

Lindqvist, Erik

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IFN Working Paper No. 750, 2008

# **Privatization of Credence Goods: Theory and an Application to Residential Youth Care**

Erik Lindqvist

# Privatization of Credence Goods: Theory and an Application to Residential Youth Care\*

Erik Lindqvist<sup>†</sup>

September 23, 2008

## Abstract

This paper analyzes public sector contracting of credence goods, i.e., services for which the producer has private information whether a certain treatment is needed or not. I develop a model where a credence good is supplied by an agent who can invest in quality and exert effort to reduce costs. If quality is important but non-contractible, public agencies cannot commit to contracts with private firms that induce a truthful diagnosis. Privatization therefore increases costs due to overtreatment. In contrast, optimal contracts under in-house production entail weak financial incentives to induce treatment, implying that public sector managers use their private information to avoid unattractive tasks. I test the model on a data set of residential youth care facilities and find support for the theoretical predictions: Total cost is twice as high in private facilities due to a much longer length of stay. The fact that a teenager is troublesome has a much stronger negative impact on outcomes in public facilities.

**Keywords:** Privatization; public sector contracting; credence goods; incomplete contracts; contracting out; residential youth care; juvenile delinquency.

**JEL codes:** H11; H40; L32; L33.

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<sup>†</sup>Research Institute of Industrial Economics (IFN), Stockholm. E-mail: erik.lindqvist@ifn.se

# 1 Introduction

There has been an intense debate since the early 1980's on the merits of handing over the production of government funded services to private firms. The key issues in this debate is how privatization affects quality and cost. In one influential view, firm ownership affects incentives to undertake investments that improve quality or reduce cost when contracts are incomplete (Hart, Shleifer and Vishny 1997, Shleifer 1998). According to this theory, private producers have stronger incentives to reduce costs but may shirk on quality.

Another aspect of the agency problem in service contracting – the one dealt with in this paper – is that producers often have private information on the quality or quantity that it is optimal for the government to buy. Goods and services for which this type of information is neither verifiable ex post nor ex ante are called *credence goods* (Darby and Karni, 1973).<sup>1</sup> Procurers of credence goods face a particular form of moral hazard problem as producers can use their private information either to overstate or to understate the need for a service. For example, since it is hard for a procurer of health care to assess a patient's need for surgery, surgeons could act opportunistically by undertaking an unnecessary operation or by abstaining from undertaking an operation that is needed. Other examples of credence goods are treatment programs for alcoholism and drug abuse; dental care; legal advice; and repair services.

Despite the prevalence of credence goods in public sector contracting, there is little theoretical and empirical work on how privatization affects the incentives to reveal information truthfully. Moreover, the theoretical literature on credence goods has treated the information extraction problem in isolation from other agency problems, such as producers' incentives for service quality and cost efficiency. In this paper, I develop and test a model where a credence good is supplied by an agent who can invest in non-contractible quality and undertake non-contractible effort in order to reduce costs. There are two main results of the paper. First, if service quality is important, contracting out to private firms gives rise to seller-induced demand – the case known as *overtreatment* in the credence good literature. Second, in-house production may generate *undertreatment* as public managers use their informational advantage to avoid unattractive tasks. Both of these results contrast with the standard view that contracting out saves costs, but that private firms may shirk on quality. To the best of my knowledge, this paper is the first to study how ownership affects the provision of credence goods from a theoretical perspective.

I consider a model where a public agency can choose to provide a credence good in-house or by procuring it from a private firm. The service is produced if and only if the producer gives a diagnosis in support of treatment. Once started, treatment can go on for several periods. Agents are compensated by a fixed fee per treatment period, i.e., a fee-for-service contract, or by a wage contract that does not depend on the extent of treatment. Explicit performance contracts on quality are not feasible, but the number of treatment periods is increasing in service quality.

By assumption, owners of private firms have a strong incentive to cut costs and therefore shirk on quality unless they expect to earn a rent from continued treatment. Private firms thus invest in quality only if treatment fees are high. However, the expectation of rents implies that

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<sup>1</sup>See Dulleck and Kerschbamer (2006) for a review and synthesis of the theory literature on credence goods.

private firms give a diagnosis in support of treatment also when treatment is not needed. If quality is sufficiently important, the public agency cannot commit to low treatment fees and treatment is always undertaken under private production.

Managers of public facilities are assumed to have no stake in cost savings. Optimal contracts under public ownership therefore imply weak financial incentives for treatment which eliminates the risk for overtreatment. However, in the absence of financial incentives to induce treatment, public sector managers always give a diagnosis against treatment in case treatment requires additional effort. For example, public hospitals may avoid treating patients that are particularly burdensome to deal with.

I test the model on a rich data set of Swedish residential youth care facilities for teenagers with behavioral problems. Youth care is a credence good in the sense that the facility staff has private information regarding teenagers' optimal length of stay. Contracts on quality are highly incomplete and facilities are compensated by a fixed fee per day of treatment. In this case, the model predicts that private facilities try to prolong treatment periods. By contrast, public facility managers receive a fixed wage and have no financial incentives to keep teenagers in care. As a result, the model predicts that public facility managers give a truthful diagnosis regarding the treatment progress of non-troublesome teenagers, but try to avoid the most troublesome teenagers.

The prediction that private ownership prolongs the duration of treatment has strong support in the data. On average, teenagers in public facilities are treated for 10.1 months compared to 21.9 months in private for-profit facilities. The longer duration of treatment in private facilities is due both to a longer planned length of stay and to an increase in length of stay beyond plan. When treatment does not break down prematurely, duration of treatment in public facilities deviate from plan by less than a week, while private facilities prolong the duration of treatment beyond plan by eight months on average. Although the average cost *per day of treatment* is lower in private facilities, the longer duration of treatment implies that *total* cost is double that of public facilities.

I also find that public facilities shun troublesome teenagers. For example, while violent and non-violent teenagers experience almost the same probability of a treatment breakdown in private facilities, the breakdown frequency is three times higher for violent teenagers than for non-violent teenagers in public facilities. Unlike owners of private facilities, managers of public facilities, have a significantly higher propensity to initiate treatment breakdowns for troublesome than for non-troublesome teenagers. The lack of effort on troublesome teenagers in public facilities matters for teenagers' post-treatment outcomes: Troublesome teenagers have higher rates of recidivism relative to non-troublesome teenagers if treated in public facilities. The empirical results are robust to controlling for non-random selection of teenagers into private facilities.

The model gives two additional predictions that are supported by the empirical analysis. First, the model predicts that private facilities should have lower treatment fees than public facilities for low levels of quality, but a higher treatment fee for high levels of quality. Second, private facilities should focus on low-quality care as a result of this relative cost-efficiency. Using

personnel density as a quality measure, I find support for both predictions in the data. The prediction that private facilities have lower quality is also supported by the fact that private facilities have higher rates of treatment breakdowns for non-troublesome teenagers and a staff with a lower level of education.

My empirical fit well with Bayer and Pozen (2005) who study juvenile correctional facilities in Florida. Interestingly, their data suggest that teenagers serve longer sentences in private for-profit facilities. As juvenile correctional facility operators in Florida have significant discretion to lengthen or shorten their inmates' length of stay by holding back the "good behavior" points necessary for early release, this result could reflect owner incentives to prolong sentences, though the authors point out that the results could also be due to non-random selection of teenagers into facilities. My results are also consistent with research on privatization of hospital care. Silverman and Skinner (2004) found that for-profit hospitals engaged in up-coding patients' diagnostic related group in order to increase reimbursement from the Medicare system. In a similar vein, Sloan et al. (2001) found that for-profit hospitals were more expensive, a result they attributed to the credence good characteristics of hospital care. Similarly, Silverman et al. (1999) find that Medicare spending is increasing in the share of for-profit hospitals. More generally, the information asymmetry between patient and physician has been a recurrent theme in the health economics literature since Arrow (1963), and there is substantial evidence that physicians respond to economic incentives to induce demand for a certain treatment.<sup>2</sup>

There are two key differences between the model in this paper and the previous theoretical literature on credence goods. First, the previous literature has not considered how ownership affects service providers' incentives to reveal information truthfully.<sup>3</sup> Second, unlike this paper, the price of treatment plays no role in terms of providing incentives for quality. The previous literature either assumes that prices are set ex ante by the producer or that prices are exogenous.<sup>4</sup> In my model, the credence good problem cannot be solved even though the price of treatment is set by a public agency that maximizes social welfare.<sup>5</sup> In essence, this result is due to combining a model of credence goods with repeated purchases as a means to enforce contractual performance (Klein and Leffler, 1981).

The paper is also connected to a literature which has studied how privatization may give rise to informational losses (e.g., Laffont and Tirole 1993; Schmidt 1996). This literature emphasizes informational losses due to the handing over ownership per se (like more limited access to accounting data), whereas the informational loss in my model derive from the effect privatization has on economic incentives to reveal information truthfully. Moreover, it is not certain in my model that in-house production implies that principals get more accurate information.

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<sup>2</sup>See, for example, Gruber and Owings (1996), Gruber et al. (1999) and the survey by Gosden et al. (1999).

<sup>3</sup>Two exceptions are Darby and Karni (1973) and Vetter and Karantinins (2002) who argue informally that vertical integration mitigates the information problems of credence goods.

<sup>4</sup>Most papers consider the case when experts can commit to prices ex ante. Examples include the papers by Wolinsky (1993); Taylor (1995); Emons (1997) and Dulleck and Kerschbamer (2006). Darby and Karni (1973); Woodward and Warren-Boulton (1984); Pitchik and Schotter (1987) and McGuire and Pauly (1991) assume that prices are exogenous. I refer to Dulleck and Kerschbamer (2006) for an extensive review of this literature.

<sup>5</sup>An exception to this result is the case when large lump-sum payments from the producer to the procurer at the onset of production are feasible, see Supplementary Appendix A.

The theoretical model is developed in the next section. In Section 3, I test the model using the data on residential youth care. Section 4 concludes the paper. Additional material is provided in Supplementary Appendix A (theory) and Supplementary Appendix B (empirical results).<sup>6</sup> All empirical results not reported in the text or in Supplementary Appendix B are available from the author upon request.

## 2 Model

Consider a public agency that buys some form of treatment for a patient from an agent. I use the words *patient* and *treatment* as hospital care is one of the most important credence goods procured by the public sector. Yet *patient* could also refer to a project or a physical object. The agent is a manager in case production is organized in-house or an owner of a private facility.<sup>7</sup> Let the superscript *o* denote the owner and the superscript *m* the manager. I begin by describing the treatment stage which occurs in case the producer gives a diagnosis in support of treatment. To simplify the exposition in this part, I assume that all patients need treatment and that this is common knowledge (i.e., treatment is not a credence good). In Section 2.4, I then analyze how ownership affects the incentives to give a truthful diagnosis prior to treatment.

Treatment consists of several subsequent periods. In each period, the agent spends effort  $e$  on reducing production cost and (monetary) resources  $q$  on improving treatment quality, both of which are non-contractible.<sup>8</sup> For example,  $q$  could denote the amount of time a physician spends with a patient. In my empirical application to residential youth care, I will use personnel density (employees per treatment place) as a proxy for  $q$ . Producers are assumed never to be capacity constrained.

Every treatment period gives a benefit  $B$  to the public agency, the size of which is assumed to be common knowledge. However, there is a per-period hazard rate,  $\lambda$ , that the value of continued treatment is zero. Failures are observed by the public agency, but cannot be contracted upon. The hazard rate is a function of treatment quality,

$$\lambda(q) = (1 + q)^{-\alpha},$$

where  $\alpha \in (0, 1]$ , implying that  $\lambda'(q) < 0$  and  $\lambda''(q) > 0$ . The parameter  $\alpha$  measures the sensitivity of the hazard rate with respect to quality. That the hazard rate is decreasing in quality is a key assumption of the paper. For example, a low level of quality may induce patients to switch physician; prison inmates to apply for transfer, or parents to change school for their child.<sup>9</sup> In the case of residential youth care, the parameter  $\lambda$  corresponds to the risk of unplanned

<sup>6</sup>The appendices are available at <http://www.ifn.se/web/2008.aspx>.

<sup>7</sup>Even though I discuss the model in the context of privatization, the model is applicable also to the make-or-buy decision of firms.

<sup>8</sup>In a previous version of this paper, I considered a multi-tasking model (Holmström and Milgrom, 1991) where effort affected both production cost and quality. The multi-tasking model and the model considered here produce similar results, but the multi-tasking model is more complicated and does not fit the empirical application to youth care equally well.

<sup>9</sup>As the benefactors of many services procured by the public sector – e.g. patients in care – are better informed

treatment breakdowns.

Note that  $\lambda(q)$  gives the *net* effect of quality on the hazard rate. That is,  $\lambda(q)$  is a reduced form for a richer model where "failures" could occur both because a patient is "cured" quickly due to high quality, or because patients have little to gain from future treatment due to a low level of quality. For the purposes of this paper, it is not important to distinguish between those two types of failures. Yet there are certainly cases where the net effect of quality on the hazard rate is positive. This case can be easily analyzed in the model, but as the outcome is trivial (private firms never invest in quality), I do not consider this case explicitly.

The agent's utility in each period is  $u(x, e) = x - C(e)$ , where  $x$  is the financial compensation, and  $C(e)$  the total cost of effort. I assume that  $C(e)$  is strictly convex, twice continuously differentiable and minimized at  $\underline{e} \geq 0$ . I consider a fee-for-service contract, implying that  $x = p - \gamma[F(e) + cq]$  where  $p$  is the treatment fee,  $cq + F(e)$  the per-period cost of treatment and  $\gamma \in \{0, 1\}$  the agent's share of production costs.<sup>10</sup> Since  $q$  is assumed to reflect the resources spent at improving quality, I assume that the marginal cost of investment in quality is constant. The function  $F(e)$  is decreasing, strictly convex and twice continuously differentiable in  $e$ . I assume that  $-F'(e) > C'(e)$  for some  $e > \underline{e}$ , i.e., it is profitable to exert effort on cost reductions above the level of effort that minimizes the cost of effort. The agent's outside option is normalized to zero.

I assume that the treatment fee is fixed over the course of treatment; i.e., the contract space is restricted to time-invariant  $p$ . There are two reasons for this assumption. First, it significantly simplifies the model without changing its main result – that privatization of credence goods generates overtreatment in case quality is important. The exception is a contract where the first period treatment fee is set such that the producer makes a loss on the first period equal to his entire expected rent from continued treatment. This issue is discussed in more detail in Supplementary Appendix A. Second, a fixed treatment fee fits well with my empirical application to Swedish residential youth care where facilities are paid the same monthly fee throughout the contract duration. By restricting contracts to time-invariant fees, I can derive predictions for how fees vary with quality and ownership that I then take to the data.

In Hart, Shleifer and Vishny (1997), ownership matters because the implementation of ex ante non-contractible investments requires the approval of the firm owner. In my model, ownership is associated with different ex ante contracts on cost reductions: The firm owner is assumed to pay the entire costs of production, i.e.,  $\gamma = 0$  under public ownership and  $\gamma = 1$  under private ownership. In Supplementary Appendix A, I develop a simple extension to the basic model that provides a microfoundation for this assumption. Central to my argument is the distinction between costs and expenditures. Whereas expenditures are readily measurable from accounting

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than public officials about service quality, various forms of voucher systems are often used to strengthen incentives for quality through the exit mechanism.

<sup>10</sup>I abstract from fixed costs in the model though this is probably important in many real-world applications, including the case of residential youth care discussed in the latter part of this paper. However, it is trivial to show that private firms have an incentive to induce overtreatment in case treatment fees must cover fixed costs. The model shows that it is difficult to commit to incentives that induce truth-telling under private ownership *even if* this is not the case.

data, it is not always clear to what extent they reflect costs or investments. Moreover, many costs, such as depreciation of physical or human capital, will not be reflected in expenditures. In this case, ownership matters since investments affect the future value of productive assets. A manager of a public firm that is given strong incentives to cut expenses will be tempted to shirk on investments that ensure the long-term value of the firm. In contrast, an owner of a private firm that is reimbursed for his expenses will be tempted to overinvest. As a result, optimal contracts entail stronger incentives for cost reductions under private ownership.<sup>11</sup>

Since there is no scope for explicit contracts on quality, the only contractual parameter except for ownership is the treatment fee,  $p$ . Assuming a discount rate of zero (since  $\lambda(q) > 0$  for all  $q$ ), a producer's value of a treatment contract at the start of the first treatment period,  $V_1$ , is

$$V_1 = p - \gamma [cq + F(e)] - C(e) + [1 - \lambda(t_q)] V_2. \quad (2.1)$$

where  $V_2$  denotes the producer's value of a contract at the beginning of the second period. It can be shown that the maximization problem of  $V_1$  has a unique solution for any given  $V_2$ .<sup>12</sup> Since  $p$  and  $\gamma$  are constant and there are no state variables, the producer faces a sequence of identical problems as he continues to subsequent periods. This implies that  $V_1 = V_2 = V_3 \dots$  and, since the solutions to the effort and investment problems are unique, that there are no non-stationary equilibria and a unique stationary equilibrium. Rearranging (2.1) using  $V_1 = V_2$  gives

$$V_1 = \frac{p - C(e) - \gamma [F(e) + cq]}{\lambda(q)}. \quad (2.2)$$

## 2.1 Private Firm

Since  $\lambda(q) = (1 + q)^{-\alpha}$ , the owner's maximization problem of  $V_1$  with respect to  $q$  and  $e$  is

$$\max_{\{q, e\}} [p - F(e) - C(e) - cq] (1 + q)^\alpha.$$

There is a unique interior solution to this problem in which the owner sets  $e = e^*$  where  $e^*$  is such that  $-F'(e^*) = C'(e^*)$  and

$$q = \frac{\alpha}{(1 + \alpha)c} \left[ p - F(e^*) - C(e^*) - \frac{c}{\alpha} \right]. \quad (2.3)$$

It follows that for all

$$p > C(e^*) + F(e^*) + \frac{c}{\alpha}, \quad (2.4)$$

the owner's investment in quality is continuously increasing in the price of treatment with deriv-

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<sup>11</sup>The extended model does not imply that cost-plus contracts are *never* optimal in the case of contracting out, only that cost-plus contracts require that buyers can be protected from overinvestment. When this is impossible or costly, fixed-price contracts are optimal under private ownership.

<sup>12</sup>See Supplementary Appendix A. The only exception is when managers face a contract where  $V_2 = 0$ . This case is dealt with separately in Section 2.2.

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$$\frac{\partial q}{\partial p} = \frac{\alpha}{(1 + \alpha)c}, \quad (2.5)$$

implying that the marginal cost of quality under private ownership is  $((1 + \alpha)/\alpha)c$ . It is straightforward to show that the owner's utility is strictly increasing in the price of treatment, and that there is a unique price  $\underline{p} = F(e^*) + C(e^*)$  such that  $V_1^o(\underline{p}) = 0$ , i.e., such that the owner's participation constraint binds. The public agency's maximization problem is

$$\begin{aligned} \max_{\{p\}} \quad & (B - p)(1 + q^o(p))^\alpha \\ \text{s.t.} \quad & p \geq \underline{p}. \end{aligned}$$

There exists a finite threshold on the valuation of quality,  $B^o$ , such that the public agency sets  $p = \underline{p}$  for  $B \leq B^o$ , but

$$p = \frac{B\alpha + F(e^*) + C(e^*) - c}{1 + \alpha} > \underline{p} \quad (2.6)$$

when  $B > B^o$ .<sup>13</sup> Note that a price strictly above  $\underline{p}$  implies that the owner earns a rent from treatment. It follows from (2.6) that the optimal price is continuously increasing in  $B$  for all  $B > B^o$ . The complete solution to the public agency's maximization problem is provided in Supplementary Appendix A.

## 2.2 Public Firm

The manager's maximization problem under a fee-for-service contract is

$$\max_{\{q, e\}} [p - C(e)](1 + q)^\alpha.$$

Since the manager has no incentive to contain costs, it follows that the manager sets  $e = \arg \min C(e) = \underline{e}$ . As the manager's outside option is zero, prices below  $C(\underline{e})$  do not fulfill the participation constraint and are not feasible. When  $p = C(\underline{e})$ , the manager is indifferent regarding the level of  $q$ . In this case, I assume that the public agency can in effect set the level of quality by transferring the sufficient amount of resources to the public firm. Whenever  $p > C(\underline{e})$ , managers spend all available resources on quality. Hence, it is always optimal for the public agency to set  $p = C(\underline{e})$ , i.e., there is no point in providing a manager of a public firm with rents. This implies that the marginal cost of quality under public ownership ( $c$ ) is strictly lower than under private ownership.

The public agency's maximization problem can be formulated as

$$\max_{\{q\}} [B - C(\underline{e}) - F(\underline{e}) - cq](1 + q)^\alpha,$$

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<sup>13</sup>See Lemma A1 in Supplementary Appendix A.

The optimal level of quality in the interior solution is

$$q = \frac{\alpha}{c(1+\alpha)} \left[ B - C(\underline{e}) - F(\underline{e}) - \frac{c}{\alpha} \right]. \quad (2.9)$$

Note that the fee-for-service contract with  $p = C(\underline{e})$  gives the same solution to the manager's problem as a *wage contract* that gives the manager a wage  $w \geq C(\underline{e})$  in every period regardless of whether a patient is treated or not, but require the manager to show up at work. The public agency is indifferent between a wage contract, and a fee-for-service contract with  $p = 0$  if the agent has a productivity equal to his wage in periods where treatment is not undertaken. The complete solution to the public agency's maximization problem is provided in Supplementary Appendix A.

### 2.3 Treatment outcomes

Since owners have stronger incentives to reduce costs, private firms are cheaper for no investment on quality, i.e., when  $q = 0$ . To see this, note that the cost reduction effort is equal to  $F(\underline{e})$  under public ownership. Since  $C'(e) < -F'(e)$  for some  $e > \underline{e}$ , this is a suboptimally low level of effort. In contrast, the owner of the private firm receives the full amount of cost savings and exerts the efficient level of effort ( $e^*$ ). However, since the marginal cost of quality is higher for private firms, private firms are more expensive for high levels of quality.

**Proposition 1** *Total cost of production is lower under private ownership for no investment in quality, but marginal cost of quality is higher under private ownership.*

Proofs are provided in the Appendix.

### 2.4 Credence goods

The model above analyzed treatment outcomes under the assumption that there was no information asymmetries regarding treatment needs. We now consider the full game where producers give a diagnosis on the needs of treatment before treatment is undertaken. Let  $N$  denote the needs of treatment which can be either  $NT$  (treatment not needed) or  $T$  (treatment needed). The public agency gets a benefit  $B$  for each period of treatment when treatment is needed and a benefit of zero when treatment is not needed. I assume that only a proportion  $\theta \in (0, 1)$  of prospective patients actually need care. The public agency knows the distribution of types in the population, but not the type of a particular patient. This is the case both before and after treatment, implying that producers cannot be held accountable for giving an incorrect diagnosis.<sup>14</sup>

Firms thus perform two functions. First, they give a (costless) diagnosis  $D \in \{NT, T\}$  on the patient's need of treatment. The firm's diagnosis is binding for both parties. Managers

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<sup>14</sup>The assumption that producers cannot be held liable for undertreatment, i.e., the case when  $N = T$  and  $D = NT$  can be relaxed without changing Proposition 2, as it is never in the producer's interest to give a  $NT$  diagnosis anyway in this version of the model. It is, however, critical for Proposition 3. If producers can be held liable for not providing treatment when it is needed, undertreatment is not a problem.

and owners need not give a truthful diagnosis, but lying entails a small cost  $l \in (0, \frac{c}{\alpha})$ .<sup>15</sup> This assumption implies that an agent that is indifferent between undertaking treatment or not tells the truth. Second, in case of a diagnosis in support of treatment, managers and owners undertake treatment along the lines of the model for treatment described above. I thus assume that the public agency cannot hire an external expert that only gives a diagnosis. The producer can behave opportunistically in two different ways with respect to the stated diagnosis. First, the producer can engage in *overtreatment* by giving a diagnosis in support of treatment even though treatment is not needed. Second, the producer could induce *undertreatment* by abstaining from treating a patient that actually needs care. As it is verifiable that treatment is undertaken, the producer cannot shirk by charging for a treatment that is not undertaken.

I assume that the public agency can make a take-it-or-leave-it offer on the price of treatment just before the start of treatment. In case the agent does not accept this offer, the default is given by  $p^o = \underline{p}$  and  $p^m = C(\underline{e})$ , i.e., prices such that the participation constraint binds.<sup>16</sup> The timing of the game is thus as follows (the extensive form of the game is provided in the Appendix):

1. Nature draws the treatment needs of patients  $N \in \{NT, T\}$ .
2. The firm observes the needs of treatment  $N \in \{NT, T\}$  and gives a non-verifiable diagnosis  $D \in \{NT, T\}$ .
3. If  $D = NT$ , the game ends. If  $D = T$ , the public agency can make a take-it-or-leave-it offer on the price of treatment.
4. Treatment is undertaken in line with the model of treatment above.

We first consider this game under private ownership. For a given price of treatment, outcomes at Stage 4 are the same as in the treatment model analyzed above, implying that the public agency sets prices at Stage 3 depending on the expected value of treatment. From the solution to the public agency's problem in Section 2.1, we know that the owner will earn a rent in case the public agency's valuation of treatment is above a finite threshold,  $B^o$ . Hence, if  $\theta B > B^o$ , the public agency will set a price that gives the owner a rent even if he expects the owner always to induce treatment. The owner foresees this and gives a diagnosis in support of treatment regardless of whether treatment is needed or not.<sup>17</sup> Hence, it is not possible for the public agency to commit to prices that induce truth-telling in case quality is important. In case quality is of intermediate importance, there is a unique equilibrium in mixed strategies where the owner always tells the truth when treatment is needed, but induces treatment with a positive probability when it is not

<sup>15</sup>Gneezy (2005) and Lundquist et al. (2007) provide experimental evidence that people attach a cost to lying in cheap talk games.

<sup>16</sup>The equilibrium outcome is the same if we allow the public agency and the producer to sign a contract on the default price prior to the producer's diagnosis. To see this, note that a price which is below the equilibrium outcome is not credible as the public agency can simply set a higher price ex post. The effect of committing to high prices ex ante is to induce the owner to always initiate treatment.

<sup>17</sup>The formal condition for the owner to induce treatment is that  $E[V_1^o] > l$ . Since  $l < \frac{c}{\alpha}$ , this condition is always fulfilled for any price such that the owner invests in quality.

needed. Only if quality is relatively unimportant can the public agency commit to prices that induce truthtelling.

The solution for this game under public ownership is simple. As the manager does not pay the costs of production, there is no need to give him rents in order to induce more investment on quality. Therefore, the public agency can credibly commit not to raise prices before the onset of production, implying that the manager will not gain nor lose financially by inducing treatment. Consequentially, the manager always tells the truth.

**Proposition 2** *There are three different outcomes with respect to treatment under private ownership:*

1. *If  $B \geq B^o/\theta$  treatment is always undertaken.*
2. *If  $B \in (B^o, B^o/\theta)$  treatment is always undertaken in state  $T$  and with probability  $(\theta B/B^o - \theta) / (1 - \theta)$  in state  $NT$ .*
3. *If  $B \in [\underline{B}^o, B^o]$  treatment is undertaken in state  $T$ , but not in state  $NT$ .*

*Under public ownership, treatment is undertaken in state  $T$  but not in state  $NT$*

When quality is important, the informational asymmetry of credence goods give rise to two types of inefficiencies under private ownership. First, the public agency cannot commit to prices that keep the firm from initiating treatment also when treatment is not needed. Second, as a result of expected overtreatment, public agencies set prices such that quality is suboptimally low when treatment is actually needed. There is thus an interaction between the two types of moral hazard in the model: The need to provide private firms with incentives for quality gives rise to overtreatment, which in turn reduces the optimal strength of incentives for quality.

## 2.5 Troublesome patients

Some patients are harder to treat than others. For example, certain patients in hospital care may engage in conflicts with the staff. Suppose there is a fixed utility cost  $\kappa > 2l$  of starting to treat such "troublesome" patients. In the case of youth care, I will use violent behavior and previous treatment breakdowns as indicators of particularly troublesome teenagers. The public agency does not know whether a patient is troublesome or not, implying that prices cannot be conditioned on the patient's type. In this case, there is no contract such that agents give a truthful diagnosis for both troublesome and non-troublesome patients. To see this, consider the manager's problem at Stage 2. When a troublesome patient is in need of care, the manager gives a truthful diagnosis if and only if

$$E[V_1^m] - \kappa > -l$$

i.e., if the expected rent from treatment minus the additional cost is larger than the cost of lying. For  $E[V_1^m] \in [0, l]$ , managers give a truthful diagnosis for non-troublesome patients, but avoid treating troublesome patients as the expected rent is not large enough to offset the cost of

treating a troublesome patient. When  $E[V_1^m] \in (l, \kappa - l)$ , managers still avoid the troublesome patients but always induce treatment for non-troublesome patients. If  $E[V_1^m] \in [\kappa - l, \kappa + l]$ , managers give a truthful diagnosis for troublesome patients, but try to induce treatment for non-troublesome patients. Under wage contracts, managers give truthful information for non-troublesome patients, but try to avoid treating troublesome patients. The argument for private firms is the same if one just replaces  $E[V_1^m]$  with  $E[V_1^o]$ . Yet, as shown above, public agencies are less likely to go for weak incentives under private ownership in the first place.

**Proposition 3** *There is no completely informative equilibrium regardless of ownership if patients differ in the minimum cost of effort required for treatment.*

Public agencies can respond to the managers' reaction to patient heterogeneity either by accepting that troublesome patients are not treated under public ownership, or by increasing treatment fees at the expense of cost efficiency and overtreatment for non-troublesome patients.

### 3 Empirical test: Residential youth care

#### 3.1 Institutional background

Residential care is the most comprehensive measure for youth at risk which the Swedish social services can undertake. In November 2000, about 3,300 Swedish children and teenagers were staying in approximately 500 different facilities.<sup>18</sup> Most teenagers are placed in residential care due to their own behavior, such as violent crime, drug addiction or suicidal tendencies. There are two different types of residential youth care facilities in Sweden. The first type, *§12-homes*, are all owned by the government and mainly used for youth convicted for violent crimes. This study focuses on the other type of facility, *HVB-homes*, in which adolescents with a less heavy criminal record are placed.

The responsibility to act when children have some kind of social problem lies at the municipality level, the lowest tier in Swedish government. It is the municipality social service that acts as buyer in the market for residential youth care. Though each placement must be confirmed by a political committee, the decision to place a teenager in youth care is prepared and implemented by a social welfare secretary, employed by the municipality. At the seller side, public facilities are managed by municipalities or county councils (CCs), whereas private facilities are run both by firms and non-profit organizations.<sup>19</sup> At the time when the teenagers in my data were placed in youth care (1991), there were few formal requirements that hindered entry into the market for youth care.<sup>20</sup>

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<sup>18</sup>Swedish National Audit Office (2002) and National Board of Health and Welfare (2001).

<sup>19</sup>The counties constitute the second tier in Swedish government, in between the State and the municipalities.

<sup>20</sup>See Swedish National Audit Office (2002) for a discussion of entry requirements in youth care. A set of stricter requirements for starting a youth care facility were introduced on January 1st 2002. For example, managers at private facilities now have to hold a university degree in a field relevant for youth care, such as psychology or social work.

To get a notion of the social services' working practices, I conducted interviews with nine social welfare secretaries from different municipalities.<sup>21</sup> According to the social welfare secretaries, several considerations influence the choice of facility. First, the facility's treatment program should fit the needs of the teenager. Second, the distance between the facility and the teenager's home should neither be too long (expensive to monitor the facility and harder to integrate a teenager back to a normal life in his or her home environment), nor too short (increases the risk of recidivism and escape). Third, the social services are often unwilling to place teenagers that already know each other in the same facility as this might make it harder for teenagers to change their behavior. Many of the social welfare secretaries stressed that decisions about residential youth care are often taken under tough time-constraints. Moreover, municipalities often lack information on available facilities and existing treatment options. This is a particular problem for small municipalities that place few teenagers.<sup>22</sup>

There is no standardized contracting procedure between buyers and sellers in the market for residential youth care, and it is up to the municipality and facility to negotiate the contractual terms, including the price of treatment.<sup>23</sup> A standard contract stipulates what kind of treatment the teenager should undergo and how it is supposed to be documented, how contacts between the social services and the facility should proceed, the price of treatment and period of notice. Facilities are compensated per day of treatment and the length of stay is typically not contracted upon in advance. In a sense, the contract between municipalities and facilities is a form of cost-plus contract as facilities are compensated for each additional day of treatment. However, for any given day of treatment, facilities have a fixed-price contract and are not compensated for any additional expenses. Most contracts entail few direct incentives for quality provision.

A likely reason for why municipalities and facilities do not sign explicit contracts on quality is that many aspects of residential care are inherently difficult to quantify and might even be subject to secrecy (an example is therapy). There is also considerable ambiguity as to exactly what constitutes good youth care; there is an abundance of different theories on how problematic teenagers should best be treated, with relatively little agreement on basic principles (Sallnäs 2000). In addition, facilities are typically situated at some distance from the municipality center, making monitoring visits costly. Another difficulty stressed by several of the interviewed social welfare secretaries is that treatment quality is sensitive to changes in the personnel force. Contracting on ex post outcomes has two significant disadvantages: First, it would expose facilities to considerable risk as outcomes depend on many factors out of the facility's control. Second, it would introduce a strong incentive for private facilities to avoid teenagers with a high risk of recidivism when this is not fully compensated for. However, there are also indications that the social services put little effort into writing contracts and monitoring facility performance.

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<sup>21</sup>Eight interviews were undertaken in 2005 and one interview in 2002.

<sup>22</sup>According to Sallnäs (2005), 87 percent of 97 interviewed private facility managers said that the municipalities' most important source of information about their facility was their previous experiences.

<sup>23</sup>The discussion about contracting procedures is partly based on a number of actual contracts I was able to study in connection with the interviews. It is uncertain how accurate these contracts are as indicators of a typical contract in 1991, the year the teenagers in our data set were first placed in residential youth care. However, virtually all of the interviewed social welfare secretaries said that contracting procedures have become more rigorous since the early 1990's.

According to Sallnäs (2005), 60 percent of 97 interviewed managers at private facilities said that the social services "rarely" or "never" asked for evaluations of treatment quality when placing a teenager at their facility. The Swedish National Audit Office (2002) argues that the municipalities' and counties' lack of adequate monitoring of quality is a major problem of Swedish residential youth care.

Public facilities can be separate legal entities (i.e., firms) or separate units within the municipality or county administration. When youth care is provided in-house, the social services are still charged a price for treatment, which is set internally in case of a municipality facility, or by the county in case of a county facility.<sup>24</sup> Trade across municipalities and counties regarding publicly provided youth care is quite limited: In my data, 93.3 % of placements in a municipality facility were done by the municipality owning the facility and 91.5 % of placements in a county facility were done by a municipality within the same county. In their discussion of the cost of treatment in youth care, Vinnerljung et al. (2001), whose data I use, treat prices in public facilities as reflecting true costs. Nevertheless, the possibility that internal prices do not perfectly reflect costs cannot be ruled out. For example, public HVB-homes might be charged below-market rents for their facilities or receive loans on favorable conditions. To the best of my knowledge, managers of public facilities all get a fixed salary and there are no public managers with explicit incentive contracts. Even though career concerns and other indirect mechanisms may provide some incentive for public facility managers, such incentives are relatively weak due to the compressed wage structure in the Swedish public sector. At a direct question, most interviewed social secretaries said that the main difference between private and public youth care facilities is the private facilities' stronger incentive to keep teenagers in care.

### 3.2 From model to data

The case of residential youth care fits the contractual structure of the model. Facilities are paid per day of treatment with no contract on cost, whereas managers of public facilities receive a fixed wage which is not conditioned on the number of teenagers in care. In terms of the model, the contract under private ownership is characterized by the parameter set  $\{p, \gamma = 1\}$  and contracts with public sector managers by the set  $\{w, \gamma = 0\}$ .

In youth care, the hazard rate ( $\lambda$ ) corresponds to the risk of treatment breakdowns. About one third of placements in my data end in a treatment breakdown, defined as "a placement that is ended abruptly and without planning."<sup>25</sup> The most common form of treatment breakdowns are those initiated by the teenager. For private facilities, placements that end in a treatment breakdown have a duration which is a year shorter on average than those that end in an orderly manner.

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<sup>24</sup>The division of the municipality organization into separate units responsible for covering costs and the use of an internal price system became common within Swedish municipalities during the 1980's (Haglund et al., 1993). In the data I analyze, 92.5 % of files for teenagers in public facilities contained data on costs, compared to 87.2 % of files for teenagers in private facilities. There is thus strong reason to believe the missing data on costs in public facilities reflect incomplete documentation, not the lack of a system of internal prices.

<sup>25</sup>Vinnerljung, Sallnäs and Kyhle-Westermarck, 2001, p. 67, translated by the author.

I use personnel density (employees per treatment place) as a proxy for investment in quality ( $q$ ). There is a strong negative effect of personnel density on the risk of treatment breakdowns in private facilities in my data, supporting the assumption that the hazard rate is falling in quality (i.e.,  $\lambda'(q) < 0$ ).<sup>26</sup> Still, there are a number of potential sources of bias in using this measure. First, if private facilities use their personnel more efficiently, personnel density underestimates quality in private facilities. On the other hand, private facilities have a stronger incentive to overstate their actual personnel density. In addition, the quality of staff is probably lower in private facilities. Sallnäs (2000) found that only 50 % of private for-profit facilities in the mid 1990's had personnel with "core competence" (defined as an education in psychology or social work), compared to 83 % of private non-profit facilities and 95 % of public facilities.<sup>27</sup>

Another feature of youth care is that some teenagers are arguably more troublesome to work with than others. I use two dummy variables as indicators of particularly troublesome teenagers ( $\kappa$ ); *Previous breakdown* and *Violent behavior*. Apart from the arguably strong a priori reasons to think that violent teenagers and those that have already experienced a breakdown are extra hard to treat, these variables have the strongest pairwise correlation with treatment breakdown among the set of teenager characteristics.

### 3.3 Predictions

According to Proposition 1, we should expect private facilities to have lower treatment fees for low levels of personnel density ( $q$ ), but higher marginal cost.

*P1: Private facilities have lower treatment fees for low levels of personnel density, but higher marginal cost.*

If P1 is true, we should expect the social services to buy low-quality care from private facilities. This prediction is only strengthened if we take into account that it is harder for social services with a high  $B$  to commit to prices that induce truth-telling under private ownership.

*P2: Private facilities have lower personnel density.*

If quality is lower in private facilities, this should also be reflected in a higher level of treatment breakdowns, at least for teenagers that are not particularly troublesome (see below).

*P3: Non-troublesome teenagers have a higher risk of treatment breakdown in private facilities.*

P1-P3 are derived from the basic model without asymmetric information regarding the needs for treatment. Now, let's consider the credence good aspect of youth care. In the model,

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<sup>26</sup>In private facilities, an increase in personnel density by 1.0 predicts a reduction in breakdown frequency by 18.0 percentage units in a linear regression without control variables. The effect is strengthened to 22.9 percentage units when I control for teenager characteristics. Both coefficients are statistically significant at the 5 %-level. There is no economically or statistically significant relationship between treatment breakdowns and personnel density in public facilities.

<sup>27</sup>Unfortunately, I do not have data on the educational level of the staff.

I assumed that firms made their diagnosis on the needs of treatment before treatment was undertaken. In youth care, the social services have already decided that a teenager is in need of treatment before contacting the facility. However, facilities acquire private information on treatment progress over time. If prices are sufficiently high, private facilities want to prolong treatment and do not reveal information on treatment progress truthfully. By the same argument as in Proposition 2, this implies a longer duration of treatment under private provision if the social service's valuation for quality ( $B$ ) is sufficiently high. There are two reasons to assume that this is the case. First,  $B$  reflects social welfare secretaries' willingness to spend public funds – not their own money. Second, as argued by Vinnerljung et al. (2001), criticism of the social services tend to focus on whether teenagers are provided with care or not. The easiest option for a social welfare secretary that wants to avoid unpleasant conflicts or minimize the risk of being blamed for a bad outcome is thus to prolong treatment.

*P4: Controlling for treatment breakdowns, the length of stay is longer in private facilities.*

Since wages of managers in public facilities are not conditioned on the set of teenagers in care, we should expect them to try to actively try to shorten the duration of treatment for troublesome teenagers below the optimal level, implying a relatively higher frequency for this particular group in public facilities.

*P5: Troublesome teenagers have a relatively higher risk of treatment breakdown in public facilities.*

Even if private facilities prolong treatment when this is not optimal, the extra time spent in care might have some beneficial effect on teenagers' post-treatment outcomes. Hence, even if the general level of quality is lower under private provision, the model does not give a clear prediction for how ownership affects final outcomes. However, if managers in public facilities shun troublesome teenagers, those teenagers should do relatively better in private facilities.

*P6: Troublesome teenagers have relatively better post-treatment outcomes if treated in private facilities.*

As private facilities are relatively better at treating troublesome teenagers, the model also predicts a selection of troublesome teenagers into private facilities.

The incentives for managers in private non-profit facilities are likely to be somewhere in between those of owners of private for-profit facilities and managers in public facilities. On the one hand, non-profit organizations are residual claimants just like for-profit firms. On the other hand, managers of for-profit organizations typically do not hold any residual rights themselves. The empirical analysis below shows that outcomes in private non-profit facilities are indeed in between those of public and private for-profit facilities.

### 3.4 Data

I use a data set compiled by Vinnerljung, Sallnäs and Kyhle-Westermarck (2001) at the Institute for Evidence-Based Social Work Practice (IMS), National Board of Health and Welfare (NBHW)

in Sweden. The data is based on the files of all Swedish adolescents (13-16 years of age) who were placed in a HVB-home during 1991, with the exception of teenagers who were only placed temporarily in youth care or for the sole purpose of having their treatment needs evaluated before being assigned to their final placement.<sup>28</sup> There are some missing observations where the files could not be found or were impossible to interpret.<sup>29</sup> I also exclude one facility from the sample where treatment took the form of long, large-scale sailing trips. The teenagers were followed as long as they were subject to residential care, or until their 18th birthday. In addition, the data set contains information on post-treatment outcomes at the age of 25.<sup>30</sup> In total, the data set consists of 357 placements of 336 different teenagers in 173 different facilities (186 placements in 63 public facilities and 171 placements in 111 private facilities).<sup>31</sup> The number of observations from a single facility varies from 1 to 10. Using NBHW registers, I have separated privately owned facilities run by firms (78) from those run by non-profit organizations (20). There are 13 cases where I could not determine whether a facility should be considered "for-profit" or "non-profit".<sup>32</sup> The public facilities in the sample are owned by county councils (43) or municipalities (16). There are 3 public facilities in the sample that could not be classified either as a county or a municipality facility.<sup>33</sup> Summary statistics for the variables in the data are listed in Table A1 in the Appendix.

The teenagers' differ in terms of treatment history and the reason for placement, but the majority of teenagers were placed in care due to their own behavior. As shown in Table A1, the proportion of teenagers with severe problems is higher in private facilities. Regressing each teenager characteristic on an indicator variable of private ownership and a set of facility characteristics, I find that part of the selection of troublesome teenagers into private facilities is explained by distance from facility to municipality center.<sup>34</sup> A likely explanation for this result is that social welfare secretaries want to place teenagers with severe problems at facilities some distance from their home environment, thereby disqualifying the municipality's own facilities.<sup>35</sup>

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<sup>28</sup>As facilities are likely to acquire private information on treatment progress during treatment, evaluating teenagers' needs of treatment before undertaking treatment will probably not solve the credence goods problem completely.

<sup>29</sup>This was the case for about one in three placements from Stockholm and Malmö, Sweden's largest and third largest city, but only for about one in thirty placements from the rest of the country. According to Vinnerljung et al (2001), there is nothing that indicates that the missing files were concentrated on a certain group of children.

<sup>30</sup>The data on post-treatment outcomes come from various sources of register data collected by different government agencies. The data have been compiled by Bo Vinnerljung and Marie Sallnäs at IMS who generously provided it to me.

<sup>31</sup>As my interest is in the behavior of facilities, I use placements as my unit of analysis. This raises two different issues. First, as some teenagers experienced more than one placement, the sample is not perfectly representative with respect to the set teenagers that were ever placed in youth care. Second, placements for the same teenager might not be independent observations. In order to check the first problem, I have run the main regressions reported below excluding all placements in HVB-care except the first for every teenager. To deal with the second problem, I run the same regressions with standard errors clustered at the teenager level. The results do not change substantially in any of these cases and are available upon request.

<sup>32</sup>There were 107 placements in private firms, 51 in non-profit organizations and 14 in facilities that could not be classified.

<sup>33</sup>There were 134 placements in county facilities, 48 in municipality facilities and 5 in facilities that could not be classified.

<sup>34</sup>See Table B1 to B3.

<sup>35</sup>There is some support for this notion in the data. For example, 20.0 % of teenagers in public facilities situated

As shown in Table B4, the propensity to choose private facilities is unrelated to political majority (left or right); population size; the number of teenagers the municipality placed in HVB-homes during 1991; and the share of spending on child care and elderly care that went to private providers in 1998.<sup>36</sup> Municipalities within the largest cities in Sweden – Stockholm and Gothenburg – were significantly less likely to buy youth care from private providers, but this result is sensitive to the exclusion of non-profit facilities from the sample.

### 3.5 Results

As predicted by theory and shown above, the selection of teenagers into private and public facilities is not random and any empirical strategy that aims at establishing a causal effect of ownership on treatment outcomes must take this into account. To this end, I make use of the rich set of control variables in the data by subsequently adding vectors of covariates for teenager, facility and municipality characteristics to the regressions. As we will see, my results are robust to controlling for these sets of covariates. This is not because the set of teenager characteristics are uninformative about the teenagers' problems. For example, 53 percent of teenagers that were considered "violent" at the time of placement were convicted for a violent crime between the age of 20 and 24 compared to 21 percent for teenagers that were not considered violent. I also run regressions with municipality fixed effects, thereby controlling for all variation in  $B$  and  $\alpha$  that depends on municipality characteristics. As there are 17 teenagers in my data with more than one placement (38 placements in total), I am also able to run regressions with teenager-fixed effects in the test of Prediction 2 and 4.<sup>37</sup>

Another important consideration in the empirical analysis is which facility characteristics to control for. I want to control for aspects of youth care which indicate basic differences in the types of services offered but which are not themselves a consequence of ownership. For example, I include a dummy variable for whether a facility evaluates the treatment needs of teenagers in the vector of facility characteristics, but not choice of therapy as this is likely to be affected by financial incentives. Similarly, I control for the geographic location of municipalities, but not the location of facilities, since strong incentives to cut cost should induce private owners (but not public managers) to seek out a locations with low costs of production.

#### 3.5.1 P1: Treatment fees

I consider the following model for the price per month municipality  $h$  pays for placing teenager  $i$  in facility  $j$

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less than 100 km from the municipality center had experienced a previous breakdown compared to 28.6 % in the corresponding private for-profit facilities. In private for-profit facilities situated more than 100 km from the municipality, 54.2 % of teenagers had experienced a previous treatment breakdown, compared to 33.3 % in the very few (15) placements in public facilities.

<sup>36</sup>This data is provided by Statistics Sweden. Data on the extent of service contracting in Swedish municipalities is not available prior to 1998.

<sup>37</sup>The low number of degrees of freedom in estimations with teenager-fixed effects makes it impossible to test the predictions that imply interaction effects with any precision.

$$\begin{aligned}
Price_{hij} = & \alpha_{hij} + \beta_1 Personneld_j + \beta_2 Private_j + \beta_3 Private_j * Personneld_j \\
& + \beta_4 Nonprofit_j + \beta_5 County_j + \mathbf{X}\beta_{\mathbf{X}} + \mathbf{Y}\beta_{\mathbf{Y}} + Private_j * \mathbf{Y}^*\beta_{\mathbf{Y}^*} \\
& + \mathbf{Z}\beta_{\mathbf{Z}} + \varepsilon_{hij},
\end{aligned} \tag{3.1}$$

where  $Personneld_j$  is the personnel density of facility  $j$ ,  $Private_j$  is a dummy variable equal to one when  $j$  is a private facility,  $Nonprofit_j$  is a dummy equal to one when a private facility is owned by a non-profit organization and  $County_j$  is a dummy equal to one when a public facility is owned by a county.  $\mathbf{X}$  is a vector of facility characteristics, including number of treatment places; treatment characteristics (school at the facility and whether the facility did evaluations of teenagers' need of treatment); and a dummy variable equal to one when distance between facility  $j$  and municipality  $h$  exceeded 100 km.  $\mathbf{Y}$  is a vector of teenager characteristics, including sex; age; immigrant status; treatment history and problem background (see Table A1 for a complete list of the variables included in  $\mathbf{Y}$ ).  $\mathbf{Y}^*$  is a subset of  $\mathbf{Y}$  with the teenager characteristics that denote particularly troublesome teenagers, i.e., teenagers with violent behavior and previous breakdown.  $\mathbf{Z}$  is a vector of municipality characteristics, including the logarithm of municipality population in 1990; a dummy for right-wing political majority in the municipality council; and six regional dummies.

If Prediction 1 is correct,  $\beta_2$  (the cost difference for no investment in quality) should be negative and  $\beta_3$  (the difference in marginal cost) should be positive.<sup>38</sup> The estimate of  $\beta_2$  will be biased upward if personnel density underestimates the true level of quality in private facilities, or biased downward if it is overestimated. I include  $Nonprofit_j$  and  $County_j$  to control for different intercepts between the two ownership sub-categories. The interaction effects  $\mathbf{Y}^* * Private_j$  are included to control for a potential interaction effect between ownership and troublesome teenagers.

Table 1 gives the results for five different specifications of regression (3.1). Private firms are cheaper for low levels of quality, i.e.,  $\beta_2$  is negative. In the specifications without municipality fixed effects, private for-profit facilities are between 10,066 and 14,860 SEK cheaper than municipality facilities for a personnel density of "zero" and the effect is statistically significant in three out of four regressions. The difference between private-for-profit and county facilities ( $\beta_2 - \beta_5$ ) is negative as expected and statistically significant in specifications three and four which include controls for facility characteristics. The estimate of  $\beta_2$  drops to -5,022 SEK and is not statistically significant when I control for municipality fixed effect, but the interaction effect remains sizable and statistically significant. There is no evidence of cost differences between for-profit and non-profit private facilities. The marginal cost difference,  $\beta_3$ , has the expected positive sign and is statistically significant in all specifications. Depending on the exact specification, an increase in personnel density by 1.0 increases the price by between 15,505 and 20,374 SEK more in private than in public facilities.<sup>39</sup>

The results in Table 1 are unlikely to be the effect of non-random selection of troublesome

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<sup>38</sup> As we have no observation for zero personnel density, the difference in intercept ( $\beta_2$ ) should therefore not be interpreted literally.

<sup>39</sup> I have tested for non-linearities in personnel density by including a quadratic term in regression (4). The quadratic term was never statistically significant and the adjusted  $R^2$  decreased in three out five specifications.

teenagers. First, the results in Table 1 are robust to controlling for teenager characteristics. Second, the type of teenagers' problems does not have predictive power for personnel density within each type of ownership. Third, the results remain robust when I rerun regression (3.1) restricting the sample to teenagers that are not violent or have experienced a previous breakdown.

TABLE 1. TREATMENT FEES

Variable	Price per month (SEK)				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Constant	29,165*** (8, 438)	26,819*** (9, 560)	27,557*** (7, 674)	40,892*** (13, 073)	21,266** (12, 651)
Personnel density	15,642*** (5, 883)	17,680*** (6, 422)	13,869*** (4, 704)	11,148*** (4, 046)	16,052** (8, 742)
Private	-12,350* (8, 895)	-10,066 (9, 841)	-11,490* (7, 986)	-14,860** (7, 734)	-5,022 (12, 109)
Private* pers. density	17,682*** (6, 673)	15,505** (7, 366)	18,828*** (5, 592)	20,374*** (5, 817)	15,423** (9, 158)
Nonprofit	-1,956 (4, 147)	-1,617 (4, 246)	366 (4, 008)	1,256 (4, 838)	8,960 (7, 587)
County	-1,467 (3, 356)	-919 (3, 602)	-466 (3, 163)	-502 (4, 545)	5,704 (5, 646)
Private*violence		811 (3, 505)	571 (3, 357)	944 (3, 929)	2,504 (4, 074)
Private*prev. breakdown		6,791* (4, 991)	2,953 (4, 574)	1,935 (4, 852)	1,056 (3, 974)
Teenager charact.	No	Yes	Yes	Yes	Yes
Facility charact.	No	No	Yes	Yes	Yes
Municipality charact.	No	No	No	Yes	No
Municipality FE	No	No	No	No	Yes
$p\text{-value}^* \hat{\beta}_2 < \hat{\beta}_5$	.15	.24	.09	.04	.21
$N$	302	289	288	258	263
Number of clusters	127	125	124	114	114
$R^2$	.36	.38	.50	.57	.82

The standard errors within parentheses have been corrected for clustering at the facility level and heteroskedasticity. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a one-sided test.

Table B5 shows the results from additional specification checks where I use the specification with controls for teenager, facility and municipality characteristics as the base case. First, I interact personnel density with non-profit and county facility ownership and add these variables to the regression. Neither of the extra interaction effects are statistically significant, though the interaction between non-profit facility and personnel density is positive and quite large. Second, I add an interaction effect between private ownership and right-wing political majority in municipality  $h$  to control for political preferences for private provision. This effect is negative and statistically significant, implying that right-wing municipalities pay less for privately provided

youth care. Third, I add an interaction effect between private provision and the size of the population in municipality  $h$ .<sup>40</sup> This effect is negative and statistically significant, indicating that large municipalities have market power. The results for  $\beta_2$  and  $\beta_3$  are robust to these specification tests.

To check that the results for  $\beta_3$  is not an artefact of selection on the level of quality, I rerun all five specifications of regression (3.1) restricting the sample to facilities with a personnel density of at least 0.8, thereby excluding 73 out of 155 placements in private facilities. As shown in Table B6, the interaction effect is weaker in the specifications without controls for facility characteristics, but stronger in the specifications with the full set of controls and municipality fixed effects.<sup>41</sup>

FIGURE 1. Private facilities

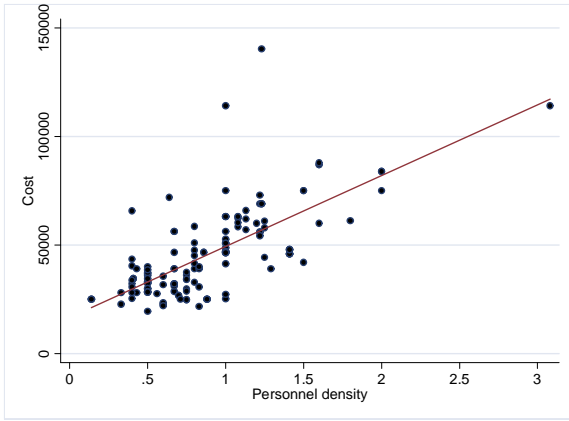
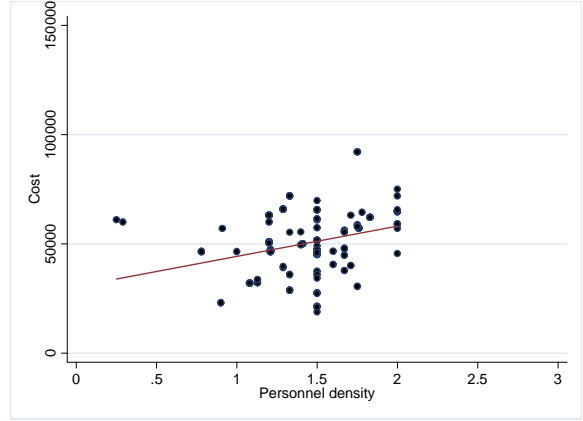


FIGURE 2. Public facilities



Another potential source of bias in regression (3.1) is that stated costs in the public sector do not reflect true costs. As seen in Figure 1 and Figure 2, the correlation between cost and personnel density is much stronger for private than for public facilities. This is due to a low correlation for county facilities (.218) and not for municipality facilities (.789).<sup>42</sup> A potential explanation for this discrepancy is that some counties sponsor their facilities, thereby weakening the link between personnel density and cost. As a further robustness check, I therefore run regression (3.1) excluding county facilities. Due to the lower number of observations, these estimates (reported in Table B7) are less precise than those in Table 1. The intercept ( $\beta_2$ ) is negative in all specifications, but not statistically significant in the two most basic specification without controls for facility and municipality characteristics. The difference in marginal cost ( $\beta_3$ ) is positive and statistically significant in all specifications except in the specification where

<sup>40</sup>To facilitate comparison with the specifications presented above, I normalize the interaction term around the mean of municipality size.

<sup>41</sup>Note that the ownership dummy does not have a causal interpretation when we restrict the sample to facilities with a personnel density of at least 0.8.

<sup>42</sup>The pairwise correlation for private for-profit facilities is .690 and .514 for non-profit facilities. The relatively strong correlation between prices and personnel density in the municipality facilities is reassuring as it indicates that prices track costs. As shown in Table B9, county and municipality facilities have practically identical mean values for personnel density and cost of treatment, but county facilities have a much lower variance in personnel density and higher variance in cost.

I only control for teenager characteristics (2). Relatedly, I test for differential prices when social services place teenagers in public facilities owned by another municipality or county. As shown in Table B8, the results only change marginally compared to Table 1.

### 3.5.2 P2: Personnel density

I measure investment in quality by personnel density. Figure 1 and 2 shows visually that private facilities have lower personnel density in general. More formally, I use the following regression for personnel density in facility  $j$  with teenager  $i$  from municipality  $h$ :

$$\begin{aligned} Personnel_{hij} = & \alpha_{hij} + \beta_1 Private_j + \beta_2 Nonprofit_j + \beta_3 County_j \\ & + \mathbf{X}\beta_{\mathbf{X}} + \mathbf{Y}\beta_{\mathbf{Y}} + Private_j * \mathbf{Y}^*\beta_{\mathbf{Y}^*} + \mathbf{Z}\beta_{\mathbf{Z}} + \varepsilon_{hij}, \end{aligned} \quad (3.2)$$

where  $\mathbf{X}$ ,  $\mathbf{Y}$ ,  $\mathbf{Y}^*$  and  $\mathbf{Z}$  are the same vectors of control variables as above.

TABLE 2. PERSONNEL DENSITY

Variable	Personnel density				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Constant	1.517*** (.169)	1.419*** (.201)	1.328*** (.205)	1.699*** (.365)	1.514*** (.340)
Private	-.720*** (.180)	-.730*** (.192)	-.680*** (.192)	-.866*** (.226)	-1.055*** (.397)
Nonprofit	.217** (.105)	.222** (.097)	.237*** (.087)	.239** (.103)	.167 (.190)
County	-.013 (.175)	-.002 (.179)	-.011 (.176)	-.122 (.207)	-.307 (.332)
Private*vioence		-.073 (.122)	-.088 (.112)	.034 (.145)	.074 (.218)
Private*prev. breakdown		.065 (.113)	.130 (.116)	.225 (.149)	.443* (.238)
Teenager characteristics	No	Yes	Yes	Yes	Yes
Facility characteristics	No	No	Yes	Yes	Yes
Municipality characteristics	No	No	No	Yes	No
Municipality FE	No	No	No	No	Yes
$p$ -value* $\hat{\beta}_1 < \hat{\beta}_3$	.00	.00	.00	.00	.00
$N$	328	312	311	279	284
Number of clusters	150	145	144	133	133
$R^2$	.34	.37	.39	.47	.66

The standard errors within parentheses have been corrected for clustering at the facility level and heteroskedasticity. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a two-sided test.

As shown in Table 2, private for-profit facilities have on average .866 fewer employees per treatment place than municipality facilities when I control for the full set of covariates, and the coefficient is robust to different specifications. Including municipality fixed effects strengthens

the estimated effect to 1.055 employees per treatment place. Non-profit private facilities have somewhat higher personnel density than for-profit facilities. There is no statistically significant difference between public facilities run by municipalities and counties.

As a further way of controlling for selection of teenagers, I run personnel density on a private ownership dummy and teenager fixed effects for the subsample of teenagers with more than one placement. The coefficient on the private ownership dummy is  $-.535$  and strongly statistically significant ( $t$ -statistic 3.03;  $p$ -value .003).<sup>43</sup> Dropping teenager fixed effects from this regression give only a slightly larger effect of private ownership ( $-.618$ ). This indicates that the result that private facilities invest less in quality is not driven by non-random selection of teenagers.

### 3.5.3 P4: Duration of treatment

To test if private facilities prolong treatment periods, I run the following regression for the duration of treatment of teenager  $i$  from municipality  $h$  in facility  $j$ :

$$\begin{aligned} Duration_{hij} = & \alpha_{ij} + \beta_1 Private_j + \beta_2 Nonprofit_j + \beta_3 County_j + \beta_4 Break_i \\ & + \mathbf{X}\beta_{\mathbf{X}} + \mathbf{Y}\beta_{\mathbf{Y}} + Private_j * \mathbf{Y}^*\beta_{\mathbf{Y}^*} + \mathbf{Z}\beta_{\mathbf{Z}} + \varepsilon_{hij}, \end{aligned} \quad (3.3)$$

where  $Break_i$  is the breakdown-dummy from above and  $\mathbf{X}$ ,  $\mathbf{Y}$ ,  $\mathbf{Y}^*$  and  $\mathbf{Z}$  are the same vectors of control variables as above. I control for treatment breakdowns as I want to identify the effect of ownership on duration of treatment that goes through information on treatment progress, not the effect that goes through treatment quality. In terms of the model, I want to control for treatment breakdowns  $\lambda(q)$ ; teenager characteristics ( $\kappa$ ) and municipality preferences ( $B$  and, to some extent,  $\alpha$ ).

As shown in Table 3, private for-profit ownership increases duration of treatment by between 13.0 and 16.0 months compared to municipality facilities depending on the specification and the effect is statistically significant. Non-profit private facilities have 4.4 months shorter duration of treatment than for-profit private facilities in the full regression and the difference is statistically significant. Estimation using exponential and Weibull duration models, and least absolute deviations give similar results.<sup>44</sup>

The results are robust to a number of further tests, reported in Table B14. To better control for quality, I add personnel density and the full set of control variables for treatment programs. The estimated partial effect of private for-profit ownership is then 12.6 months when I control for teenager, facility and municipality characteristics and 12.0 months in the regression with municipality fixed effects, and the coefficient is statistically significant in both cases.

Using the subsample of teenagers with more than one placement give similar results. Controlling for teenager fixed effects, the coefficient on the private ownership dummy is 15.881 months ( $t$ -value 2.75;  $p$ -value .005). Dropping the teenager fixed effects leads to a *reduction* in the estimated effect of private ownership to 11.613 months. This suggests that the results for duration

<sup>43</sup>Controlling for non-profit ownership strengthens the estimated effect to  $-.707$ . As there are only 2 placements in municipality-owned facilities (out of 18 in public facilities), I do not control for county ownership.

<sup>44</sup>I was not able to use the LAD estimator with fixed effects due to the limited degrees of freedom.

of treatment and ownership are not caused by non-random selection of teenagers. Controlling for treatment breakdown increases the estimated effect of private ownership in both the specification with and without teenager fixed effects.

TABLE 3. DURATION OF TREATMENT

Variable	Duration (months)					
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Constant	9.042*** (2.099)	10.385*** (2.135)	9.321*** (2.911)	9.257 (3.057)	13.542 (10.780)	14.319*** (5.349)
Private	13.015*** (2.660)	14.879*** (2.613)	16.033*** (2.850)	14.401*** (2.826)	14.223*** (3.266)	13.021** (6.590)
Nonprofit	-3.194 (3.123)	-4.294 (2.928)	-3.038 (2.921)	-4.922** (2.889)	-4.400 (3.053)	-.759 (3.883)
County	1.511 (2.453)	2.122 (2.487)	1.908 (1.987)	2.410 (1.739)	1.603 (2.669)	-.139 (5.586)
Breakdown		-7.166*** (1.685)	-7.995*** (1.738)	-7.382*** (1.611)	-7.502*** (1.790)	-9.004*** (2.450)
Private*vioence			-3.750 (3.310)	-2.810 (2.933)	-1.549 (3.257)	-1.856 (5.099)
Private*pr. break			-2.960 (3.300)	-2.666 (3.016)	-2.921 (3.334)	.317 (5.386)
Teenager ch.	No	No	Yes	Yes	Yes	Yes
Facility ch.	No	No	No	Yes	Yes	Yes
Municipality ch.	No	No	No	No	Yes	No
Municipality FE	No	No	No	No	No	Yes
$p$ -value* $\hat{\beta}_1 > \hat{\beta}_3$	.00	.00	.00	.00	.00	.00
$N$	336	336	319	311	279	284
Number of clusters	157	157	152	144	133	133
$R^2$	.15	.21	.31	.37	.40	.68

The standard errors within parentheses have been corrected for clustering at the facility level and heteroskedasticity. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a one-sided test.

Is the longer duration of treatment in private facilities due to a longer planned duration of treatment, or a prolongement of treatment beyond plan? Table 4 gives the average planned and actual duration of treatment for placements where treatment did not break down (there is data on the planned duration of treatment for about a third of the sample).<sup>45</sup> Placements in private facilities have a longer planned duration of treatment, but the bulk of the effect is

<sup>45</sup>The only statistically significant difference among the set of teenager characteristics between the subsamples with and without data on planned duration of treatment is that teenagers with planned duration of treatment are less likely to be placed in care on a non-voluntary basis. The partial effect of private ownership on the duration of treatment in the second specification with controls for treatment breakdown is somewhat lower for teenagers with a planned duration of treatment (12.2 months) compared to teenagers without a planned duration of treatment (16.1 months). Hence, considering the subsample with data on planned duration of treatment is likely to underestimate the effect of ownership on duration of treatment.

due to a prolonged duration of treatment in private facilities. Whereas the length of stay does not deviate from plan in public facilities, private facilities prolong the duration of treatment by about eight months.<sup>46</sup> I get a similar result when I control for planned duration of treatment in the first five specifications of regression (3.3). Controlling for planned duration of treatment gives the effect of private ownership on duration of treatment conditional on all the information about teenager characteristics that is available to the social services at the time of placement. As shown in Table B15, the effect of private ownership is between eight and nine months in all specifications, except in the specifications with controls for teenager, facility and municipality characteristics.<sup>47</sup>

TABLE 4. DURATION COMPARED TO PLAN

	Duration (months), no breakdown		
	Planned duration	Actual duration	Difference
Private for-profit facilities	14.58	22.11	+7.53
Private non-profit facilities	12.82	21.59	+8.76
Public facilities	10.19	10.05	-0.14

The table refers to placements with a known planned duration of treatment (N=108).

As a simple way of controlling for influential observations, I compare the share of placements that have the length of stay prolonged beyond plan to the share that are shortened. As shown in Table 5, a clear majority of placements are prolonged in private facilities, and this is true both for troublesome and non-troublesome teenagers.<sup>48</sup> In contrast, public facilities are more likely to shorten than to prolong the duration of treatment for troublesome teenagers. Excluding treatment breakdowns attenuates the result that public facility managers shorten the duration of treatment for troublesome teenagers. However, as shown below, the majority of treatment breakdowns for troublesome teenager in public facilities are initiated by the facility staff.

As a more formal test, I run an ordered probit of the three outcomes (treatment prolonged; treatment according to plan; treatment shortened) on ownership, planned duration of treatment, treatment breakdown and the standard set of control variables. Private ownership has a positive and statistically significant effect on the probability of prolonged treatment in the specifications when vector of control variables ( $\mathbf{X}$ ,  $\mathbf{Y}$ ,  $\mathbf{Z}$ ) are included individually, but is not statistically significant when all vectors are included simultaneously (though the point estimate is similar). However, standard errors are inflated in this case due to the low number of degrees of freedom.

<sup>46</sup>The null hypothesis that the difference between actual and planned duration of treatment is identical in private for-profit facilities and public facilities is rejected at the five percent level in a two-sided test, and at the one percent level in the corresponding test for non-profit facilities.

<sup>47</sup>I also run the duration regressions with imputed values for planned duration of treatment. In this case, the estimated effect of private ownership on the duration of treatment was similar to the results in Table 5, indicating that sample selection may affect the estimates for the sample with data on planned duration of treatment (see Table B15).

<sup>48</sup>I consider a single indicator variable for "troublesome" teenagers. The results are similar if I instead consider violent teenagers, and teenagers with a previous breakdown separately (results available on request).

TABLE 5. PROLONG VS. SHORTEN

%	Private		Public	
	Prolong	Shorten	Prolong	Shorten
<i>All placements</i>				
Troublesome teenagers	60.0	28.0	19.0	42.9
Non-troublesome teenagers	64.0	20.0	33.3	27.3
<i>Placements without breakdown</i>				
Troublesome teenagers	68.2	22.7	20.0	33.3
Non-troublesome teenagers	73.7	5.3	33.3	27.3

The table refers to placements with a known planned duration of treatment (N=108).

Teenagers are "troublesome" if they have a previous breakdown or are violent.

The longer duration of treatment in private facilities implies that privatization increases costs. Whereas private for-profit facilities have a lower average treatment cost per month (43,497 SEK) compared to private for-profit facilities (48,761 SEK) and public facilities (50,645 SEK), average *total* cost was 1,045,976 SEK in private-for-profit facilities and 886,409 SEK in private non-profit facilities compared to 501,492 SEK in county facilities and 425,282 SEK in municipality facilities.<sup>49</sup>

Does the longer duration of treatment in private facilities reflect overtreatment? An alternative explanation for the longer treatment periods in private facilities is that all teenagers receive undertreatment in public facilities. However, this explanation requires that municipalities systematically underestimate the required duration of treatment. Moreover, the view that all teenagers are undertreated in public facilities is not consistent with the very low frequency of facility-initiated treatment breakdowns for non-troublesome teenagers in public facilities displayed in Table 7 below.

### 3.5.4 P3 and P5: Treatment breakdowns

The linear probability model of a treatment breakdown for teenager  $i$  from municipality  $h$  in facility  $j$  is

$$P(Break_{hij} = 1 | x) = \alpha_{hij} + \beta_1 Private_j + \beta_2 Nonprofit_j + \beta_3 County_j + \mathbf{X}\beta_{\mathbf{X}} + \mathbf{Y}\beta_{\mathbf{Y}} + Private_j * \mathbf{Y}^*\beta_{\mathbf{Y}^*} + \mathbf{Z}\beta_{\mathbf{Z}} + \varepsilon_{hij}, \quad (3.4)$$

where  $Break_{hij}$  is a dummy variable equal to one when treatment breaks down and  $\mathbf{X}$ ,  $\mathbf{Y}$ ,  $\mathbf{Y}^*$  and  $\mathbf{Z}$  are the same vectors of control variables as above.

As shown in Table 6, the effect of private for-profit ownership on the breakdown frequency of non-troublesome teenagers ( $\beta_1$ ) has the expected positive sign in all specifications (Prediction 3). Controlling for teenager, facility and municipality characteristics, a non-troublesome teenager

<sup>49</sup>The cost estimates are unadjusted for inflation. Multiplying prices by the change in consumer price index between 1991 and 2008 (1.28) gives a total cost in private facilities of 1 337 000 SEK, which corresponds to 221 000 dollars using the SEK/Dollar exchange rate as of June 24th 2008 (6.04).

face a 22.7 percentage units higher risk of treatment breakdown in a private for-profit facility than in a municipality facility. The estimated effect is robust to the inclusion of control variables, though it is not statistically significant in the regression with municipality fixed effects due to an increase in standard errors. Nonprofit private facilities have lower breakdown frequency for non-troublesome teenagers than private for-profit facilities, but the coefficient is statistically significant only in the specifications without controls and in the municipality fixed-effects regressions. The difference between private for-profit and county facilities ( $\beta_1 - \beta_3$ ) is statistically significant in all specifications.

TABLE 6. TREATMENT BREAKDOWNS

Variable	Treatment breakdowns				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Private	.265*** (.073)	.226*** (.087)	.191** (.114)	.227** (.114)	.249 (.180)
Nonprofit	-.159* (.087)	-.108 (.087)	-.064 (.090)	-.105 (.090)	-.251* (.131)
County	.091 (.070)	.045 (.072)	.048 (.075)	.035 (.106)	-.044 (.158)
Private*vioence		-.395*** (.141)	-.375*** (.144)	-.372*** (.153)	-.508*** (.185)
Private*prev. break		-.038 (.116)	-.074 (.123)	-.055 (.137)	-.064 (.196)
Teenager characteristics	No	Yes	Yes	Yes	Yes
Facility characteristics	No	No	Yes	Yes	Yes
Municipality characteristics	No	No	No	Yes	No
Municipality FE	No	No	No	No	Yes
$p\text{-value}^* \hat{\beta}_1 > \hat{\beta}_3$	.00	.01	.03	.00	.01
$N$	338	321	313	281	286
Number of clusters	158	153	145	134	134
$R^2$	.04	.20	.20	.26	.58

The standard errors within parentheses have been corrected for clustering at the facility level and heteroskedasticity. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a one-sided test, except for Nonprofit and County which refers to a two-sided test.

In line with Prediction P5, the interaction effect between private ownership and violent teenagers is negative and statistically significant in all specifications. In the specification with the full set of control variables (except municipality fixed effects), the fact that a teenager is "violent" increases the risk of breakdown with 37.2 percentage units more in a public than in a private facility. The corresponding figure for previous breakdown is 5.5 percentage units, but the effect is not statistically significant. As shown in Table B10, the results are very similar when I rerun regression (3.4) excluding private non-profit facilities from the sample. Running regression (3.4) with the single "troublesome" indicator variable (that takes the value one when a teenager

is violent, has experienced a previous breakdown, or both), gives an interaction effect between  $-.207$  and  $-.337$ , which is statistically significant in all specifications.

A potential concern is that the prolonged treatment periods in private facilities increases the risk of an eventual breakdown, thereby giving an upward bias on the estimate of  $\beta_1$ . To test for this, I include the planned duration of treatment and an interaction term between planned duration and ownership in regression (3.4). As shown in Table B11, the results are robust to this specification check.<sup>50</sup>

Another potential concern is that there might be a non-monotonicity in the selection on teenager characteristics: Even though private facilities treat more teenagers with severe problems, the teenagers with the most severe problems may be treated by public facilities. If so, the "troublesome" indicator could be a stronger predictor of the extent of a teenager's problems in public facilities, implying that the interaction effect does not measure a causal effect of ownership. In fact, as shown in Table B12, the fact that a teenager is "troublesome" is generally a stronger predictor of other problems like criminal behavior or drug addiction in private facilities, suggesting that the interaction effect is actually biased toward zero.

TABLE 7. FACILITY INITIATIVE TO BREAKDOWN

%	Private for-profit	Private non-profit	Public
Troublesome	15.1	22.7	31.0
Non-troublesome	13.5	14.8	3.3

The table refers to the proportion of placements that ended in a treatment breakdown initiated by the facility staff. Teenagers are "troublesome" if they have a previous breakdown or are violent.

Consistent with the view that public facilities shun troublesome teenagers, the staff at public facilities have a significantly higher propensity to initiate treatment breakdowns for troublesome than for non-troublesome teenagers. As shown in Table 7, only 3.3 percent of non-troublesome teenagers in private facilities experienced a treatment breakdown initiated by the facility staff, but 31.0 percent of troublesome teenagers did, and the difference is strongly statistically significant. In contrast, there is no significant differences between the level of facility-initiated treatment breakdowns for troublesome and non-troublesome teenagers in private facilities. As shown in Table B20, the result that public facilities are relatively more prone to initiate treatment breakdowns for troublesome teenagers is statistically significant and robust to the full set

<sup>50</sup>The estimated effect of private ownership on treatment breakdowns is not statistically significant in specification (1). However, this result is mostly due to sample selection, not of controlling for planned duration of treatment per se. The estimated effect of private ownership on the probability of treatment breakdowns in specification (1) is .188 when the sample is restricted to observations with data on the planned duration of treatment, but planned duration of treatment is not controlled for, compared to .265 in the unrestricted sample and .144 when controlling for planned duration of treatment. The estimated effect of private ownership and the interaction effect between private ownership and violent teenagers in specification (2), (3) and (4) are statistically significant and stronger than those in Table 3. The estimates in specification (5) with municipality fixed effects are not precise due to the few degrees of freedom.

of control variables.<sup>51</sup> I get the similar results if I consider violent teenagers and teenagers with previous breakdown separately, instead of using the combined "troublesome" indicator.

There are three reasons to believe that the high fraction of treatment breakdowns for troublesome teenagers initiated by public facilities does not reflect a concern for the teenagers' well-being. First, given the strong detrimental effects of treatment breakdowns documented by researchers within social work, it seems unreasonable that breakdown frequencies of 50 percent or higher (which troublesome teenagers experience in public facilities) should be optimal.<sup>52</sup> Second, if private facilities are too reluctant to initiate treatment breakdowns for troublesome teenagers, we should expect the other parties involved (the teenager, his or her parents, and the social services) to be relatively more prone to initiate treatment breakdowns for this group. However, as shown in Table B13, the interaction term between private ownership and violent teenagers is still negative and statistically significant when I rerun regression (3.4) with facility-initiated breakdowns excluded from the sample. The interaction term with previous breakdown is positive, though not statistically significant. The results are similar if I instead treat treatment breakdowns to which facilities took the initiative as "not breakdown" and include them in the sample. Third, as shown below, troublesome teenagers also have relatively better post-treatment outcomes if treated in private facilities.

### 3.5.5 P6: Post-treatment outcomes

As measures of post-treatment outcomes, I consider data on economic self-reliance, educational attainment, mental health and criminal record at the age of 25.<sup>53</sup> Whereas the previous outcome measures all pertain to a particular *placement*, adult outcomes focuses on an *individual*, with a history of treatment which may go beyond a single placement. When a teenager experienced more than one placement in 1991, I consider the placement with the longest duration. I exclude four teenagers from the sample where the difference between the longest and second longest placement was one month or less. To control for treatment history, I add an indicator variable equal to one when a teenager continued treatment in some other facility to the vector of teenager characteristics. In addition, I include an indicator variable that takes the value one if a teenager had multiple placements during 1991.

The results on post-treatment outcomes are presented in Table A2 to A4. There are no statistically significant differences between teenagers at private and public facilities in terms of

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<sup>51</sup>It may seem puzzling that private facilities initiate any treatment breakdowns at all. However, the theoretical result that private facilities never initiate breakdowns rests upon the assumption that facilities are never capacity-constrained. Though I argue that this is a reasonable assumption in the general case, facilities will occasionally have all their placements filled at the same time. In this case, they will try to replace teenagers for whom they get paid a low treatment fee.

<sup>52</sup>Summarizing the research on treatment breakdowns, Vinnerljung et al. (2001) write (p. 21): "In all studies – Swedish and foreign – have adolescents consistently been saying that treatment breakdowns are painful experiences that leave dwelling feelings of bitterness and guilt." [translation by the author]

<sup>53</sup>An alternative measure of post-treatment outcomes is to consider whether a teenager continued treatment in some other facility after the placement had ended. As shown in Table A2, teenagers in private facilities are less likely to continue treatment than teenagers in public facilities. Yet this effect is not robust when I control for facility characteristics. In particular, the difference in terms of continued treatment is explained by the larger share of facilities that do evaluations of teenagers' treatment needs.

reliance on social assistance, educational attainment or mental health problems between the age of 20 and 24, defined as hospital care for suicide attempt, drug addiction or psychiatric illness. However, violent teenagers are relatively less likely to be convicted for a crime between the age of 20 and 24 if treated in a private facility and the effect is statistically significant in all specifications. The interaction effect between previous breakdown and private ownership is also negative, but not statistically significant in the specification with municipality fixed effects. Moreover, though the likelihood that non-troublesome teenagers are imprisoned between the age of 20 and 24 does not depend on facility ownership, violent teenagers are relatively less likely to be imprisoned if treated in a private facility and the effect is statistically significant. The interaction effect between private ownership and previous breakdown has a positive sign, but is not statistically significant. The results are robust to restricting the sample to teenagers that only experienced one placement during 1991.<sup>54</sup>

The results for post-treatment outcomes indicate that public provision is superior for non-troublesome teenagers since outcomes are similar but total costs substantially lower. One important caveat to this assumption is that costs may be underestimated for public providers. However, for this to invalidate the conclusion that public providers are more expensive for non-troublesome teenagers, stated cost should amount to less than 50 % of true costs.

The cost-benefit analysis is less clear-cut for troublesome teenagers. Though we have seen that private facilities are better at treating troublesome teenagers *relative* to non-troublesome teenagers, a cost-benefit analysis should focus on the *absolute* effect. To get an estimate of the absolute difference in quality I rerun the post-treatment regressions for convictions and imprisonment restricting the sample to troublesome teenagers. As shown in Table B19, there is some evidence that troublesome teenagers have better outcomes if treated in private facilities.<sup>55</sup> However, the estimated effect is not stable across specifications, making it hard to quantify the benefits of sending troublesome teenagers to private facilities.

## 4 Concluding Remarks

According to the standard view in the literature on service contracting (Hart, Shleifer and Vishny, 1997), privatization reduces costs but may imply lower quality. In this paper, I have argued that this result may be overturned for credence goods.

I develop a model where the procurer can credibly threat to exit from a relationship that gives the producer rents. As pointed out by Klein and Leffler (1981), this is an effective way of enforcing contracts on quality in circumstances where explicit contracts are impossible or costly to write and enforce. Yet for credence goods such contracts leads to another form of moral

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<sup>54</sup>See Table B16 to B18. This restriction solves the problem of which placement to refer to each teenager. However, as the risk of treatment breakdown depends on quality, restricting the sample to teenagers who did not switch facility implies that we are in effect selecting a high-quality sample (the breakdown frequency was 27.6 percent for teenagers that experienced one placement compared to 43.3 percent for teenagers with more than one placement).

<sup>55</sup>Due to the limited number of degrees of freedom, I include controls for teenager and facility/municipality characteristics in separate regressions.

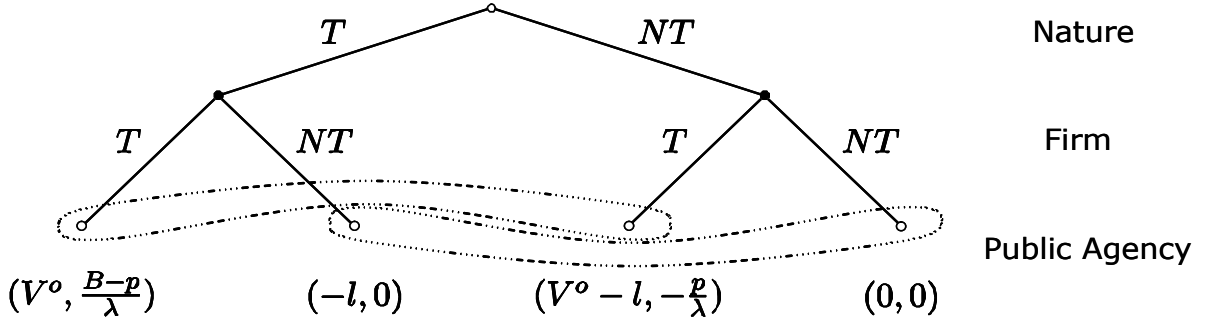
hazard: In the expectation of future rents, private contractors use their informational advantage to induce treatment also in cases where there are small or no benefits to treatment. As a result, privatization may substantially increase total costs. Empirical studies that only consider the cost per produced unit will give misleading results.

Since public managers do not pay the costs of production, they need not be provided with explicit financial incentives for quality. However, the absence of financial incentives to undertake treatment implies that public managers may shirk by avoiding unpleasant tasks.

The empirical analysis of residential youth care showed that both types of moral hazard were important. In case of non-troublesome teenagers, contracting out significantly increases total cost with no visible improvement in quality. The total trade-off is less clear for troublesome teenagers. Though private facilities have higher total cost, the net impact of ownership on quality is uncertain as there are two counteracting effects: Private facilities shirk on quality in order to cut costs, but public providers are too prone to initiate treatment breakdowns.

## Appendix A

### A.1 Extensive form



### A.2 Proof of Proposition 1

Consider the expressions for total cost from the solution to the owner's and manager's maximization problem in Supplementary Appendix A. Total cost under public ownership is given by the function

$$T^m(q) = F(\underline{e}) + C(\underline{e}) + cq,$$

and total cost under private ownership by the function

$$T^o(q) = p(q) = \begin{cases} F(e^*) + C(e^*) & \text{if } q = 0, \\ \left(\frac{(1+\alpha)c}{\alpha}\right)q + F(e^*) + C(e^*) + \frac{c}{\alpha} & \text{if } q > 0. \end{cases}$$

First, note that total cost is lower under private ownership. That is,

$$T^o(0) = F(e^*) + C(e^*) < F(\underline{e}) + C(\underline{e}) = T^m(0)$$

since  $-F'(e^*) = C'(e^*)$  but  $-F'(\underline{e}) > C'(\underline{e})$ . Second, taking the derivative with respect to  $q$  shows that marginal cost of quality is strictly higher under private ownership, i.e.,

$$\left. \frac{\partial T^o(q)}{\partial q} \right|_{q>0} = \frac{(1+\alpha)c}{\alpha} > c = \left. \frac{\partial T^m(q)}{\partial q} \right|_{q \geq 0}.$$

### A.3 Proof of Proposition 2

First, note that, for a given price of treatment, outcomes at Stage 4 are the same as in the model of treatment analyzed above. Now consider how the public agency sets prices at Stage 3. Let  $\rho$  denote the public agency's subjective probability that  $N = T$  conditioning on  $D = T$ . From the solution to the public agency's problem in Section 2.1, we know that the public agency sets a price, which gives rents to the owner, if  $\rho B > B^o$ . If  $\rho B < B^o$ , the public agency sets  $p = \underline{p}$ , implying that the owner earns no rent. The public agency is indifferent between a price that gives a rent and  $\underline{p}$  if  $\rho B = B^o$ . Let the high price in this case be denoted by  $p(B^o)$ .

As the agent's outside option is zero and there is a cost of lying, managers and owners always give a truthful diagnosis in Stage 2 when  $N = T$ . In case  $N = NT$ , the owner gives a truthful diagnosis in Stage 2 if and only if

$$E[V_1^o(p)] \leq l, \quad (2.10)$$

i.e., if his expected rent from treatment is lower than the cost of lying. Since  $l < \frac{c}{\alpha}$  by assumption, any price that induce the owner to set  $q > 0$  also implies that the owner will lie. We get

$$\rho = \frac{\theta}{\theta + (1 - \theta)\pi} \quad (2.11)$$

where  $\pi$  is the subjective probability that the owner or manager will give a  $T$  diagnosis when  $N = NT$ . It follows that  $\rho \in [\theta, 1]$ .

The game has a unique equilibrium in pure strategies in case the public agency's valuation of quality is either high or low. If  $B > B^o/\theta$ , the public agency sets a price that entails rents even if  $\rho = \theta$ , implying that the owner's best response is to always initiate treatment. When  $B \leq B^o$  it is optimal to set  $p = \underline{p}$  even if  $\rho = 1$ , implying that the owner's best response is to always tell the truth. There is no equilibrium in pure strategies when  $B \in (B^o, B^o/\theta]$ . As  $B > B^o$ , public agencies would always set a price that entail rents for the owner in case of a  $T$  diagnosis if they believe the diagnosis to be truthful. But then the owner always initiates treatment, implying that  $p = \underline{p}$  is optimal since  $B < \theta B^o$ . There is, however, a mixed strategy equilibrium where the owner sets

$$\pi = \frac{\theta B/B^o - \theta}{1 - \theta} \quad (2.12)$$

implying that  $\rho B = B^o$ . The public agency in turn sets  $p = \underline{p}$  with probability

$$\frac{l}{V^o(p(B^o))} = \mu \quad (2.13)$$

and  $p = p(B^o)$  with probability  $1 - \mu$ , implying that the owner is indifferent between giving a  $T$  and a  $NT$  diagnosis in state  $NT$ .

### A.4 Proof of Proposition 3

Consider the public manager's problem. First note that  $E[V_1^m] < 0$  is unfeasible as managers would never give a diagnosis if they incur a loss from treatment.

For  $E[V_1^m] \in [0, l]$ , managers give a truthful diagnosis for non-troublesome patients, but avoid treating troublesome patients. To see this, first consider non-troublesome teenagers. The

manager tells the truth in state  $T$  as  $E[V_1^m] > -l$  and in state  $NT$  as  $E[V_1^m] - l < 0$ . When the teenager is troublesome, the manager gives a  $NT$  diagnosis in state  $T$  as  $E[V_1^m] - \kappa < l - 2l = -l$ , and also in state  $NT$  as  $E[V_1^m] - \kappa - l < l - 2l - l < -l$ .

For  $E[V_1^m] \in (l, \kappa - l)$ , managers always induce treatment for non-troublesome patients but still avoid the troublesome patients. When a teenager is non-troublesome, the manager induces treatment in state  $T$  as  $E[V_1^m] > -l$  and in state  $NT$  as  $E[V_1^m] - l > 0$ . When a teenager is troublesome, the manager gives an  $NT$  diagnosis in state  $T$  as  $E[V_1^m] - \kappa < -l$  and in state  $NT$  as  $E[V_1^m] - \kappa - l < 0$ .

For  $E[V_1^m] \in [\kappa - l, \kappa + l]$ , managers try to induce treatment for non-troublesome patients, but give a truthful diagnosis for troublesome patients. When teenagers are non-troublesome, managers give a truthful diagnosis in state  $T$  as  $E[V_1^m] \geq \kappa - l > -l$  and a  $T$  diagnosis in state  $NT$  as  $E[V_1^m] - l \geq \kappa - 2l > 0$ . When teenagers are troublesome, managers give a truthful diagnosis in state  $T$  as  $E[V_1^m] - \kappa \geq \kappa - l - \kappa = -l$ , and a truthful diagnosis in state  $NT$  as  $E[V_1^m] - \kappa - l \leq \kappa + l - \kappa - l = 0$ .

For  $E[V_1^m] > \kappa + l$ , managers always induce treatment. To see this, note that a manager that induces treatment for troublesome teenagers in state  $NT$  will do so also in all other cases. As  $V^m - \kappa - l > \kappa + l - \kappa - l = 0$ , managers will indeed initiate treatment also in this case.

The argument for private firms is the same if one just replaces  $E[V_1^m]$  with  $E[V_1^o]$ .

TABLE A1. Summary statistics of variables, data at the placement level

Variable	Public			Private			p
	Obs	Min	Max	Obs	Min	Max	
<i>Teenager characteristics</i>							
Previous exp. of residential care*	186	0	1	171	0	1	.444 .004
Previous breakdown*	180	0	1	164	0	1	.402 .000
Psychological disorder*	186	0	1	171	0	1	.269 .037
Addiction*	186	0	1	171	0	1	.415 .004
Evaluated at §12-home*	186	0	1	169	0	1	.107 .104
Non-voluntary placement*	186	0	1	170	0	1	.353 .011
Violent behavior*	186	0	1	171	0	1	.222 .184
Criminal behavior*	186	0	1	171	0	1	.468 .010
Sex* (male = 1)	186	0	1	171	0	1	.556 .176
Immigrant background*	186	0	1	171	0	1	.351 .417
Age* (1991)	186	13	16	171	13	16	14.9 .360
Problems at home during childhood*	186	0	1	171	0	1	.614 .097
Placed in care due to own behavior*	186	0	1	171	0	1	.684 .005
Previously in youth- or foster care*	183	0	1	169	0	1	.456 .000
Placement number	186	1	4	171	1	4	1.30 .004

The *p*-value regards the hypothesis that the proportion or mean of a certain variable is equal in private and public facilities. Variables marked with an asterisk are included in the vector of basic teenager characteristics.

TABLE A1, cont.

Variable	Public				Private				<i>p</i> -value
	Obs	Min	Max	Mean	Obs	Min	Max	Mean	
<i>Facility characteristics</i>									
County facility (yes = 1)	181	0	1	.735	—	0	0	—	—
Nonprofit facility (yes = 1)	—	0	0	—	157	0	1	.325	—
Distance (>100 km = 1)*	186	0	1	.081	171	0	1	.468	.000
Places*	185	4	46	9.0	157	2	46	10.2	.204
Personnel density	185	.25	5.00	1.49	154	.14	3.08	.87	.000
Outsider: Municipality (yes = 1)	186	0	1	.016	—	—	—	—	—
Outsider: County (yes = 1)	186	0	1	.054	—	—	—	—	—
Treatment: Evaluation* (yes = 1)	183	0	1	.306	155	0	1	.052	.000
Treatment: School* (yes = 1)	183	0	1	.279	155	0	1	.277	.979
Treatment: Work (yes = 1)	183	0	1	.005	155	0	1	.084	.000
Treatment: Family (yes = 1)	183	0	0	.000	155	0	1	.168	.000
Treatment: Milieu therapy (yes = 1)	183	0	1	.344	155	0	1	.174	.000
Treatment: Other (yes = 1)	183	0	1	.148	155	0	1	.232	.046
Treatment: Not stated (yes = 1)	186	0	1	.016	163	0	1	.049	.079
Treatment: "Medlevarskap" (yes = 1)	183	0	1	.044	155	0	1	.187	.000

The *p*-value regards the hypothesis that the proportion or mean of a certain variable is equal in private and public facilities. Variables marked with an asterisk are included in the vector of basic facility characteristics.

TABLE A1, cont.

Variable	Public			Private			<i>p</i> -value
	Obs	Min	Max	Mean	Obs	Min	Max
<i>Municipality characteristics</i>							
Log (population 1990)*	175	8.60	13.42	11.42	150	8.72	13.42
Right-wing majority in municip. legislature* (yes = 1)	173	0	1	.399	145	0	1
Number of teenagers placed in youth care 1991	175	13,086	1	40	150	1	40
Geography: "Norrland"* (yes = 1)	175	0	1	.097	150	0	1
Geography: "Svealand"* (yes = 1)	175	0	1	.371	150	0	1
Geography: "Göteborg"* (yes = 1)	175	0	1	.531	150	0	1
Geography: "Stockholm"* (yes = 1)	175	0	1	.246	150	0	1
Geography: "Göteborg"* (yes = 1)	175	0	1	.149	150	0	1
Geography: "Malmö"* (yes = 1)	175	0	1	.034	150	0	1
<i>Outcome measures</i>							
Cost	172	18,984	92,000	50,645	149	19,410	140,300
Breakdown of placement (yes = 1)	186	0	1	.258	171	0	1
Treatment length (months)	185	1	41	10.11	170	0	74
Treatment continued (yes = 1)	179	0	1	.458	153	0	1
Multiple placements 1991	172	0	1	.302	171	0	1
Post-treatment: Social assistance (yes = 1)	136	0	1	.257	142	0	1
Post-treatment: At most primary school (yes = 1)	134	0	1	.649	141	0	1
Post-treatment: Convicted (yes = 1)	136	0	1	.485	142	0	1
Post-treatment: Imprisoned (yes = 1)	136	0	1	.169	142	0	1
Post-treatment: Mental health problems (yes = 1)	136	0	1	.228	142	0	1

The *p*-value regards the hypothesis that the proportion or mean of a certain variable is equal in private and public facilities. Variables marked with an asterisk are included in the vector of basic municipality characteristics.

TABLE A2. Post-treatment outcomes I

	Treatment continued					Mental health			
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS
Constant	0.457*** (0.081)	0.356*** (0.128)	0.334** (0.138)	1.060** (0.440)	0.254 (0.230)	0.167* (0.085)	0.093 (0.129)	0.031 (0.502)	0.618 (0.420)
Private	0.109 (0.097)	-0.153 (0.101)	-0.070 (0.109)	-0.062 (0.139)	-0.012 (0.208)	0.114 (0.101)	0.089 (0.114)	-0.034 (0.172)	0.007 (0.265)
Nonprofit	-0.007 (0.099)	0.062 (0.099)	0.104 (0.097)	0.081 (0.102)	0.269* (0.143)	-0.068 (0.076)	-0.079 (0.096)	-0.089 (0.096)	-0.153 (0.191)
County	0.012 (0.096)	0.039 (0.094)	0.018 (0.096)	0.056 (0.134)	0.127 (0.187)	0.086 (0.097)	0.018 (0.098)	-0.012 (0.151)	-0.113 (0.209)
Private*violence							-0.073 (0.177)	-0.106 (0.177)	0.018 (0.242)
Private*Pr. break							-0.007 (0.130)	-0.019 (0.137)	0.076 (0.241)
Teenager ch.	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Facility ch.	No	No	Yes	Yes	Yes	No	No	Yes	Yes
Municipality ch.	No	No	No	Yes	No	No	No	Yes	No
Municipality FE	No	No	No	No	Yes	No	No	No	Yes
<i>N</i>	316	300	295	264	269	260	227	202	211
<i>R</i> <sup>2</sup>	0.01	0.11	0.17	0.20	0.55	0.01	0.16	0.20	0.61

Robust standard errors clustered on the facility level in parentheses. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a two-sided test.

TABLE A3. Post-treatment outcomes II

	Social Assistance			Education				
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Constant	0.361*** (0.069)	0.180 (0.119)	-0.580 (0.488)	-0.161 (0.510)	0.694*** (0.084)	0.725*** (0.166)	0.688 (0.569)	1.061* (0.543)
Private	-0.129 (0.083)	-0.136 (0.102)	-0.104 (0.152)	-0.078 (0.247)	0.001 (0.099)	-0.081 (0.129)	-0.116 (0.147)	-0.417 (0.280)
Nonprofit	0.087 (0.090)	0.068 (0.111)	0.037 (0.118)	0.128 (0.144)	-0.057 (0.084)	-0.114 (0.089)	-0.121 (0.105)	0.151 (0.211)
County	-0.130 (0.080)	-0.164* (0.098)	-0.159 (0.140)	-0.137 (0.238)	-0.060 (0.096)	-0.153 (0.102)	-0.141 (0.127)	-0.298 (0.260)
Private*violence		-0.140 (0.162)	-0.112 (0.157)	-0.256 (0.216)		-0.057 (0.154)	0.027 (0.186)	0.205 (0.318)
Private*Pr. break		0.042 (0.145)	0.119 (0.158)	0.250 (0.288)		-0.173 (0.134)	-0.133 (0.164)	0.254 (0.288)
Teenager ch.	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Facility ch.	No	No	Yes	Yes	No	No	Yes	Yes
Municipality ch.	No	No	Yes	No	No	No	Yes	No
Municipality FE	No	No	No	Yes	No	No	No	Yes
N	260	227	207	211	258	225	205	209
R <sup>2</sup>	0.01	0.13	0.22	0.61	0.00	0.13	0.15	0.57

Robust standard errors clustered on the facility level in parentheses. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a two-sided test.

TABLE A4. Post-treatment outcomes III

	Convictions				Imprisonment			
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Constant	0.500*** (0.066)	0.232* (0.122)	0.249 (0.468)	0.204 (0.441)	0.111** (0.044)	0.036 (0.119)	-0.699 (0.441)	-0.213 (0.415)
Private	0.024 (0.088)	0.102 (0.094)	0.139 (0.141)	-0.042 (0.224)	0.047 (0.060)	0.048 (0.089)	-0.016 (0.113)	0.088 (0.177)
Nonprofit	0.008 (0.099)	0.009 (0.101)	0.065 (0.111)	-0.019 (0.186)	0.076 (0.075)	0.074 (0.096)	0.076 (0.108)	0.087 (0.199)
County	-0.005 (0.088)	-0.020 (0.072)	0.047 (0.121)	-0.294 (0.202)	0.078 (0.067)	0.042 (0.077)	-0.001 (0.103)	-0.052 (0.168)
Private*Violence		-0.267** (0.143)	-0.263* (0.171)	-0.395*** (0.207)		-0.290** (0.138)	-0.290** (0.148)	-0.458** (0.195)
Private*Pr. break		-0.267* (0.164)	-0.217 (0.174)	-0.219 (0.299)		0.080 (0.119)	0.081 (0.122)	0.072 (0.259)
Teenager ch.	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Facility ch.	No	No	Yes	Yes	No	No	Yes	Yes
Municipality ch.	No	No	Yes	No	No	No	Yes	No
Municipality FE	No	No	No	Yes	No	No	No	Yes
<i>N</i>	260	227	207	211	260	227	202	211
<i>R</i> <sup>2</sup>	0.00	0.30	0.35	0.71	0.01	0.26	0.32	0.68

Robust standard errors clustered on the facility level in parentheses. One asterisk denotes 10 percent significance level, two asterisks 5 percent significance level and three asterisks 1 percent significance level in a one-sided test for the interaction terms, and two-sided tests otherwise.

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