Competitive bidding for long-term, non-exclusive contracts

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Abstract

When public service contract is up for auction, the government typically has two options regarding the time length of the contract: They may opt for a short-term contract, which means that the exclusive right to produce the service is to be up for auction frequently, or they may choose a long-term contract that gives the winning firm an exclusive right to the market for a longer period of time. In this paper we introduce what we call *long-term, non-exclusive contracts*. Instead of choosing the length of the contract prior to the firms' bidding, the time length of the contract is made a function of the firms' performance. We then study to what extent these types of contracts may be designed so as to give firms sufficient incentives to provide quality. By reducing the government's information about quality to a noisy rank order measure, the selected firms are forced to participate in a rank order contest. In contrast to the general literature on rank order tournaments, in our scenario rewards are made in terms of an extension of the contract period.

1 Introduction

A serious problem facing a regulator that puts up service contracts for auction is related to quality of the service. In order to save costs, a regulated firm may have incentives to renege on the quality of the product. The obvious way to ensure a satisfactory quality level is to write contracts that specify quality standards. However, since the quality of service is considerably more difficult to monitor than, for instance, the price of service, it may be impossible to write enforceable contracts that completely specify all relevant aspects of quality. There will always be room for disputes between the firm and the government over the level of quality, which cannot simply be resolved by a court of law.

The regulator may still give the regulated firms incentives to provide quality through the time length of the contract. If a firm is promised a long-term contract, the incentives to provide quality in the beginning of the contract period may be weak. The problem of verifying quality favors shorter-term contracts, since firms that reduce quality in order to increase short-term profit are punished by being left out when new contracts are awarded in the near future.

In this paper, we explore how the government may create incentives for regulated firms by letting the contract length depend on the firms' performance. This is achieved by introducing what we call *long-term, non-exclusive contracts*. We do not assume that quality can be observed directly. However, since most often there are several firms that produce the same type of services for the government (e.g. nursing homes, bus companies, refuse collection companies), it may be feasible for the government, or a third party, to perform some type of comparison of firms' quality. In this case, the prolongation of the contract (without competition) is made contingent on the firm's relative performance. What seems realistic is that an independent party can determine - with noise - the firms' quality level relative to other service providers. Measurement methods are available that make it possible to identify both firms that supply good quality and firms that supply poor quality, without evaluating exactly how good the best firms actually are.

Provided with rank order information from a third party, the government may initiate a rank order contest. The rewards to the firms are based on the their ordinal positions alone and not on the actual level of performance (see e.g. Lazear and Rosen (1981), Nalebuff and Stiglitz (1983), and the more recent work by Clark and Riis (1998)).

By linking payment to ranking, the government may actually implement the first best quality level. However, such contracts are not the focus of this paper, most importantly because noise associated with the ranking may make contracts where payment are linked to ranking prone to disputes, costly trials, and even corruption. Instead we study a much simpler mechanism, in which the rewards for the winners of the tournament are renewals of their contracts. We show that by its choice of the number of "winners", the government in effect controls the incentives to provide quality (to a certain extent). In particular, the government may implement the first-best (full information) quality level. However, increasing the incentives to provide quality comes at a cost, as it requires that more firms are replaced each period. Since this means that firms expect to hold the contract for a shorter time spell, the per period transfer to the firms must be higher in order to cover entry costs. The optimal design of long-term non-exclusive contracts therefore implies a lower level of quality than the first-best quality level with full information.

Long-term, non exclusive contracts are widely used. For instance, describing franchise bidding of cable television contracts in the US, Viscusi et al. (1992) refer to long-term, non-exclusive contracts as the most common contract used. These contracts were typically 15 years in length, and the nonexclusivity was explained to give the local government the right to put the franchise up for auction if it found the current franchise owner to be performing in an unsatisfactory manner. A formal analysis of the scope and limits of such contracts therefore seems to be in order.

There exists a literature that addresses the issue of quality and regulation. Che (1993) analyses multidimensional auctions where firms submit bids on price and quality. This obviously require that quality is observable. Laffont and Tirole (1993) analyse the regulation of a firm that produces what they refer to as an "experience good", which has to be purchased before its quality is learned. They derive the optimal contract with heterogenous firms, and show that this contract provides lower incentives for cost reduction (and thus lower information rents) in order to increase the incentives to provide high quality. In Laffont and Tirole's model, as in our model, a motivating factor for providing quality is an increased probability of servicing the government next period. However, in Laffont and Tirole, the probability of service next period is not under direct control of the government, and can therefore not be used as an instrument to improve quality. In our study, in contrast, the probability of continued service is the only tool available for the regulator.

This paper is organized as follows. Section 2 presents the basic model and establishes what we refer to as the first best quality level. Section 3 investigates the renewal policy when only noisy rank order information is available to the government. Sections 4 concludes.

2 The model

Public services are provided by several firms or contractors (e.g. nursing homes or local bus transport in a city). While the level of services produced in these firms is perfectly controlled by the local government, the quality of service is only imperfectly controlled. Although some aspects of quality can be enforced by means of contracts, there will always be some discretion left to the firms when it comes to the quality of service provided. Here we assume that all the verifiable aspects of the service only guaranty a minimum quality level which would be deemed unsatisfactory by the government. The task is therefore to provide a mechanism that will increase the firms' incentives to provide quality.

The basic model goes as follows: The government wants the firms to perform n separate tasks, one task for each firm. All the tasks are identical. The model is set in discrete time, and in each period, the government's preferences are given by the welfare function

$$W = \sum_{i=1}^{n} [U(q_i) - B_i] \tag{1}$$

where q_i is the quality of task i and B_i is the payment to firm i (firm i being the firm performing task i).

The prices of the service, B_i, is determined with the use of a simple auction at the beginning of period 1. Prior to the bidding stage, the government specifies (in addition to the size of production and as far as possible the level of quality) the rule of the game the winning firms will be allowed to play in the future.

The firms are identical and risk neutral and maximize expected discounted profit given by the Bellman equation

$$E\pi = B - c(q) + \gamma\delta E\pi', \tag{2}$$

where γ is the probability of contract renewal after one period. The cost of producing quality is given by a convex function $c(q)$, while δ denotes the discount factor, the same as for the regulator. Finally, $E\pi'$ is the expected discounted profit from the next period and onward. Let q^* denote the value of q that maximizes $E\Pi$. Due to the stationary of the problem, it follows that

$$E\pi = \frac{B^* - c(q^*)}{1 - \gamma\delta}. \tag{3}$$

Due to entry costs, denoted by C, there must always be a strictly positive per period operating surplus, $B - c(q)$. Assuming perfect competition for the contract at the bidding stage, a simple auction makes sure that

$$E\pi = C. \tag{4}$$

When quality is verifiable, γ does not play an important role since a penalty for not supplying the quality that is specified in the contract can be set so as to make it unprofitable to deviate from the contract. When incentives are created by replacing firms obtaining a low ranking, γ plays a potentially much more important role. A firm which has supplied sufficiently low quality compared to other firms, may not have the contract renewed, even though the firm may not have failed in supplying a service in line with the specification of the contract.

Let us first analyze a situation where the government makes the contract contingent on quality. The timing is then as follows. First, the government announces the quality level that will be requested in each period. Second, firms compete for the contract by announcing the per period transfer B they will need in order to produce. Using (3) and (4) above, we see that at stage 1 the government confronts the following relationship between quality and per period transfer: $B = c(q)+C(1-\delta)$. Maximizing welfare with respect to q subject to this relationship, gives

$$U'(q^{FB}) = c'(q^{FB}).$$

We refer to q^{FB} as the first best quality level.

With observable quality, first best may typically also be implemented by playing with the possibility of contract renewal. The government may advertise that whenever a quality level different from q^{FB} is observed, the firm will not have the contract renewed. For this to constitute an equilibrium strategy, the firms best response must be to supply the first best quality level:

$$B^* - c(q^V) < \frac{B^* - c(q^*)}{1-\delta}.$$

Rearranging this condition gives

$$\delta > \frac{c(q^*) - c(q^V)}{B^* - c(q^V)} \equiv \delta^*$$

Intuitively, this constitutes an equilibrium only if the firms put sufficient weight on future profit, or more precisely, as long as $\delta^* < \delta < 1$, there exists an equilibrium in which the firms supply the first best quality level each period.

3 Quality rank-order contests

Although the above section showed that the first best could be reached even if quality was not verifiable, the observability of quality was a crucial assumption behind the result. In many situations, however, observing quality may seem like a strong assumption. What seems more realistic is that the government or an independent party may observe - with some noise though - the ranking of a firm's quality level. They may have a qualified opinion about which firm supplies the best quality, and which firm supplies the poorest quality, without being able to tell exactly how good the quality of the best firm actually is.

The government may then construct a rank order contest, which means that the rewards to the firms are based on the their ordinal positions alone and not on the actual level of performance. If payments are made contingent on ranking, the designer of the contest may govern the incentives of the contestants by manipulating the "prices" associated with a given ranking, and thereby obtaining first best when the contestants are identical (see Lazear and Rosen (1981), Green and Stokey (1983) and Nalebuff and Stiglitz (1983)).

However, as argued in the introduction, it may be hard for the regulator to make payments contingent on ranking: due to the measurement errors, such a system will be prone to costly disputes and even corruption. Still, it is typically at the regulator's discretion whether or not a contract will be renewed at the end of a contract period. Therefore, the regulator may still use the rank-order information to govern incentives; not as in the existing literature by manipulating the prices associated with different rankings, but rather by manipulating the probabilities of getting a price (renewed contract) as a function of ranking.

In what follows, we assume that even though the government knows the technical relationship between costs c that a firm incurs and quality q, it cannot observe a firm's realized costs (which, with our model specification, would imply that the government could infer q). The government,therefore, cannot write contracts on the basis of c.

We assume that the government sets up n different units to be auctioned off prior to period 1. We assume that a third party is able to come up with an ordinal ranking of the quality supplied by the n firms after each period. The government then assigns a probability for having the contract renewed to each of the n possible positions as a function of their ranking. We denote the probability of contract renewal for a firm with ranking k by P_k $(k = 1, .., n)$.

We assume that there is some noise in the ranking process. Formally, we assume that the third party in effect ranks a vector $(q_1 + \epsilon_1, q_2 + \epsilon_2, ..., q_n + \epsilon_n)$, where the error terms $\epsilon_1, ..., \epsilon_n$ are independently drawn from a symmetric unimodal distribution F with mean zero, where f denotes its density. Let the probability that a firm with quality q obtains ranking k, given that the other firms' quality is $\overline{q}$, be denoted by $\mu_k(q, \overline{q})$. Denote by $F_k(\epsilon)$ the k-th order statistics, the probability that k-th largest error term among the $n - 1$ competitors is below ϵ, and by f_k its density. Then it follows

$$\mu_k(q, \overline{q}) = \int_{-\infty}^{\infty} \int_{-\infty}^{q_1 - \overline{q} + \epsilon} f_k(\epsilon) f(\epsilon_1) d\epsilon d\epsilon_1$$

Using the fact that $F_k(\epsilon) := \frac{(n-1)!}{(n-k)!(k-1)!}[1 - F(q_i - \overline{q} + \epsilon)]^{k-1} F(q_i - \overline{q} + \epsilon)^{n-k}$ we find,

$$\mu_k(q,\overline{q}) = \frac{(n-1)!}{(n-k)!(k-1)!}\int [1-F(q_i-\overline{q}+\epsilon)]^{k-1}F(q_i-\overline{q}+\epsilon)^{n-k}f(\epsilon)d\epsilon,$$

Firm i's profit, evaluated at the beginning of period 1, may now be written

$$E\pi = B^i - c(q_i) + \delta\left[\sum_{k=1}^{n}\mu_k P_k\right]E\pi.$$

The first order condition defining the optimal choice of quality is given by

$$-c'(q_i) + \delta\left[\sum_{k=1}^{n}\frac{\partial\mu_k}{\partial q_i}P_k\right]E\pi = 0.$$

In order to investigate the firms' incentives to supply quality, we start by looking at the relationship between the choice of quality and the probability distribution over the n possible positions. Holding the other firms' quality level constant, the effect on μ_k of a marginal increase in quality by firm i is given by

$$\begin{aligned}\frac{\partial\mu_k(q_i,\overline{q})}{\partial q_i} &= \frac{(n-1)!}{(n-k)!(k-1)!}* \\ &\int[(n-k)F(q_i-\overline{q}+\epsilon)^{n-k-1}[1-F(q_i-\overline{q}+\epsilon)]^{k-1} \\ &-(k-1)F(q_i-\overline{q}+\epsilon)^{n-k}[1-F(q_i-\overline{q}+\epsilon)]^{k-2}]f(q_i-\overline{q}+\epsilon)f(\epsilon)d\epsilon.\end{aligned} \tag{5}$$

The first observation we can make is the symmetry around the median position. Inserting the median position in the above expression (i.e. setting $k=\frac{n+1}{2}\equiv m$), we observe that $\frac{\partial\mu_m}{\partial q_i}=0$ evaluated at $q_i=\overline{q}$. That is, increasing quality does not affect the probability of being the median-ranked firm. Further, defining the pairs of position $\{k,k'\}$ by $k'=n+1-k$, we observe that

$$\frac{\partial\mu_k(q_i,\overline{q})}{\partial q_i} = -\frac{\partial\mu_{k'}(q_i,\overline{q})}{\partial q_i},$$

since the distribution of ϵ by assumption is symmetric around zero. This equality says that the increase in the probability of having position k *from the top* exactly balances the decrease in the probability of getting position k up *from the bottom* (i.e. having position k'). This symmetric effect on the probability distribution over the n positions allows us to write the first order condition in the following way

$$-c'(q_i) + \delta \left[\sum_{k=1}^{m} (P_k - P_{k'}) \frac{\partial \mu_k}{\partial q_i} \right] E\pi = 0, \quad \text{with } k' = n + 1 - k.$$

Consequently, the incentive to supply quality can only be provided by treating firms at the k-th and the k'-th positions differently at renewal stages. Increasing P_k and $P_{k'}$ by the same number Δ (keeping all the order Ps constant) will not change the overall incentives to supply quality.

This leads us to the following result.

Proposition 1 *If the government prefers to minimize the number of auctions after each period (everything else being equal),* $\max\{P_k, P_{k'}\} = 1$.

If $\max\{P_k, P_{k'}\} < 1$, the government can reduce the probability of setting up new auctions by increasing both P_k and $P_{k'}$ (i.e. choose a Δ) without changing the incentives to provide quality.

Due to the first order condition, we may also characterize a set of incentive equivalent tournaments. Focusing on a particular set of tournaments that assigns probabilities $\{0, 1\}$ to the n possible positions, we find that the following pair of tournaments

$$(i) \qquad [P_1, .., P_k, P_{k+1}, .., P_m, .., P_{k'}, P_{k'+1}, .., P_n] = [1, .., 1, 0, .., 0, .., 0, 0, .., 0]$$
$$(ii) \qquad [P_1, .., P_k, P_{k+1}, .., P_m, .., P_{k'}, P_{k'+1}, .., P_n] = [1, .., 1, 1, .., 1, .., 1, 0, .., 0]$$

must be incentive equivalent. That is, the power of the incentives, and, hence, the equilibrium quality level, will be identical in these two tournaments. Setting up a tournament that makes the n firms compete to be among the few that are allowed to continue gives exactly the same incentives as a tournament that makes n firms compete not to be among the few that are replaced. However, based on selection criteria accepted in the above lemma, tournament (ii) is preferable to (i), since the number of auctions after each period are lower with (ii).

We now have enough information to draw conclusions about the possibility of implementing the first best quality level with a probability vector $[P_1, .., P_n]$. From the previous subsection, we know that a symmetric equilibrium characterized by

$$\sum_{k=1}^{m} (P_k - P_{k'}) \frac{\partial \mu_k}{\partial q_i} = \frac{U'(q^{FB})}{\delta C} \equiv \Omega$$

implements the first best quality level. Given that the distribution of ϵ is unimodal, it follows that the partial derivatives $\frac{\partial \mu_k}{\partial q_i}$ evaluated at $\bar{q}$ are positive for all k above the median. It thus follows that the power of the incentive scheme is maximized when $[P_1, .., P_m, P_{m+1}, .., P_n] = [1, .., 1, 0, .., 0]$. The following proposition must then hold:

Proposition 2 *If* $\sum_{k=1}^{m} \frac{\partial \mu_k}{\partial q_i} \geq \Omega$, *there exists a vector* $P^* = [1, ..1, P_{\overline{k}'}, 0, ..0]$, *with* $0 \leq P_{\overline{k}'} \leq 1$ *and* $\overline{k}' > m$, *that implements the first best quality level.*

Proof. If $\sum_{k=1}^{m} \frac{\partial \mu_k}{\partial q_i} \geq \Omega$, there exist a $\overline{k}' - 1$, with $\overline{k}' \geq m$, such that (when we use the above definition of a pair of positions $\{k, k'\}$) $\sum_{k=1}^{\overline{k}-1} \frac{\partial \mu_k}{\partial q_i} < \Omega \leq \sum_{k=1}^{\overline{k}} \frac{\partial \mu_k}{\partial q_i}$. But then there must exist a $P_{\overline{k}-1}$ so that $\sum_{k=1}^{\overline{k}-1} \frac{\partial \mu_k}{\partial q_i} + P_{\overline{k}} \frac{\partial \mu_{\overline{k}}}{\partial q_i} = \Omega$. ∎

The government is able to influence the incentives to provide quality by choosing the fraction of firms that are allowed to continue without being challenged by other firms, and under certain conditions, this fraction may be set so as to induce the firms to provide the first best quality level. Due to the incentive equivalence result, we also know that more than 50 per cent of the firms should be allowed to continue. What may obstruct the government in achieving the first best is first of all that firms put to much weight on current profit, i.e. future profit is heavily discounted. Intuitively, an incentive mechanism that awards firms by giving access to future profit, will then not be very efficient in affecting the firms' decisions. Moreover, if entry costs and then also the equilibrium operating profit is low, this way of awarding firms may turn out to be insufficient.

To see why the incentives are maximised when all firms with less than median ranking are replaced, consider first a situation where n is high. Suppose all firms have a quality level $\overline{q}$. The law of large numbers then ensures that the median firm has an error term $\epsilon \approx 0$. Let ΔP_k denote the increased probability of contract renewal obtained by increasing q from $\overline{q}$ to $\overline{q} + \Delta q$, when in total k firms obtain renewal. If all firms below a median ranking get their contract renewed, $\Delta P_m = f(0)\Delta q$. If the firms needs a ranking $k < m$ in order to obtain a new contract, the corresponding increase in probability is $f(\hat{\epsilon}_k)\Delta q$, where $\hat{\epsilon}_k > 0$ is the error term associated with obtaining ranking k (given by $F(\hat{\epsilon}) = (n-k)/n$). Since $f(0) > f(\hat{\epsilon}_k)$ it follows that the equilibrium effect of increased effort in terms of higher probability of contract renewal is higher at the median, hence also the incentives to provide effort. For lower values of n, we cannot apply the law of large number, and the error term for the k'th best firm is stochastich. Still, the density of the error term for the median firm will be highest at 0, and the flavour of the argument still holds.

The value of $f(0)$ can be seen as a measure of the noise in the ranking process. In line with our intuition, we see that maximum quality incentives are lowered if the noise in the ranking process become larger. If there is much noise, it does not pay off to increase quality (which reduces current operating profit) since the probability of getting the low (or high) ranking is not much influenced. In other word, if the ranking decision is noisy, the the firms' actual choice of quality is not important for future renewal decisions. However, as the ranking becomes more accurate, the quality choice becomes more important for the ranking, and hence the probability of renewal. Finally, we see that as the valuation of future profit (δ) increases, the equilibrium quality increases.

It is straight forward to show that the conditons for a local maximum i satisfied in the solution described by Propostion 2. From Proposition 2, inserting P^*, we can write the first order condition as follows,

$$-c'(q_i) + \delta \frac{(n-1)!}{(n-\overline{k}')!(\overline{k}'-1)!} \int S(q_i - \overline{q} + \epsilon; n, \overline{k}') f(\epsilon) d\epsilon E\pi = 0.$$

where

$$\begin{aligned} S(q_i - \overline{q} + \epsilon; n, \overline{k}') \quad : \quad &= [P_{\overline{k}'}(n-\overline{k}')F(q_i - \overline{q} + \epsilon)^{n-\overline{k}'-1}(1 - F(q_i - \overline{q} + \epsilon))^{\overline{k}'-1} + \\ &(1 - P_{\overline{k}'})(\overline{k}'-1)F(q_i - \overline{q} + \epsilon)^{n-\overline{k}'}(1 - F(q_i - \overline{q} + \epsilon))^{\overline{k}'-2}]f(q_i - \overline{q} + \epsilon) \end{aligned}$$

The second order condition for a local maximum is,

$$-c''(q_i) + \delta \frac{(n-1)!}{(n-\overline{k}')!(\overline{k}'-1)!} \int S\prime(q_i - \overline{q} + \epsilon; n, \overline{k}') f(\epsilon) d\epsilon E\pi < 0.$$

Using integration by parts, we can write the second order condition as follows,

$$-c''(q_i) - \delta \frac{(n-1)!}{(n-\overline{k}')!(\overline{k}'-1)!} \int S(q_i - \overline{q} + \epsilon; n, \overline{k}') f\prime(\epsilon) d\epsilon E\pi < 0.$$

Since $\overline{k}' > m = (n+1)/2$ it follows that the function $S(q_i - \overline{q} + \epsilon; n, \overline{k}')$ is tilted to the left (note that $F(1-F)$ is symmetric). As $f(\epsilon)$ is symmetric and unimodal then $|f'(\epsilon)|$ is symmetric as well. Furthermore, since $f'(\epsilon)$ is positive below zero, the integral is clearly positive. Hence the local conditions for a maximum holds. However at low values of q_i the expected profit function becomes convex. The reason is that as the difference $\overline{q} - q_i$ increases, the probability of a renewal is very low (at a finite noise). Hence, the marginal effect on the renewal probability is close to zero at a further decrease. Since the cost of providing quality falls as q_i decreases, expected profits actually increase. This convexity is not disturbing as long as the noise is sufficiently large in the sense that $\overline{k}' < n$, thus $P_n = 0$, which means that a firm that deviates by providing minimum quality loses the contract almost with certainty. In that case $\overline{q}$ is the global maximum if $E\pi > B^*$, that is, if the expected profit in equilibrium exceeds the one period income obtained by providing zero quality. Concequently, the problem may arise only at noise levels so low that even the lowest ranked firm may be awarded a contract renewal, that is if $P_n > 0$. This illustrates the nonconvexity pointed to by Nalebuff and

Stiglitz (1983): If the variance of the ϵ-distribution becomes sufficiently low, a pure strategy equilibrium q^* does not exist. As the variance decreases, the density at zero increases, and, further, as the variance approaches zero, the density $f(0)$ goes to infinity. Consequently, for a sufficiently low variance, the above inequality cannot be met. Although the probability of renewal can be accounted for by lowering $P_1 - P_n$ in order to support a symmetric solution defined by the above first order condition, the solution will for a P_n sufficiently close to one be a local maximum only. Instead of choosing q^*, a firm will benefit from jumping to the lowest possible quality level. With a low variance, this almost guarantees the firm a low ranking, but since the probability of renewal is almost unchanged, the increase in operating profit $c(q^*) - c(q)$ clearly dominates.

3.1 Optimal incentives

We have thus shown that the government may implement the first best quality level through long-term nonexclusive contracts. Note, however, that higher quality comes at a higher cost than in a full information case. In order to increase incentives, more firms will have to be replaced each period, and hence each firm has a smaller number of periods to capitalise on their fixed and sunk entry costs. The regulator must compensate for this through a higher value of B.

To be more specific, note that since all firms choose the same quality level in equilibrium, the probability of obtaining any rank is the same and equal to $1/n$. It follows that the probability of being replaced can be written as $\sigma = \sum_{i=1}^{n} P_i/n$. From the analysis in the last section it follows that we can write the quality level as a function of σ; $q = q(\sigma)$, where $q'(\sigma) > 0$. Alternatively, we may write the required probability σ of replacement as a function of the desired quality level, $\sigma = \sigma(q)$, with $\sigma'(q) > 0$. From equations (3) and (4) we thus find that (since $\sigma = 1 - \gamma$)

$$B = C(1 - (1 - \sigma)\delta) + c(q) \tag{6}$$

The optimal quality level, q^r, maximizes $U(q) - B$, and is thus given by

$$U'(q^r) = c'(q^r) + \sigma'(q^r) \tag{7}$$

Obviously, $q^r < q^{FB}$.

4 Concluding remarks

In this paper, we have investigated how a regulator may give the regulated firms incentives to provide quality by awarding long-term non-exclusive contracts, where firms that fail to perform well compared to other regulated firms are replaced. The need for an awarding mechanism stems from the government's inability to write complete contracts that specify in detail the required level of quality. We show that such a mechanism (under certain conditions) can be used to implement the first best quality level. However, giving incentives to provide quality by replacing firms is costly, and it is therefore optimal for the regulator to implement a quality level that is below the first best level.

Our analysis rests on several simplifying assumptions. Firms that compete for contracts are assumed to be identical, and there is always perfect competition when the government chooses to put contracts up for auction. Competition for the contracts may, however, vary from time to time due to capacity constraints or asymmetric productivity growth between firms. These long-term, non-exclusive contracts may be vulnerable to such variations in the degree of competition. If a firm happens to win a contract at a time of little competition, operating profit will be much higher than "normal". Consequently, such a firm will have more interest in getting a renewal of the contract than other firms.

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