Competition and Screening with Motivated Health Professionals

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Abstract

Two hospitals compete for the exclusive services of health professionals, who are privately informed about their ability and motivation. Hospitals differ in their ownership structure and in the mission they pursue. The non-profit hospital sacrifices some profits to follow its mission but becomes attractive for motivated workers. In equilibrium, when both hospitals are active, the sorting of workers to hospitals is efficient and ability-neutral. Allocative distortions are decreasing in the degree of competition and disappear when hospitals are similar. The non-profit hospital tends to provide a higher amount of care and to offer lower salaries than the for-profit one.

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1 Introduction

A characteristic feature of the health care industry is that non-profit hospitals coexist with for-profit ones. For example, Nolte *at al.* (2014) report that the proportions of non-profit and for-profit hospitals are, respectively, 58% and 21% in the United States and, as for Europe, 29% and 39% in France or 36% and 35% in Germany. In Italy, about 22% of hospitals are non-profit while 39% are for-profit (see Barros and Siciliani 2012).

There exists both theoretical and empirical literature studying the relationship between hospitals' ownership structure and either quality provision or workers' remuneration.

As for differences in quality provision, the theoretical literature seems to agree on the fact that non-profit firms provide higher quality than their for-profit counterparts, although for different reasons. More

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specifically, Hansmann (1996) and Glaeser and Shleifer (2001) show that the non-profit status serves as a commitment device to provide softer incentives, which translate into an improvement of the quality of the product sold; Malani *et al.* (2003) and Lakdawalla and Philipson (2006) assume instead that non-profit firms are altruistic and have a preference for quality.[1] Nonetheless, the empirical evidence on quality differentials is essentially mixed (see Sloan 2000).

As for wage differentials, lower average wages in non-profit firms relative to for-profits have been documented in a number of empirical analyses.[2] Theoretically, the "donative labour hypothesis" has been proposed as the source of wage penalties in non-profit firms: workers are intrinsically motivated for being employed at non-profit firms and thus enjoy some non-monetary benefits which make them willing to accept lower wages.[3] However, wage differentials might also arise because of a selection bias, given that wage gaps can also reflect unobservable differences in workers' ability across firms or sectors. Therefore, when neither workers' productivity nor motivation are observable, it becomes important to disentangle the pure compensating wage differential *à la* Rosen (1986), which might be due to motivation, from the selection effect of ability.

We build a theoretical model that sheds light on the relationship between hospitals' ownership structure and both performance (in terms of amount and, possibly, quality of care provided) and wage differentials. In particular, we focus on the sorting of health professionals to a non-profit and a for-profit hospital; we consider the design of optimal incentive schemes when physicians and nurses are privately informed about their skills and their intrinsic motivation, with both characteristics being discretely distributed and taking two possible values each.

All health professionals experience a cost from exerting effort, which differs across workers' types (being it negatively related to workers' ability), but which does not depend on the status of the hospital. Conversely, intrinsic motivation only matters when workers are hired by the non-profit hospital. In our view, one of the main distinguishing features of non-profit hospitals is that they provide a substantial amount of free treatment for poor and uninsured patients.[4] Charity care is valuable for some health professionals, precisely those who are not only moved by standard extrinsic incentives, but are also

[1] There are just two recent exceptions, namely Brekke *et al.* (2011 and 2012).

[2] See Hwang *et al.* (1992), Gibbons and Katz (1992), and Roomkin and Weisbrod (1999) for hospitals or Jones (2015) for nursing homes.

[3] This idea has been fostered by Preston (1989), by Heyes (2005) for nurses, and by Delfgaauw and Dur (2007).

[4] In exchange for sizeable tax exemptions, non-profit hospitals in the U.S. must engage in activities that meet the Internal Revenue Service's community benefit standard. The provision of charity care helps meet that standard. The mean proportion of total operating expenses spent on charity care by non-profit hospitals in California during 2011-2013 is 1.9%, with about 4% of non-profit hospitals devoting 5% or more of their operating expenses to charity care (see Valdovinos et al. 2015). In Texas, there exists a lower bound to the percentage of charity care to be provided by non-profit hospitals, that must dedicate at least 4% of net patient revenue to the poor.

characterized by non-pecuniary motivations. More precisely, when motivated workers are employed by the non-profit hospital, they receive a vocational premium because they benefit, to a certain extent, from their personal contribution to the mission or the performance of their organization.[5]

Thus, on the one hand, the non-profit hospital has a competitive advantage with respect to the for-profit provider because the former can employ motivated health professionals, who exert more effort and provide a higher amount of care relative to non-motivated workers. On the other hand, being non-profit implies that the hospital bears more costs, because it must renounce to part of its revenues in the form of charity care and other contributions to the local community. Then, the for-profit hospital also has a competitive advantage with respect to the non-profit rival, because the former can fully appropriate its revenues and is not profit constrained.

The two hospitals simultaneously offer screening contracts defined by a task level (the observable effort) and a non-linear wage rate which depends on effort. Because of the strategic interaction between the two hospitals, the workers' outside options are type-dependent and endogenous and thus the analysis of a multi-principal framework with bidimensional screening is called for.

When the competitive advantage of the for-profit hospital dominates, only the for-profit hospital is active, but the threat of entry by the non-profit hospital reduces or even eliminates allocative inefficiencies caused by asymmetric information.

When both hospitals are active at equilibrium, health professionals sort themselves by motivation: motivated workers choose to be employed by the non-profit hospital whereas non-motivated workers are hired by the for-profit hospital. Hence, workers' self-selection is ability-neutral and it is efficient.

Optimal allocations (i.e. effort levels or amount of care) are determined according to the degree of competition between hospitals. The latter influences the importance of workers' outside opportunities (i.e. a worker's threat of accepting the contract offered by the rival hospital) *vis-à-vis* workers' informational advantages (i.e. a worker's threat of pretending to be of a different type and accepting the contract offered by the same hospital to a different type) in the hospitals' screening contracts. In particular, if competition is harsh, because hospitals are similar as to revenue appropriation, and workers' motivation is not significant, then outside options dominate incentive compatibility and screening contracts resemble the ones arising with duopolistic competition under full information. Thus, effort levels are set at the first-best by both hospitals and allocative distortions do not exist. If, instead, competition is mild, because the non-profit firm is truly profit constrained and workers' motivation is relevant, then internal incentive compatibility is the driving force shaping optimal contracts. Then, downward distortion

[5] As an example, consider the mission statement of Kaiser Permanente, the fourth largest non-profit hospital system in the U.S. (according to 2015 data from the American Hospital Directory): "Improving health care access for those with limited incomes and resources is Kaiser Permanente's mission. Our Medical Financial Assistance program helps low-income, uninsured, and underserved patients receive access to care." (See http://share.kaiserpermanente.org).

emerge in optimal allocations, that coincide with those observed under monopsony and (bidimensional) asymmetric information. In a nutshell, the 'no distortion at the top' property holds for high-ability health professionals, whereas allocative distortions for low-ability types are higher the lower the degree of competition between the two hospitals. Moreover, given ability, effort levels are almost always higher for health professional employed at the non-profit hospital than for workers employed at the for-profit hospital. Thus, interpreting effort as quality-enhancing effort, our model predicts higher quality provision by non-profit rather than for-profit hospitals, in line with most of the theoretical literature.

As for non-linear wages, we find that, when the competitive advantage of the for-profit hospital is sufficiently high with respect to the competitive advantage of the non-profit hospital, a wage penalty emerges. Indeed, given ability, the salary gained by health professionals employed at the non-profit hospital is lower than the salary offered by the for-profit hospital. The wage penalty for motivated health professionals is always associated with higher effort provision and thus better performance by the non-profit hospital. Given that sorting is ability-neutral and that workers' average ability is the same across hospitals (a consequence of the independent distribution of skills and motivation), the earnings penalty possibly experienced by non-profit motivated workers is due to a true compensating wage differential and is not driven by the negative selection with respect to ability. Finally, the wage gap is increasing in ability, which implies that the non-profit hospital offers its employees lower returns to ability than the for-profit provider.

The rest of the paper is organized as follows. In the following subsection, we describe the related literature. In Section 2, we set up the model. Section 3 presents, as benchmark cases, the first-best and the equilibrium with perfectly informed competing hospitals. Subsection 3.3 introduces asymmetric information and describes the optimal screening contracts offered by the for-profit hospital when it deters entry of the non-profit rival. In Section 4, we focus on competition between hospitals under bidimensional screening, and consider the equilibrium sorting of workers to hospitals. In Subsection 4.3, the full characterization of optimal contracts is provided, when ability and motivation are uniformly distributed. Section 5 comments on the impact that hospitals' ownership structure has on quality of care and on workers' salaries. Finally, Section 6 concludes.

1.1 Related literature

Our work contributes to two different strands of literature. From the point of view of health economics, it adds both to the literature studying the design of optimal incentive schemes for health professionals and to the literature dealing with the issue of competition among hospitals (possibly characterized by different ownership structures). From a technical point of view, it explicitly solves a multi-principal game in a market where two firms compete to attract agents characterized by two different dimensions of private information.

In the health economics literature, the paper is related to those works analyzing incentive schemes for health providers. Ma (1994) studies the optimal regulation of a provider that chooses both effort aimed at quality enhancement and effort aimed at cost containment, when the purchaser observes the provider's costs of treating patients. Chalkley and Malcomson (1998) consider a richer environment where quality is multidimensional, costs are not observable and it is inefficient to treat all patients. More recently, the literature has studied altruistic providers, who are concerned with their patients' health status and who choose the quality of their services. In Jack (2005), the provider is characterized by private information about his level of altruism, whereas, in Choné and Ma (2011), the physician also has private information about the health status of the patient. In both papers, the principal uses a screening mechanism based only on the provider's altruism. The design of screening contracts when health providers are privately informed about their ability while their altruism is common knowledge and homogeneous is the subject of Makris (2009) and Makris and Siciliani (2013). Makris and Siciliani (2014) extend the analysis to account for unobserved heterogeneity about both motivation and productivity of providers, but they restrict attention to linear incentive schemes.

Another strand of the health economics literature studies competition between altruistic providers under full information. Among others, Brekke *et al.* (2011 and 2012) consider the effect of competition between altruistic providers on quality of services in a spatial competition framework. The paper more closely related to ours is Brekke *et al.* (2012), where two altruistic providers/hospitals compete in quality to attract patients. Our paper is different because, besides introducing asymmetric information, it focuses on hospitals competing to attract health professionals instead of patients. To the best of our knowledge, our paper is the first to address the issue of heterogeneous providers competing for heterogeneous health professionals (under bidimensional adverse selection), thus studying both non-linear incentive schemes and competition in a unified framework.

From a technical point of view, our paper draws both from the literature on multidimensional screening and from the literature on multi-principals. Models where both problems are simultaneously considered are very few and tend to rely on simplifying assumptions.

Screening when agents have several unobservable characteristics and types distributions are continuous has been analyzed by Armstrong (1996), Rochet and Choné (1998) and Basov (2005), among others. Our model is characterized by a discrete type space, and by one screening instrument available to the principal (namely the contractible effort level) so that the closest paper to ours is Armstrong (1999), which considers optimal price regulation of a monopoly that is privately informed about its cost and demand. Smart (2000) solves a bidimensional screening problem in a perfectly competitive insurance market in which customers differ with respect to both accident probability and risk aversion. More recently, Olivella and Schroyen (2014) have studied a monopolistic insurance company selling contracts to individuals who differ in their risks and risk aversion. Finally, Barigozzi and Burani (2016) consider the screening problem of a mission-oriented monopsonist willing to hire workers of unknown ability and motivation. The present paper adds the important dimension of competition between two differentiated firms.

In the multi-principal literature, the paper that is most closely related to ours is Biglaiser and Mezzetti (1993), which studies two heterogeneous principals competing for the exclusive services of an agent in the presence of both adverse selection and moral hazard. Another related article is Armstrong and Vickers (2001) that examines price discrimination in an oligopolistic framework by modelling firms as competing directly in utility space. In a similar vein, Rochet and Stole (2002) study duopolists competing in nonlinear prices when consumers are heterogeneous and privately informed about preferences for quality and outside opportunities.[6]

Our paper is also related to the recent literature on self-selection of motivated workers into different firms/sectors of the labor market. Handy and Katz (1998), Heyes (2005) and Delfgaauw and Dur (2007) are the first papers claiming that low wages are necessary to select workers characterized by high motivation.[7] Delfgaauw and Dur (2008, 2010) consider workers characterized by different productivity and motivation self-selecting into the public and the private sector. In Delfgaauw and Dur (2010), both sectors are perfectly competitive and workers' attributes are perfectly observable. In Delfgaauw and Dur (2008), instead, workers' attributes are private information and the screening problem of the governmental agency is tackled, although in a simplified way. We depart from these works because we consider strategic interaction between firms under asymmetric information and non-linear contracting.[8]

[6] In both papers, outside options only affect the consumers' participation decisions but not their incentives to reveal information. In our setup, instead, both workers' characteristics influence both participation and incentive constraints, so that the single-crossing condition does not hold. As a consequence, while those papers show that an equilibrium outcome always consists in firms offering efficient two-part tariffs, we find that departures from efficiency often emerge.

[7] Barigozzi *et al.* (2014) and Barigozzi and Turati (2012) consider labor supply in a market where the wage rate is flat and where workers have private information about both productive ability and motivation, that follow a general joint distribution.

[8] The matching of workers to firms with different missions and the design of optimal incentive schemes for intrinsically motivated workers have been analyzed by Besley and Ghatak (2005) in a moral-hazard framework. Moreover, Kosfeld and von Siemens (2011) model a competitive labor market with team production and adverse selection, where selfish and conditionally cooperative workers exist. They show that workers separate in equilibrium, thereby leading to the emergence of heterogeneous "corporate cultures", like for-profit and non-profit. Finally, DeVaro *et al.* (2015) consider a non-profit firm that competes with perfectly competitive for-profit rivals in hiring workers who differ in skills and derive intrinsic motivation from the non-profit social mission. The non-profit firm faces a non-distribution constraint and, differently from our model, is bound to offer flat wages to its employees.

2 The model

Two hospitals (principals) compete to hire physicians or nurses (agents). Each health professional (she) can work exclusively for one principal (he).[9] Hospitals and health professionals are risk neutral. From a technical point of view, we study a multi-principal setting with bidimensional adverse selection.

Medical care supplied by health professionals is the only input the two hospitals need in order to treat patients. We call e the observable and measurable quantity of care or treatment that the worker is asked to provide, or, more generally, her exerted effort. Both hospitals have the same technology which displays constant returns to treatment provision, in such a way that the number of diagnosis and procedures or, equivalently, the number of patients treated is given by

$$q(e) = e.$$

As an alternative interpretation, e is effort exerted by a health professional to enhance the quality of care. Thus, with a slight abuse of terminology and notation, e can represent the quality of care at each hospital, as in Ma (1994). Accordingly, higher quality attracts a higher number of patients, which increases hospitals' revenues.[10]

Every hospital is paid a fixed tariff for every patient admitted for treatment, as in Diagnosis Related Group (DRG) systems, like Medicare in the U.S. or prospective payment systems in many European countries. Therefore, the hospital's profit from hiring a single worker is given by

$$\pi^H(e, w) = pk^H q(e) - w = k^H e - w,$$

where the superscript $H \in \{FP, NP\}$ denotes the organizational form of the hospital, with FP referring to the for-profit hospital and NP referring to the non-profit hospital; the DRG tariff is equal for both hospitals, exogenous, and set at $p = 1$, and w is the total wage or salary paid to the health professional hired by the hospital. The parameter k^H represents the impact of the hospital's ownership structure on revenues. We assume that $k^{FP} > k^{NP}$ because the for-profit hospital is able to fully appropriate its revenues whereas the non-profit hospital devotes a fraction of its revenues to charity care. For simplicity, we set $k^{FP} \equiv k > 1$ and $k^{NP} = 1$.[11] Therefore k captures the competitive advantage of the for-profit

[9] In our context with two hospitals that only differ in terms of ownership structure, common agency (i.e. a setting where relationships are not exclusive) is less appropriate. The related phenomenon of "moonlighting", occurring when public-service physicians may refer patients to their private practices, has been analyzed by Biglaiser and Ma (2007).

[10] We will revert to this interpretation in Section 5.1, when we will compare our results with those of the theoretical and empirical literature relating quality to hospitals' organizational form.

[11] Notice that this is just a reduced form of a more detailed modelling of the difference between hospitals' organizational forms, which could be the following. Let the production function of the hospital be $q(e) = Ae$, with $A > 1$, and assume that the non-profit hospital's mission consists in providing care to both insured and uninsured patients. Then, hospital NP is compensated only for the fraction of insured patients that it treats, while its revenue is zero when treating uninsured

hospital relative to the non-profit provider in terms of revenue appropriation.[12] But, as we explain below, being non-profit also comes with a competitive advantage: the non-profit hospital is able to attract motivated workers and benefits from their labor donations.

Suppose that a unit-mass population of health professionals differ in two characteristics, ability and intrinsic motivation, that are independently distributed and can take two values each. In order to make notation less cumbersome, we use upper-case letters to denote high (good) values of workers' characteristics and lower-case letters to denote low (bad) values.

A health professional characterized by high ability incurs in a low cost of providing a given effort level. Ability is denoted by $\theta_i \in \{\theta_A, \theta_a\}$ where $\theta_a > \theta_A$. A fraction ν of workers has high ability (i.e. a low cost of effort) θ_A, the fraction $1-\nu$ is instead characterized by low ability (i.e. a high cost of effort) θ_a. Ability is the only relevant workers' characteristic for the for-profit hospital. Health professionals, to a certain extent, derive utility from exerting effort or providing treatment at the non-profit hospital. Indeed, only when employed by the non-profit hospital, can motivated workers supply care to poor and uninsured patients.[13] Thus, ability and motivation are both relevant for the non-profit hospital. Paralleling ability, we assume that motivation takes two possible values $\gamma_j \in \{\gamma_m, \gamma_M\}$, with $\gamma_M > \gamma_m$. A fraction μ of workers is characterized by high motivation γ_M, the fraction $1-\mu$ has instead low motivation γ_m.[14]

For simplicity, we set the lower bounds of the support of the distribution for both attributes at $\theta_A = 1$ and $\gamma_m = 0$ (then, workers can be either intrinsically motivated or not motivated at all) and denote $\theta_a = \theta$ and $\gamma_M = \gamma$. Furthermore, we impose that $0 < \gamma \leq 1$: this ensures that the non-profit hospital pays non-negative salaries to motivated workers at the first-best. Finally, we assume that $1 < \theta \leq 2$: this implies that the non-profit hospital has two possible different orderings of effort levels exerted by workers' types (see the chains of inequalities 3 and 6 referring to the first-best and to implementable allocations, respectively).

patients. Let $\alpha^{NP} \in (0,1)$ denote the fraction of compensated care, so that profits to hospital NP from hiring a single worker are $\pi^{NP} = \alpha^{NP} q^{NP}(e) - w = \alpha^{NP} A e - w$, where the price of treatment is already set at $p = 1$. With a slight loss of generality, set A in such a way that $\alpha^{NP} A = 1$, whereby hospitals' profits per worker are as the ones proposed in the main text, with $k^{NP} \equiv \alpha^{NP} A = 1$ and $k^{FP} \equiv \frac{1}{\alpha^{NP}} = k > 1$.

[12] A similar interpretation of a non-profit firm as a profit-constrained organization was first proposed in Glaeser and Shleifer (2001), following the ideas expressed in Hansmann (1996) (see also Ghatak and Mueller 2011 and Brekke *et al.* 2012). However, in this literature, it is assumed that the non-profit firm is only able to appropriate a fraction α of its profits, so that $\alpha^{NP} < 1 = \alpha^{FP}$. Another difference is that, in our specification, k^H multiplies revenues rather than profits. We emphasise again that $k^{FP} = k > 1$ has to be interpreted in relative terms and not in absolute value.

[13] Since there exists a one-to-one relationship between effort exerted and number of patients treated by the hospital, we consider intrinsic motivation as the enjoyment of one's personal contribution to the mission of the non-profit organization. A similar interpretation of intrinsic motivation can be found in Besley and Ghatak (2005) and Delfgaauw and Dur (2008, 2010-only as for Section 5).

[14] In Sections 4.3 and 5, in order to fully characterize optimal contracts, we will restrict attention to a uniform distribution of both workers' characteristics.

To sum up, there are four types of health professionals, denoted as $ij = \{AM, Am, aM, am\}$, where the first index represents ability and the second index represents motivation.

When a worker is not hired by any hospital, we assume that her utility is zero. If a worker is hired by one hospital, her *reservation utility* or *outside option* is endogenous and it depends on the contract offered by the rival hospital.

When a health professional is hired by the for-profit hospital, her utility is

$$U_{ij}^{FP} = w_{ij} - \frac{1}{2}\theta_i e_{ij}^2.$$

Motivated workers do not enjoy any benefit from motivation when hired by the for-profit hospital. As a consequence, from the point of view of the for-profit hospital, workers AM and Am are equivalent, because they are equally productive, as well as workers aM and am.[15]

When a worker is hired by the non-profit hospital, her utility depends both on monetary rewards and on work activities, and takes the form

$$U_{ij}^{NP} = w_{ij} - \frac{1}{2}\theta_i e_{ij}^2 + \gamma_j e_{ij},$$

where both ability θ_i and motivation γ_j are related to effort exertion. The marginal rate of substitution between effort and wage is given by

$$MRS_{e,w}^{NP} = -\frac{\partial U_{ij}^{NP}/\partial e_{ij}}{\partial U_{ij}^{NP}/\partial w_{ij}} = \theta_i e_{ij} - \gamma_j,$$

which is always positive for non-motivated workers with $\gamma_j = 0$. When the effort required by the non-profit hospital is sufficiently low, i.e. $e_{ij} < \frac{\gamma_j}{\theta_i}$ for $j = M$, then motivated workers' indifference curves have a negative slope in the space (e, w). Notice that workers' utility function U_{ij}^{NP} satisfies the single-crossing property but only with respect to each parameter of private information at a time. In fact, the indifference curves of workers with the same motivation but different ability, or with the same ability but different motivation, intersect only once at $e = 0$. Nonetheless, the single-crossing property does not hold when both ability and motivation change simultaneously.

Remark 1 *The indifference curves of high-ability non-motivated workers and low-ability motivated workers (i.e. intermediate types Am and aM), hired by the non-profit hospital, cross twice at* $e = 0$ *and also at* $e = \frac{2\gamma_M}{\theta_a - \theta_A} = \frac{2\gamma}{\theta - 1}$.

Figure 1 represents these facts. The failure of the single-crossing condition makes the screening problem of the non-profit hospital hard to solve.

[15] However, workers with the same ability but different motivation potentially benefit from different outside options.

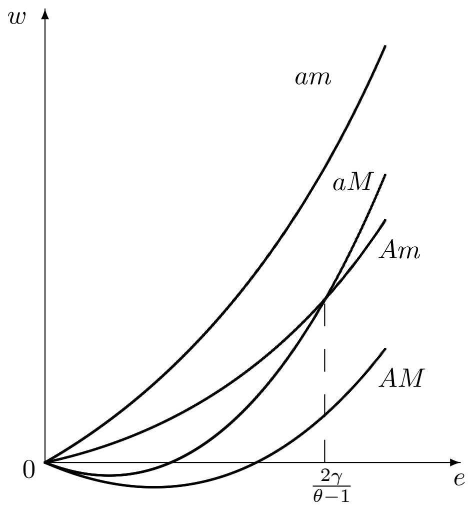

Figure 1. Zero-level indifference curves for workers hired by hospital NP

The timing of the game is as follows. The two hospitals simultaneously offer menus of contracts of the form $\left\{e_{ij}^{H}, w_{ij}^{H}\right\}$, with $H \in \{FP, NP\}$. Workers observe the contracts, and choose which hospital (if any) to work for. Then workers exert the effort level specified by the chosen contract, patients are treated and the contracted wage is paid.

An equilibrium is such that each hospital chooses a menu of contracts that maximizes its expected profit, given the contracts offered by the rival hospital and given the equilibrium choice of workers. Health professionals choose the contract which maximizes their utility. Hospitals are bound to offer contracts that make non-negative profits. If a worker is indifferent between working for the two hospitals, it is assumed that, with probability one, she will work for the hospital making the highest profit on that type.[16]

In Section 4, we will study competition with (bidimensional) adverse selection. Our framework originates from the combination of two simpler environments: (*i*) two firms competing to attract heterogeneous workers under full information; (*ii*) a monopsonistic firm designing screening contracts under asymmetric information. Competition under full information will be shortly examined in Subsection 3.2, whereas, for monopsonistic bidimensional screening, we refer the reader to Barigozzi and Burani (2016). In the qualitative description of optimal contracts in Section 4, we will refer to "second-best" effort levels as the solution to the screening program of the monopsony, with type-independent (i.e. zero) outside options.

3 Benchmark cases

In this section, we illustrate the first-best allocation and the efficient assignment of workers to hospitals, the equilibrium with competing hospitals under full information, and, finally, the outcome with

[16] In fact, the hospital with the higher, strictly positive payoff is able to raise her reward by $\varepsilon > 0$ and break the tie.

monopsony and entry deterrence under asymmetric information.

3.1 The first-best

Consider the total surplus generated by a specific hospital-worker pair, i.e. the sum of hospital H profit and worker ij utility

$$TS_{ij}^{H} = \left(k^{H} + \gamma_j\right) e_{ij}^{H} - \frac{1}{2}\theta_i \left(e_{ij}^{H}\right)^2 ,$$

where the term $\gamma_j e_{ij}^{H}$ is equal to zero when $H = FP$. Then, the first-best effort levels are those that maximize total surplus TS_{ij}^{H}, for each hospital H and for each worker's type ij. They have the following expressions

$$e_{AM}^{FB,FP} = e_{Am}^{FB,FP} = k, \quad e_{aM}^{FB,FP} = e_{am}^{FB,FP} = \tfrac{k}{\theta} \tag{1}$$

for the for-profit hospital, where $e_{Aj}^{FB,FP} > e_{aj}^{FB,FP}$ always holds for $j = m, M$, and

$$e_{AM}^{FB,NP} = 1+\gamma, \quad e_{Am}^{FB,NP} = 1, \quad e_{aM}^{FB,NP} = \tfrac{1+\gamma}{\theta} \quad \text{and } e_{am}^{FB,NP} = \tfrac{1}{\theta} \tag{2}$$

for the non-profit hospital, where

$$e_{AM}^{FB,NP} > \max\left\{e_{Am}^{FB,NP}; e_{aM}^{FB,NP}\right\} \geq \min\left\{e_{Am}^{FB,NP}; e_{aM}^{FB,NP}\right\} > e_{am}^{FB,NP}, \tag{3}$$

with $e_{aM}^{FB,NP} > e_{Am}^{FB,NP}$ if and only if

$$\Delta\gamma \equiv \gamma > (\theta - 1) \equiv \Delta\theta. \tag{4}$$

The ranking of first-best effort levels for workers hired by the non-profit hospital depends on the relative importance of the difference in ability $\Delta\theta$ *vis à vis* the difference in motivation $\Delta\gamma$.[17] When condition (4) holds, the heterogeneity in motivation is higher than the heterogeneity in ability and motivated workers provide the highest levels of effort (irrespective of ability); when instead inequality (4) is reversed, the heterogeneity in ability is higher than the heterogeneity in motivation and high-ability health professionals provide the highest levels of effort (irrespective of their motivation).

Health professionals are efficiently assigned to the hospital for whom the highest total surplus is realized. In particular, by inspection of expressions (1) and (2), it is easy to see that the efficient assignment of workers to hospitals depends on the relative magnitude of the terms $1 + \gamma$ and k.

Remark 2 ***Efficient assignment of workers to hospitals***. *The efficient assignment is such that: (a) when $k > 1 + \gamma$, all workers are allocated to the for-profit hospital; (b) when $k < 1 + \gamma$, motivated workers are assigned to the non-profit hospital and non-motivated types are assigned to the for-profit hospital; (c) when $k = 1 + \gamma$, non-motivated workers are allocated to the for-profit hospital and motivated types are randomly assigned to any hospital.*

[17] Given the simplification $\gamma_m = 0$, we will refer to the difference in motivation $\Delta\gamma$ and to the level of motivation γ interchangeably.

The efficient assignment is such that non-motivated workers are always employed by the for-profit hospital, whereas motivated workers can be employed by either the non-profit or the for-profit hospital depending on which employer has a competitive advantage in hiring these workers.

When $k < 1+\gamma$ holds, the level of motivation is sufficiently high so as to exceed the relative advantage of the for-profit with respect to the non-profit hospital in terms of revenue appropriation. In this case, it is efficient that for-profit and non-profit hospitals coexist. So, when $k < 1 + \gamma$, the non-profit hospital has a competitive advantage with respect to the for-profit competitor in employing motivated workers. Otherwise, when $k > 1 + \gamma$, the for-profit hospital has a competitive advantage with respect to the rival in employing all types of workers; it is then efficient that only the for-profit hospital survives. In the boundary case in which $k = 1 + \gamma$, motivated workers are are randomly assigned to any hospital.[18]

3.1.1 The first-best total surplus

When studying the interaction between hospitals, a crucial role is played by the concept of *first-best total surplus*, which is defined as follows.

A hospital $H \in \{FP, NP\}$ offers a worker her first-best total surplus when the contract is such that: (i) the effort level is set at the first-best $e_{ij}^{FB,H}$, and (ii) the total wage is obtained imposing that the hospital makes zero profits from that type of worker, i.e.

$$\pi_{ij}^{H} = k^{H} e_{ij}^{FB,H} - w_{ij}^{H} = 0 \Longleftrightarrow w_{ij}^{H} = k^{H} e_{ij}^{FB,H}.$$

In this way, a health professional receives the maximal possible utility, corresponding to the whole total surplus, which is given by

$$U_{ij}^{TS,H} = k^{H} e_{ij}^{FB,H} - \frac{1}{2}\theta_i \left(e_{ij}^{FB,H}\right)^2 + \gamma_j e_{ij}^{FB,H}, \tag{5}$$

where the superscript TS stands for total surplus and where, again, the term $\gamma_j e_{ij}^{FB,H}$ is equal to zero when the hospital is the for-profit one.

An important feature of first-best total surplus utilities is that, for the for-profit hospital, they only differ according to ability and are such that $U_{Aj}^{TS,FP} > U_{aj}^{TS,FP}$ with $j = m, M$, whereas, for the non-profit hospital, they are such that $U_{AM}^{TS,NP} > U_{Am}^{TS,NP}$ and $U_{aM}^{TS,NP} > U_{am}^{TS,NP}$. Indeed, the non-profit hospital offers a strictly higher maximal utility to motivated workers than to non-motivated types with the same ability, because the former provide more effort and treat more patients than the latter.

[18] This will have implications for the efficiency of the equilibrium sorting of workers to hospitals under asymmetric information (see Remark 5).

3.2 Competition under full information

Suppose now that the two hospitals observe the workers' types and compete to attract them. The two hospitals simultaneously offer each worker a contract $\left(e_{ij}^{H}, w_{ij}^{H}\right)$, with $H \in \{FP, NP\}$.

The best strategy for each hospital is to ask every health professional to provide her first-best effort level: this allows the two hospitals to generate the highest revenue to be used to attract the worker.[19] The hospital that has a competitive disadvantage in hiring a worker's type makes zero profits on that type and offers her a wage providing the first-best total surplus utility defined in (5).[20] The hospital that has a competitive advantage, instead, designs a contract which just meets the rival's offer and is able to attract the worker.

Remark 3 ***Equilibrium under full information.*** *(i) The sorting of workers to hospitals is efficient. (ii) Optimal contracts are such that: (ii.a) All effort levels are set at the first-best; (ii.b) Workers receive a payoff corresponding to the first-best total surplus offered by the hospital not hiring them; (ii.c) Both hospitals earn positive profits from the types they hire.*

When $k < 1 + \gamma$, the non-profit hospital has a competitive advantage in hiring motivated health professionals. The disadvantaged for-profit hospital will offer the first-best total surplus to motivated workers, and the non-profit hospital will meet that offer attracting motivated workers. In the same way, the non-profit hospital will offer the first-best total surplus to non-motivated workers, and the for-profit hospital will meet that offer attracting these workers. When instead $k > 1 + \gamma$, the for-profit hospital has a competitive advantage over all workers' types and hires all of them. Finally, when $k = 1 + \gamma$, no hospital has a competitive advantage relative to motivated types and the tie-breaking rule does not apply either, because both hospitals earn zero profits from these types.

In Appendix A, we derive the wages offered by the two hospitals in equilibrium.

3.3 Asymmetric information and entry deterrence

This subsection introduces screening under asymmetric information but avoids interacting it with competition between the two hospitals, which will instead be the subject of the next Section 4.

Recall that, when $k > 1 + \gamma$, the for-profit hospital has a competitive advantage in hiring all workers' types. Accordingly, we will show that all worker's types are hired by the for-profit hospital, whereas the non-profit hospital remains inactive. Following Biglaiser and Mezzetti (1993), the for-profit hospital is *fully dominant* in this case, because it is able to hire all workers and to make non-negative profits on

[19] Notice that the game describes a situation in which two heterogeneous firms compete *à la* Bertrand to attract a worker of known type.

[20] Indeed, any lower wage possibly offered by the disadvantaged hospital would generate profitable deviations and thus cannot be part of an equilibrium strategy.

all types, even when the dominated non-profit hospital offers them the first-best total surplus $U_{ij}^{TS,NP}$. Thus, we are going to study a screening problem with type-dependent but exogenous outside options.

3.3.1 The fully dominant for-profit hospital

Let us start with illustrating a general property of screening contracts offered by the for-profit hospital, which also holds when the for-profit hospital is not fully dominant.

Remark 4 ***For-profit hospital's screening contracts***. *Any incentive compatible contract that the for-profit hospital might offer must be the same for workers with the same ability, whereby*

$$e_{AM}^{FP} = e_{Am}^{FP} \quad and \quad e_{aM}^{FP} = e_{am}^{FP}$$

and

$$w_{AM}^{FP} = w_{Am}^{FP} \quad and \quad w_{aM}^{FP} = w_{am}^{FP}.$$

The for-profit hospital is only able to screen applicants on the basis of their ability, whereas intrinsic motivation does not affect the contracted effort and the amount of care provided. However, types characterized by the same ability and different intrinsic motivation are not identical from the for-profit hospital's viewpoint, because they enjoy different outside options. In particular, intrinsic motivation positively affects motivated workers' outside options. The fully dominant for-profit hospital must offer to all workers' types a utility just exceeding their highest outside option, i.e. the first-best total surplus utility left by the non-profit hospital to motivated workers.

The program of the fully dominant for-profit hospital corresponds to the two-types (i.e. high and low-ability workers)[21] screening problem

$$\max_{(e_i^{FP}, w_i^{FP})} E\left[\pi^{FP}\right] = \nu\left(ke_A^{FP} - w_A^{FP}\right) + (1-\nu)\left(ke_a^{FP} - w_a^{FP}\right) , \qquad (PFP)$$

with $i = a, A$, subject to the two participation constraints of motivated types

$$w_i^{FP} - \frac{1}{2}\theta_i\left(e_i^{FP}\right)^2 \geq U_{iM}^{TS,NP}, \qquad (PC_{iM}^{FP})$$

for every $i = a, A$,[22] and to the two incentive compatibility constraints

$$w_i^{FP} - \frac{1}{2}\theta_i\left(e_i^{FP}\right)^2 \geq w_{i'}^{FP} - \frac{1}{2}\theta_i\left(e_{i'}^{FP}\right)^2 \qquad (IC_{ivsi'}^{FP})$$

for every $i = a, A$ with $i' \neq i$ (see Appendix B). Adding the two incentive constraints, one obtains the standard *monotonicity* condition $e_A^{FP} \geq e_a^{FP}$, requiring that high-ability workers provide more effort than low-ability types.

[21] Accordingly, we omit subindeces $j = m, M$ related to motivation, when no confusion arises.

[22] Given the magnitudes of $U_{ij}^{TS,NP}$, only the participation constraints of motivated types matter. Indeed, once PC_{AM}^{FP} is satisfied, then PC_{Am}^{FP} is slack and, similarly, once PC_{aM}^{FP} holds, then PC_{am}^{FP} is slack.

In order to solve this problem, we build on the analysis of Laffont and Martimort (2002, Chapter 3.3). They study type-dependent participation constraints and countervailing incentives when there are two types of agent and the outside option of the efficient type is strictly higher than that of the inefficient type, which is normalized to zero. The solution exhibits five different regimes according to which participation and incentive compatibility constraints are binding.

In our case, which regime is in place depends on the magnitude of the difference in outside opportunities given by the non-profit hospital to high-skilled and low-skilled motivated workers, respectively, i.e. $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$.

At one extreme, when the difference $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$ is low, Regime 1 holds. The competitive pressure exerted by hospital NP on the rival is low and the problem of the for-profit hospital is not perturbed substantially with respect to a standard, two-types screening problem with exogenous and type-independent reservation utilities: outside options are irrelevant and the for-profit hospital sets second-best effort levels. In this regime, high-ability workers try to mimic low-ability colleagues and, thus, the incentive constraint that high-skilled workers do not choose the contract designed for low-skilled types is binding. The for-profit hospital optimally distorts the effort required from low-ability workers downwards in order to save in information rents left to high-ability health professionals. Moreover, low-skilled types are indifferent between the contract offered by the for-profit hospital or the reservation utility $U_{aM}^{TS,NP}$ offered by the non-profit hospital.

At the other extreme, when the difference $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$ is high, Regime 5 attains. The competitive pressure exerted by the non-profit hospital is sufficiently strong so as to alter the natural ordering of incentive and participation constraints in the screening problem of the for-profit hospital. Now, countervailing incentives arise, meaning that low-ability workers try to mimic high-ability colleagues (because the latter enjoy much higher rents than the former), so that the incentive constraint that low-skilled workers do not choose the contract designed for high-skilled types is binding. The for-profit hospital optimally distorts the effort required from high-ability workers upwards, making them indifferent between its contract and the high outside option $U_{AM}^{TS,NP}$ offered by the non-profit hospital.

In-between, when the difference in total surplus utilities is intermediate, Regimes 2 to 4 occur. Both types' participation constraints are binding, whereby both high- and low-ability workers are indifferent between employment contracts offered by the two hospitals. In particular, in Regime 3, no incentive constraint is binding, so that there is no envy between workers with different skills, and the efficient effort levels are set.

The solution to the screening program of the fully dominant for-profit hospital is derived in Appendix B, where the 5 regimes in which the for-profit hospital might find itself are analyzed in turn. The lemma that follows summarizes our main findings, using the fact that the relevant thresholds for the difference $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$ are inversely related to the magnitude of parameter k.

Lemma 1 ***Fully dominant for-profit hospital.*** *(i) The for-profit hospital is fully dominant only if* $k > 1 + \gamma$*. (ii) Optimal allocations are such that the 'no distortion at the top' property is satisfied and (downward) effort distortions for low-ability workers are increasing in k. In particular: (ii.1) when k is high (sufficiently higher than* $1 + \gamma$*), outside options are irrelevant and effort for low-ability workers is set at the second-best; (ii.2) when k is intermediate, the effort for low-ability types is distorted downwards but less than at the second-best; and (ii.3) when k is low (close to* $1 + \gamma$*), all effort levels are set at the first-best.*

Lemma 1 states that the for-profit hospital can be fully dominant only when it has a competitive advantage with respect to the rival hospital in hiring all workers. In particular, the higher is k with respect to $1 + \gamma$, the lower the competitive pressure exerted by the rival non-profit hospital (this occurs because, as mentioned before, high levels of k correspond to low values of the difference $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$). Given that k is bounded below by $1 + \gamma$ when the for-profit hospital is fully dominant, the competitive pressure from the rival hospital is never so high as to give rise to countervailing incentives: optimal contracts are such that the effort level required from high-ability workers is never distorted, whereas the effort level set for low-ability workers can be distorted downward. Moreover, when the competitive pressure from the non-profit hospital is irrelevant, Regime 1 holds and the standard second-best solution attains. When the competitive advantage of the for-profit hospital decreases, also the downward distortion in the effort level required from low-ability workers decreases, and Regime 2 holds. Finally, when the threat of entry by the non-profit hospital becomes relevant, then Regime 3 attains and the allocation is fully efficient.[23]

4 Competition under bidimensional adverse selection

Suppose now that $1 < k \leq 1 + \gamma$, in which case the for-profit hospital is not fully dominant and both hospitals are active in equilibrium. Still, each hospital is dominant relative to a subset of types. In particular, the non-profit hospital has a competitive advantage in hiring motivated workers and is thus dominant relative to these workers, whereas the for-profit hospital has a competitive advantage in hiring non-motivated workers and it is dominant relative to these workers.

In equilibrium, each hospital offers four (potentially different) contracts that must always satisfy internal incentive compatibility, independently of the fact that some contracts will not be chosen and will remain out-of-equilibrium contracts. Moreover, each hospital forms a conjecture about the workers' self-selection to hospitals and this will help it define which are the relevant (now endogenous) outside options and thus which are the possible binding participation constraints.[24] In equilibrium, hospitals'

[23] Note that, when $k = 1 + \gamma$, we would expect Regime 3 to hold, but the for-profit hospital cannot not be fully dominant in this case. See the discussion below Remark 5.

[24] As will be clear in what follows, for each hospital, only the participation constraints of non-motivated workers will be

conjectures about the sorting of workers are correct and are such that the hospital, which is dominated relative to a given subset of types, will expect these types to be hired by the rival hospital and will offer these types out-of-equilibrium contracts.

Intuitively, when $1 < k \leq 1 + \gamma$, at equilibrium, the sorting of workers to hospitals is based on motivation.[25]

Proposition 1 ***Equilibrium sorting of workers to hospitals.*** *When $1 < k \leq 1 + \gamma$, the equilibrium sorting of workers to hospitals is unique and it only depends on motivation (i.e. it is ability-neutral): motivated workers self-select into the non-profit hospital and non-motivated workers self-select into the for-profit hospital.*

Proof. See Appendix C. ■

Proposition 1 delivers some general insights about the average level of ability of workers hired by the two hospitals. In effect, the results contained in Proposition 1 do not depend on the assumptions made about the distribution of types and are thus robust to changes in such distribution.

Corollary 1 ***Workers' self-selection and the distribution of types.*** *The equilibrium sorting of workers according to motivation is independent of the distribution of types.* (*i*) *When skills and intrinsic motivation are independently distributed, ability-neutrality implies that average ability is the same for both hospitals' employees.* (*ii*) *When skills and intrinsic motivation are positively (respectively, negatively) correlated, ability-neutrality implies that average ability is higher (respectively lower) for workers employed at the non-profit than at the for-profit hospital.*

We can thus foresee which are the determinants of wage differentials in labour markets where non-profit and for-profit hospitals coexist. Suppose that a wage penalty for workers hired by the non-profit hospital exists and suppose that we want to disentangle the pure compensating differential effect caused by workers' motivation from the negative selection effect of ability. Then, when skills and intrinsic motivation are independently distributed, the wage gap is totally driven by motivation and the non-profit hospital is not affected by adverse selection with respect to ability. If instead skills and intrinsic motivation were negatively correlated, then the wage penalty would partly be explained by a true compensating wage differential and it would partly be caused by adverse selection with respect to ability. Finally, if skills

relevant.

[25] Proposition 1 extends to our setting with asymmetric information the result obtained by Delfgaauw and Dur (2010). They show that, when motivation is output-oriented (as in our case), workers' self-selection is ability-neutral, and workers sorting into the public sector are the more motivated ones. When, instead, motivation is unrelated to effort provision or output, then only workers with low ability sort into the public sector, where wages are efficiently lower than in the private sector.

and intrinsic motivation were positively correlated, the wage gap would only arise because of motivation and it would partially be offset by a propitious selection effect with respect to ability.

In the next subsections, we first describe the procedure followed in order to find candidate equilibria and we then provide the full characterization of equilibrium contracts. Before doing so, let us mention that, combining the results contained in Proposition 1 and in Lemma 1, it is possible to talk about the efficiency of the equilibrium sorting of workers to hospitals under asymmetric information, considering not only the case of full competition between hospitals considered in the present section, but also the case of deterred entry analyzed in Section 3.3.

Remark 5 ***Workers' self-selection and efficiency.*** *The sorting of workers to hospitals under asymmetric information is efficient when* $1 < k \leq 1 + \gamma$ *or when* k *is sufficiently higher than* $1 + \gamma$.

The outcome of the self-selection of workers under asymmetric information is the same as the assignment that a fully informed social planner would choose, the unique exceptions consisting in the case in which $k = 1 + \gamma$ or in the case in which k approaches $1 + \gamma$ from above. To understand why, consider that, when $k = 1 + \gamma$, efficiency requires that motivated workers be randomly allocated to either the for-profit or the non-profit hospital, whereas, when k is slightly higher than $1 + \gamma$, efficiency requires that all workers be assigned to the for-profit hospital (see Remark 2). However, from Proposition 1, the unique equilibrium sorting when $k = 1 + \gamma$ is such that motivated workers choose to work for the non-profit hospital; also Lemma 1 states that the for-profit hospital is fully dominant and is thus able to attract all workers only when k is sufficiently higher than $1 + \gamma$, but not when k is close to $1 + \gamma$. When hiring all workers, the for-profit hospital is bound by incentive compatibility to offer the same contract to workers with the same ability, providing them with a utility that just exceeds the high outside option of motivated workers. This drives its profits from all types close to (or down to) zero when k is close to (or equal to) $1 + \gamma$. Such a situation cannot be an equilibrium because the for-profit hospital can profitably deviate by renouncing to hire motivated workers. By so doing, the for-profit hospital would obtain higher profits from non-motivated workers, which more than compensate the profits lost from motivated workers.[26]

4.1 The for-profit hospital

Recall that the for-profit hospital offers the same contract to workers with the same ability. It is dominated with respect to motivated workers, so it anticipates that it is going to attract non-motivated types only. As already mentioned, in order to succeed in hiring non-motivated types Am and am, the for-profit principal must be able to provide them with a level of utility which just exceeds U_{Am}^{NP} and U_{am}^{NP}, respectively. Then,

[26] Biglaiser and Mezzetti (1993) also find an inefficient assignment of workers to principals under some parameter configurations.

the for-profit hospital's program is (PFP) as in Section 3.3.1 when it is fully dominant, but with different relevant participation constraints, namely those of non-motivated workers

$$w_i^{FP} - \frac{1}{2}\theta_i \left(e_i^{FP}\right)^2 \geq U_{im}^{NP} \qquad (PC_{im}^{FP})$$

for every $i = a, A$.

One can replicate the analysis which has been carried out in Section 3.3.1 and in Appendix B, using PC_{im}^{FP} above and substituting the difference in total surplus utilities of motivated types $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$, which mattered there, with the difference in reservation utilities of non-motivated types $U_{Am}^{NP} - U_{am}^{NP}$.

Notice that the two hospitals' programs are now interdependent. Indeed, when PC_{im}^{FP} is binding for the worker with ability $i = a, A$, then it must necessarily be the case that PC_{im}^{NP} is binding as well. In other words, $U_{iM}^{FP} = U_{im}^{FP} = U_{im}^{NP}$ and type im is indifferent between working for either hospital (the tie-breaking rule mentioned at the end of Section 2 might then apply). Conversely, when PC_{im}^{FP} is slack, then it must be that $U_{im}^{FP} > U_{im}^{NP}$, so that type im strictly prefers to work for the for-profit rather than for the non-profit hospital.

Also notice that the difference in reservation utilities $U_{Am}^{NP} - U_{am}^{NP}$ is now endogenous but, because of the simultaneity of moves, is taken as given by the for-profit hospital. One can then build the best response of the for-profit hospital, which specifies, for each possible difference in reservation utilities offered by the non-profit hospital, the incentive scheme that maximizes the expected profits of the for-profit hospital that is interested in hiring non-motivated types only. Such best response has two nice features: (i) it depends on a single variable, i.e. the difference $U_{Am}^{NP} - U_{am}^{NP}$, and (ii) it is single-valued, because, for each level of $U_{Am}^{NP} - U_{am}^{NP}$, the optimal contract offered by the for-profit hospital is uniquely defined. Figure 2 summarizes the analysis by representing the reaction function of the for-profit hospital.[27]

Insert Figure 2 here

The five different regimes presented in Section 3.3.1 and Appendix B are still in place and so are the optimal effort levels associated with each regime.

4.2 The non-profit hospital

As opposed to the for-profit hospital, the non-profit hospital offers up to four different contracts, one for each type of health professional. In equilibrium, the non-profit organization expects to hire motivated agents only and designs out-of-equilibrium contracts for non-motivated types so as to satisfy internal

[27] Notice that Figure 2 could also represent the best response of the for-profit hospital when it is fully dominant (see Section 3.3.1). The distinction concerns the horizontal axis, where, here, the endogenous difference in non-motivated workers' outside options is displayed, whereas, there, the exogenous difference in motivated workers' total surplus utilities should be represented.

incentive compatibility. The program of the non-profit hospital consists in a bidimensional screening problem with type-dependent and endogenous outside options, which is as follows

$$\begin{aligned}\max_{\left(e_{ij}^{NP},w_{ij}^{NP}\right)} E\left[\pi^{NP}\right] = \quad & \nu\mu\left(e_{AM}^{NP}-w_{AM}^{NP}\right)+\nu\left(1-\mu\right)\left(e_{Am}^{NP}-w_{Am}^{NP}\right)+\left(1-\nu\right)\mu\left(e_{aM}^{NP}-w_{aM}^{NP}\right)\\ & +\left(1-\nu\right)\left(1-\mu\right)\left(e_{am}^{NP}-w_{am}^{NP}\right)\end{aligned} \tag{PNP}$$

subject to four participation constraints whose generic form is

$$w_{ij}-\frac{1}{2}\theta_i\left(e_{ij}^{NP}\right)^2+\gamma_j e_{ij}^{NP}\geq U_{ij}^{FP} \tag{PC_{ij}^{NP}}$$

and twelve incentive compatibility constraints that are such that

$$w_{ij}^{NP}-\frac{1}{2}\theta_i\left(e_{ij}^{NP}\right)^2+\gamma_j e_{ij}^{NP}\geq w_{i'j'}^{NP}-\frac{1}{2}\theta_i\left(e_{i'j'}^{NP}\right)^2+\gamma_j e_{i'j'}^{NP} \tag{$IC_{ij\text{vs}i'j'}^{NP}$}$$

with ij different from $i'j'$. The complete list of participation and incentive constraints is given in Appendix D.

The solution to this program is found extending the analysis of a companion paper, Barigozzi and Burani (2016), where bidimensional screening is considered for type-independent reservation utilities, which are normalized to zero. As usual in these kind of problems, one first guesses which participation and incentive constraints are binding and then checks *ex-post* that the omitted constraints are satisfied as well.

As for participation constraints, one can show (see again Appendix D) that, once $IC_{iM\text{vs}im}^{NP}$ and PC_{im}^{NP} are both satisfied, then PC_{iM}^{NP} is slack, with $i=a,A$. In other words, when considering types with the same ability but different motivation, one can disregard the participation constraint of motivated health professionals, because it is implied by the participation constraint of non-motivated workers. The same conclusion cannot be drawn for workers with the same motivation but different ability. Thus, both PC_{Am}^{NP} and PC_{am}^{NP} might be relevant and the latter does not imply the former.

As for incentive compatibility constraints, adding them two by two, one obtains the following *implementability* or *monotonicity* condition

$$e_{AM}^{NP}\geq\max\left\{e_{Am}^{NP};e_{aM}^{NP}\right\}\geq\min\left\{e_{Am}^{NP};e_{aM}^{NP}\right\}\geq e_{am}^{NP}. \tag{6}$$

Therefore, in line with the first-best, there exist two different orderings of workers' effort levels. Worker AM will be asked to exert the highest effort, and to treat the highest number of patients, whereas worker am will provide the lowest effort and will treat the smallest number of patients. The levels of effort required from types Am and aM are in-between and cannot be ranked unambiguously. Three possible states of the word must then be considered (see conditions 22 and 23 in Appendix D).

(i) *Motivation prevails* (Case $\mathcal{M}$). If the heterogeneity in motivation is more relevant than the heterogeneity in ability (i.e. if γ is high with respect to $\Delta\theta$), then optimal contracts are such that

$e_{AM}^{NP} \geq e_{aM}^{NP} > e_{Am}^{NP} \geq e_{am}^{NP}$. Hence, motivated health professionals are asked to provide more effort and treat a higher number of patients than non-motivated workers, irrespective of ability.

(*ii*) *Ability prevails* (Case $\mathcal{A}$). If the heterogeneity in ability is more relevant than the heterogeneity in motivation (i.e. if γ is low relative to $\Delta\theta$), then optimal effort levels are such that $e_{AM}^{NP} \geq e_{Am}^{NP} > e_{aM}^{NP} \geq e_{am}^{NP}$. Then, high-ability health professionals provide more effort and treat more patients than low-ability workers, irrespective of motivation.

(*iii*) *Pooling of intermediate types* (Case $\mathcal{P}$). When neither ability nor motivation prevail (i.e. when γ is close to $\Delta\theta$), it becomes impossible for the non-profit hospital to separate intermediate types and optimal allocations are such that $e_{AM}^{NP} \geq e_{Am}^{NP} = e_{aM}^{NP} \geq e_{am}^{NP}$. A pooling contract must be designed for types aM and Am, who provide the same effort.

Monotonicity condition (6) has to be confronted with the equilibrium sorting of workers, according to which only motivated health professionals accept employment at the non-profit hospital. When motivation prevails, the non-profit hospital is able to hire the two most productive workers and designs out-of-equilibrium contracts for the two least productive workers. We show that, when motivation prevails, optimal allocations are the same as at the second-best (i.e. without competition) because the competitive pressure from the for-profit hospital does not substantially alter the design of the screening problem for the non-profit hospital.[28] When, instead, ability prevails, the participation constraints of non-motivated workers do not tie-in naturally with the ranking imposed by implementability, because the non-profit hospital is able to hire the first and the third most productive workers. Then, non-standard incentive constraints may become binding. The rent extraction-efficiency trade-off faced by the non-profit hospital is solved by setting efficient allocations. When neither motivation nor ability prevails, intermediate types are given the same contract and allocative distortions arise, which are nonetheless lower than at the second-best.

The first step towards finding the solution to the non-profit hospital's program consists in determining which participation constraint, between the ones of non-motivated workers, is binding for the non-profit hospital. In order to do so, we take each one of the possible five regimes, in which the for-profit hospital can find itself, as given. When PC_{im}^{FP}, with $i = a, A$, is binding, it means that PC_{im}^{NP} is binding as well and that type im is indifferent between the contracts offered by the two hospitals. Then, the dominated non-profit hospital will offer this type her first-best total surplus and will make zero profits from this type. Conversely, when PC_{im}^{FP}, with $i = a, A$, is slack, the effort required from the non-motivated worker im is set preserving incentive compatibility.[29] The solution will typically depend on whether Case $\mathcal{M}$,

[28] Nonetheless, the existence of a competing hospital shifts the division of the surplus generated by the NP hospital-worker pair in favour of workers, given that they enjoy higher outside opportunities.

[29] For the sake of concreteness, suppose that the for-profit hospital is in the regime where outside options are irrelevant

Case $\mathcal{A}$, or Case $\mathcal{P}$ prevails. Moreover, the solution might not be unique, for example because both fully separating and pooling contracts are feasible in a given parameter range. When multiple solutions coexist, we take the one guaranteeing the highest profits to hospital NP. We are then able to build the best response of the non-profit hospital, which is more difficult to characterize than the reaction function of hospital FP because: (i) it depends on more than one variable, i.e. on both U_{Am}^{FP} and U_{am}^{FP} separately, and (ii) for given levels of U_{Am}^{FP} and U_{am}^{FP}, it is not single-valued, given that the screening contracts offered by the non-profit hospital vary according to whether motivation or ability prevails (or else according to the relative magnitude of γ and $\Delta\theta$).

Once the bidimensional screening problem of the non-profit hospital is solved, the difference in reservation utilities $U_{Am}^{NP} - U_{am}^{NP}$, which enters the solution to the for-profit hospital's program, is fully determined. The last step of the analysis consists in checking whether such difference in reservation utilities is compatible with the bounds defining the selected regime for the for-profit hospital. If so, then the solution obtained is an equilibrium, otherwise it must be discarded. In other words, one must check whether the best responses of the two competing hospitals are compatible with each other. We repeat the same procedure for all possible regimes for hospital FP, from 1 to 5. This analysis is relegated to Appendix E, where we also show that, paralleling the case of the for-profit hospital being fully dominant, not all regimes in which the for-profit hospital can find itself are relevant, because only the first three are feasible. Accordingly, the for-profit hospital will either distort effort required from low-ability workers downwards, or it will set the efficient level of effort for all workers.

Last, but not least, consider that the for-profit hospital is constrained to offer only two contracts and that non-motivated types are worse-off when mimicking motivated workers employed by the non-profit hospital. Thus, one may easily check that incentive compatibility *between* hospitals is always satisfied in equilibrium.

4.3 Sorting according to motivation

In what follows, we characterize the optimal incentive schemes offered by the two competing hospitals when $1 < k \leq 1 + \gamma$ and when workers sort themselves by motivation. We simplify the analysis by restricting attention to a uniform distribution of types, whereby the probability of each type is set equal to 1/4.

In our setting, there are two driving forces that shape optimal contracts. The first is incentive compatibility, which is important for each hospital in isolation. It prescribes that, when 'good' types of workers have incentive to mimic 'bad' types, then it is optimal for the principal to distort allocations for

(Regime 1 in Figure 2). Then PC_{Am}^{FP} is slack, i.e. $U_{Am}^{FP} > U_{Am}^{NP}$, while PC_{am}^{FP} is binding, i.e. $U_{am}^{FP} = U_{am}^{NP}$. Thus, the program for the non-profit hospital is such that only PC_{am}^{NP} is binding, and the contract offered to type am provides her with the total surplus utility $U_{am}^{TS,NP} = U_{am}^{NP} = U_{am}^{FP}$.

'bad' types in order to reduce the informational advantage of 'good' types. The second force is represented by outside options, which make the screening problems of the two hospitals interdependent, because a worker's outside option sets a lower bound on the utility that she must obtain from the hospital hiring her. The more intense competition between hospitals is, the more relevant outside options become relative to internal incentive compatibility, and the lower the need for each hospital to save in information rents by distorting allocations. Therefore, distortions tend to disappear when competition is tough and optimal allocations revert to the first-best.

When k is high (i.e. close to $1 + \gamma$), it means that the for-profit hospital has a high competitive advantage in terms of revenue appropriation. Similarly, when γ is significant, it means that the non-profit hospital has a high advantage stemming from workers' intrinsic motivation. Therefore, when both k and γ are high, hospitals are sufficiently differentiated from each other and the degree of competition between them is mild. When this occurs, outside options are not particularly relevant and internal incentive compatibility is the driving force in determining optimal allocations. Indeed, effort levels for hired workers are set at the second-best, as in the absence of competition. Conversely, when k is low (i.e. close to 1), and motivation γ is also low, it means that the degree of competition between hospitals is high, because hospitals are very similar to each other. Then, outside options are the main determinant of optimal effort levels, whereas internal incentive compatibility only plays a minor role. This outcome resembles the full information equilibrium corresponding to Bertrand competition, with each hospital setting first-best effort levels.

Proposition 2 summarizes the above discussion.

Proposition 2 ***Competition and optimal allocations***. *Effort provided by high-ability workers is not distorted. Effort provided by low-ability workers is such that:* (*i*) *If competition is mild (if k is high and γ is not too low), then effort is set at the second-best by both hospitals.* (*ii*) *If competition is harsh (i.e. if both k and γ are low), then effort is set at the first-best by both hospitals* (*iii*) *Otherwise, effort levels might be set in-between the first- and the second-best.*

Therefore, the 'no distortion at the top' property holds and (downward) distortions in effort provided by low-ability workers are decreasing in the degree of competition between hospitals.

Moreover, notice that a high value of k can be interpreted as a high mandatory charity care standard (or else a high voluntary charity care provision).[30] Thus, the government can affect the degree of competition between hospitals by properly setting the value of k. In particular, Proposition 2 has the following policy implication.[31]

[30] See Footnote 4.

[31] See also the Concluding remarks.

Corollary 2 *From an efficiency viewpoint, a low mandatory charity care standard (a low k) is beneficial for two reasons:* (i) *it allows the non-profit hospital to coexist with the for-profit one (i.e. it allows the condition $1 < k \leq 1 + \gamma$ to be met);* (ii) *it increases the degree of competition between hospitals, by decreasing their heterogeneity, so that it leads to lower allocative distortions in the market for health professionals.*

Going into detail of the allocative distortions characterising equilibrium contracts, different situations emerge according to the magnitude of k, which governs the for-profit hospital's regimes, and according to the relative magnitudes of γ and $\Delta\theta$, that influence the states of the world in which the non-profit hospital can find itself. The reader, who is not interested in contract details and binding constraints, might want to skip the following subsections and go directly to Section 5.

4.3.1 Mild competition

This situation corresponds to point (i) in Proposition 2. It occurs when k is sufficiently high (close to $1 + \gamma$) and also when γ is not too low, so that each hospital has a sizeable competitive advantage with respect to the rival.

- The for-profit hospital is in Regime 1 (irrelevance of outside options). Low-ability workers are indifferent between hospitals, i.e. PC_{am}^{FP} is binding; as for internal incentive compatibility, high-ability workers are indifferent between accepting their contract or the contract designed for low-ability health professionals, i.e. constraint $IC_{A\text{vsa}}^{FP}$ is binding. The for-profit hospital sets second-best effort levels.

- The non-profit hospital is in Case $\mathcal{M}$: optimal effort levels are such that $e_{AM}^{NP} > e_{aM}^{NP} > e_{Am}^{NP} = e_{am}^{NP}$ and a pooling contract is offered out-of-equilibrium to non-motivated types. Worker am is just indifferent between hospitals, i.e. PC_{am}^{NP} is binding, and $e_{Am}^{NP} = e_{am}^{NP} = e_{am}^{FB,NP}$. Worker Am, despite being offered the same contract as worker am, is strictly better-off than am because of her lower effort cost. Still, worker Am strictly prefers to be employed by hospital FP and thus PC_{Am}^{NP} is slack. Motivated workers are given a contract such that worker aM is made indifferent between her contract and the pooling contract proposed to non-motivated workers, and worker AM is made indifferent between her contract and type aM's contract. Hence, motivated types are required to make second-best efforts.

4.3.2 Harsh competition

This situation corresponds to point (ii) in Proposition 2. It is in place when k is low (i.e. close to 1) and when γ is also low (i.e. lower than $\Delta\theta$), so that no hospital has a significant competitive advantage with respect to the rival.

- The for-profit hospital is in Regime 3, with both participation constraints of non-motivated types being binding. Thus, both high- and low-ability workers are indifferent between the two hospitals. Moreover, all incentives constraints are slack, so that there is no envy between workers with different skills. Then, first-best effort levels are set for all workers by the for-profit hospital.

- The non-profit hospital is in Case $\mathcal{A}$: optimal effort levels are such that $e_{AM}^{NP} > e_{Am}^{NP} > e_{aM}^{NP} > e_{am}^{NP}$. Since participation constraints of non-motivated health professionals are binding, the non-profit hospital offers these types their first-best total surplus utilities $U_{Am}^{TS,NP}$ and $U_{am}^{TS,NP}$ and asks them to provide first-best effort levels. Worker AM is indifferent between her contract and the contract offered to type Am, whereas worker aM is indifferent between her contract and the contract offered to either type Am or type am. In any event, since no other type of worker is trying to mimic them, motivated types AM and aM are asked to provide first-best effort levels.

4.3.3 Intermediate degrees of competition

All remaining situations encompassed by point (*iii*) in Proposition 2 refer to intermediate degrees of competition between hospitals. Then, all remaining combinations among Regimes 2 or 3 for the for-profit hospital and Cases $\mathcal{A}$ or $\mathcal{M}$ or $\mathcal{P}$ for the non-profit hospital can occur.

A characteristic feature of all these cases is that both participation constraints of non-motivated types are binding for the for-profit hospital, as under harsh competition. Then, the non-profit hospital offers workers Am and am their first-best total surplus utilities $U_{Am}^{TS,NP}$ and $U_{am}^{TS,NP}$ and requires first-best effort levels from these types. Finally, the non-profit hospital chooses its optimal contracts according to the relative magnitudes of γ and $\Delta\theta$, which determine whether motivation or ability prevails.[32]

[32] More precisely, the non-profit hospital is in Case $\mathcal{P}$ when γ is intermediate (i.e. higher than $\Delta\theta$ but not close to 1). Intermediate types' effort levels are pooled and $e_{AM}^{NP} > e_{aM}^{NP} = e_{Am}^{NP} = e_{Am}^{FB,NP} > e_{am}^{NP}$. Worker AM is indifferent between her contract and the pooling contract, and she gets the first-best. The effort for worker aM is in-between the first- and the second-best. Alternatively, the non-profit hospital is in Case $\mathcal{M}$ when γ is high (i.e. higher than $\Delta\theta$ and close to 1). Optimal effort levels are such that $e_{AM}^{NP} > e_{aM}^{NP} > e_{Am}^{NP} > e_{am}^{NP}$. As under mild competition, worker aM is made indifferent between her contract and the first-best total surplus contract proposed to worker Am, and worker AM is made indifferent between her contract and type aM's contract. Hence, motivated types are required to make second-best efforts. Finally, the for-profit hospital is in Regime 2 when k is intermediate (i.e. neither close to 1 nor to $1+\gamma$). High-ability types are indifferent between their contract and the contract targeted to low-ability colleagues. Thus, high-ability workers are given by the for-profit hospital their first-best allocation and effort of low-ability workers is distorted downward but less than at the second-best.

5 Ownership structure and performance

In this section, we will consider the impact that the hospitals' ownership structure has on their performance, measured both in terms of quality of care provided to their patients and in terms of rewards offered to their health professionals.

5.1 Quality of care

Up to now, we focused on how competition affects distortions in optimal allocations, interpreting literally our contracting instrument in terms of effort. Nonetheless, even more relevant from a policy perspective is the interpretation of the contracting variable in terms of quality of care. Indeed, a hotly debated issue in health economics is whether non-profit hospitals offer higher quality with respect to for-profit ones. Our model provides the following interesting insights.

Proposition 3 ***Quality differentials.*** *Given ability, health professionals employed at the non-profit hospital almost always deliver higher quality of care than colleagues employed at the for-profit hospital.*

Proof. It follows directly from inspection of the optimal allocations derived in Appendix E. ■

The intuition for this result is the following. Recall that sorting is ability-neutral, so that (with independent distributions of workers' characteristics) average ability is the same for both hospitals' workforce; moreover, motivated workers hired by the non-profit hospital partly donate their quality-enhancing effort, thus improving their employer's performance.

There is a unique exception to the previous result, which only refers to low-ability types, and which occurs when the non-profit hospital has a high competitive advantage whereas the competitive advantage of the for-profit hospital is low, or when the degree of competition is intermediate, motivation prevails for the non-profit hospital and the for-profit hospital is in Regime 3 (see Subsection 4.3.3). In this case, the for-profit hospital does not distort quality provided by low-ability non-motivated workers, whereas the non-profit hospital distorts the quality provided by low-ability motivated workers downward in order to save in information rents.

The results in Proposition 3 are coherent with those of the formal theory explaining the existence of non-profit organizations by contractual incompleteness (see Hansmann 1996 and Glaeser and Shleifer 2001) and according to which non-profits' weak incentives to maximize profits act as a commitment device, assuring customers that quality will be high.

As for the empirical literature analyzing the correlation between quality and ownership structure, our results are in line with the studies documenting higher quality for non-profit hospitals.[33] Eggleston *et al.*

[33] As mentioned in the Introduction, the empirical evidence concerning the relationship between hospital status and quality provision is rather mixed. See, for example, the literature review in Brekke *et al.* (2012).

(2008) find that the effect of hospital ownership on quality in the U.S. depends mainly on the institutional context, including differences across regions, markets, and over time. The authors conclude that non-profit ownership appears to be systematically related to higher quality among hospitals in several contexts. Shen (2002) examines the effect of U.S. hospitals' ownership choice on patients' outcomes after treatment for myocardial infarction and finds that for-profit and government hospitals have higher incidence of adverse outcomes than non-profit hospitals by 3-4%. This is interpreted as strong evidence that for-profit hospitals produce worse health outcomes than non-profit hospitals. Lien et al. (2008) find that patients admitted to non-profit hospitals in Taiwan receive better quality care measured by mortality rates. Finally, studying the nursing home market in the U.S., Hillmer *et al.* (2005) and Grabowski and Hirth (2003) offer evidence that quality is higher in the non-profit sector. Such result has been recently confirmed by Jones (2015). Analyzing the market for nursing homes in the U.S. as well, he documents that the quality of non-profit work is highest when non-profit labor demand is low relative to for-profit (i.e. when the non-profit share of labor in a given locality is low).

5.2 Wage differentials and returns to ability

In this section, we compare the wage schemes offered by the two hospitals when they coexist and workers sort themselves according to motivation, i.e. when $1 < k \leq 1 + \gamma$. In particular, it is interesting to consider the model's predictions as for the wage differential, if any, between the non-profit and the for-profit hospital.[34] We first compare the wage rate offered by the two hospitals to motivated and non-motivated workers, fixing the level of ability. Then, we compare the *returns to ability* across hospitals, that is we consider the wage increase that health professionals hired by a given hospital receive in response to an increase in their level of ability.[35]

For a wide range of parameter configurations, it can be shown that

$$w_{AM}^{NP} < w_{AM}^{FP} = w_{Am}^{FP}, \tag{7}$$

and also that

$$w_{aM}^{NP} < w_{aM}^{FP} = w_{am}^{FP}. \tag{8}$$

These results hold when the competitive advantage of the for-profit hospital is sufficiently higher than the competitive advantage of the non-profit hospital. Inequalities (7) and (8) hold under mild competition, provided that k is sufficiently high (see Subsection 4.3.1), or when the degree of competition is

[34] Our framework is particularly appropriate to study the wage differential because out-of-equilibrium constracts allow to compare the salary offered to the same worker by the different hospitals.

[35] This concept bears some similarity to the *power of incentives* studied in moral hazard frameworks (see Besley and Ghatak 2005, where it is suggested that mission-oriented firms offer low-powered incentives to their employees, and Ghatak and Mueller 2011) and transposed in an adverse selection framework by Delfgaauw and Dur (2008), Makris (2009), and Makris and Siciliani (2014).

intermediate, in particular when ability prevails for the non-profit hospital (i.e. γ is low) and k is still sufficiently high (see Subsection 4.3.3). The intuition is the following: under mild competition and when the non-profit hospital offers out-of-equilibrium a pooling contract to non-motivated types, or when the degree of competition is intermediate and ability prevails for the non-profit hospital, then motivated agents do not cumulate large information rents, because they are unable to mimic many other types of workers. These health professionals are thus offered low wages. This fact depresses the left-hand side of the above inequalities. On the other hand, when k is sufficiently high, the for-profit hospital has an important advantage in terms of revenue appropriation and this increases the wages that it is able to pay, thus raising the right-hand side of the above inequalities.

Importantly, given that average ability is the same for both hospitals (see Corollary 1), a wage gap represents a true compensating wage differential between the two hospitals, because it is entirely driven by intrinsic motivation and does not depend on differences in workers' ability. However, ability does matter because inequality (7) is easier to be satisfied than inequality (8). Moreover, not only is the wage penalty larger for high-ability workers than for low-ability employees, but it might also be the case that the wage penalty exists for high-ability types but not for low-ability workers.[36] Hence, equally skilled workers provide higher effort, which translates into higher quality, when hired by the non-profit hospital that offers lower wage rates (see Proposition 3).[37]

Therefore, when a non-profit wage penalty is observed for motivated workers, it is increasing in ability. This fact has immediate implications for the returns to ability provided by the two hospitals. Let us then consider the difference between the returns to ability for workers hired by the non-profit hospital, i.e. $w_{AM}^{NP} - w_{aM}^{NP}$, and the returns to ability for workers hired by the for-profit hospital, i.e. $w_{Am}^{FP} - w_{am}^{FP}$. In particular, if

$$w_{AM}^{NP} - w_{aM}^{NP} < w_{Am}^{FP} - w_{am}^{FP}$$

holds, then, in equilibrium, the gain from increased ability is lower for non-profit workers. Importantly, our model shows that, when the non-profit wage penalty exists, the non-profit hospital also provides lower returns to ability relative to the for-profit rival.

The Proposition that follows fixes the main ideas illustrated in this subsection.

Proposition 4 ***Compensating wage differentials and returns to ability.*** *When the competitive advantage of the for-profit hospital is sufficiently higher than that of the non-profit hospital, then:* (*i*) *a non-profit wage penalty exists: given ability, health professionals employed at the non-profit hospital earn*

[36] This is in line with some empirical findings in the wage comparison of non-profit and for-profit firms (see Preston, 1989). Relative to hospitals, the fact that the non-profit wage penalty is higher for managers and top executives with respect to lower levels in the hierarchy is documented by Roomkin and Weisbrod (1999).

[37] However, this is not sufficient to generate higher profits for the non-profit hospital, because its propensity to appropriate revenues is inferior to that of the for-profit hospital.

less (while exerting more effort) than what they would gain if employed at the for-profit hospital; (*ii*) *the non-profit hospital provides its employees with lower returns to ability relative to the for-profit hospital.*

Proof. See Appendix F. ■

Conversely, a non-profit wage premium is observed when the competitive advantage of the for-profit hospital is low relative to the one of the non-profit hospital (in particular, when k is sufficiently low and γ is high, namely under intermediate levels of competition with motivation prevailing for the non-profit hospital). This is due to the fact that the non-profit hospital must give high information rents to motivated workers in order to elicit their private information. And this translates into high wages offered by the non-profit hospital.[38]

To conclude, our model can accommodate both the empirical evidence showing the existence of a wage penalty for workers employed at non-profit firms, and the evidence of a wage premium for non-profit workers. Focusing on the health care market in the U.S., Borjas *et al.* (1983) and Holtmann and Idson (1993) document higher wages in non-profit nursing homes than in for-profit ones, although results are only slightly significant. Also James (2002) shows that, on average, wages are higher in non-profit hospitals than in for-profit ones. Conversely, Roomkin and Weisbrod (1999) find higher pay in for-profit than in non-profit hospitals. Finally, Jones (2015) finds that non-profit wage penalties exist in the U.S. nursing home industry when the non-profit share of labor demand is low. He also reports suggestive evidence that non-profit workers facing the largest wage gaps (and producing the highest quality work, as mentioned in the previous subsection) are also most likely to have high job satisfaction.

6 Concluding remarks

We analyze a model in which the non-profit mission (for example providing charity care) generates a non-monetary benefit that motivated health professionals enjoy when they exert quality-enhancing effort and contribute to the non-profit hospital's provision of care. The interaction between a non-profit hospital and a motivated health professional increases the total surplus that an employer-employee pair can obtain. Such an additional surplus comes with a cost because, by being non-profit, the hospital sacrifices some of its revenues.

The model's results crucially depend on the relative magnitudes of the competitive advantage of the for-profit hospital with respect to the non-profit one in terms of revenue appropriation, i.e. $k-1$, and of the benefit that the non-profit hospital derives from motivated workers' labor donations, i.e. γ. Here, we comment on the different economic scenarios (i.e. k lower or higher than $1+\gamma$) described in the paper and provide some policy implications. Although hospitals' differentiation according to their organizational

[38]Notice that neither a non-profit wage penalty nor a wage premium can be clearly associated to harsh competition.

form is exogenously given in our framework, the model is sufficiently rich to accommodate for alternative market structures.

Suppose first that the two hospitals have the same for-profit status: in our model, this corresponds to the case in which both hospitals fully appropriate their revenues and $k^{FP} = k^{NP}$. Notice that motivated workers would not obtain their 'vocational' premium and no hospital would benefit from labor donations. The two hospitals would be identical and competition would be so tough as to drive profits to zero. Acquiring the non-profit status and, for instance, adhering to the mission of providing care to the poor and uninsured, would allow a hospital to obtain positive profits from motivated health professionals. Thus, the mission-orientation of the non-profit hospital could provide a way out of the Bertrand paradox and could serve the same goal as firms' horizontal product differentiation, the distinction being that the non-profit status increases workers' willingness to accept lower wages, whereas product differentiation increases the consumers' willingness to pay for goods or services.

In sectors where non-profit firms operate, they tend to coexist with for-profit firms (see Rose-Ackerman 1996). In this respect, our model predicts that a non-profit hospital can survive in a market populated by for-profit competitors as long as the benefit from attracting motivated health professionals is sufficiently high and/or the competitive advantage of the for-profit hospital is sufficiently low, i.e. as long as $1 < k \leq 1 + \gamma$. This is the most interesting situation, in which the non-profit and the for-profit hospitals compete to attract the best health professionals, and workers sort according to motivation. Coherent with this prediction of the model is the observation that non-profit firms abound in the health care and education sector where collective goods and services, which matter for motivated workers, are provided.

Finally, consider the instance in which the for-profit hospital's competitive advantage is very high relative to the non-profit's, whereby $k > 1 + \gamma$. Then, only the for-profit firm is active in the market, while the non-profit hospital is a potential entrant. Recall, however, that the coexistence of non-profit and for-profit hospitals is welfare-improving for two reasons: first because of the additional surplus generated by the matching of the non-profit firm and motivated workers, second because competition reduces allocative distortions. The latter decrease even more when competition is intense. Therefore, the participation of non-profit hospitals in the market for health care provision should be encouraged. This could be accomplished, for example, if the government sets a sufficiently low mandatory charity care standard for non-profit hospitals. Not only would this make k fall below $1 + \gamma$ and help restore market segmentation, but it would also increase allocative efficiency.

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A Competition under full information

When $k > 1+\gamma$, the for-profit hospital is able to hire all workers by asking them to provide the first-best effort (see equation 1) and by offering each of them a payoff that equals the best offer of the non-profit hospital, i.e. the first-best total surplus utility of the non-profit hospital. Note that all workers are indifferent between accepting the contracts proposed by the two hospitals: the tie-breaking rule applies in favor of the for-profit hospital, that makes positive profits on all types. Wages are given by

$$w_{AM}^{FP} = U_{AM}^{TS,NP} + \frac{1}{2}\left(e_{AM}^{FP}\right)^2 = \underbrace{\frac{(1+\gamma)^2}{2}}_{\text{outside option}} + \underbrace{\frac{k^2}{2}}_{\text{cost of effort}} \tag{9}$$

$$w_{aM}^{FP} = U_{aM}^{TS,NP} + \frac{1}{2}\theta\left(e_{aM}^{FP}\right)^2 = \underbrace{\frac{(1+\gamma)^2}{2\theta}}_{\text{outside option}} + \underbrace{\frac{k^2}{2\theta}}_{\text{cost of effort}} \tag{10}$$

$$w_{Am}^{FP} = U_{Am}^{TS,NP} + \frac{1}{2}\left(e_{Am}^{FP}\right)^2 = \underbrace{\frac{1}{2}}_{\text{outside option}} + \underbrace{\frac{k^2}{2}}_{\text{cost of effort}} \tag{11}$$

$$w_{am}^{FP} = U_{am}^{TS,NP} + \frac{1}{2}\theta\left(e_{am}^{FP}\right)^2 = \underbrace{\frac{1}{2\theta}}_{\text{outside option}} + \underbrace{\frac{k^2}{2\theta}}_{\text{cost of effort}} \tag{12}$$

where the first term in each line covers the best offer of the competitor (the first-best total surplus utility) while the second term rewards the cost of exerting the first-best effort.

When, instead, $k < 1+\gamma$, there is segmentation in that motivated workers are hired by the non-profit hospital at wages

$$w_{AM}^{NP} = U_{AM}^{TS,FP} + \frac{1}{2}\left(e_{AM}^{NP}\right)^2 - \gamma e_{AM}^{NP} = \underbrace{\frac{k^2}{2}}_{\text{outside option}} + \underbrace{\frac{(1+\gamma)^2}{2} - \gamma(1+\gamma)}_{\text{net cost of effort}} \tag{13}$$

$$w_{aM}^{NP} = U_{aM}^{TS,FP} + \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2 - \gamma e_{aM}^{NP} = \underbrace{\frac{k^2}{2\theta}}_{\text{outside option}} + \underbrace{\frac{(1+\gamma)^2}{2\theta} - \frac{\gamma(1+\gamma)}{\theta}}_{\text{net cost of effort}}, \tag{14}$$

whereas non-motivated workers are hired by the for-profit hospital at wages (11) and (12).

B Fully dominant for-profit hospital

Suppose that the for-profit hospital is able to hire all types of workers when the non-profit rival is giving, to each one of them, the first-best total surplus

$$U_{AM}^{TS,NP} = \tfrac{(1+\gamma)^2}{2}, \quad U_{aM}^{TS,NP} = \tfrac{(1+\gamma)^2}{2\theta}, \quad U_{Am}^{TS,NP} = \tfrac{1}{2}, \quad \text{and } U_{am}^{TS,NP} = \tfrac{1}{2\theta} \tag{15}$$

where $U_{AM}^{TS,NP} > U_{Am}^{TS,NP}$ and $U_{aM}^{TS,NP} > U_{am}^{TS,NP}$.

The program of the fully dominant for-profit hospital is (PFP) presented in the main text (see page 14). The solution to this problem exhibits five different regimes according to which participation and incentive compatibility constraints are binding, where only the participation constraints of motivated workers are relevant. Our results are in line with those obtained by Rochet and Stole (2002) in their Lemma 1 (see page 285) because the upward incentive constraint (requiring that the low-ability worker does not choose the contract designed for the high-ability colleague) can never be binding. Thus, only the first three out the five possible regimes are relevant in our setup, and the for-profit hospital never resorts to countervailing incentives.

The five different regimes that possibly arise are illustrated below.

B.1 Regime 1: Irrelevance of outside options

Suppose that PC_{aM}^{FP} and $IC_{A\text{vs}a}^{FP}$ are the binding constraints, as in the two-types adverse selection problem of the for-profit hospital. Solving the binding constraints for wages (and omitting, when no confusion arises, both the superscript FP, referring to the for-profit hospital, and the second subindex, referring to motivation) one obtains

$$w_a = \frac{1}{2}\theta e_a^2 + U_{aM}^{TS,NP} \tag{16}$$

and

$$w_A = \frac{1}{2}e_A^2 + \frac{1}{2}(\theta-1)e_a^2 + U_{aM}^{TS,NP}. \tag{17}$$

Substituting such wages into the for-profit hospital's program yields

$$E\left(\pi^{FP}\right) = \nu\left(ke_A - \left(\frac{1}{2}e_A^2 + \frac{1}{2}(\theta-1)e_a^2 + U_{aM}^{TS,NP}\right)\right) + (1-\nu)\left(ke_a - \left(\frac{1}{2}\theta e_a^2 + U_{aM}^{TS,NP}\right)\right).$$

Maximizing with respect to effort levels gives

$$e_A = k = e_A^{FB}$$

and

$$e_a = \frac{k(1-\nu)}{\theta-\nu} = e_a^{SB} < e_A.$$

Let us then check ex-post that omitted constraints are indeed satisfied. Participation constraint PC_{AM} is slack iff

$$\frac{1}{2}e_A^2+\frac{1}{2}(\theta-1)e_a^2+U_{aM}^{TS,NP}-\frac{1}{2}e_A^2>U_{AM}^{TS,NP}$$

that is iff

$$e_a>\sqrt{\frac{2\left(U_{AM}^{TS,NP}-U_{aM}^{TS,NP}\right)}{(\theta-1)}}$$

or, substituting for the optimal value of e_a, iff

$$U_{AM}^{TS,NP}-U_{aM}^{TS,NP}<\frac{(\theta-1)k^2(1-\nu)^2}{2(\theta-\nu)^2}\equiv\Delta U_1. \tag{18}$$

Since $U_{AM}^{TS,NP}-U_{aM}^{TS,NP}$ is known to the for-profit hospital and is equal to $\frac{(\theta-1)(1+\gamma)^2}{2\theta}$, condition (18) can be rewritten, solving explicitly for k, as

$$k>\frac{(1+\gamma)(\theta-\nu)}{\sqrt{\theta}(1-\nu)}=k_1$$

where $k_1>1+\gamma$ always holds.

The payoff to the for-profit hospital from hiring high-ability workers is equal to

$$\pi_A=ke_A-w_A=ke_A-\left(\frac{1}{2}e_A^2+\frac{1}{2}(\theta-1)e_a^2+U_{aM}^{TS,NP}\right),$$

which, substituting for optimal effort levels and for $U_{aM}^{TS,NP}$, amounts to

$$\pi_A=\frac{k^2}{2}-\frac{(\theta-1)k^2(1-\nu)^2}{2(\theta-\nu)^2}-\frac{(1+\gamma)^2}{2\theta},$$

where $\pi_A>0$ is true provided that $k>k_1$. Similarly, the payoff to the for-profit hospital from hiring low-ability workers is equal to

$$\pi_a=ke_a-w_a=ke_a-\left(\frac{1}{2}\theta e_a^2+U_{aM}^{TS,NP}\right),$$

which, substituting for the optimal effort e_a^{SB} and for $U_{aM}^{TS,NP}$, amounts to

$$\pi_a=\frac{k^2(1-\nu)(\theta-2\nu+\theta\nu)}{2(\theta-\nu)^2}-\frac{(1+\gamma)^2}{2\theta},$$

where $\pi_a>0$ is true provided that $k>k_1$.

Summarizing, Regime 1 is characterized by PC_{aM} and $IC_{A\text{vs}a}$ holding with equality and by effort levels set at $e_A^{FB}=k$ and $e_a^{SB}=\frac{k(1-\nu)}{\theta-\nu}$; it is relevant for $k>\frac{(1+\gamma)(\theta-\nu)}{\sqrt{\theta}(1-\nu)}=k_1>1+\gamma$.

B.2 Regime 2: Both PCs and the high-ability workers' IC are binding

Suppose now that the participation constraint PC_{aM} and the incentive constraint $IC_{A\text{vs}a}$ are binding, together with participation constraint PC_{AM}. Solving the binding constraints for wages one obtains, respectively, expressions (16), (17) and

$$w_A = \frac{1}{2}e_A^2 + U_{AM}^{TS,NP}. \tag{19}$$

Equating (17) and (19) one gets

$$U_{AM}^{TS,NP} - U_{aM}^{TS,NP} = \frac{1}{2}(\theta - 1)e_a^2$$

or

$$e_a = \sqrt{\frac{2\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right)}{(\theta - 1)}} = e_a^*.$$

Finally, maximizing the principal's objective function with respect to e_A only yields

$$e_A = k = e_A^{FB}.$$

Note that the effort of low-ability types is less downward distorted than in Regime 1 iff $e_a^* \geq e_a^{SB}$ or else iff

$$U_{AM}^{TS,NP} - U_{aM}^{TS,NP} \geq \frac{(\theta - 1)k^2(1-\nu)^2}{2(\theta - \nu)^2} = \Delta U_1.$$

Moreover, it must be that $e_a^* < e_a^{FB} = k$, hence it must be that

$$U_{AM}^{TS,NP} - U_{aM}^{TS,NP} < \frac{(\theta - 1)k^2}{2\theta^2} \equiv \Delta U_2, \tag{20}$$

where $\Delta U_2 > \Delta U_1$. So this case holds for $\Delta U_1 \leq U_{AM}^{TS,NP} - U_{aM}^{TS,NP} < \Delta U_2$. Alternatively, replacing $U_{AM}^{TS,NP} - U_{aM}^{TS,NP}$ for its value, i.e. $\frac{(\theta-1)(1+\gamma)^2}{2\theta}$, yields $e_a^* = \frac{1+\gamma}{\sqrt{\theta}}$; this allows to solve condition (20) explicitly for k as

$$k > (1+\gamma)\sqrt{\theta} = k_2,$$

where $1 + \gamma < k_2 < k_1$. Hence, Regime 2 holds for $k_2 < k \leq k_1$.

The payoff to the for-profit principal from hiring high-ability workers is equal to

$$\pi_A = ke_A - w_A = ke_A - \left(\frac{1}{2}e_A^2 + U_{AM}^{TS,NP}\right) = \frac{k^2}{2} - \frac{(1+\gamma)^2}{2}$$

and it is strictly positive when $k > 1 + \gamma$. Similarly, the payoff to the for-profit hospital from hiring low-ability workers is equal to

$$\pi_a = ke_a - w_a = ke_a - \left(\frac{1}{2}\theta e_a^2 + U_{aM}^{TS,NP}\right) = \frac{k(1+\gamma)}{\sqrt{\theta}} - \frac{(\theta+1)(1+\gamma)^2}{2\theta}$$

and it is such that $\pi_a > 0$ whenever $k < k_2$.

In short, Regime 2 is characterized by PC_{aM}, PC_{AM} and $IC_{A\text{vs}a}$ all holding with equality and by effort levels set at $e_A^{FB} = k$ and $e_a^* = \frac{1+\gamma}{\sqrt{\theta}}$; it is relevant for $1 + \gamma < k_2 = (1+\gamma)\sqrt{\theta} < k \leq k_1$.

B.3 Regime 3: Both PCs are binding

Suppose now that the participation constraints of both types AM and aM are binding and that the low-ability agents' incentive compatibility constraint is slack. Then, effort levels are the efficient ones, namely

$$e_A^{FB} = k$$

and

$$e_a^{FB} = \frac{k}{\theta}.$$

Examining the incentive compatibility constraint $IC_{A\text{vs}a}$, one finds that it is satisfied if and only if

$$e_a \leq \sqrt{\frac{2\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right)}{(\theta - 1)}}$$

which is true for $\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right) \geq \Delta U_2$. As far as the incentive compatibility constraint $IC_{a\text{vs}A}$ is concerned, it is slack iff

$$e_A > \sqrt{\frac{2\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right)}{(\theta - 1)}}$$

holds. So this case is relevant if and only if

$$\Delta U_2 \leq U_{AM}^{TS,NP} - U_{aM}^{TS,NP} < \frac{(\theta - 1)\, k^2}{2} \equiv \Delta U_3$$

or iff

$$k_3 = \frac{1+\gamma}{\sqrt{\theta}} < k \leq k_2,$$

where $k_3 < 1 + \gamma$.

The payoff to the for-profit hospital from hiring high-ability workers is the same as in Regime 2 and it is non-negative iff $k \geq 1 + \gamma$. Similarly, the payoff to the for-profit hospital from hiring low-ability workers is equal to

$$\pi_a = ke_a - w_a = ke_a - \left(\frac{1}{2}\theta e_a^2 + U_{aM}^{TS,NP}\right) = \frac{k^2}{2\theta} - \frac{(1+\gamma)^2}{2\theta}$$

which is non-negative for $k \geq 1 + \gamma$. Hence, Regime 3 is only valid when $1 + \gamma \leq k \leq k_2$; otherwise the principal makes negative profits on all workers' types.

Summarizing, Regime 3 is characterized by PC_{aM} and PC_{AM} holding with equality and by effort levels set at $e_A^{FB} = k$ and $e_a^{FB} = \frac{k}{\theta}$. It holds for $k_3 = \frac{1+\gamma}{\sqrt{\theta}} < k \leq k_2$, but, because the for-profit hospital is making strictly negative profits for $k < 1 + \gamma$, then Regime 3 is only relevant when $1 + \gamma \leq k \leq k_2$.

B.4 Regime 4: Both PCs and low-ability workers' IC are binding

Suppose that both participation constraints remain binding but, because low-ability types are attracted by the contract offered to high-ability workers, low-ability agents' incentive constraint is binding as well. Solving the binding constraints for wages one obtains expressions (16) and (19) together with

$$w_a = \frac{1}{2}\theta e_a^2 - \frac{1}{2}(\theta - 1) e_A^2 + U_{AM}^{TS,NP}. \tag{21}$$

Equating expressions (16) and (21) yields

$$e_A^* = \sqrt{\frac{2\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right)}{(\theta - 1)}} = \frac{1+\gamma}{\sqrt{\theta}}$$

and maximizing the principal's programme with respect to e_a only one gets

$$e_a^{FB} = \frac{k}{\theta}.$$

Note that the incentive compatibility constraint IC_{Avsa}^{FP} that was ignored is slack if and only if $U_{AM}^{TS,NP} - U_{aM}^{TS,NP} > \Delta U_3$. Precisely the same condition ensures that high-ability workers' effort is distorted upwards with respect to its first-best level. After the discussion of Regime 5 below, it will be clear that Regime 4 arises when

$$\Delta U_3 < U_{AM}^{TS,NP} - U_{aM}^{TS,NP} < \frac{(\theta - 1) k^2 \nu^2}{2(1 - \theta(1-\nu))^2} \equiv \Delta U_4$$

or, in terms of k, when

$$k_4 \equiv \frac{(1+\gamma)(1 - \theta(1-\nu))}{\nu\sqrt{\theta}} < k < k_3 < 1 + \gamma.$$

The payoff to the for-profit hospital from hiring high-ability workers is the same as the payoff from low-ability workers in Regime 2 and it is equal to

$$\pi_A = ke_A - w_A = ke_A - \left(\frac{1}{2}e_A^2 + U_{AM}^{TS,NP}\right) = \frac{k(1+\gamma)}{\sqrt{\theta}} - \frac{(\theta+1)(1+\gamma)^2}{2\theta},$$

where $\pi_A < 0$ is always true when $k < 1 + \gamma$. Similarly, the payoff to the for-profit hospital from hiring low-ability workers is the same as in Regime 3 and it is strictly negative if $k < 1 + \gamma$. Hence, Regime 4 can be discarded because it yields strictly negative profits to the for-profit hospital from all workers' types.

B.5 Regime 5: Countervailing incentives

Finally, suppose that participation constraint PC_{AM} and incentive constraint $IC_{\text{avs}A}$ are both binding. Wages must then satisfy conditions (19) and (21). Substituting these expressions into the hospital's profit function one obtains

$$\max_{e_A;e_a} E\left(\pi^{FP}\right) = \nu\left(ke_A - \left(\frac{1}{2}e_A^2 + U_{AM}^{TS,NP}\right)\right) + (1-\nu)\left(ke_a - \left(\frac{1}{2}\theta e_a^2 - \frac{1}{2}(\theta-1)e_A^2 + U_{AM}^{TS,NP}\right)\right).$$

The solutions to the above program are

$$e_A^{CI} = \frac{\nu k}{1-\theta\left(1-\nu\right)},$$

where the superscript CI stands for countervailing incentives, and

$$e_a^{FB} = \frac{k}{\theta}.$$

Note that $e_A^{CI} > 0$ if and only if $\theta < \frac{1}{(1-\nu)}$ and that $e_A^{CI} > e_a^{FB}$ always holds. The incentive compatibility constraint $IC_{\text{Avs}a}$ that was ignored is always satisfied, whereas participation constraint PC_{aM} is satisfied for

$$e_A \leq \sqrt{\frac{2\left(U_{AM}^{TS,NP} - U_{aM}^{TS,NP}\right)}{(\theta-1)}}$$

or else for

$$U_{AM}^{TS,NP} - U_{aM}^{TS,NP} \geq \frac{\left(\theta-1\right)\nu^2 k^2}{2\left(1-\theta\left(1-\nu\right)\right)^2} = \Delta U_4.$$

Alternatively, the above condition can be expressed in terms of k as

$$k \leq \frac{\left(1+\gamma\right)\left(1-\theta\left(1-\nu\right)\right)}{\nu\sqrt{\theta}} = k_4.$$

The payoff to the for-profit hospital from hiring high-ability workers is equal to

$$\pi_A = ke_A - w_A = ke_A - \left(\frac{1}{2}e_A^2 + U_{AM}^{TS,NP}\right) = \frac{\left(2\left(1-\theta\left(1-\nu\right)\right)-\nu\right)\nu k^2}{2\left(1-\theta\left(1-\nu\right)\right)^2} - \frac{\left(1+\gamma\right)^2}{2}$$

which is always negative for $k < 1+\gamma$. Hence, Regime 5 can be discarded because it yields strictly negative profits to the hospital.

C Equilibrium sorting of workers to hospitals

(i) When $k < 1+\gamma$, in equilibrium the unique possible matching of workers to hospitals is such that motivated workers are hired by the non-profit hospital and non-motivated workers are hired by the for-profit hospital. This occurs because it is always optimal for a hospital to hire the workers relative to whom it is dominant and to offer out-of-equilibrium contracts to the types relative to whom it is dominated. Indeed, consider non-motivated workers. Take any contract offered by the non-profit hospital to non-motivated workers. Then, the for-profit hospital is always able to offer precisely the same contract while making strictly higher profits from these types (because of its advantage in revenue appropriation). The for-profit hospital could then use these higher profits to raise all workers' rewards without violating incentive compatibility, and make non-motivated workers strictly prefer its contract. Consider now motivated workers. Take any contract offered by the for-profit firm to such workers. Then, the non-profit hospital is always able to offer a contract characterized by the same effort level but lower wage, such that

$w^{NP} = w^{FP} - \gamma e < w^{FP}$, and make strictly higher profits from these types.[39] Again, the non-profit hospital could use these higher profits to raise all workers' rewards without violating incentive compatibility, and to make motivated workers strictly better-off.

(ii) When $k = 1 + \gamma$, both hospitals are weakly dominant relative to motivated workers and competition drives profits from these types to zero for both principals, who offer the same utility to all motivated workers. Hence, the for-profit hospital is still dominant relative to non-motivated types, whereas motivated workers are indifferent between firms. But the situation in which the for-profit hospital is hiring all workers cannot be an equilibrium because the for-profit hospital is actually making zero profits from all types (because incentive compatibility forces it to offer the same contract to equally able types) and it can profitably deviate by renouncing to hire motivated types and by making strictly positive profits from non-motivated workers, who have strictly lower outside options than motivated workers.

D Bidimensional screening for the non-profit hospital

The non-profit hospital screening problem is (PNP) given in the main text (see page 20). Participation constraints are the following: for type AM

$$w_{AM}^{NP} - \frac{1}{2}\left(e_{AM}^{NP}\right)^2 + \gamma e_{AM}^{NP} \geq U_{AM}^{FP}, \tag{PC_{AM}^{NP}}$$

for type Am

$$w_{Am}^{NP} - \frac{1}{2}\left(e_{Am}^{NP}\right)^2 \geq U_{Am}^{FP}, \tag{PC_{Am}^{NP}}$$

for type aM

$$w_{aM}^{NP} - \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2 + \gamma e_{aM}^{NP} \geq U_{aM}^{FP} \tag{PC_{aM}^{NP}}$$

and, finally, for type am one has

$$w_{am}^{NP} - \frac{1}{2}\theta\left(e_{am}^{NP}\right)^2 \geq U_{am}^{FP}, \tag{PC_{am}^{NP}}$$

where $U_{AM}^{FP} = U_{Am}^{FP}$ and $U_{aM}^{FP} = U_{am}^{FP}$.

The incentive compatibility constraints are the following: for type AM

$$w_{AM}^{NP} - \frac{1}{2}\left(e_{AM}^{NP}\right)^2 + \gamma e_{AM}^{NP} \geq w_{Am}^{NP} - \frac{1}{2}\left(e_{Am}^{NP}\right)^2 + \gamma e_{Am}^{NP}, \tag{$IC_{AM\text{vs}Am}^{NP}$}$$

$$w_{AM}^{NP} - \frac{1}{2}\left(e_{AM}^{NP}\right)^2 + \gamma e_{AM}^{NP} \geq w_{aM}^{NP} - \frac{1}{2}\left(e_{aM}^{NP}\right)^2 + \gamma e_{aM}^{NP}, \tag{$IC_{AM\text{vs}aM}^{NP}$}$$

$$w_{AM}^{NP} - \frac{1}{2}\left(e_{AM}^{NP}\right)^2 + \gamma e_{AM}^{NP} \geq w_{am}^{NP} - \frac{1}{2}\left(e_{am}^{NP}\right)^2 + \gamma e_{am}^{NP}; \tag{$IC_{AM\text{vs}am}^{NP}$}$$

[39] Observe that profits to the for-profit hospital are equal to $\pi^{FP} = ke - w^{FP}$ while profits to the non-profit hospital are given by $\pi^{NP} = e - w^{NP}$. Setting $w^{NP} = w^{FP} - \gamma e < w^{FP}$ yields $\pi^{NP} = (1+\gamma)\, e - w^{FP} > \pi^{FP}$, given that $1 + \gamma > k$.

for type Am

$$w_{Am}^{NP} - \frac{1}{2}\left(e_{Am}^{NP}\right)^2 \geq w_{AM}^{NP} - \frac{1}{2}\left(e_{AM}^{NP}\right)^2, \qquad (IC_{Am\text{vs}AM}^{NP})$$

$$w_{Am}^{NP} - \frac{1}{2}\left(e_{Am}^{NP}\right)^2 \geq w_{aM}^{NP} - \frac{1}{2}\left(e_{aM}^{NP}\right)^2, \qquad (IC_{Am\text{vs}aM}^{NP})$$

$$w_{Am}^{NP} - \frac{1}{2}\left(e_{Am}^{NP}\right)^2 \geq w_{am}^{NP} - \frac{1}{2}\left(e_{am}^{NP}\right)^2; \qquad (IC_{Am\text{vs}am}^{NP})$$

for type aM

$$w_{aM}^{NP} - \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2 + \gamma e_{aM}^{NP} \geq w_{AM}^{NP} - \frac{1}{2}\theta\left(e_{AM}^{NP}\right)^2 + \gamma e_{AM}^{NP}, \qquad (IC_{aM\text{vs}AM}^{NP})$$

$$w_{aM}^{NP} - \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2 + \gamma e_{aM}^{NP} \geq w_{Am}^{NP} - \frac{1}{2}\theta\left(e_{Am}^{NP}\right)^2 + \gamma e_{Am}^{NP}, \qquad (IC_{aM\text{vs}Am}^{NP})$$

$$w_{aM}^{NP} - \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2 + \gamma e_{aM}^{NP} \geq w_{am}^{NP} - \frac{1}{2}\theta\left(e_{am}^{NP}\right)^2 + \gamma e_{am}^{NP}; \qquad (IC_{aM\text{vs}am}^{NP})$$

and, finally, for type am one has

$$w_{am}^{NP} - \frac{1}{2}\theta\left(e_{am}^{NP}\right)^2 \geq w_{AM}^{NP} - \frac{1}{2}\theta\left(e_{AM}^{NP}\right)^2, \qquad (IC_{am\text{vs}AM}^{NP})$$

$$w_{am}^{NP} - \frac{1}{2}\theta\left(e_{am}^{NP}\right)^2 \geq w_{Am}^{NP} - \frac{1}{2}\theta\left(e_{Am}^{NP}\right)^2, \qquad (IC_{am\text{vs}Am}^{NP})$$

$$w_{am}^{NP} - \frac{1}{2}\theta\left(e_{am}^{NP}\right)^2 \geq w_{aM}^{NP} - \frac{1}{2}\theta\left(e_{aM}^{NP}\right)^2. \qquad (IC_{am\text{vs}aM}^{NP})$$

As mentioned in the main text, omitting the superscript relative to the type of hospital and considering incentive compatibility constraints, implementability requires that condition

$$e_{AM} \geq \max\left\{e_{Am}; e_{aM}\right\} \geq \min\left\{e_{Am}; e_{aM}\right\} \geq e_{am}$$

be satisfied. Furthermore, concerning intermediate types Am and aM, one has that either

$$e_{aM} > e_{Am} \text{ and } e_{aM} + e_{Am} \leq \frac{2\gamma}{\theta - 1}, \qquad (22)$$

or

$$e_{Am} > e_{aM} \text{ and } e_{aM} + e_{Am} \geq \frac{2\gamma}{\theta - 1}, \qquad (23)$$

or that $e_{aM} = e_{Am}$. When $e_{aM} > e_{Am}$, we will say that motivation prevails, whereas, when $e_{Am} > e_{aM}$, we will say that ability prevails. These implementability conditions allow to disregard some global downward incentive constraints and to focus on local ones.

Considering now the participation constraints, one can show that

$$\underbrace{w_{aM} - \frac{1}{2}\theta e_{aM}^2 + \gamma e_{aM} \geq w_{am} - \frac{1}{2}\theta e_{am}^2 + \gamma e_{am}}_{IC_{aM\text{vs}am}} > \underbrace{w_{am} - \frac{1}{2}\theta e_{am}^2 \geq U_{am}^{FP}}_{PC_{am}}$$

implying that

$$w_{aM} - \frac{1}{2}\theta e_{aM}^2 + \gamma e_{aM} > U_{am}^{FP} = U_{aM}^{FP}$$

so the participation constraint PC_{aM}^{NP} of type aM is automatically satisfied with strict inequality when PC_{am}^{NP} holds. Also

$$\underbrace{w_{AM} - \frac{1}{2}e_{AM}^2 + \gamma e_{AM} \geq w_{Am} - \frac{1}{2}e_{Am}^2 + \gamma e_{Am}}_{IC_{AMvsAm}} > \underbrace{w_{Am} - \frac{1}{2}e_{Am}^2 \geq U_{Am}^{FP} = U_{AM}^{FP}}_{PC_{Am}}$$

thus the participation constraint PC_{AM}^{NP} of type AM is automatically satisfied with strict inequality when PC_{Am}^{NP} holds. So PC_{aM}^{NP} and PC_{AM}^{NP} can be discarded because they are implied by PC_{am}^{NP} and PC_{Am}^{NP}, respectively. Finally, one can write

$$\underbrace{w_{Am} - \frac{1}{2}e_{Am}^2 \geq w_{am} - \frac{1}{2}e_{am}^2}_{IC_{Am\text{vs}am}} > \underbrace{w_{am} - \frac{1}{2}\theta e_{am}^2 \geq U_{am}^{FP}}_{PC_{am}}.$$

In order for PC_{Am}^{NP} to be satisfied when PC_{am}^{NP} is, assume first that PC_{am}^{NP} is binding and then substitute the corresponding expression for w_{am} into the right hand side of $IC_{Am\text{vs}am}$. Thus, one obtains

$$w_{Am} - \frac{1}{2}e_{Am}^2 \geq \frac{1}{2}(\theta - 1) e_{am}^2 + U_{am}^{FP} > U_{Am}^{FP},$$

where the last inequality is satisfied if and only if

$$e_{am} > \sqrt{\frac{2\left(U_{Am}^{FP} - U_{am}^{FP}\right)}{(\theta - 1)}},$$

which need not be the case. So, PC_{Am} is not always implied by PC_{am}, whereby PC_{Am} must also be taken into account as relevant. In other words, when all types of health professionals can be offered a different contract by the non-profit hospital, it is necessary to consider the participation constraint of the worst type am together with the one of type Am.

E Optimal contracts with competing hospitals

From now on, assume that the distribution of types be not only independent but uniform, with 1/4 being the probability that any type of worker realizes.

As mentioned in the main text, when $1 < k \leq 1 + \gamma$ and none of the hospitals is fully dominant, we proceed by taking as given one of the regimes in which principal FP might find itself (starting from Regime 1 and moving to Regime 5). By so doing, we are imposing that the difference $U_{Am}^{NP} - U_{am}^{NP}$, which is still not known at this stage, belongs to a certain interval. The relevant thresholds are the ones computed for the five regimes in Appendix B, simplified by considering a uniform distribution of workers' types, and they depend on the magnitude of k. Given the program of hospital FP, we know which participation constraint(s) is(are) binding and we then solve for the non-profit hospital's optimal incentive schemes, finding the actual value of $U_{Am}^{NP} - U_{am}^{NP}$. Finally, we check whether the latter is compatible with the selected regime for hospital FP. If the menus of screening contracts designed by the two hospitals are compatible, we obtain an equilibrium.

E.1 Hospital FP is in Regime 1

When the for-profit hospital is in Regime 1, it must be the case that $U_{Am}^{NP} - U_{am}^{NP} < \frac{(\theta-1)k^2}{2(2\theta-1)^2} = \Delta U_1$ (see Figure 2). In this regime, the only binding participation constraint is PC_{am}^{FP}. Therefore, type am must be indifferent between the two hospitals and PC_{am}^{NP} must be binding as well. The non-profit hospital offers to this type the first-best effort level and makes zero profits from this type of agent, whereby $e_{am}^{FB,NP} = \frac{1}{\theta} = w_{am}^{FB,NP}$ and $U_{am}^{TS,NP} = \frac{1}{2\theta} = U_{am}^{FP}$.

E.1.1 Motivation prevails (Case $\mathcal{M}$)

Suppose further that motivation prevails for the non-profit hospital (Case $\mathcal{M}$), so that optimal effort levels must be ordered as $e_{AM} > e_{aM} > e_{Am} \geq e_{am}$.[40]

Full separation of types One could solve a problem in which each type of worker gets a different contract and in which the binding constraints are the downward local incentive compatibility ones $IC_{AM\text{vs}aM}$, $IC_{aM\text{vs}Am}$ and $IC_{Am\text{vs}am}$, together with PC_{am}. Solving the binding constraints for the wage rates, substituting them into the hospital's objective function and maximizing it with respect to effort levels (omitting e_{am} which is already fixed at e_{am}^{FB}) yields

$$e_{AM}^{FB} = 1+\gamma \quad e_{aM}^{SB} = \frac{1+\gamma}{2\theta-1} \quad e_{Am}^{SB} = \frac{1-2\gamma}{3-2\theta} \quad e_{am}^{FB} = \frac{1}{\theta} \ .$$

This candidate solution with full separation of types exists for $\theta < \frac{3}{2}$ and $\gamma < \frac{1}{2}$ (ensuring that $e_{Am} > 0$) and for $\frac{4(\theta-1)}{2\theta+1} = \underline{\gamma}^{\mathcal{M}} < \gamma < \overline{\gamma}^{\mathcal{M}} = \frac{3(\theta-1)}{2\theta} < \frac{1}{2}$, where inequalities $\underline{\gamma}^{\mathcal{M}} < \gamma$ and $\gamma < \overline{\gamma}^{\mathcal{M}}$, respectively, are equivalent to the monotonicity conditions $e_{aM} > e_{Am}$ and $e_{Am} > e_{am}$.[41] Profits to the non-profit hospital from hired types AM and aM are equal to

$$\pi^{\mathcal{M},S} = \frac{1}{4}\left(\frac{\theta(1+\gamma)^2}{(2\theta-1)} + \frac{(1-2\gamma)(\theta-4\gamma+2\theta\gamma-1)}{(3-2\theta)^2} - \frac{(2\theta-1)}{\theta^2}\right) \ , \tag{24}$$

where the superscript $\mathcal{M}, S$ stands for Motivation prevails, Separation of types. There remains to compute the outside option left by hospital NP to type Am, which is given by $U_{Am}^{NP} = w_{Am}^{NP} - \frac{1}{2}e_{Am}^2$; substituting for $w_{Am}^{NP} = \frac{1}{2}e_{Am}^2 + \frac{2\theta-1}{2\theta^2}$ (which has been found imposing that $IC_{Am\text{vs}am}$ binds) yields $U_{Am}^{NP} = \frac{2\theta-1}{2\theta^2}$ and thus $U_{Am}^{NP} - U_{am}^{TS,NP} = \frac{\theta-1}{2\theta^2}$. Such difference in reservation utilities is compatible with hospital FP being in Regime 1 if and only if $U_{Am}^{NP} - U_{am}^{TS,NP} = \frac{\theta-1}{2\theta^2} < \frac{(\theta-1)k^2}{2(2\theta-1)^2} = \Delta U_1$ or else if and only if

$$k > \frac{2\theta-1}{\theta} \equiv \overline{k},$$

[40] From now on, when no confusion arises, we omit the superindex relative to the type of hospital considered.

[41] All omitted participation and incentive compatibility constraints have been checked to hold ex-post. The same is true for all subsequent problems so that we avoid repeating a similar statement each time.

where $\overline{k} > 1$ always holds while $\overline{k} < 1 + \gamma$ iff

$$\gamma > \frac{\theta - 1}{\theta} \equiv \underline{\gamma}.$$

Note that $\underline{\gamma} < \underline{\gamma}^{\mathcal{M}}$ always holds, so the condition $\gamma > \underline{\gamma}$ is always verified when motivation prevails, and in turn $\overline{k} < 1 + \gamma$ is true in this case.

Pooling of non-motivated types Am and am Suppose that PC_{am}^{NP} is still binding but that a pooling contract is offered to non-motivated types, so that effort levels are ordered as $e_{AM} > e_{aM} > e_{Am} = e_{am} = \frac{1}{\theta}$, and wages are such that $w_{am} = w_{Am} = \frac{1}{\theta}$ (again, hospital NP makes zero profits on types that it is not able to hire). Optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM}^{SB} = \tfrac{1+\gamma}{2\theta - 1} \quad e_{Am} = e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

This solution exists when the monotonicity condition $e_{aM} > e_{Am}$ is satisfied, which is equivalent to $\gamma > \frac{\theta - 1}{\theta} = \underline{\gamma}$. This solution thus holds for a larger set of parameter configurations relative to the fully separating solution when motivation prevails. Profits for hospital NP from the hired types AM and aM are given by

$$\pi^{\mathcal{M},P_{Am=am}} = \tfrac{1}{8}\left((1+\gamma)^2 + \tfrac{(1+\gamma)^2}{(2\theta-1)} - \tfrac{2(2\gamma+1)}{\theta}\right) \ , \tag{25}$$

where the superscript now stands for Motivation prevails, Pooling between types Am and am. It can be checked that $\pi^{\mathcal{M},P_{Am=am}} > \pi^{\mathcal{M},S}$ iff $\gamma > \frac{(\theta-1)(3-\theta)}{2\theta(2-\theta)} = \gamma_1$ where $\gamma_1 < \underline{\gamma}^{\mathcal{M}}$ always holds for $\theta < \frac{3}{2}$. Hence, when motivation prevails and both solutions with full separation and pooling between non-motivated types are feasible, then hospital NP strictly prefers pooling to full separation, meaning that the latter solution can be discarded. Finally, note that outside options for non-motivated types are the same as in the previous case with full separation of types, whereby $U_{Am}^{NP} - U_{am}^{NP,TS} = \frac{(\theta-1)}{2\theta^2}$. Compatibility with Regime 1 for hospital FP is still given by the condition $k > \overline{k}$.

E.1.2 Pooling of intermediate types

Suppose now that effort levels offered by hospital NP are ordered as $e_{AM} > e_{aM} = e_{Am} > e_{am}$. There are two possible types of solutions with pooling of intermediate types, depending on whether $IC_{aM\text{vs}am}$ or $IC_{Am\text{vs}am}$ binds first. In particular, $IC_{aM\text{vs}am}$ binds first if and only if $e_{aM} = e_{Am} + e_{am} > \frac{2\gamma}{\theta - 1}$ holds, whereas $IC_{Am\text{vs}am}$ binds first if and only if $e_{aM} = e_{Am} + e_{am} < \frac{2\gamma}{\theta-1}$ holds.

Case $\mathcal{P}(1)$ Suppose that $IC_{aM\text{vs}am}$ is binding while $IC_{Am\text{vs}am}$ is slack: we call this situation Case $\mathcal{P}(1)$. Consider further PC_{am} and $IC_{AM\text{vs}aM}$ as binding constraints, so that optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM}^{SB} = e_{Am} = \tfrac{1+\gamma}{2\theta - 1} \quad e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

Monotonicity condition $e_{aM} = e_{Am} > e_{am}$ holds iff $\gamma > \underline{\gamma}$ and $IC_{aM\text{vs}am}$ is binding while $IC_{Am\text{vs}am}$ is slack iff $e_{aM} = e_{Am} + e_{am} > \frac{2\gamma}{\theta-1}$ or else iff $\gamma < \underline{\gamma}$. Since these two conditions are not compatible, Case $\mathcal{P}(1)$ can be discarded.

Case $\mathcal{P}(2)$ Suppose now that $IC_{Am\text{vs}am}$ is binding while $IC_{aM\text{vs}am}$ is slack: we call this situation Case $\mathcal{P}(2)$ and denote it with the superscript $\mathcal{P}2$. Consider further PC_{am} and $IC_{AM\text{vs}Am}$ as binding constraints so that optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM} = e_{Am} = \tfrac{2-\gamma}{2} \quad e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

Monotonicity condition $e_{aM} = e_{Am} > e_{am}$ holds iff $\gamma < \frac{2(\theta-1)}{\theta} = \overline{\gamma}^{\mathcal{P}2} = 2\underline{\gamma}$. Moreover, $IC_{Am\text{vs}am}$ is binding while $IC_{aM\text{vs}am}$ is slack iff $e_{aM} = e_{Am} + e_{am} < \frac{2\gamma}{\theta-1}$ or else iff $\gamma > \frac{2(\theta-1)(\theta+1)}{\theta(\theta+3)} = \underline{\gamma}^{\mathcal{P}2}$. Hence Case $\mathcal{P}(2)$ exists iff $\underline{\gamma}^{\mathcal{P}2} < \gamma < \overline{\gamma}^{\mathcal{P}2}$. Since $\underline{\gamma}^{\mathcal{P}2} > \underline{\gamma}$, Case $\mathcal{P}(2)$ coexists with the solution that is in place when motivation prevails and there is pooling between non-motivated types. Profits to hospital NP in the present case are equal to

$$\pi^{\mathcal{P}2} = \quad \tfrac{1}{8}\left((1+\gamma)^2 + \tfrac{(2-3\gamma)(2-\gamma)}{4} - \tfrac{2(2\theta-1)}{\theta^2}\right)$$

and it possible to show that $\pi^{\mathcal{P}2} < \pi^{\mathcal{M},P_{Am=am}}$ whenever the two solutions coexist. So Case $\mathcal{P}(2)$ can be discarded.

E.1.3 Ability prevails (Case $\mathcal{A}$)

Suppose that ability prevails for the non-profit hospital, in which case the solution to hospital NP's program must be such that effort levels are ordered as $e_{AM} > e_{Am} > e_{aM} \geq e_{am}$.

Full separation of types Here we distinguish between two possible solutions with full separation of types: Case $\mathcal{A}.a$ that holds when $IC_{AM\text{vs}Am}$, $IC_{Am\text{vs}aM}$ and $IC_{aM\text{vs}am}$ are binding, which is equivalent to $e_{aM} + e_{am} > \frac{2\gamma}{\theta-1}$, and Case $\mathcal{A}.b$ that holds when $IC_{AM\text{vs}Am}$, $IC_{Am\text{vs}am}$ and $IC_{aM\text{vs}Am}$ are binding, or else when $e_{Am} + e_{am} < \frac{2\gamma}{\theta-1} < e_{Am} + e_{aM}$.[42]

Case $\mathcal{A}.a$ In Case $\mathcal{A}.a$, the binding constraints are the downward local incentive compatibility constraints $IC_{AM\text{vs}Am}$, $IC_{Am\text{vs}aM}$ and $IC_{aM\text{vs}am}$, together with participation constraint PC_{am}. Optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{Am}^{SB} = 1 - \gamma \quad e_{aM}^{SB} = \tfrac{1+3\gamma}{3\theta-2} \quad e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

[42] See Barigozzi and Burani (2016). When the distribution of types is not uniform another case emerges, which is such that the binding constraints are $IC_{AM\text{vs}Am}$, $IC_{Am\text{vs}am}$ and $IC_{aM\text{vs}am}$ and which holds for $e_{aM} + e_{am} < \frac{2\gamma}{\theta-1} < e_{Am} + e_{am}$.

Monotonicity condition $e_{Am} > e_{aM}$ holds iff $\gamma < \frac{3(\theta-1)}{3\theta+1} = \overline{\gamma}_1^{\mathcal{A}a}$ while $e_{aM} > e_{am}$ holds iff $\gamma > \frac{2(\theta-1)}{3\theta} = \underline{\gamma}^{\mathcal{A}a}$. Moreover, the requirement $e_{aM} + e_{am} \geq \frac{2\gamma}{\theta-1}$ is satisfied iff $\gamma \leq \frac{2(2\theta-1)(\theta-1)}{\theta(3\theta-1)} = \overline{\gamma}_2^{\mathcal{A}a}$, but $\overline{\gamma}_1^{\mathcal{A}a} < \overline{\gamma}_2^{\mathcal{A}a}$ and so this candidate solution exists for $\underline{\gamma}^{\mathcal{A}a} < \gamma < \overline{\gamma}^{\mathcal{A}a} = \overline{\gamma}_1^{\mathcal{A}a}$. Now, $\overline{\gamma}^{\mathcal{A}a} < \underline{\gamma}$ so this case $\mathcal{A}.a$ does not coexist with the case in which motivation prevails and there is pooling of non-motivated types. Reservation utilities for non-motivated types are equal to $U_{am}^{TS,NP} = \frac{1}{2\theta}$ and $U_{Am}^{NP} = w_{Am} - \frac{1}{2}e_{Am}^2$. Substituting for w_{Am} as given by $IC_{Am\text{vs}aM}$ binding one has $U_{Am}^{NP} = \frac{1}{2}(\theta-1)e_{aM}^2 - \gamma e_{aM} + \gamma e_{am}$. Finally, considering optimal effort levels, the latter expression becomes $U_{Am}^{NP} = \frac{8\gamma-\theta-26\theta\gamma+\theta^2+3\theta\gamma^2+18\theta^2\gamma-9\theta^2\gamma^2}{2\theta(3\theta-2)^2}$ and the difference in reservation utilities is equal to $U_{Am}^{NP} - U_{am}^{NP} = \frac{11\theta+8\gamma-26\theta\gamma-8\theta^2+3\theta\gamma^2+18\theta^2\gamma-9\theta^2\gamma^2-4}{2\theta(3\theta-2)^2}$. Case $\mathcal{A}.a$ is compatible with hospital FP being in Regime 1 if and only if $U_{Am}^{NP} - U_{am}^{NP} < \frac{k^2(\theta-1)}{2(2\theta-1)^2} = \Delta U_1$. Solving for k, the latter inequality becomes

$$k > \frac{(2\theta-1)}{(3\theta-2)}\sqrt{\frac{(11\theta+8\gamma-26\theta\gamma-8\theta^2+3\theta\gamma^2+18\theta^2\gamma-9\theta^2\gamma^2-4)}{\theta(\theta-1)}} = k_5$$

but note that $k_5 > 1+\gamma$ always holds. Hence, Case $\mathcal{A}.a$ can be discarded because it can never be compatible with hospital FP being in Regime 1.

Case $\mathcal{A}.b$ In Case $\mathcal{A}.b$, the binding incentive compatibility constraints are $IC_{AM\text{vs}Am}$, $IC_{Am\text{vs}am}$ and (upward) $IC_{aM\text{vs}Am}$, together with participation constraint PC_{am}. Optimal effort levels are given by

$$e_{AM}^{FB} = 1+\gamma \quad e_{Am}^{SB} = \frac{1-2\gamma}{2-\theta} \quad e_{aM}^{FB} = \frac{1+\gamma}{\theta} \quad e_{am}^{FB} = \frac{1}{\theta} \ .$$

Monotonicity condition $e_{Am} > e_{aM}$ is satisfied iff $\gamma < \frac{2(\theta-1)}{\theta+2} = \overline{\gamma}^{\mathcal{A}b}$ while condition $e_{Am} + e_{am} < \frac{2\gamma}{\theta-1}$ holds iff $\gamma > \frac{\theta-1}{\theta} = \underline{\gamma}$ where $\overline{\gamma}^{\mathcal{A}b} < \underline{\gamma}$. So, the above conditions are not compatible with each other and Case $\mathcal{A}.b$ can be discarded.

Pooling of low-ability types Suppose now that a pooling contract is offered by hospital NP to low-ability types, whereby effort levels are ordered as $e_{AM} > e_{Am} > e_{aM} = e_{am} = \frac{1}{\theta}$. The incentive compatibility constraints that one assumes to be binding are $IC_{AM\text{vs}Am}$ and $IC_{Am\text{vs}aM}$ together with participation constraint PC_{am}. Optimal effort levels are

$$e_{AM}^{FB} = 1+\gamma \quad e_{Am} = 1-\gamma \quad e_{aM} = e_{am}^{FB} = \frac{1}{\theta} \ .$$

This solution exists iff $\gamma < \underline{\gamma}$ or else iff the monotonicity condition $e_{Am} > e_{aM}$ holds. Reservation utilities are such that $U_{Am}^{NP} - U_{am}^{TS,NP} = \frac{2\theta-1}{2\theta^2} - \frac{1}{2\theta} = \frac{\theta-1}{2\theta^2}$, as in the previous regimes, and compatibility with hospital FP being in Regime 1 occurs for $k > \frac{2\theta-1}{\theta} = \overline{k}$. But note that $\overline{k} > 1+\gamma$ holds whenever $\gamma < \underline{\gamma}$, so the condition $k > \overline{k}$ can never be satisfied in this case and this candidate solution must be discarded.

E.2 Hospital FP is in Regimes from 2 to 4

When the for-profit hospital is in Regimes from 2 to 4, the binding participation constraints are both PC_{am}^{FP} and PC_{Am}^{FP}. Therefore, both PC_{am}^{NP} and PC_{Am}^{NP} must be binding as well and both non-motivated workers am and Am must be indifferent between the two hospitals. The non-profit hospital offers them their first-best total surplus and makes zero profits from these types of agent, whereby $e_{am}^{NP} = \frac{1}{\theta}$ and $U_{am}^{TS,NP} = \frac{1}{2\theta}$ together with $e_{Am}^{NP} = 1$ and $U_{Am}^{TS,NP} = \frac{1}{2}$. Now, the difference in reservation utilities for non-motivated types is fully determined and is equal to $U_{Am}^{TS,NP} - U_{am}^{TS,NP} = \frac{1}{2} - \frac{1}{2\theta} = \frac{(\theta-1)}{2\theta}$.

E.2.1 Motivation prevails

Suppose that motivation prevails for the non-profit hospital, whereby effort levels must be ordered as $e_{AM} > e_{aM} > e_{Am} = 1 > e_{am} = \frac{1}{\theta}$. The binding constraints are the downward local incentive compatibility $IC_{AM\text{vs}aM}$ and $IC_{aM\text{vs}Am}$, together with PC_{Am} and PC_{am}. Solving for the wage rates, substituting them into the hospital's objective function and maximizing with respect to effort levels (omitting e_{Am} and e_{am} which are already determined) yields

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM}^{SB} = \frac{1+\gamma}{2\theta-1} \quad e_{Am}^{FB} = 1 \quad e_{am}^{FB} = \frac{1}{\theta} \ .$$

This candidate solution exists for $\theta < \frac{3}{2}$ and $\gamma > \gamma^{\mathcal{M}} = 2(\theta - 1)$, where inequality $\gamma > \gamma^{\mathcal{M}}$ is equivalent to the monotonicity condition $e_{aM} > e_{Am}$, and where $\gamma^{\mathcal{M}} < 1$ whenever $\theta < \frac{3}{2}$. Also, condition $\gamma > \gamma^{\mathcal{M}}$ is sufficient for the requirement $e_{aM} + e_{Am} < \frac{2\gamma}{\theta-1}$ being satisfied. Finally, profits to the non-profit hospital from hired types AM and aM are equal to

$$\pi_{\mathcal{M}} = \frac{\theta(1+\gamma)^2 - (2\gamma-\theta+2)(2\theta-1)}{4(2\theta-1)} \ . \tag{26}$$

The difference in reservation utilities $U_{Am}^{TS,NP} - U_{am}^{TS,NP} = \frac{(\theta-1)}{2\theta}$ is compatible with hospital FP being in Regime 2 if and only if $\Delta U_1 = \frac{k^2(\theta-1)}{2(2\theta-1)^2} < U_{Am}^{NP} - U_{am}^{NP} = \frac{(\theta-1)}{2\theta} \leq \frac{k^2(\theta-1)}{2\theta^2} = \Delta U_2$. The left-most inequality, i.e. $\Delta U_1 < U_{Am}^{NP} - U_{am}^{NP}$, is satisfied when

$$k < \frac{(2\theta-1)}{\sqrt{\theta}} = \overline{\overline{k}},$$

where $\overline{\overline{k}} > 1$ always holds and $\overline{\overline{k}} < 1 + \gamma$ is true iff

$$\gamma > \frac{(2\theta-1) - \sqrt{\theta}}{\sqrt{\theta}} = \overline{\gamma},$$

where $\overline{\gamma} < \gamma^{\mathcal{M}}$. So $\overline{\overline{k}}$ is always included in the interval $(1; 1+\gamma)$ when motivation prevails. The right-most inequality, i.e. $U_{Am}^{NP} - U_{am}^{NP} \leq \Delta U_2$, is satisfied iff

$$k \geq \sqrt{\theta} = \underline{k},$$

with $\underline{k} > 1$ and $\underline{k} < 1+\gamma$ iff $\gamma > \sqrt{\theta}-1 = \underline{\underline{\gamma}}$, where $\underline{\underline{\gamma}} < \gamma^{\mathcal{M}}$. Hence, $\overline{k}$ is also included in the interval $(1; 1+\gamma)$ when motivation prevails. Finally note that

$$\underline{k} < \overline{k} < \overline{\overline{k}}$$

always holds. Conversely, hospital FP is in Regime 3 for $\Delta U_2 = \frac{k^2(\theta-1)}{2\theta^2} < U_{Am}^{NP} - U_{am}^{NP} = \frac{(\theta-1)}{2\theta} \leq \frac{k^2(\theta-1)}{2} = \Delta U_3$. The left-most inequality is satisfied for $k < \underline{k}$ while the right-most inequality holds iff

$$k \geq \frac{1}{\sqrt{\theta}} = k_6$$

with $k_6 < 1$. So $k \geq k_6$ is always satisfied and hospital FP is in Regime 3 for $1 < k < \underline{k}$, whereas Regime 4 cannot be compatible with motivation prevailing for hospital NP.

E.2.2 Pooling of intermediate types

Suppose that the ordering of effort levels is such that $e_{AM} > e_{aM} = e_{Am} = 1 > e_{am} = \frac{1}{\theta}$. Now the binding constraints are $IC_{AM\text{vs}Am}$, PC_{Am} and PC_{am}. Optimal effort levels are

$$e_{AM}^{FB} = 1+\gamma \quad e_{aM} = e_{Am}^{FB} = 1 \quad e_{am}^{FB} = \tfrac{1}{\theta}$$

and this solution exists iff

$$\gamma \geq \frac{\theta-1}{2} = \gamma^{\mathcal{P}},$$

with $\gamma^{\mathcal{P}} < \gamma^{\mathcal{M}}$, which ensures that $IC_{aM\text{vs}am}$ is satisfied. Note that, at this solution, hospital NP is making positive profits from type AM only, which are equal to

$$\pi_{\mathcal{P}} = \frac{\gamma^2}{8} \tag{27}$$

and which are always smaller than the profits when motivation prevails. So this solution is only relevant for $\gamma^{\mathcal{P}} \leq \gamma < \gamma^{\mathcal{M}}$. It is compatible with Regime 2 for hospital FP iff $\underline{k} < k \leq \overline{\overline{k}}$, where $\overline{\overline{k}} < 1+\gamma$ when $\gamma > \overline{\gamma}$, with $\overline{\gamma} > \gamma^{\mathcal{P}}$. Hence, when $\gamma^{\mathcal{P}} < \gamma < \overline{\gamma}$ we have $\overline{\overline{k}} > 1+\gamma$, so the condition $k \leq \overline{\overline{k}}$ is always satisfied. The solution is also compatible with Regime 3 holding for hospital FP when $k \geq \underline{k}$, where $\underline{k} < 1+\gamma$ iff $\gamma > \underline{\underline{\gamma}}$ and $\underline{\underline{\gamma}} < \gamma^{\mathcal{P}}$. Thus, $\underline{k} < 1+\gamma$ is always true when $\gamma^{\mathcal{P}} \leq \gamma < \gamma^{\mathcal{M}}$ and the pooling solution holds. Conversely, Regime 4 can be neglected because the difference in reservation utilities is not compatible with values of k bigger than one.

E.2.3 Ability prevails

Suppose now that ability prevails for hospital NP and that the ordering of effort levels is such that $e_{AM} > e_{Am} = 1 > e_{aM} > e_{am} = \frac{1}{\theta}$. Again, one has to distinguish between Case $\mathcal{A}.a$ and Case $\mathcal{A}.b$.

Case $\mathcal{A}.a$ In Case $\mathcal{A}.a$, the binding incentive compatibility constraints are $IC_{AM\text{vs}Am}$ and $IC_{aM\text{vs}am}$, together with participation constraints PC_{Am} and PC_{am}. Optimal effort levels are given by

$$e^{FB}_{AM} = 1+\gamma \quad e^{FB}_{Am} = 1 \quad e^{FB}_{aM} = \tfrac{(1+\gamma)}{\theta} \quad e^{FB}_{am} = \tfrac{1}{\theta} \ . \tag{28}$$

The monotonicity condition $e_{Am} > e_{aM}$ holds when $\gamma < (\theta-1) = \gamma^{\mathcal{A}}$. This solution exists when $IC_{aM\text{vs}am}$ binds before $IC_{aM\text{vs}Am}$, which occurs when $\gamma < \frac{(\theta-1)}{2} = \gamma^{\mathcal{P}} < \gamma^{\mathcal{A}}$. Compatibility conditions are the same as before: this solution is compatible with hospital FP being in Regime 3 when $1 < k \leq \underline{k}$ or in Regime 2 when $\underline{k} < k \leq \overline{\overline{k}}$. But note that $\underline{k} < 1+\gamma$ iff $\gamma > \underline{\underline{\gamma}}$ where $\underline{\underline{\gamma}} < \gamma^{\mathcal{P}}$. Then, if $0 < \gamma \leq \underline{\underline{\gamma}}$, this solution is compatible with hospital FP being in Regime 3 only. Conversely, when $\underline{\underline{\gamma}} < \gamma < \gamma^{\mathcal{P}}$, this solution is compatible with hospital FP being in Regime 3 for $1 < k \leq \underline{k}$ or with hospital FP being in Regime 2 for $\underline{k} < k \leq 1+\gamma$, because $\overline{\overline{k}} > 1+\gamma$ when $\gamma < \gamma^{\mathcal{P}}$.

Case $\mathcal{A}.b$ In Case $\mathcal{A}.b$, the binding incentive compatibility constraints are $IC_{AM\text{vs}Am}$ and $IC_{aM\text{vs}Am}$, together with participation constraints PC_{Am} and PC_{am}. Optimal effort levels are the same as in (28) and this solution exists for $\gamma^{\mathcal{P}} \leq \gamma < \gamma^{\mathcal{A}}$. Within these bounds, the monotonicity condition $e_{Am} > e_{aM}$ is satisfied and $IC_{aM\text{vs}Am}$ binds before $IC_{aM\text{vs}am}$. This solution coexists with pooling of intermediate types, therefore a comparison between profits associated with the two solutions is called for. Profits in this case are given by

$$\pi_{\mathcal{A}b} = \ \frac{1}{8}\left((1+\gamma)^2 + \frac{(1+\gamma)^2}{\theta} - (4\gamma+3-\theta)\right) \tag{29}$$

and they are always higher than profits given by expression (27). Therefore, Case $\mathcal{A}.b$ is relevant for $\gamma^{\mathcal{P}} \leq \gamma < \gamma^{\mathcal{A}}$, whereas pooling of intermediate types will be the solution only when $\gamma^{\mathcal{A}} \leq \gamma \leq \gamma^{\mathcal{M}}$. Compatibility of this solution with Regime 3 for hospital FP is ensured when $1 < k \leq \underline{k}$ and with Regime 2 when $\underline{k} < k \leq 1+\gamma$, being $\overline{\gamma} > \gamma^{\mathcal{A}}$. Again, Regime 4 can be discarded.

Before turning to Regime 5 for the for-profit hospital, straightforward computations lead us to observe that profits which hospital NP makes when motivation prevails and it offers a pooling contract to non-motivated types, and when hospital FP is in Regime 1, are always strictly higher than profits accruing to hospital NP given that the rival hospital FP is in Cases 2-4. In other words, profits given by expression (25) are always strictly higher than those in expressions (26), (27) and (29).[43]

E.3 Hospital *FP* is in Regime 5

When the for-profit hospital is in Regime 5, the only binding participation constraint is PC^{FP}_{Am}. Type Am is indifferent between the two hospitals and PC^{NP}_{Am} must be binding as well. The non-profit hospital offers the first-best effort level to type Am and makes zero profits from this worker, whereby $e^{NP}_{Am} = 1$ and $U^{TS,NP}_{Am} = \frac{1}{2}$. Conversely, type am strictly prefers the for-profit hospital and $U^{FP}_{am} > U^{NP}_{am}$.

[43] Profits associated with Case $A.a$ are not displayed here but they are lower than those in (25) too.

E.3.1 Motivation prevails

Suppose that motivation prevails for the non-profit hospital, whereby effort levels are ordered as $e_{AM} > e_{aM} > e_{Am} = 1 \geq e_{am}$.

Full separation of types Assume that each type of agent is offered a different contract and that the binding constraints are the downward incentive compatibility $IC_{AM\text{vs}aM}$ and $IC_{aM\text{vs}Am}$, the upward incentive constraint $IC_{am\text{vs}Am}$, together with participation constraint PC_{Am}. Solving for the wage rates, substituting them into the hospital's objective function and maximizing with respect to effort levels (omitting e_{Am} which is already determined) yields

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM}^{SB} = \tfrac{1+\gamma}{2\theta-1} \quad e_{Am}^{FB} = 1 \quad e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

This candidate solution exists for $\theta < \frac{3}{2}$ and $\gamma > \gamma^{\mathcal{M}} = 2(\theta - 1)$, where inequality $\gamma > \gamma^{\mathcal{M}}$ is equivalent to the monotonicity condition $e_{aM} > e_{Am}$ and where $\gamma^{\mathcal{M}} < 1$ whenever $\theta < \frac{3}{2}$. The outside option of type am is $U_{am}^{NP} = w_{am} - \frac{1}{2}\theta e_{am}^2$. Substituting for w_{am} from the binding constraint $IC_{am\text{vs}Am}$ one gets $U_{am}^{NP} = \frac{1}{2}\theta e_{am}^2 + \frac{(2-\theta)}{2} - \frac{1}{2}\theta e_{am}^2 = \frac{(2-\theta)}{2}$. Hence the difference in reservation utilities for non-motivated types is equal to $U_{Am}^{TS,NP} - U_{am}^{NP} = \frac{1}{2} - \frac{(2-\theta)}{2} = \frac{(\theta-1)}{2}$ and this solution is compatible with hospital FP being in Regime 5 for $U_{Am}^{TS,NP} - U_{am}^{NP} = \frac{(\theta-1)}{2} > \frac{(\theta-1)k^2}{2(2-\theta)^2} = \Delta U_4$ or else for

$$k < (2 - \theta) = k_7$$

where $k_7 < 1$ always holds. So this solution can be discarded.

Pooling of non-motivated types Suppose that effort levels are such that $e_{AM} > e_{aM} > e_{Am} = 1 = e_{am}$. The binding constraints are the downward incentive compatibility ones $IC_{AM\text{vs}aM}$ and $IC_{aM\text{vs}Am}$, together with the participation constraint PC_{Am}. Optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM}^{SB} = \tfrac{1+\gamma}{2\theta-1} \quad e_{Am}^{FB} = e_{am} = 1 \ .$$

The outside option for type am is equal to $U_{am}^{NP} = w_{am} - \frac{1}{2}\theta e_{am}^2 = \frac{(2-\theta)}{2}$ and it is the same as in the previous case. Hence, as before, the difference in reservation utilities $U_{Am}^{NP} - U_{am}^{NP} = \frac{(\theta-1)}{2}$ is not compatible with the bounds that define Regime 5.

E.3.2 Pooling of intermediate types

Suppose that effort levels are ordered as $e_{AM} > e_{aM} = e_{Am} = 1 > e_{am}$. Now the constraints that one assumes to be binding are $IC_{AM\text{vs}aM}$, PC_{Am} and $IC_{am\text{vs}Am}$ yielding optimal effort levels

$$e_{AM}^{FB} = 1 + \gamma \quad e_{aM} = e_{Am}^{FB} = 1 \quad e_{am}^{FB} = \tfrac{1}{\theta} \ .$$

The difference in reservation utilities $U_{Am}^{NP} - U_{am}^{NP}$ is still the same as in the preceding cases and thus this solution can be discarded because it is not compatible with the bounds defining Regime 5 for hospital FP.

E.3.3 Ability prevails

Suppose that, for the non-profit hospital, ability prevails and that the ordering of effort levels is such that $e_{AM} > e_{Am} = 1 > e_{aM} \geq e_{am}$. Now, the only possible set of binding constraints is $IC_{AM\text{vs}Am}$, PC_{Am}, $IC_{aM\text{vs}Am}$ and finally $IC_{am\text{vs}aM}$. Optimal effort levels are given by

$$e_{AM}^{FB} = 1 + \gamma \quad e_{Am}^{FB} = 1 \quad e_{aM} = \frac{(2\gamma+1)}{2\theta} \quad e_{am}^{FB} = \frac{1}{\theta} \ ,$$

where e_{aM} is upward distorted. This solution exists when the monotonicity condition $e_{Am} > e_{aM}$ is satisfied, namely when $\gamma < \frac{2\theta-1}{2}$. The reservation utility of type am is equal to $U_{am}^{NP} = \frac{(1-2\gamma)(1+2\gamma)+4\theta(2\gamma-\theta+2)}{8\theta}$ and thus the difference in reservation utilities becomes $U_{Am}^{NP} - U_{am}^{NP} = \frac{1}{2} - \frac{(1-2\gamma)(1+2\gamma)+4\theta(2\gamma-\theta+2)}{8\theta} = \frac{4\theta(\theta-1-2\gamma)-(1-2\gamma)(1+2\gamma)}{8\theta}$ which is lower than in the preceding cases and thus not compatible with the bounds delimiting Regime 5 for hospital FP.

Finally note that, when hospital FP is in Regime 5, it is never optimal for the non-profit hospital to offer the null contract to type am. Indeed, this type would always have an incentive to take the contract offered by hospital NP to type Am and then IC_{amvsAm}^{NP} would always be violated. Therefore, Regime 5 for hospital FP can never be attained in equilibrium when hospitals compete and $1 < k \leq 1 + \gamma$.

Let us summarize what we have found so far, introducing the terminology used in the main text.

Mild competition When k is high and γ is not too low, i.e. when $\overline{k} = \frac{(2\theta-1)}{\theta} \leq k \leq 1 + \gamma$ and $\underline{\gamma} = \frac{(\theta-1)}{\theta} \leq \gamma < 1$,[44] then optimal incentive schemes are such that:

Hospital *FP* is always in Regime 1 (irrelevance of outside options) and sets the second-best effort levels $e_{AM}^{FB,FP} = e_{Am}^{FB,FP} = k$ and $e_{aM}^{SB,FP} = e_{am}^{SB,FP} = \frac{k}{(2\theta-1)}$.

Hospital *NP* is such that motivation always prevails (Case $\mathcal{M}$): employed types AM and aM are required to make second-best efforts $e_{AM}^{FB,NP} = 1+\gamma$ and $e_{aM}^{SB,NP} = \frac{1+\gamma}{(2\theta-1)}$; non-employed types Am and am are offered out-of-equilibrium a pooling contract with effort $e_{Am}^{NP} = e_{am}^{FB,NP} = \frac{1}{\theta}$.

Harsh and intermediate degrees of competition When k is not high and $1 \leq k < \overline{k}$, optimal incentive schemes are as follows:

Hospital *FP* is such that:

[44] Observe that $\overline{k} \leq 1 + \gamma$ if and only if $\gamma \geq \underline{\gamma}$ therefore $\gamma < \underline{\gamma}$ is necessary for $k > \overline{k}$.

- when $1 \leq k < \underline{k} = \sqrt{\theta}$, Regime 3 holds and first-best effort levels $e_{AM}^{FB,FP} = e_{Am}^{FB,FP} = k$ and $e_{aM}^{FB,FP} = e_{am}^{FB,FP} = \frac{k}{\theta}$ are set for all workers.
- when $\underline{k} \leq k < \overline{k}$, Regime 2 holds and optimal effort levels are $e_{AM}^{FB,FP} = e_{Am}^{FB,FP} = k$ and $e_{aM}^{*,FP} = e_{am}^{*,FP} = \frac{1}{\sqrt{\theta}}$.

Hospital $\boldsymbol{NP}$ is such that:

- when $0 < \gamma < \gamma^{\mathcal{A}} = (\theta - 1)$, ability prevails (Case $\mathcal{A}$), motivated types are asked to provide first-best effort levels $e_{AM}^{FB,NP} = 1 + \gamma$ and $e_{aM}^{FB,NP} = \frac{1+\gamma}{\theta}$ and non-motivated types are offered out-of-equilibrium contracts with first-best effort levels $e_{am}^{FB,NP} = \frac{1}{\theta}$ and $e_{Am}^{FB,NP} = 1$.
- for $\gamma^{\mathcal{A}} \leq \gamma \leq \gamma^{\mathcal{M}} = 2(\theta - 1)$, neither ability nor motivation prevail, intermediate types' effort levels are pooled and the first-best total surplus is offered out-of-equilibrium to non-motivated types, whereby $e_{AM}^{FB,NP} = 1 + \gamma$, $e_{aM}^{NP} = e_{Am}^{FB,NP} = 1$ and $e_{am}^{FB,NP} = \frac{1}{\theta}$, with $e_{aM}^{SB,NP} < e_{aM}^{NP} = 1 < e_{aM}^{FB,NP}$.
- for $\gamma^{\mathcal{M}} < \gamma \leq 1$ and $\theta < \frac{3}{2}$ (ensuring that $\gamma^{\mathcal{M}} < 1$), motivation prevails (Case $\mathcal{M}$), motivated types are required to provide second-best effort levels $e_{AM}^{FB,NP} = 1 + \gamma$ and $e_{aM}^{SB,NP} = \frac{1+\gamma}{2\theta - 1}$ and non-motivated types are offered the first-best $e_{am}^{FB,NP} = \frac{1}{\theta}$ and $e_{Am}^{FB,NP} = 1$.

F Wage differentials and returns to ability

Depending on the different combinations of states of the world for the two hospitals, different wages characterize the optimal contracts. Let us consider each possible combination in turn.

Let us start with mild competition of Subsection 4.3.1. The for-profit hospital is in Regime 1 and offers wages

$$w_{aj}^{FP} = \frac{1}{2}\theta \left(e_{aj}^{FP}\right)^2 + U_{am}^{TS,NP} \quad = \frac{1}{2}\theta \left(\frac{k}{2\theta-1}\right)^2 + \frac{1}{2\theta} = \frac{(2\theta-1)^2 + k^2\theta^2}{2\theta(2\theta-1)^2}$$

to low-ability workers and

$$w_{Aj}^{FP} = \frac{1}{2}\left(e_{Aj}^{FP}\right)^2 + \frac{1}{2}(\theta-1)\left(e_{aj}^{FP}\right)^2 + U_{am}^{TS,NP} \quad = \frac{1}{2}k^2 + \frac{1}{2}(\theta-1)\left(\frac{k}{2\theta-1}\right)^2 + \frac{1}{2\theta} = \frac{(2\theta-1)^2 + \theta^2 k^2(4\theta-3)}{2\theta(2\theta-1)^2}$$

to high-ability workers. The non-profit hospital offers pooling contracts to non-motivated types and optimal wages are

$$w_{aM}^{NP} = \frac{1}{2}\theta \left(e_{aM}^{NP}\right)^2 - \gamma e_{aM}^{NP} + \frac{2\gamma+1}{2\theta} \quad = \frac{1}{2}\theta \left(\frac{1+\gamma}{2\theta-1}\right)^2 - \frac{\gamma(1+\gamma)}{2\theta-1} + \frac{(2\gamma+1)}{2\theta} = \frac{\theta^2(1+\gamma)^2 - 2\gamma\theta(1+\gamma)(2\theta-1) + (1+2\gamma)(2\theta-1)^2}{2\theta(2\theta-1)^2}$$

for low-ability motivated types and

$$w_{AM}^{NP} = \frac{1}{2}\left(e_{AM}^{NP}\right)^2 - \gamma e_{AM}^{NP} + \frac{1}{2}(\theta-1)\left(e_{aM}^{NP}\right)^2 + \frac{(2\gamma+1)}{2\theta} \quad = \frac{\theta(2\theta-1)^2(1-\gamma)(1+\gamma) + \theta(\theta-1)(1+\gamma)^2 + (1+2\gamma)(2\theta-1)^2}{2\theta(2\theta-1)^2}$$

for high-ability motivated types. Then, type aM gets a lower wage from the non-profit hospital if and only if $w_{aM}^{NP} < w_{aM}^{FP}$, i.e. if and only if

$$k > \frac{\sqrt{(2\gamma - 6\theta\gamma + \theta^2 + 2\theta\gamma^2 + 6\theta^2\gamma - 3\theta^2\gamma^2)}}{\theta} = k_8 \ ,$$

where $\overline{k} < k_8 < 1 + \gamma$. As for type AM, we have $w_{AM}^{NP} < w_{AM}^{FP}$ if and only if

$$k > \sqrt{\frac{(2\gamma - 10\theta\gamma - 3\theta^2 + 4\theta^3 - 2\theta\gamma^2 + 10\theta^2\gamma + 5\theta^2\gamma^2 - 4\theta^3\gamma^2)}{\theta^2(4\theta - 3)}} = k_9,$$

with $k_9 < k_8$. Hence, it is easier to observe the wage penalty for motivated workers with high rather than with low ability. Moreover, $k_9 < \overline{k}$ for $\gamma < \frac{(5\theta^2 - 5\theta + 1) - (2\theta - 1)\sqrt{28\theta^3 - 16\theta^2 - 12\theta^4 + 1}}{\theta(4\theta^2 - 5\theta + 2)} = \gamma_2$ where $\gamma_2 > \underline{\gamma}$. Then, for sufficiently low motivation, that is for $\underline{\gamma} \leq \gamma < \gamma_2$, high-ability motivated workers always experience an earnings penalty, independently of k. As for the returns to ability, we have $w_{AM}^{NP} - w_{aM}^{NP} < w_{Am}^{FP} - w_{am}^{FP}$ iff $k > \sqrt{\frac{(1+\gamma)(\theta - \gamma(\theta - 1))}{\theta}} = k_{10}$, where $k_{10} < \overline{k}$ always holds. Hence we always observe lower returns to ability for the non-profit hospital under mild competition.

Consider now harsh competition and intermediate degrees of competition described in Subsections 4.3.2 and 4.3.3.[45]

When ability prevails for hospital NP and Case $\mathcal{A}.a$ holds, while hospital FP is in Regime 3, then wages at the for-profit hospital are such that

$$w_{Am}^{FP} = w_{AM}^{FP} = \frac{k^2+1}{2} \quad w_{am}^{FP} = w_{aM}^{FP} = \frac{k^2+1}{2\theta} \tag{30}$$

whereas wages at the non-profit hospital are equal to

$$w_{AM}^{NP} = \frac{2\gamma + 2 - \gamma^2}{2} \quad w_{aM}^{NP} = \frac{2\gamma + 2 - \gamma^2}{2\theta} \ . \tag{31}$$

Then, motivated types earn less at the non-profit hospital where they choose to work (irrespective of their ability) if and only if

$$k > \sqrt{1 + \gamma(2 - \gamma)} = k_{11},$$

where $k_{11} < \underline{k}$ for $\gamma < 1 - \sqrt{(2 - \theta)} = \gamma_3$, with $\gamma^{\mathcal{A}} > \gamma_3 > \gamma^{\mathcal{P}}$. Hence, when hospital NP is in Case $\mathcal{A}.a$, one observes the wage differential for $k_{11} < k < \underline{k}$. As for the returns to ability, one has $w_{AM}^{NP} - w_{aM}^{NP} < w_{Am}^{FP} - w_{am}^{FP}$ iff $k_{11} < k < \underline{k}$, namely lower returns to ability are offered by the non-profit hospital precisely under the same conditions under which an earnings penalty emerges.

When hospital FP is in Regime 2 and $\underline{k} \leq k < \overline{k}$ while hospital NP is still in Case $\mathcal{A}.a$, the only wage that changes with respect to expressions (30) and (31) is w_{aM}^{FP}, which becomes lower and equal to $w_{aM}^{FP} = \frac{\theta+1}{2\theta}$. Now, motivated types always earn less at the non-profit hospital. Lower returns

[45] From now on, we only provide the final expression for wages and omit the relevant binding constraints that can be solved for total wages.

to ability are also offered by the non-profit hospital, because $w_{AM}^{NP} - w_{aM}^{NP} < w_{Am}^{FP} - w_{am}^{FP}$ holds iff $k > \sqrt{\frac{(\theta-1)(2\gamma+2-\gamma^2)+1}{\theta}} = k_{12}$ but $k_{12} < \underline{k}$, so inequality $k > k_{12}$ is always satisfied in this case.

Suppose now that ability prevails for hospital NP and Case $\mathcal{A}.b$ holds whereas hospital FP is in Regime 3. Then, wages are the same as in expressions (30) and (31) except for w_{aM}^{NP}, which increases to $w_{aM}^{NP} = \frac{2\theta+1-(\theta-\gamma)^2}{2\theta}$. We observe a wage penalty for type AM only when $\gamma^{\mathcal{P}} < \gamma < \gamma_3$ and $k_{11} < k < \underline{k}$, but the wage penalty never exists for type aM. Lower returns to ability are offered by the non-profit hospital iff $\sqrt{(\theta - \gamma^2)} = k_{13} < k < \underline{k}$. If instead hospital FP is in Regime 2 then the pay penalty is in place for type AM when $\gamma^{\mathcal{P}} < \gamma < \gamma_3$, or when $\gamma_3 \leq \gamma < \gamma^{\mathcal{A}}$ and $k_{11} < k < \overline{k}$ occur, whereas the pay penalty exists for type aM when $\gamma^{\mathcal{P}} < \gamma < \theta - \sqrt{\theta} = \gamma_4 < \gamma_3$. And lower returns to ability are offered by the non-profit hospital iff $k > \sqrt{\frac{(\theta^2-(\theta-1)\gamma^2)}{\theta}} = k_{14}$. But $k_{14} < \underline{k}$, therefore lower returns to ability are always offered when hospital FP is in Regime 2 and hospital NP in Case $\mathcal{A}.b$.

When hospital NP offers a pooling contract to intermediate types Am and aM, wages at the non-profit hospital are

$$w_{AM}^{NP} = \frac{2\gamma+2-\gamma^2}{2} \quad w_{aM}^{NP} = 1 \ .$$

Then, irrespective of whether hospital FP is in Regime 2 or 3, type aM is always paid more by the non-profit hospital, whereas a wage penalty still exists for type AM provided that $k_{11} < k < \overline{k}$. As for the returns to ability, lower returns always exist when hospital FP is in Regime 2 because the necessary and sufficient condition is $k > \sqrt{\frac{1+(2-\gamma)\theta\gamma}{\theta}} = k_{15}$ and $k_{15} < \underline{k}$. Finally, lower returns to ability exist when hospital FP is in Regime 3 iff $\sqrt{\frac{(2-\gamma)\gamma\theta-(\theta-1)}{(\theta-1)}} = k_{16} < k < \underline{k}$.

To conclude, suppose that motivation prevails for hospital NP so that wages at the non-profit hospital are

$$w_{AM}^{NP} = \frac{(1-\gamma)(1+\gamma)(2\theta-1)^2+(\theta-1)(1+\gamma)^2+(2\gamma+2-\theta)(2\theta-1)^2}{2(2\theta-1)^2} \quad w_{aM}^{NP} = \frac{(1+\gamma)(\theta+2\gamma-3\theta\gamma)+(2\gamma+2-\theta)(2\theta-1)^2}{2(2\theta-1)^2} \ .$$

Again, irrespective of whether hospital FP is in Regime 2 or 3, both types aM and AM are always paid more by the non-profit hospital. Now, lower returns to ability are never offered by the non-profit hospital when principal FP is in Regime 2, although they do arise for $k_{17} = \frac{\sqrt{4\theta(\gamma+\theta-\theta\gamma)(\gamma+1)-(2\theta-1)^2}}{(2\theta-1)} < k < \underline{k}$ when hospital FP is in Regime 3.

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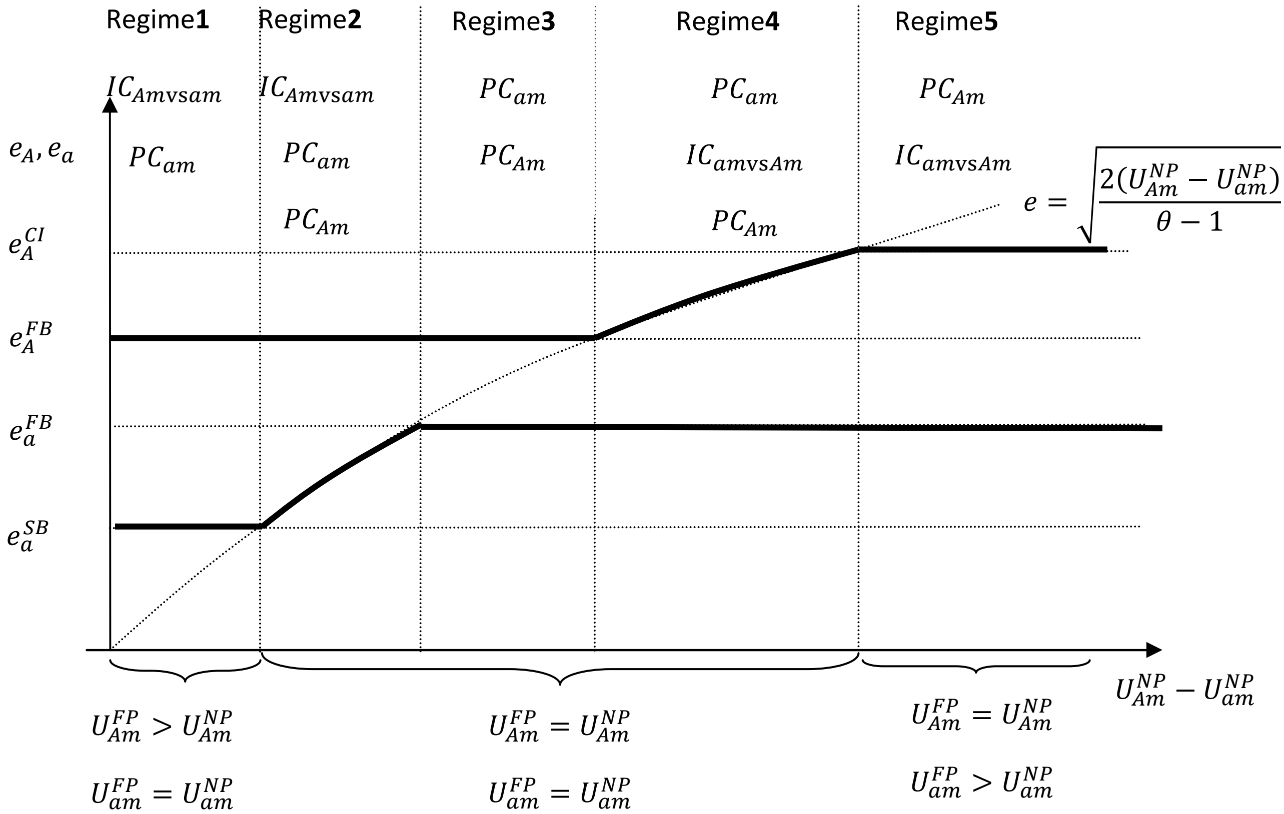

Figure 2: Reaction function of hospital FP when 1≤k≤1+γ.