Choosing among Contractor Ownership Types with Endogenously Incomplete Contracts

Patrick Warren

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Abstract

When contracting is difficult, there is the risk of opportunistic behavior by the contractor. Strong incentives for cost savings, for example, can also induce strong incentives to look for loopholes. One well-known solution is to bring the activities in house and provide them with employees facing relatively weak incentives. In this paper, I investigate an alternative approach, outsourcing to nonprofits, that maintains some of the advantages of outsourcing but provides dulled incentives for both good and bad efforts. I find the conditions under which contracting with non-profit is preferable to a similarly-situated for-profit. With exogenously incomplete contracts, the non-profit becomes more attractive as the harm of opportunistic behavior increases, as the degree of incompleteness increases, and (in a repeated game), as the parties become less patient. When the buyer can choose the level of contractual completeness, however, things change. Nonprofits are more attractive as the cost of contractual completeness increases, the scope for cost-reducing effort decreases, and (surprisingly) for intermediate levels of patience and intermediate harms from opportunistic behavior. The intuition for this monotonicity is that when the risks are severe the buyer will choose to write very complete contracts, which, in turn, make for-profit contractors attractive.

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1 Introduction

This paper analyzes the implications of endogenously incomplete contracts for the decision to contract with non-profit providers.

With exogenous contractual completeness, the key tension (identified by Glaeser and Shleifer (2001)) is that non-profit providers have weaker incentives to make cost-saving non-monetary efforts, including efforts that can be harmful to the buyer, than similarly situated for-profit providers do. If the harmful efforts are particularly bad, the buyer may prefer the firm with weak incentives, even though the final cost of the contract will be higher. Furthermore, the non-profit option is particularly attractive when the contract is very incomplete. When the buyer-seller relationship is a repeated game there are opportunities to improve on this outcome. Vlassopoulos (2009) shows for sufficiently patient agents, the repeated arrangement always favors contracting with the for-profit, even for very bad harmful efforts, and that, more generally, the attractiveness of the for-profit option increases in the degree of patience (or, alternatively, the frequency of interaction).

When the degree of contractual completeness is allowed to vary endogenously, so the buyer is able to invest in improved contracting and oversight in order the hem in the providers' ability to take harmful cost-saving efforts, the buyer now has a substitute mechanism to shift the providers' incentives. I show that this extension upends some of the basic predictions of the exogenous-completeness model. In particular, even with spot contracting, both very benign and very severely harmful efforts lead to the use of a for-profit provider, with the non-profit provider being preferred for intermediate levels of harm, only. It remains true that very patient agents induce the use of a for-profit provider, but the attractiveness of the for-profit option is no longer monotonic in patience, at least for sufficiently bad harmful efforts. Finally, a few additional comparative static predictions arise in this model. Non-profit providers become more attractive as the cost of writing more complete contracts increases or as the marginal cost of seller effort (both harmful and beneficial) increases.

2 One-Shot Model

2.1 Setup

Players and Preferences Consider a principal (P) who must procure some good or services from a third-party provider. He values this good at $v - \alpha b(1-d)$, where

v is the value of the base good, and b is the amount of gaming effort put in by the producer, and d is the completeness of the contract. In addition the the payoff from the good, net of its cost, the principal pays a contracting cost of $A_d d^2/2$ of writing a contract that covers d percent of all gaming possibilities, where $A > 0$ measures the difficulty of writing complete contracts. So the total expected payoff of a principal buying the good at price p is

$$V^p = v - \alpha b(1-d) - p - Ad^2/2 \tag{1}$$

There are two types of qualified provider, a for-profit firm and a nonprofit. Other than their profit status, the two firms are identical, and can produce the good at marginal cost $c - b(1-d) - g < v$. c measures the marginal cost of the base good, and b and g are non-monetary efforts that reduce the cost of production. Effort of type j has marginal cost $Bj^2/2$. The only difference between the nonprofit and for-profit firms is the restriction that for-profit firms must consume excess revenues as perquisites, so a nonprofit with excess revenues of x receives a payoff of πx, where $0 < \pi < 1$. So the total payoff of a type-π seller selling the good at price p is

$$V(\pi) = \pi\Big(p - c + g + (1-d)b\Big) - Bb^2/2 - Bg^2/2, \tag{2}$$

Timing and Contracting Technology The timing of the game is as follows.

a) The principal writes a contract (d) and opens it for bids.

b) Two firms of each ownership type simultaneously make offers, p_j.

c) The principal chooses the winner and pays him p_j.

d) The winning firm chooses b and g.

e) The good or service is delivered to the principal.

The contracts are contingent on delivery, but cannot be made contingent on b, g, c, or the principal's payoff. The game is slightly different if the contract is written after the winning firm is selected. There is no incomplete information, here, so we will solve for the subgame perfect Nash equilibibrium

2.2 Solution

To solve for the SPNE, progress, as usual, from the end. The final decisions in each subgame are effort choices. Starting from the end, a firm of type j who has won a contract of type (d,p) will choose b and g to maximize (2). This implies the following optimal effort choices, as function of π (where $\pi = 1$ gives the for-profit's choice):

$$\begin{aligned} g(\pi) &= \frac{\pi}{B} \\ b(\pi) &= \frac{(1-d)\pi}{B}. \end{aligned} \tag{3}$$

Backing up to the choice among contractors, the contractual design effort is sunk, so the principal facing offers of p^{np} and p^{fp} will strictly prefer the the for-profit offer if and only if

$$\alpha b(1)(1-d) + p^{fp} < \alpha b(\pi)(1-d) + p^{np}. \tag{4}$$

Moving back to the pricing stage, there will be Bertrand Competition, so all firms must be making zero payoff. From 2, replacing for optimal efforts, zero-payoff for a firm of type π entails

$$p(\pi) = c - \frac{\pi}{2B} - \frac{(1-d)^2\pi}{2B}. \tag{5}$$

Replacing for these prices in (4) gives the following value function for the buyer

$$V(\pi|d) = v - c + \frac{\pi}{2B} + \pi(1-d)^2\frac{\frac{1}{2}-\alpha}{B} \tag{6}$$

Taking the derivative of the buyers' objective function with respect to π and checking its value at $\pi = 1$, the buyer prefers the for-profit firm whenever

$$\frac{1}{2} + (1-d)^2(\frac{1}{2} - \alpha) \geq 0. \tag{7}$$

If $\alpha \leq 1/2$, so bad effort is not too bad, the principal strictly prefers the for-profit provider. Otherwise, there is a cutoff level of completeness, $\tilde{d}$ satisfying

$$(1-\tilde{d})^2 = \frac{1}{2\alpha - 1},$$

where the nonprofit is chosen whenever $d < \tilde{d}$ and the for-profit is chosen whenever $d > \tilde{d}$. This cutoff is always strictly below $d = 1$, and it is strictly above zero whenever $\alpha > 1$.

If the level of completeness is exogenous, this ends the analysis, and the following proposition characterizes the buyer's choice.

Proposition 1. *If the degree of contractual completeness is exogenously given, then the principal will choose the contracting with a non-profit firm if and only if both* $\alpha > 1$ *and* $d < \tilde{d}$.

This choice is represented by the curve labeled Spot in Figure 1a. The x-axis represents the severity of the harmful effort (α), running up from zero, and the y-axis represents the degree of completeness ($(1-d)^2$), running from 0 to 1. Parameter combinations in the upper-right lead the buyer to choose a non-profit firm, and parameter combinations in the lower-left lead him to choose the for-profit firm.

If the degree of completeness is endogenous, we must also analyze the principal's choice of d. The marginal cost of increasing d is always $A_d d$, while the marginal benefit depends on the type of firm who will produce. Conditional on choosing a firm of type π, replacing for prices and bad effort, the principal solves the problem

$$\max_d v - c + \frac{\pi}{2B} + \pi(1-d)^2 \frac{\frac{1}{2} - \alpha}{B} - A_d \frac{d^2}{2} \tag{8}$$

The solution of which is

$$d(\pi) = \begin{cases} 0 & \text{if } \alpha \leq \frac{1}{2}, \\ \frac{\pi(2\alpha-1)}{\pi(2\alpha-1)+AB} & \text{if } \alpha > \frac{1}{2}. \end{cases} \tag{9}$$

Thanks to the envelope theorem on d, the condition for the buyer to prefer the for-profit firm is the same as in (7), above. Replacing for the optimal choice of d gives the following proposition.

Proposition 2. *There is a generically unique SPNE of the one-shot procurement game with endogenous contractual completeness.*

- *If* $\alpha \leq 1$*, the principal buys from the for-profit firm.*
- *Otherwise, there is a cutoff*

$$Z(\alpha) = \frac{2\alpha - 1}{2\alpha - 2}\left\{1 + \sqrt{2\alpha - 1}\right\} > 0,$$

where the principal prefers some $\pi < 1$ *to* $\pi = 1$ *if and only if* $AB > Z$.

- *This cutoff decreases toward* 4 *for* $\alpha \in (1, \frac{5}{2})$ *then increases for* $\alpha > \frac{5}{2}$.

This choice is represented by the curve labeled Spot in Figure 1b. The x-axis again represents the severity of the harmful effort (α), running up from zero, but the y-axis now represents a measure of the average marginal costs of effort, either by the buyer to complete the contract or by the seller to reduce costs (AB), running up from zero. Parameter combinations in the upper-right lead the buyer to choose a non-profit firm, and parameter combinations in the lower-left lead him to choose the for-profit firm.

In the spot contract, the key difference between the exogenous and endogenous contracting models is the non-monotonicity with respect to the severity of the harmful action. This non-monotonicity arises because an increase in α has two effects on the key condition (7)– a direct effect on the harm experienced given the level of harmful action taken (the second term becomes more and more negative), and an indirect effect through an increase in completeness- reducing the level of harmful action and its effects ($(1-d)^2$ approaches zero). For large enough α, that second effect dominates, making the for-profit supplier more attractive.

3 Relational Contracting

Consider repeating the baseline model an infinite number of times, in a long-run relationship, where the buyer agrees to pay some p^{RC}, and set some d^{RC} and the producer agrees to produce choose some g^{RC}, b^{RC}. Assuming a common discount factor of β, this contract yields per-period payoff to the principal of

$$V_P^{RC} = v - \alpha b^{RC}(1 - d^{RC}) - p^{RC} - Bd^{RC2}/2, \tag{10}$$

and the seller of type j a per-period payoff of

$$V_{Sj}^{RC} = \pi_j[p^{RC} - c + (1 - d^{RC})b^{RC} + g^{RC}] - \frac{A}{2}(b^{RC2} + g^{RC2}). \tag{11}$$

3.1 Feasible Relational Contracts with no Performance Bonuses

Since the price is paid before the efforts are exerted, the temptation to reneg falls upon the producer. In a subgame after a completeness of d^{RC}, he would prefer to choose the efforts as outlined in the spot-transaction 3. This deviation would increase the stage payoff of a producer of type j by

$$
\begin{aligned}
r_j(d^{RC}, g^{RC}, b^{RC}) &= \pi_j[(\frac{\pi_j}{A} - g^{RC}) + (1-d^{RC})(\frac{\pi_j(1-d^{RC})}{A} - b^{RC})] - (\frac{\pi_j^2}{2A} - A\frac{g^{RC2}}{2}) \\
&- (\frac{(1-d)^2\pi_j^2}{2A} - A\frac{b^{RC2}}{2}) \\
&= \frac{\pi_j^2}{2A} + \frac{\pi_j^2(1-d)^2}{2A} - [\pi_j g^{RC} - A\frac{g^{RC2}}{2}] - [\pi_j(1-d)b^{RC} - A\frac{b^{RC2}}{2}]
\end{aligned} \tag{12}
$$

In order to maintain this relational contract, this reneging temptation must be exceeded by the difference between the firm's equilibrium payoff and the worst equilibrium payoff. In this case, the most stringent punishment the buyer can enact is to buy from an alternative producer, yielding the producer a payoff of zero. Thus, the no-reneging constraint is given by

$$
r_j(d^{RC}, g^{RC}, b^{RC}) \leq \frac{\beta}{1-\beta}V_{Sj}^{RC} \tag{13}
$$

Obviously, for $\beta > 0$ there is a p^{RC} that satisfies this condition. Replacing for the price that satisfy this constraint with equality, the buyer's per-period payoff from enacting the specified relational contract with a type-j producer is given by

$$
W_{Pj}^{RC}(g,b,d) = v - c + (1-\alpha)(1-d)b + g - (\frac{1}{\pi_j})[(\frac{1-\beta}{\beta})r_j + \frac{A}{2}(b^2+g^2)] - \frac{B}{2}d^2. \tag{14}
$$

Given a seller type, the buyers problem is to maximize this function respect to b, g, and d. The shape of the contract will depend on the cost of bad effort, the ease of contract, the buyers type, and the discount factor.

Lemma 1. *Facing a seller of type π the best feasible relational contract, from the buyer's perspective, is given by*

- $g^{RC} = \frac{\pi}{A}$, *for all other parameters.*
- *If* $1 \leq \beta\alpha$:

$$
b^{RC} = 0 \text{ and } d^{RC} = \frac{\pi(1-\beta)}{\pi(1-\beta) + AB\beta}
$$

.

- *If* $1-\sqrt{1-\beta} \leq \beta\alpha < 1$*:*

$$\begin{aligned} d^{RC} &= \tfrac{\pi[(1-\beta)-[1-\beta\alpha]^2]}{\pi[(1-\beta)-[1-\beta\alpha]^2]+AB\beta} \\ b^{RC} &= \tfrac{\pi}{A}[1-\beta\alpha](1-d^{RC}). \end{aligned}$$

- *If* $\beta\alpha < 1-\sqrt{1-\beta}$*:*

$$d^{RC} = 0 \text{ and } b^{RC} = \frac{\pi}{A}[1-\beta\alpha].$$

To understand the effects of non-profit status of the buyer's payoff, we can differentiate his objective function (14) with respect to π. Using the envelope theorem we can ignore the indirect effects through g, b, and d, yielding the following expression at $\pi = 1$:

$$\frac{\partial W_{Pj}^{RC}(g,b,d)}{\partial \pi}|_{\pi=1} = \frac{1}{2}[A(g^2+b^2) - \frac{1-\beta}{A}(1+(1-d)^2)], \tag{15}$$

replacing for g^{RC}, this becomes:

$$\frac{1}{2}[\frac{\beta}{A} + Ab^2 - \frac{1-\beta}{A}(1-d)^2] \tag{16}$$

Given an exogenous level of contactual completeness, the following proposition characterizes the buyer's preferred choice of seller.

Proposition 3. *In the relational contract with exogenous completeness a for-profit firm is preferred whenever* $\beta > 1/2$*. Otherwise,*

- *If* $1 \leq \beta\alpha$*: The for-profit firm is preferred to any non-profit if and only if* $\frac{\beta}{1-\beta} \geq (1-d)^2$.
- *If* $1-\sqrt{1-2\beta} \leq \beta\alpha < 1$*: The for-profit firm is preferred to any non-profit if and only if* $\frac{\beta}{1-\beta-(1-\beta\alpha)^2} \geq (1-d)^2$.
- *If* $\beta\alpha < 1-\sqrt{1-2\beta}$*: The for-profit firm is preferred over all non-profit firms.*

Figure 1a represents these choices for various levels of patience (β). Increasing patience and increasing harm always increases the attractiveness of the for-profit firm.

The following proposition provides the parallel analysis for the case where the buyer also controls the level of contractual completeness (d).

Proposition 4. *In the relational contract with endogenous completeness a for-profit firm is preferred whenever* $\beta > 1/2$*. Otherwise,*

- *If* $1 \leq \beta\alpha$*: The for-profit is preferred to any non-profit if and only if*

$$AB < [\frac{1-\beta}{1-2\beta}]\Big\{1 + \sqrt{\frac{1-\beta}{\beta}}\Big\}.$$

  This cutoff reaches its minimum (of 4) when $\beta = 0.2$*.*

- *If* $1 - \sqrt{1-2\beta} \leq \beta\alpha < 1$*: The for-profit is preferred to any non-profit if and only if*

$$AB < \frac{M}{M-1}\Big\{1 + \sqrt{M}\Big\},$$

  where $M = 2\alpha - \beta\alpha^2 - 1$*.*

- *If* $\beta\alpha < 1 - \sqrt{1-2\beta}$*: The for-profit firm is preferred over any non-profit.*

Figure 1b represents these choices for various levels of patience (β). Increasing patience and increasing harm no longer always increases the attractiveness of the for-profit firm. The key to the non-monotonicity is, again, in 16. Take the case of increasing harm. With exogenous completeness, the only effect of increasing harm is to decrease the level of bad effect (b) specified in the relational contract. This change decreases the second term in 16 and, therefore, the attractiveness of the for-profit firm. The mechanism to have in mind is that a contract requiring lower bad effort requires a higher price to prevent reneging, and and the for-profit firm's reneging temptation grows more rapidly. With endogenous completeness, however, there is a second indirect effect, similar to the spot contract, where increasing the harm of bad effort encourages more complete contracting that, in turn, encourages the use of the for-profit seller. The difference from the spot market is that once the relational contract specifies no bad effort ($1 \leq \alpha\beta$), additional changes in harm no longer have any effect, so the threshold above which non-profits are preferred no longer increases indefinitely.

The case of patience is more complex. With exogenous completeness, increasing patience always increases (16), since it increases the weight on the first (positive) term and decreases the weight on the second (negative) term. It also decreases bad effort (b) but not enough to offset these first two effects. With endogenous completeness, however, there is a second effect where the degree of completeness also affected by increasing patience. For small β and large α, so there is a heavy weight on the third term, this indirect effect can actually drive the effect of increasing β the other way, so non-profits actually become more attractive at β increases. At $\beta = 0.2$, the effect then goes back the other way and further increases in β again make for-profits more attractive.

4 Discussion

Factors that unambiguously drive toward for-profit contracting in the exogenous completeness case, such as lower gaming risk (smaller α) and more patience (higher β), have less straightforward effects when contractual completeness is endogenous. It remains true that very frequent interactions/patient parties ($\beta > 1/2$) and situations with little gaming risk ($\alpha < 1$) will always lead to contracting with for-profits, but neither relation remains monotonic as we move away from these extremes. With endogenous completeness situations with very severe gaming risk ($\alpha >> 1$) and very impatient agents ($\beta \approx 0$) will also lead to contracting with for-profits. Instead, contracting with non-profits is most often preferred for intermediate gaming risk or patience.

There do remain some unambiguous comparative statics on some parameters that it may be possible to match with data. For instance, an increase in the marginal cost of contractual completeness (A) or an increases in the marginal cost of seller effort (B) weakly increases the attractiveness of contracting with non-profits, and the effect is strict for $\alpha > 1$ and $\beta < 1/2$. The first effect is straightforward, since more complete contracts are used

5 Basic Empirics

To Come.

References

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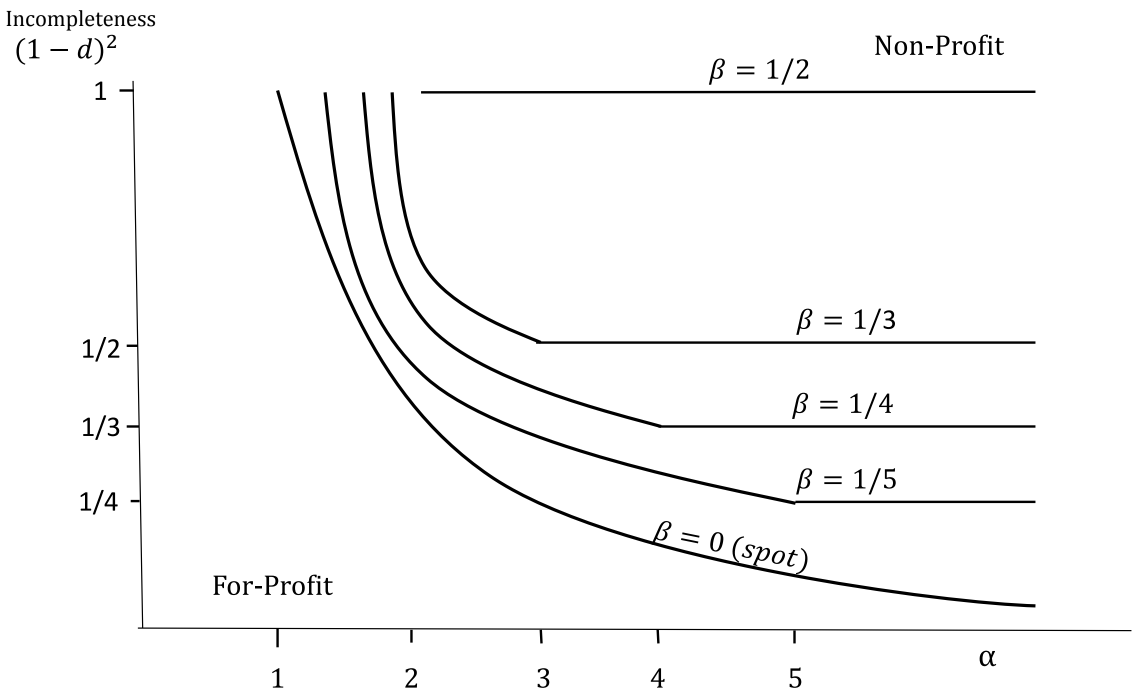
Figure 1: Choice of Seller Ownership Form

(a) Exogenous Completeness



(b) Endogenous Completeness