*) + \theta m^*)e^* - \frac{1}{2}{e^*}^2 \geq M(0)e^{**} - \frac{1}{2}{e^{**}}^2 \\
\iff\ &(M(m^*) - M'(m^*)m^*)^2 \geq (M(0))^2 \\
\iff\ &M(m^{oc}) - M'(m^{oc})m^{oc} \geq M(0)
\end{aligned}$$

where the second inequality follows after substituting in e^* and e^{**} and the third follows immediately from the fact that taking the square root is order preserving in the positive domain. Finally, the third inequality follows from a standard rooftop theorem of concave functions. Thus, the characterizations given in (4) and (5) constitute a global maximum. ■

A-2. Proof of Proposition 2

Proof. The optimal e^{oc} follows immediately. To show that m^{oc}, characterized by (7), is global maximum, note that we have the following local first order condition (FOC):

$$(M'(m) + \theta)m + M(m) = 0 \tag{A-3}$$

Since $M(0) > 0, M'(m) < 0$ for all $m > 0, M'(0) = 0, \lim_{m\to\infty} M'(m) = -\infty$ and $\theta > 0$, there must exist a $m^* > 0$ such that (A-3) holds. Notice that $M(m^*) > 0$. Suppose this were not the case, then $-M'(m^*) < \theta$ and $M(m^*) < 0$ which is a contradiction to Assumption 2.

To show that the interior solution is a local maximum in the interior, we need to show concavity at the point, that is

$$M''(m^*)m^* + 2M'(m^*) + \theta < 0 \iff M''(m^*)m^* + M'(m^*) - \frac{M(m^*)}{m^*} < 0$$

where the last inequality follows by substituting in θ from (A-3). The inequality must hold since $M(m^*) > 0$ in every interior solution. Thus (7) characterizes the unique local maximum in the interior. To ensure global optimality, we need to show that

(i) $\Pi(m^*, e^*, \theta) \geq \lim_{m\to\infty} \Pi(m, e^{**}, \theta)$, and

(ii) $\Pi(m^*, e^*, \theta) \geq \Pi(0, e^{**}, \theta)$.

Notice that as $m \to \infty$ we have $e^{**} \to \infty$ and $M(m) \to -\infty$. Thus, $\lim_{m\to\infty} \Pi(m, e^{**}, \theta) = -\infty$, so (i) must hold. To show that (ii) holds, note that $e^{**} = 0$ for $m = 0$, so (ii) holds if $\Pi(m^*, e^*, \theta) \geq 0$, that is,

$$(M(m^*) + \theta m^*)e^* - \frac{1}{2}{e^*}^2 \geq 0 \iff M(m^*) + \frac{1}{2}e^* \geq 0$$

which must hold since $M > 0$ in any interior solution. Thus (7) characterizes a global maximum. ■

A-3. Proof of Proposition 3

Proof. The point-wise maximization problem is given by

$$\max_{m(\cdot),e(\cdot)} \big(M(m(\theta)) + (\theta - \lambda(\theta))m(\theta)\big)e(\theta) - \frac{1}{2}e(\theta)^2 \tag{A-4}$$

Which leads to the following first order conditions:

$$\big(M'(m(\theta)) + \theta - \lambda(\theta)\big)e(\theta) = 0 \tag{A-5}$$

$$M(m(\theta)) + (\theta - \lambda(\theta))m(\theta) - e(\theta) = 0 \tag{A-6}$$

Case 1 – $\theta - \lambda(\theta) > 0$: Notice that $M'(m) < 0$ for all $m > 0$, $\lim_{m\to\infty} M'(m) = -\infty$ and $M'(0) = 0$, together with $\theta - \lambda(\theta) > 0$ implies that (A-5) exists for some $m^* > 0$ when $e > 0$. Furthermore, since the left hand side of (A-5) is strictly decreasing in m when $e > 0$, m^* is unique. On the other hand, existence of $e^* \geq 0$ satisfying (A-6) holds if and only if $M(m) + (\theta - \lambda(\theta))m \geq 0$. Conditional on existence, however, uniqueness of e^* follows immediately.

In the interior of the domain, it follows that the unique critical point is characterized by (14) and (15). To see this, note that since $-M'(m^*(\theta)) = \theta - \lambda(\theta) \leq \overline{\theta}$, we must have that $M(m^*(\theta)) > 0$ by Assumption 2. To show that these constitute a local maximum, it suffices to show that

$$\begin{aligned} M''(m^*(\theta))e^* &< 0 \\ -1 &< 0 \\ -M''(m^*(\theta))e^* - [M'(m^*(\theta)) + \theta - \lambda(\theta)]^2 &> 0 \end{aligned}$$

which holds since the first term is strictly positive and the second is 0 in the last condition. To ensure global optimality, we need to show that

(i) $V(m^*, e^*, \theta) \geq \lim_{e\to\infty} V(m, e, \theta), \forall m$,

(ii) $V(m^*, e^*, \theta) \geq V(m, 0, \theta), \forall m$,

(iii) $V(m^*, e^*, \theta) \geq \lim_{m\to\infty} V(m, e, \theta), \forall e$, and

(iv) $V(m^*, e^*, \theta) \geq V(0, e, \theta), \forall e$.

It follows immediately that $\lim_{e\to\infty} V(m,e,\theta) = -\infty, V(m,0,\theta) = 0, \forall m$, and $\lim_{m\to\infty} V(m,e,\theta) \leq 0, \forall e$, so it suffices to show that $V(m^*, e^*, \theta) \geq 0$, that is,

$$(M(m^*) + (\theta - \lambda(\theta))m^*)e^* - \frac{1}{2}e^{*^2} \geq 0 \iff e^* \geq 0$$

where the last inequality follows after substituting in e^*. Thus, (i)-(iii) holds. Suppose now $m = 0$ as in (iv). It follows that the optimal effort is given by $e^{**} = M(0)$. Thus, (iv) holds if

$$\begin{aligned}(M(m^*) + (\theta - \lambda(\theta))m^*)e^* - \frac{1}{2}e^{*^2} &\geq M(0)e^{**} - \frac{1}{2}e^{**^2}\\ \iff (M(m^*) + (\theta - \lambda(\theta))m^*)^2 &\geq (M(0))^2\\ \iff M(m^*) - M'(m^*)m^* &\geq M(0)\end{aligned}$$

where the second inequality follows after substituting in e^* and e^{**} and the third follows immediately from the fact that taking the square root is order preserving in the positive domain. Finally, the third inequality follows from a standard rooftop theorem of concave functions.

Case 2 – $\theta - \lambda(\theta) \leq 0$: It follows that there are no interior solution to to (A-5). In order to show that $m^*(\theta) = 0$ and $e^*(\theta) = M(0)$ is a global maximum, we need to show that

(i) $V(0, e^*, \theta) \geq \lim_{e\to\infty} V(m,e,\theta), \forall m$,

(ii) $V(0, e^*, \theta) \geq V(m, 0, \theta), \forall m$,

(iii) $V(0, e^*, \theta) \geq \lim_{m\to\infty} V(m,e,\theta), \forall e$, and

By the same argumentation as in the prior case, it suffices to show that $V(0, e^*, \theta) \geq 0$, that is,

$$M(0)e^* - \frac{1}{2}e^{*^2} \geq 0 \iff M(0) \geq 0$$

where the last inequality follows after substituting in $e^* = M(0)$. Thus, (i)-(iii) holds.

To see that the ignored monotonicity constraints hold, notice that $m^{*'}(\theta), e^{*'}(\theta) > 0$ for all $\theta > \lambda(\theta)$ and $m^{*'}(\theta), e^{*'}(\theta) = 0$ for all $\theta \leq \lambda(\theta)$. ■

A-4. Proof of Proposition 4

Proof. Ignoring the monotonicity constraint, the point-wise maximization problem is given by

$$\max_{m(\theta)} \big(M(m(\theta)) + (\theta - \lambda(\theta))m(\theta)\big)e^{un}(\theta, m(\theta)) - \frac{1}{2}e^{un}(\theta, m(\theta))^2 \tag{A-7}$$

leading to the following first order condition after inserting the optimal effort.

$$\big(M'(m(\theta)) + \theta - \lambda(\theta)\big)m(\theta) + M(m(\theta)) - \lambda(\theta)m(\theta) = 0 \tag{A-8}$$

Firstly, notice that $M(m) - \lambda(\theta)m(\theta) > 0$ in any interior solution to (A-8). Suppose this were not the case. Then $M(m) - \lambda(\theta) \leq 0$, and thus, it must be that $M'(m) + \theta - \lambda(\theta) \geq 0$ for (A-8) to hold. If $\lambda(\theta) > \theta$, we have an immediate contradiction. Suppose now that $\theta \geq \lambda(\theta)$. But then we have $-M'(m) \leq \theta - \lambda(\theta) \leq \bar{\theta}$ such that $M(m(\theta)) > \bar{\theta}m(\theta) \geq \lambda(\theta)m(\theta)$ by Assumption 2, a contradiction.

Secondly, notice that an interior solution exists for all $\theta \in \Theta$. Suppose this were not the case. Then there exists a $\theta \in \Theta$ such that

$$\frac{M(m)}{m} < -M'(m) - \theta + 2\lambda(\theta), \quad \forall m > 0$$

however, since $\lim_{m\to 0} \frac{M(m)}{m} = \infty$ and $\lambda(\theta)$ is bounded from above by $\frac{1}{f(\underline{\theta})}$, this cannot be.

To see that (A-8) characterizes a local maximum of the interior, it suffices to show that

$$\begin{aligned} M''(m^*(\theta))m^*(\theta) + 2M'(m^*(\theta)) + \theta - 2\lambda(\theta) < 0 \\ \Longleftarrow M'(m^*(\theta)) - \lambda(\theta) + \frac{1}{2}\theta \leq 0 \\ \Longleftrightarrow -\frac{1}{2}\theta - \frac{M(m^*(\theta))}{m^*(\theta)} + \lambda(\theta) \leq 0 \\ \Longleftarrow -\frac{1}{2}\theta \leq 0 \end{aligned}$$

where the third inequality follows from substituting $M'(m*(\theta))$ from (A-8) and the fourth from the fact that $\frac{M(m^*(\theta))}{m^*(\theta)} \geq \lambda(\theta)$. Thus, an interior solution is always a maximum implying that it is unique. To show that it is a global maximum, we need to show that

(i) $V(m^*, e^*, \theta) \geq V(0, e^{**}, \theta)$, and

(ii) $V(m^*, e^*, \theta) \geq \lim_{m\to\infty} V(m, e^{**}, \theta)$.

Note that $V(0, e^{**}, \theta) = 0$ and $\lim_{m\to\infty} V(m, e^{**}, \theta) = -\infty$, so it suffices to show that $V(m^*, e^*, \theta) \geq 0$, that is,

$$\big(M(m^*(\theta)) + (\theta - \lambda(\theta))m^*(\theta)\big)e^*(\theta, m^*(\theta)) - \frac{1}{2}e^*(\theta, m^*(\theta))^2 \geq 0 \tag{A-9}$$

$$\Longleftrightarrow \; M(m^*(\theta)) - \lambda(\theta))m^*(\theta) + \frac{1}{2}e^*(\theta, m^*(\theta)) \geq 0 \tag{A-10}$$

which holds since $M(m^*(\theta)) - \lambda(\theta))m^*(\theta) \geq 0$ in any interior solution.

To see that the optimal solution satisfies the monotonicity constraint, note that from the implicit function theorem, $m^*(\theta)$ is non-decreasing in θ if and only if

$$(1 - \lambda'(\theta))m^*(\theta) - \lambda'(\theta)m^*(\theta) \geq 0 \tag{A-11}$$

which holds since $\lambda'(\theta) < 0$. ■

A-5. Proof of Proposition 5

Proof. Ignoring the monotonicity constraints, the point-wise maximization problem for the principal facing agent i is given by

$$\max_{q_i(\cdot,\cdot),m_i(\cdot,\cdot),e_i(\cdot,\cdot)} q_i(\theta)\Big(\big(M(m_i(\theta)) + (\theta_i - \lambda(\theta_i))m_i(\theta)\big)e_i(\theta) - \frac{1}{2}e_i(\theta)^2\Big) \tag{A-12}$$

which leads to the following first order conditions:

$$q_i(\theta)\big((M'(m_i(\theta)) + \theta_i - \lambda(\theta_i))e_i(\theta)\big) = 0 \tag{A-13}$$

$$q_i(\theta)\Big(M(m_i(\theta)) + (\theta_i - \lambda(\theta_i))m_i(\theta) - e_i(\theta))\Big) = 0 \tag{A-14}$$

$$(M(m_i(\theta)) + (\theta_i - \lambda(\theta_i))m_i(\theta))e_i(\theta) - \frac{1}{2}e_i(\theta)^2 = 0 \tag{A-15}$$

where (A-13) is identical to the optimal $m^{uc}(\theta)$ in (14) and (A-14) is identical to the optimal $e^{uc}(\theta)$ in (15) for $q_i(\theta) > 0$. Further, to show that $q_i^{uc}(\theta)$ is as given in 28, note that (A-15) is non-negative if

$$\big(M(m_i^*(\theta)) + (\theta_i - \lambda(\theta_i))m_i^*(\theta)\big)e_i^*(\theta) - \frac{1}{2}e_i^*(\theta)^2 \geq 0$$

which holds for $m_i^{uc}(\theta_i)$ and $e_i^{uc}(\theta_i)$, such that assigning a probability of 1 to the highest type is optimal. Furthermore, $q_i^{uc}(\theta_i), m_i^{uc}(\theta_i)$ and $e_i^{uc}(\theta_i)$ are monotonically non-decreasing and therefore the monotonicity constraints are satisfied. ■

A-6. Proof of Proposition 6

Proof. Ignoring the monotonicity constraint, the point-wise maximization problem for agent i is given by

$$\max_{q_i(\cdot,\cdot),m_i(\cdot,\cdot)} q_i(\theta)\Big(M(m_i(\theta)) + (\theta_i - \lambda(\theta_i))m_i(\theta)\big)e_i^{un}(\theta_i, m_i(\theta)) - \frac{1}{2}e_i^{un}(\theta_i, m_i(\theta))^2\Big) \tag{A-16}$$

Which leads to the following first order conditions:

$$q_i(\theta)\Big((M'(m_i(\theta)) + (\theta_i - \lambda(\theta_i)))m_i(\theta) + M(m_i(\theta)) - \lambda(\theta_i)m_i(\theta)\Big) = 0 \tag{A-17}$$

$$M(m_i(\theta)) + (\theta_i - \lambda(\theta_i))m_i(\theta)\big)\theta_i m_i(\theta) - \frac{1}{2}(\theta_i m_i(\theta))^2 = 0 \tag{A-18}$$

where (A-17) is identical to the optimal $m^{un}(\theta)$ in (20) for $q_i(\theta) > 0$. Further, to show that $q_i^{un}(\theta)$ is as given in (34), note that (A-18) is non-negative if

$$M(m_i(\theta)) + (\frac{1}{2}\theta_i - \lambda(\theta_i))m_i(\theta) \geq 0$$

which holds by Assumption 2. Furthermore, $q_i^{uc}(\theta)$ and $m_i^{uc}(\theta)$ are monotonically non-decreasing and therefore the monotonicity constraints are satisfied. ■

A-7. Proof of Lemma 1

Proof. The agents maximization problem is given by:

$$\max_m \theta m e^{un}(\theta,m) - \frac{1}{2}e^{un}(\theta,m)^2 + M(m)m^{un^{-1}}(m)m - \int_{m^{un}(\underline{\theta})}^{m} M(\tau)[m^{un^{-1}}]'(\tau)\tau \\ - 2\lambda(m^{un^{-1}}(\tau))m^{un^{-1}}(\tau)\tau \, d\tau \quad \text{(A-19)}$$

After inserting $e^{un}(\theta,m)=\theta m$, the first order condition is given by

$$(M'(m) - \lambda(m^{un^{-1}}(m))m^{un^{-1}}(m)m + \theta^2 m + (M(m) - \lambda(m^{un^{-1}}(m))m)m^{un^{-1}}(m) = 0 \quad \text{(A-20)}$$

which holds for $m = m^{un}(\theta)$. For all $\theta \in \Theta$ and $m \in [m^{un}(\underline{\theta}), m^{un}(\overline{\theta})]$, the second order condition is given by

$$(M''(m)m + 2M'(m) + \theta - 2\lambda(\theta))\,\theta + \Big((M'(m)m + M(m) - 2\lambda(\theta))m - 2\lambda'(\theta)\theta m\Big)\frac{1}{m^{un'}(\theta)} < 0$$

Note that $\frac{1}{m^{un'}(\theta)}$ is given by

$$-\frac{M''(m) + 2M'(m)m + \theta - 2\lambda(\theta)}{(1-2\lambda'(\theta))m}$$

Thus, the second order condition becomes

$$\begin{aligned} -\theta m(1-2\lambda'(\theta)) + M'(m)m + M(m) - 2\lambda(\theta)m - 2\lambda'(\theta)\theta m &< 0 \\ \iff -\theta m + M'(m)m + M(m) - 2\lambda(\theta)m &< 0 \\ \iff \theta m &> 0 \end{aligned}$$

where the last inequality follows from inserting $M'(m^{un}(\theta))m^{un}$. ■

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