OUTSOURCING IN CONTESTS

FRODE MELAND
ODD RUNE STRAUME

CESIFO WORKING PAPER NO. 1658
CATEGORY 9: INDUSTRIAL ORGANISATION
FEBRUARY 2006

CESifo *Working Paper No. 1658*

OUTSOURCING IN CONTESTS

Abstract

We study ex post outsourcing of production in an imperfectly discriminating contest, interpreted here as a research tournament or a procurement contest for being awarded some production contract. We find that the possibility of outsourcing increases competition between the contestants, leading to higher total contest effort, unless the ex-post bargaining strength of the contest winner is sufficiently low and/or there are very few contestants. However, even in the case of two contestants, outsourcing reduces the procurement costs of inducing a given level of effort if the contest organizer can collect entry fees. With respect to contest design, this suggests that outsourcing should generally be allowed if the objective is to induce stronger competition.

JEL Code: D44, L23, L24.

Keywords: contests, outsourcing, bargaining, contest design.

Frode Meland
Department of Economics
University of Bergen
Hermann Fossgt. 6
5007 Bergen
Norway
frode.meland@econ.uib.no

Odd Rune Straume
Department of Economics
University of Bergen
Hermann Fossgt. 6
5007 Bergen
Norway
odd.straume@econ.uib.no

January 2006
We thank Kurt R. Brekke, Kjell Erik Lommerud and participants at the WZB Conference on "Advances in the Theory of Contests and Tournaments" (Berlin, October 2005) for valuable comments.

1 Introduction

In many cases, competition between firms takes the form of a contest, where firms spend resources in order to win a contested "prize". In this paper, we analyze a situation where the allocation of a production contract is determined in an imperfectly discriminating contest, where a given number of potential suppliers exert sunk effort in order to increase the probability of being awarded the contract. The novel contribution of the paper is that we allow for the possibility of ex-post horizontal outsourcing of production.[1] We analyze how such outsourcing possibilities affect competition between firms in the contest for the prime contract, and we also discuss implications for contest design and social welfare.

There are several general examples of firm competition that fit our contest set-up. Consider competition for big projects or large-scale production contracts in the public procurement business, where the final allocation of the contract may crucially depend on different types of sunk effort undertaken by competing suppliers in order to influence the buyer's decision. For example, a potential supplier might undertake investments in order to improve the quality of his product and tailoring it to match the buyer's needs and requirements, thereby increasing the probability of being awarded the contract. Furthermore, firms may also spend considerable resources on lobbying – even direct bribes – in order to secure lucrative licences or contracts.[2] Since contracts might not be awarded to the most cost-efficient firm, there could be ex post incentives for horizontal outsourcing of production to firms with lower production costs. Some striking anecdotal examples can be found in the clean-up and reconstruction process after Hurricane Katrina in the US. Critical questions have been raised about a number of no-bid and limited-bid contracts which have been given to prime contractors who have allegedly earned excessive profits by subsequently subcontracting the work.[3]

[1] Horizontal outsourcing, where inputs or parts of the final production of a good are subcontracted to rival firms within the same industry, is a common phenomenon in many industries (see, e.g., Kamien et al., 1989, Spiegel, 1993 and Chen et al., 2004, for further discussions).

[2] See, e.g., Konrad (2000) for a further discussion.

[3] Perhaps one of the most controversial cases is the $40 million contract given to the

Another fitting example is R&D tournaments, where firms spend resources on R&D in order to obtain a profitable patent, licence or production contract.[4] An illustrative specific example is US defense procurement, where the "prizes" of research contests held by the Department of Defense are profitable production contracts. Thus, the regulatory structures applies well to the rent-seeking framework of a contest, as also argued by Rogerson (1989). Furthermore, this industry is also characterized by a large extent of post-award subcontracting between firms who were rivals in competition for prime contracts (see, e.g., Alexander, 1997).

How is the possibility of ex post outsourcing likely to affect firms' choice of contest effort? We find that outsourcing tends to increase effort incentives for high-cost firms, due to reduced effective production costs, while the most efficient firm has reduced incentives, since this firm will expect to appropriate part of the contested prize through ex post subcontracts in any case. More specifically, we find that the possibility of outsourcing will increase total contest effort unless there are very few contestants and the ex post bargaining strength of the contest winner is sufficiently low. If there is free entry to the contest, outsourcing tends also to increase the number of active contestants. These results shed some new light on the common view of horizontal subcontracting as a collusive device. Collusion is not an issue in the present paper, but our results show that competition may actually increase from subcontracting between potential suppliers.[5]

What are the implications for optimal contest design?[6] An R&D contest,

Alaskan-owned company Akima Site Operations for the supply of 450 portable classrooms in Mississippi. The company had allegedly not been involved in similar activity before and, therefore, had to rely on subcontracting. The controversy has been further spurred by the strong lobbying connections of Akima's parent company Nana (see, e.g., Lipton, 2005).

[4] See, e.g., Taylor (1995) and Fullerton and McAfee (1999).

[5] In a standard oligopoly model of international trade, Chen et al. (2004) find that horizontal outsourcing has a collusive effect that could raise prices, while Alexander (1997) argues that subcontracts may help facilitate collusive bidding in prime contract auctions. In a framework of strategic outsourcing – though vertical, rather than horizontal – Shy and Stenbacka (2003) and Buehler and Haucaup (2006) all find that outsourcing generally softens competition.

[6] Several suggestions for designing a contest to achieve a specific objective have been formulated in the contest literature, see, e.g., Baye et al. (1993), Fullerton and McAfee

for instance, may very well arise naturally from, say, opportunities of monopolization and patent rights. In many other cases, however, there may be a tournament sponsor initiating the contest. In the case where the prize is an exclusive production contract, should the tournament sponsor allow the winning firm to outsource production ex post? We argue that the decision to allow or disallow outsourcing is not only a potentially effective tool in contest design, it is also a tool that seems easier to support in practice than some of the other measures proposed in the literature.[7]. Indeed, practices on these matters differ, and while allowing outsourcing would probably raise no eyebrows, neither would *not* accepting such schemes, since it can easily be argued – as it frequently is – that this is needed to prevent the diffusion of control and responsibility for the project in question.

If the aim of the contest designer is to maximize total effort, our results suggest – as indicated above – that outsourcing should be allowed in a majority of cases. A case to the contrary, though, is a situation with only two contestants, where outsourcing will *reduce* total effort if the contest winner has sufficiently low bargaining power in setting the terms of the subcontract. However, we show that this latter result is overturned if the contest administrator can also collect *entry fees*. For the case of two contestants, we find that outsourcing will always reduce procurement costs (i.e., the costs of inducing a given level of effort in the contest), which reinforces the policy recommendation of allowing outsourcing.

From a viewpoint of social welfare, though, increased competition for winning a contested prize might not always be desirable. In situations where a considerable amount of contest effort is resources spent on lobbying or bribes, a social planner might want to introduce measures – such as regulation on subcontracting – in order to reduce, for instance, the potential payoff of cor-

(1999), Gradstein and Konrad (1999), Amegashie (1999,2000), Clark and Riis (2000) and Szymanski and Valletti (2004).

[7]For instance, if the aim is to increase contest effort, there may be a case for discriminating against the high-ability/low-cost contestants, by limiting their possibilities to win the contest, in some cases excluding them from the contest altogether (see, e.g., Baye et al., 1993, and Che and Gale, 2003). The aim is to level the playing field and thus induce higher effort, but the approach is questionable when it comes to fair treatment in the more common sense of the term.

rupt behavior by government officials. To capture this possibility, we also study the case where all contest effort is considered socially wasteful. In this case, social welfare is equivalent to aggregate profits. Since our previously discussed results suggested that outsourcing generally leads to increased effort, one might expect that outsourcing is welfare detrimental in these cases if effort is wasteful. However, since high-cost firms may be awarded the contract if outsourcing is not allowed, outsourcing may increase aggregate firm profits even though rent-seeking expenditures increase.

To the best of our knowledge, ours is the only paper dealing with horizontal outsourcing in a contest framework. However, the present paper relates to several earlier contributions on horizontal outsourcing focusing on other modes of competition. Kamien et al. (1989) analyze how the possibility of ex post subcontracting affects the initial competition for a contract in a duopoly under price competition, where the incentive for outsourcing stems from strictly convex production costs. Particular attention is directed towards two polar cases, where either the winner or the loser of the initial contract dictates the terms of the subcontract, and the authors find that competition is higher in the former case. An equivalent result is derived in the present paper, although the framework is quite different.

Spiegel (1993) analyses a duopoly situation which is quite similar to Kamien et al. (1989), the important difference being that firms are assumed to compete in quantities rather than prices.[8] As in our model, but in contrast to Kamien et al. (1989), incentives for subcontracting arise from cost asymmetries. Spiegel (1993) finds that ex post outsourcing is more likely to increase social welfare if the subcontractor's share of the outsourcing surplus is relatively small. Unless contest effort is socially wasteful, this result is also reflected in the present analysis since, in our model, low bargaining strength for the subcontractor tends to increase competition.

Another related paper is Gale et al. (2000), who consider a sequential auction for multiple contracts with ex post subcontracting possibilities between the initial bidders. Once more, outsourcing incentives arise because

[8] Chen et al. (2004) also study horizontal outsourcing under Cournot competition, but in a specific context of international trade.

of cost asymmetries. The authors find that the possibility of ex post outsourcing might make the sellers worse off ex ante. Although the framework is quite different from ours, this result reflects the situation with low bargaining strength for the subcontractor in our model, where we show that outsourcing might reduce ex ante aggregate profits.

The rest of the paper is organized as follows. In the next Section we present the benchmark model without outsourcing – a standard fixed-prize Tullock contest with asymmetric valuations. In Section 3 we introduce the possibility of ex post outsourcing under the assumption of price competition for the subcontract. In Section 4 we relax the assumption of price competition and consider bilateral Nash bargaining as a mechanism for determining the price of the subcontract. In Section 5 we discuss contest design and welfare, while Section 6 concludes the paper.

2 A benchmark model

There are n firms participating in a contest for being awarded a contract for the supply of a good with a gross value of V. Alternatively, the set-up can be thought of as an R&D tournament, with n firms competing to obtain a patent, license, production contract or simply a technological lead, which generates a revenue of V. We assume initially that the firm that wins the contest must supply the good by producing it in-house. The firms are different with respect to cost efficiency in production, implying that their valuation of the contested prize also differ. The net valuation for firm i is given by

$$V_i = V - c_i, \quad i = 1, ..., n. \tag{1}$$

where c_i is firm i's cost of producing the good. We rank the contestants according to their net valuations, so that $c_i < c_{i+1}$, or $V_i > V_{i+1}$.[9]

The probability of being awarded the prize depends on the relative up-front efforts of the contestants. Applying a standard Tullock framework[10]

[9] Net valuations are assumed to be common knowledge.
[10] See Tullock (1980).

the probability that firm i wins the contest is given by

$$P_i = \frac{x_i}{S_n}, \tag{2}$$

where x_i is firm i's effort (in monetary terms), while $S_n := \sum_{j=1}^{n} x_j$ is total effort exerted by all active contestants.[11] Expected profits for firm i are thus given by

$$\pi_i = P_i V_i - x_i. \tag{3}$$

The first-order conditions for profit maximization define individual efforts as

$$x_i = S_n \left(1 - \frac{S_n}{V_i}\right). \tag{4}$$

Contest effort is monotonically increasing in net valuation for each player. In our setting, this means that low-cost firms exert more effort than high-cost firms in the contest. By summing over n and re-arranging (4), assuming that all n firms actively participate in the contest, we can derive total effort in equilibrium:

$$S_n = \left(\frac{n-1}{n}\right) \overline{V}_n, \tag{5}$$

where $\overline{V}_n := n \left(\sum_{j=1}^{n} \frac{1}{V_j}\right)^{-1}$ is the harmonic mean of the n firms' valuations of the contested prize.

It remains to ensure that all n agents will actually choose to participate in the contest.[12] Following Hillman and Riley (1989), we check whether firm $n+1$ has an incentive to contribute a positive amount of effort, given that the other n contestants expect that firm $n+1$ will not contribute. Since π_i is concave in x_i it suffices to evaluate firm $(n+1)$'s contribution incentives

[11] This success function also arises from the more elaborate probability structure presented in Fullerton and McAfee (1999). Baye and Hoppe (2003) establish the strategic equivalence between the Tullock model and a variety of research tournaments and patent race games.

[12] In a perfectly symmetric contest, it is easily shown that all n firms will participate, and that free entry implies $n \to \infty$. Not so when the players' valuations of the contested prize differ.

at $x_{n+1} = 0$:

$$\left.\frac{\partial \pi_{n+1}}{\partial x_{n+1}}\right|_{x_{n+1}=0} = \frac{V_{n+1}}{S_n} - 1. \tag{6}$$

We see that firm $n+1$ will only contribute if $V_{n+1} > S_n$. In the case of free entry of contestants, this also provides the condition for the maximum number of firms that will enter the contest. Using (6), the number of contestants in a free entry equilibrium is the n lowest-cost firms, where n is the lowest integer that satisfies the following condition:

$$V_{n+1} \leq S_n = \left(\frac{n-1}{n}\right)\overline{V}_n. \tag{7}$$

From (6) it also follows, as noted by Stein (2002), that total effort is always lower than the valuation of the active player with the lowest valuation of the prize.[13]

A parametric example

For later comparison, consider the following example. Suppose, like Hillman and Riley (1989) do, that net valuations are geometrically decreasing, such that $V_{i+1} = \alpha V_i$, $\alpha < 1$. The net valuation of firm i can then be characterized as

$$V_i = \alpha^{i-1} v, \quad \alpha \in (0,1), \quad v > 0. \tag{8}$$

Using this specification[14] in (8), total effort in the contest is given by

$$S_n = \frac{v\,(n-1)\,(1-\alpha)}{\alpha\,(\alpha^{-n}-1)}. \tag{9}$$

It is straightforward to verify that $\partial S_n / \partial n < 0$, which complies with the above-stated result that total contest effort is lower than the lowest valuation among the active players in the contest.

---

[13] For a further discussion of equilibrium existence, see, e.g., Fullerton and McAfee (1999).

[14] Equivalently, the production costs of firm i are given by $c_i = V - \alpha^{i-1} v$.

3 Outsourcing

Now we depart from the standard set-up of the previous section to allow for ex-post outsourcing of the awarded prize. More specifically, the winner of the contest can subcontract, or outsource, some or all of the post-contest production activities to one of its competitors. A realistic scenario would be that only parts of the total production is outsourced (e.g., production of some parts and components). Here, we assume – like Kamien et al. (1989) do – that the winner can outsource the entire production of the good. This assumption is only made for analytical clarity and does not qualitatively affect the main workings of the model.

In this model, incentives for ex post outsourcing arise from cost differences in production. Thus, unless the lowest-cost firm (i.e., firm 1) wins the contest, there will always be an incentive for ex-post outsourcing. The crucial questions are to which firm the subcontract is allocated and how the price of the subcontract is determined. As a starting point, we make the simple assumption that the losers in the contest engage in a price competition for being allotted the subcontract. In this case, the equilibrium price for the subcontract is (marginally below) c_2, and firm 1 produces the good in all cases.

With this assumption, all except the lowest-cost firm maximize

$$\pi_i = P_i (V - c_2) - x_i, \quad i = 2, .., n. \tag{10}$$

Thus, the possibility of ex post outsourcing increases the incentives for high-cost firms to exert effort in the contest. This applies even to firms with very high costs, which would otherwise not have participated in the contest.

Firm 1 is different since it can produce with costs c_1, if winning the contest. However, this firm also receives a positive payoff if other firms win, since it then gets paid c_2 to produce the good for the winner. Expected payoffs for firm 1 are thus

$$\pi_1 = P_1 (V - c_1) + (1 - P_1) (c_2 - c_1) - x_1,$$

which can be re-arranged to

$$\pi_1 = P_1 (V - c_2) + (c_2 - c_1) - x_1. \tag{11}$$

Because of the positive payoff from others winning the contest, we see that firm 1 also behaves in the contest *as if* it had costs c_2. Accordingly, firm 1 has a lower incentive to exert effort to win the contest, compared with the benchmark case without the possibility of outsourcing.[15]

Since all firms perceive their costs to be c_2, a *symmetric* equilibrium exists and is given by[16]

$$x_i = (\frac{n-1}{n^2})(V - c_2), \tag{12}$$

which yields equilibrium total contest effort

$$S_n = \left(\frac{n-1}{n}\right)(V - c_2). \tag{13}$$

We summarize the effect of outsourcing on contest effort incentives as follows:

Proposition 1 *The possibility of ex post outsourcing, with price competition for the subcontract, implies that all contestants exert the same level of effort in the contest.*

Thus, ex post outsourcing with price competition levels the playing field completely with respect to the contest, and cost differences between firms do not affect the probability of winning. Furthermore, with respect to expected profits, only the production costs of the two most cost-efficient firms matter. For firms $i \geq 3$, relative cost efficiencies are effectually irrelevant. This follows

[15] Even though outsourcing reduces the effort incentives of firm 1 in this and later applications, firm 1 always stays active. For the case of a fully discriminatory contest, Konrad (2006) finds that cross firm shareholdings may make the ex ante best firm abstain from bidding altogether.

[16] The result that ex post outsourcing with price competition leads to a perfectly symmetric contest holds also for a more general contest success function of the form $P_i = \frac{x_i^r}{\sum_{j=1}^{n} x_j^r}$. Contrary to the benchmark case, closed form solutions for the equilibrium may then be obtained also for $r \neq 1$.

from the assumption that the price of a subcontract is determined by price competition.

How does the possibility of outsourcing affect total contest outlays? Let us first consider the case where the number of active firms, n, is constant. In this case, the effect of outsourcing on total effort is determined by how much firm 1 reduces its effort relative to how much the other firms may increase their effort. This, in turn, depends on the number of contestants and the distribution of net valuations.

Proposition 2 *With n contestants, ex post outsourcing with price competition increases total contest effort if $V_2 > \overline{V}_n$.*

Proof. Follows from a trivial comparison of (5) and (13). ■

For $n = 2$, the net valuation of firm 2 must necessarily be lower than the harmonic mean of the two players' valuations. In this case, the net effect is simply that firm 1 has a lower incentive to win the contest (i.e., firm 1 behaves *as if* it has a lower net valuation), while the objective function of firm 2 remains constant.[17] Accordingly, total effort drops.[18] For $n > 2$, however, the effect on total outlays is a priori ambiguous, and determined by the condition given in Proposition 2. It is possible, though, to say something general about the effect of the number of contestants, n. By applying the entry condition in the benchmark contest without outsourcing, we see that $\overline{V}_n$ is decreasing in n. It follows that a larger number of contestants will increase the probability that outsourcing leads to higher total effort in the contest. This also makes intuitive sense, since a higher number of contestants implies that there are more high-cost firms that have increased incentives to exert effort in the contest due to the possibility of ex post outsourcing.

[17] With only two players, price competition for the subcontract is equivalent to one of the games considered by Kamien et al. (1989), where the terms of the subcontract is determined by the loser of the initial contract.

[18] From (5) we can easily derive the effect of a change in one player's valuation on total effort in the contest. This is given by

$$\frac{\partial S_n}{\partial V_i} = \frac{S_n^2}{(n-1) V_i^2} > 0.$$

In the parametric example presented in the previous Section, total contest effort is given by

$$S_n = \left(\frac{n-1}{n}\right)\alpha v. \tag{14}$$

A comparison of (9) and (14) confirms that the possibility of outsourcing leads to higher total contest outlays if

$$\frac{n(1-\alpha)}{\alpha^2(\alpha^{-n}-1)} < 1. \tag{15}$$

The left-hand side of (15) is increasing in n, implying that outsourcing leading to higher contest effort is more likely the larger the number of firms participating in the contest, as we would expect.[19] In fact, a closer scrutiny of (15) reveals that total effort is always higher in the outsourcing regime if $n \geq 3$. This also tallies well with the results of Stein (2002), who find that more similar valuations generally increase total effort in a Tullock contest.

Entry

The possibility of ex post outsourcing may not only affect contest incentives for a given number of firms, it may also greatly affect entry of new firms into the contest. From Proposition 1 we know that the effect of outsourcing with price competition is to transform an asymmetric contest into a symmetric one, which may trigger entry. We find:

Proposition 3 *Under free entry and an infinite number of potential entrants, ex post outsourcing with price competition leads to*

(i) increased entry of firms,

(ii) increased total contest effort,

(iii) under-dissipation of the contested prize.

[19] An imbedded assumption is then that all n firms would actually participate in the contest under free entry. However, since costs are symmetric for $\alpha = 1$ (where all firms want to participate in the contest), there always exists a range for α where a given number of firms will want to participate in the non-outsourcing contest. In the contest with outsourcing, all firms would like to participate.

Proof. (i) With symmetric valuations, $V_i = \overline{V}_i = V$. From (7) it follows that firm $n+1$ has an incentive to participate in the contest as long as $\frac{n-1}{n} < 1$, which holds trivially for all n. (ii) Since free entry implies $n \to \infty$ in the contest with outsourcing, it follows from a comparison of (5) and (13) that outsourcing leads to an increase in total effort if

$$V_2 > \left(\frac{n-1}{n}\right) \overline{V}_n. \tag{16}$$

From the entry condition in the asymmetric contest we know that, *in equilibrium*, the right-hand side of (16) is decreasing in n. Thus, it suffices to check for $n = 2$. In this case, the condition reduces to $\frac{V_2^2}{V_1+V_2} > 0$, which is trivially true. (iii) In the free entry equilibrium, total contest outlays are given by $V - c_2$, while production costs are c_1. Thus, rent dissipation is given by $\frac{V-c_2+c_1}{V} < 1$. ■

When outsourcing is possible, firms that would otherwise not find it profitable, will enter the contest if entry is free. Price competition for the subcontract implies that the effective cost of all firms except the most cost-efficient, is c_2, which triggers entry of new firms. In a free entry equilibrium, this means that total contest outlays increase. Furthermore, since own production costs do not matter for expected profits, an interesting implication of the equilibrium derived in this Section is that firms that are not able profitably to produce the good themselves have incentives to participate in the contest if they can outsource production to a lower-cost firm ex post.

Once more, we can illustrate our results by applying the parametric example from Section 2. In the asymmetric contest *without outsourcing*, the number of firms, n, participating in the contest under free entry is given by the general condition $V_{n+1} \leq S_n$. In our specific example, n is given by the smallest integer satisfying

$$\alpha^n \leq \frac{(n-1)(1-\alpha)}{\alpha(\alpha^{-n}-1)}. \tag{17}$$

Assume that $\alpha = 0.9$. This yields $n = 5$, and total contest outlays in equilibrium are approximately $0.64v$. On the other hand, if these 5 firms enter the contest with the possibility of ex post outsourcing, total contest effort is given by (14), which in this example amounts to $0.72v$. Finally, if there are infinitely many potential entrants to the contest, the possibility of outsourcing produces a total contest outlay of $0.9v$. Thus, outsourcing leads to more rent dissipation, and the possibility of additional entry reinforces this effect.

Summing up, the results of this Section suggest that rent-seeking will generally be higher with outsourcing than without. The only clear-cut case to the contrary, is when there are only two potential contestants, in which case contest effort is certain to fall.

4 Nash bargaining

In the analysis thus far we have assumed that, in case of outsourcing, the terms of the subcontract are determined by price competition among the potential subcontractors. Although this is, in some sense, a natural assumption, it also yields implications that might seem somewhat unrealistic. In particular, it seems reasonable to argue that a firm's own production costs should somehow affect its expected profits in the contest. Furthermore, pure price competition might be a particularly strong assumption in the case of few contestants. For example, with only two contestants, price competition for the subcontract implies that the losing firm unilaterally determines the price of the subcontract, which is a somewhat extreme assumption. In order to deal with these concerns, we relax the assumption of price competition and assume that, in case of outsourcing, the terms of the subcontract is determined in bilateral Nash bargaining.

Assume that, upon winning the contest, firm i (≥ 2) can go to only one firm for negotiating a possible subcontract. This would be a reasonable scenario if bargaining costs are high. We assume that the winner always maximizes the total surplus of outsourcing by approaching firm 1 to negotiate the terms of a subcontract, and that the payoff to each party is given by the asymmetric Nash bargaining solution. We let the bargaining power of the contest winner be given by $\beta \in (0, 1)$. This implies that outsourcing transforms the effective costs of firm i from c_i to $(1-\beta)c_i + \beta c_1$.[20]

Under these assumptions, the maximand of firm $i \geq 2$ is

$$\pi_i = P_i \left(V - (1-\beta)c_i - \beta c_1\right) - x_i, \quad i = 2, .., n, \tag{18}$$

while firm 1 maximizes

$$\pi_1 = P_1 \left(V - c_1\right) + (1-\beta) \sum_{i=2}^{n} \left[P_i \left(c_i - c_1\right)\right] - x_1. \tag{19}$$

The first observation worth making is that, unlike for the case of pure price competition for the subcontract, the contest is generally asymmetric. This means that the participation condition given in (7) applies.

Maximizing (18) and (19), the first order conditions for firm 1 and for any firm $i \geq 2$ are given by

$$x_1 = S_n \left[1 - \left(\frac{S_n}{V - c_1}\right)\right] - \left(\frac{1-\beta}{V-c_1}\right) \sum_{i=2}^{n} \left[x_i(c_i - c_1)\right] \tag{20}$$

and

$$x_i = S_n \left[1 - \left(\frac{S_n}{V - (1-\beta)c_i - \beta c_1}\right)\right]. \tag{21}$$

Inserting (21) into (20) and aggregating, we arrive – after some manipulations – at the following expression for equilibrium total contest effort:

$$S_n = \left(\frac{n-1}{n}\right)(V - c_1) - \left(\frac{1-\beta}{n}\right) \sum_{i=2}^{n} (c_i - c_1). \tag{22}$$

We can summarize the characteristics of the contest equilibrium as follows:

Proposition 4 *With ex post outsourcing and bilateral Nash bargaining for the price of the subcontract, then*

(i) the contest is asymmetric if $\beta < 1$ and $n > 2$,

(ii) total contest effort increases in β,

[20] This cost could also arise if, for instance, the contest winner were able to make a credible take-it-or-leave-it offer to firm 1, but had to do a portion $(1-\beta)$ of the production himself.

(iii) the contested prize is fully dissipated under free entry if $\beta \to 1$.

Proof. Follows straightforwardly from (18)-(22). ■

The bargaining parameter β plays a crucial role for the firms' behavior in the contest. From the payoff functions and the first-order conditions, we see that a higher value of β effectually contributes to making the contest more symmetric, which increases total effort in the contest equilibrium. Intuitively, a higher value of β means that the lowest-cost firm gets stronger incentives to win the contest, since the expected terms of the subcontract will be worse, from firm 1's viewpoint, if another firm wins the contest. On the other hand, since a higher value of β implies that all other firms $i \geq 2$ will have lower effective costs if winning the contests, these firms are also spurred to exert more contest effort.[21] In the limit case, $\beta \to 1$, where the winner of the contest has all bargaining power in determining the price of the subcontract, total contest effort approaches $\left(\frac{n-1}{n}\right)(V - c_1)$. Thus, free entry will contribute to full rent-dissipation if $\beta \to 1$, something that was not possible with price competition for the subcontract.[22]

It is also clear that if n and β are sufficiently low, outsourcing with Nash bargaining can reduce total contest effort compared with the case of no outsourcing.[23] For the special case of $\beta = 0$, rent-seeking is actually reduced regardless of the number of firms. One might view this result with some scepticism, though. If firm i wins the contest and has low bargaining strength, the agreed price (and hence, the effective cost of firm i) will be close to firm i's own costs, even though these may far exceed the production costs of other low-cost firms. Incentives to bargain with other firms thus naturally emerge. Let us therefore restrict attention to situations where the

[21] For the case of $n = 2$, we have already seen (the price competition case) that the two firms have the same incentives to exert effort for $\beta = 0$. An increase in β for $n = 2$ turns out to increase the effort incentives of both firms equally, and thus the contest remains symmetric for all $\beta \in (0, 1)$.

[22] The extreme case of $\beta \to 1$ corresponds to the other of the (two-player) games considered by Kamien et al. (1989), where the terms of the subcontract are determined by the winner of the initial contract.

[23] For example, if $n = 2$ and $\beta = 0$, the price for the subcontract if firm 2 wins will be identical under Nash bargaining and price competition. In this case, the terms of the subcontract are effectually determined by the loser of the contest, and we have already seen that this reduces total effort.

agreed price is actually lower than or equal to c_2, i.e., $(1-\beta)c_i + \beta c_1 \leq c_2$. This places a lower bound on β, given by $\underline{\beta} := (c_i - c_2)/(c_i - c_1)$. If we let superscripts PC and NB denote price competition and Nash bargaining, respectively, this means that

$$\begin{aligned} S_n^{NB} &= \left(\frac{n-1}{n}\right)(V-c_1) - \left(\frac{1-\beta}{n}\right)\sum_{i=2}^{n}(c_i - c_1) \\ &\geq \left(\frac{n-1}{n}\right)(V-c_2) = S_n^{PC}. \end{aligned} \tag{23}$$

Thus, with the assumption that the bargained price should be better than any feasible alternative, total contest effort under Nash bargaining is never less extensive than in the price-competition case.[24]

5 Contest design and welfare

Our setting does not only apply to R&D contests and lobbying/bribery games that arise "naturally" through the potential for monopolization or patent rights. Also one-off R&D contests that are specifically designed may be discussed using our model. From a policy perspective, should ex post outsourcing of production be allowed?[25,26] This is likely to depend on the nature and

[24] The somewhat ad-hoc assumption that the bargained outsourcing price should not exceed any feasible alternative can be conceptualized by considering the following joint bargaining/price competition framework. If firm 2 wins the contest, it enters into bargaining with firm 1, since no other firm can offer a more beneficial outsourcing contract. However, if any firm $i \geq 3$ wins the contest, this firm may play the lower cost firms against one another to obtain an outsourcing price of c_2. Cooperative solutions may also be discussed, and a simple application of the Shapley value (determining ex post payoffs) to this problem seems to confirm the qualitative results found above.

[25] We are not discussing *optimal* design in this paper and the Tullock success function should therefore be seen as capturing some real aspects of innovation technology (highest effort does not secure the most desirable plan). Allowing or disallowing outsourcing is however a design instrument also in this case – and as it turns out, a potentially important one at that.

[26] The reader may ask why the contest designer cannot set up the contest in separate design and production stages so as to bypass the outsourcing issue and potentially do better for himself. This, however, raises moral hazard concerns: Launching a design contest and then auctioning out the production licence can give firms incentives to design a project in such a way that it is very hard for the competitors to produce it. Furthermore, it may be

interpretation of the contest. A widely used assumption in the contest design literature is the maximization of total contest effort. This seems a reasonable approach in the context of an R&D tournament. The effect of outsourcing on total effort has been analyzed in great detail in previous sections. The discussion so far suggests that, by allowing for outsourcing, aggregate contest effort increases if *i)* there are more than only a few potential contestants and *ii)* the high cost firms have a fair degree of ex post bargaining strength relative to the most efficient firm. With only two contestants, however, the possibility of outsourcing *reduces* total effort if the low-cost firm has sufficient bargaining power. There may be more instruments available to the contest administrator, though. In the first part of this Section we extend the analysis to consider also the case where a contest designer can collect entry fees from the contestants, along the lines of Fullerton and McAfee (1999).

However, increased contest effort may not always be desirable from a viewpoint of social welfare. Bribery is an obvious example, but socially excessive effort is also a possibility in, say, a research contest. Long patent protection or licensing periods (i.e., high prizes) may induce inefficiently high levels of effort, and in any case, higher effort also means lower aggregate profits. In the extreme case, were all effort is considered to be socially wasteful, the relevant welfare measure is aggregate profits. Outsourcing improves ex post allocative efficiency, but it may also induce more wasteful effort in the contest. In the latter part of this Section we highlight the trade-off between improved allocative efficiency and potential excessive effort, induced by ex post outsourcing.

5.1 Entry fees

The analysis in this subsection is closely related to Fullerton and McAfee (1999). They analyze a situation where the contest designer is able to collect entry fees for participation in an R&D tournament, aiming to minimize the costs of inducing a given level of effort. Assuming a uniform entry fee, E, if

of great importance to the producers to have unlimited access to the designers during the production phase, something which is not likely to be the case if a rival of the designer firm gets the production contract.

the contest designer wants n firms to participate, he must choose the entry fee such that firm n makes non-negative expected profits while firm $n+1$ makes negative expected profits. Of course, there is no reason to let the n'th firm have any surplus, so the expected profits of this firm equals the optimal entry fee, i.e., $\pi_n = E$. Fullerton and McAfee (1999) show that, for a large class of contests, the optimal number of contestants which should be chosen in order to induce a given total effort at lowest possible procurement costs, $\Omega := V - nE$, is two.[27] Here, we extend their analysis by asking whether ex post outsourcing should be allowed, restricting our attention to the two-firm case.

Benchmark: No outsourcing

In the non-outsourcing benchmark case with two firms, the prize V needed to induce aggregate contest effort S, is given by

$$S = \frac{(V - c_1)(V - c_2)}{2V - c_1 - c_2}. \tag{24}$$

Solving for V yields

$$V = S\left[1 + \frac{c_2 + c_1}{2S} + \sqrt{1 + \left(\frac{c_2 - c_1}{2S}\right)^2}\right]. \tag{25}$$

The optimal entry fee is given by $E = \pi_2$, yielding

$$E = \frac{(V - S - c_2)^2}{V - c_2}, \tag{26}$$

[27] The intuition goes as follows. A lower number of contestants increases the spending (prize) needed to induce a given level of effort, but this is outweighed by the possibility to set higher entry fees due to higher expected profits of the remaining contestants. Similar results are found by Taylor (1995), Che and Gale (2003) and Moldovanu and Sela (2006).

where V is given by (25). Total procurement costs for inducing effort S in the benchmark case are then given by

$$\Omega^{BM} = c_2 + S\left[1 + \frac{\left(\sqrt{1+\lambda^2} - \lambda\right)(1+2\lambda) - 1}{1 - \lambda + \sqrt{1+\lambda^2}}\right], \tag{27}$$

where

$$\lambda := \frac{c_2 - c_1}{2S} > 0.$$

Outsourcing

Now consider the possibility of allowing ex post outsourcing. With two contestants, asymmetric Nash bargaining for the price of the subcontract encompasses all feasible possibilities, yielding outsourcing prices in the interval $[c_1, c_2]$, depending on the bargaining parameter β. From (22), total contest effort is given by

$$S = \frac{1}{2}\left[V - c_1 - (1-\beta)(c_2 - c_1)\right]. \tag{28}$$

Thus, inducing a level of effort S necessitates a contest prize

$$V = 2S + (1-\beta)c_2 + \beta c_1, \tag{29}$$

and the optimal entry fee is found to be

$$E = \frac{S}{2}. \tag{30}$$

Perhaps surprisingly, we see that inducing a given level of effort always yields the same profits for firm 2, regardless of the ex post outsourcing arrangements. In other words, regardless of the division of ex post surplus, if a contest administrator wants to induce effort S, the highest entry fee she can take is $S/2$ to ensure that two firms will participate in the contest.

Total procurement costs with ex post outsourcing are then given by

$$\Omega^{NB} = S + \beta c_1 + (1-\beta)c_2. \tag{31}$$

The effect of outsourcing on total procurement costs are given by a comparison of (27) and (31). We see that $\Omega^{NB} < \Omega^{BM}$ for all $\beta \in (0,1)$ if the terms in square brackets in (27) exceed 1. It is easily verified that this is always the case.[28] Thus, ex post outsourcing should always be allowed in the two-firm case when the contest administrator can collect entry fees.

The intuition is as follows: Consider first the case where β is relatively high. Then outsourcing raises total contest effort, due to increased effort incentives for the high-cost firm, implying that a given level of effort can be induced by offering a lower prize. Furthermore, a larger share of aggregate profits can be captured by the entry fee. In the limit case of $\beta \to 1$, both firms have the same expected profits, all of which are captured by the optimal entry fee. In sum, total procurement costs decline.

On the other hand, if β is relatively low, we know that outsourcing always reduces total effort, due to the reduced incentives of the low-cost firm to exert effort in the contest. This must be compensated for by a higher contest prize, which – all else equal – increases total procurement costs. However, the reduction of firm 1's contest effort raises the expected profits of firm 2 in equilibrium, which implies that a higher entry fee can be collected while still inducing firm 2 to participate in the contest. This more than offsets the prize increase, implying that total procurement costs decline also in this case.

We summarize our results as follows.

Proposition 5 *With two contestants, the possibility of ex post outsourcing reduces total procurement costs when entry fees can be collected.*

5.2 Socially wasteful effort

Finally, to deal with the question of socially wasteful effort, we now make the extreme assumption that all contest effort is considered socially wasteful or unwanted. We can think of such effort as lobbying or bribery undertaken by

[28] We need to have $\frac{\left(\sqrt{1+\lambda^2}-\lambda\right)(1+2\lambda)-1}{1-\lambda+\sqrt{1+\lambda^2}} > 0$. It can be verified that this expression has a single positively valued maximum for $\lambda = \frac{3}{4}$ and approaches zero in the limits ($\lambda \to 0$ and $\lambda \to \infty$).

firms in order to increase the probability of being awarded, e.g., a government contract.[29] Is the possibility of ex post outsourcing likely to be socially beneficial in this case?

When effort is socially wasteful, the reasonable measure of social welfare is expected aggregate profits. The possibility of outsourcing improves ex post allocative efficiency, which is unambiguously positive from a welfare perspective. However, it may also increase incentives for socially wasteful effort. We can capture this trade-off by maintaining our two-firm example with asymmetric Nash bargaining for the subcontract.

Without outsourcing, individual and total contest efforts, respectively, are given by (4) and (5), yielding expected aggregate profits

$$\sum_{i=1}^{2} \pi_i^{BM} = \frac{V(V - c_1 - c_2) + c_1^2 + c_2^2 - c_1 c_2}{2V - c_1 - c_2}. \tag{32}$$

On the other hand, with ex post outsourcing, we saw in Section 4 that the contest becomes perfectly symmetric with two firms. Total effort is given by (28), while expected aggregate profits are

$$\sum_{i=1}^{2} \pi_i^{NB} = \frac{1}{2}\left[V - c_1 + (1-\beta)(c_2 - c_1)\right]. \tag{33}$$

Comparing the two cases, outsourcing is socially beneficial if

$$\sum_{i=1}^{2} \left(\pi_i^{NB} - \pi_i^{BM}\right) = \frac{(c_2 - c_1)}{2}\left[\frac{3(V - c_2)}{2V - c_1 - c_2} - \beta\right] > 0. \tag{34}$$

For the special case of $\beta = 0$, where the most efficient firm dictates the terms of the subcontract, the possibility of ex post outsourcing unambiguously improves social welfare. Wasteful effort is reduced, due to the reduced effort incentives of the most efficient firm, and ex post allocative efficiency is improved.

However, outsourcing is less likely to be socially beneficial the higher is β.

[29] Clark and Riis (2000) study allocational efficiency in bribery contests for government contracts. Ex post outsourcing of the contract is not an issue, though.

The reason is that a higher level of β increases incentives for socially wasteful effort when ex post outsourcing is a possibility. More bargaining strength to the least efficient firm increases this firm's net valuation of winning the contest, with a corresponding stronger incentive to exert effort. At the same time, the low-cost firm also gets a stronger incentive to win the contest, since a higher β implies that the subcontract becomes less profitable for this firm if it does not win the contest.

From (34) we see that outsourcing will in fact reduce expected aggregate profits for sufficiently high levels of β if

$$\frac{3\,(V - c_2)}{2V - c_1 - c_2} < 1, \tag{35}$$

which can be expressed as

$$V - c_2 < c_2 - c_1. \tag{36}$$

In words, this condition states that the net valuation of the high-cost firm in the absence of outsourcing must be lower than the cost difference between the firms. If this is the case, the high-cost firm has low incentives to exert effort in the contest, absent outsourcing, relative to the low-cost firm. Thus, the probability that the most efficient firm will win the contest anyway is relatively high. This implies, in turn, that the improved allocative efficiency due to outsourcing is relatively moderate, and outweighed by the effect of increased total effort for sufficiently high level of β. In other words, if $V - c_2 < c_2 - c_1$, there exists a critical value $\beta^* < 1$ such that outsourcing is socially detrimental if $\beta \in (\beta^*, 1)$.

6 Concluding remarks

We have analyzed the strategic effects and implications of ex post outsourcing in situations where competition between firms take on the characteristics of an imperfectly discriminating contest for profitable production contracts or licences. While horizontal outsourcing is often thought to facilitate collusion, we have shown that such arrangements might instead increase competition between firms in a majority of cases. With respect to contest design, whether or not such competition is desirable depends both on the interpretation of the model and the objective of the contest organizer. In a procurement contest, allowing outsourcing might increase the quality of the procured good, for example through higher R&D investments by the contestants, but it might also increase incentives for lobbying and bribery.

References

[1] Alexander, B.J., 1997. Mechanisms for rent transfers: subcontracting among military aircraft manufacturers. Public Choice, 91, 251–269.

[2] Amegashie, J.A., 1999. The design of rent-seeking competitions: comittees, preliminary and final contests. Public Choice, 99, 63–76.

[3] Amegashie, J.A., 2000. Some results on rent-seeking contests with shortlisting. Public Choice, 105, 245–253.

[4] Baye, M.R., Kovenock, D., de Vries, C.G., 1993. Rigging the lobbying process: an application of the all-pay auction. American Economic Review, 83, 289–294.

[5] Baye, M.R., Hoppe, H.C., 2003. The strategic equivalence of rent-seeking, innovation, and patent-race games. Games and Economic Behavior, 44, 217–226.

[6] Buehler, S., Haucap, J., 2006. Strategic outsourcing revisited. Journal of Economic Behavior & Organization, forthcoming.

[7] Che, Y.-K., Gale, I., 2003. Optimal design of research contests. American Economic Review, 93, 646–671.

[8] Chen, Y., Ishikawa, J., Yu, Z., 2004. Trade liberalization and strategic outsourcing. Journal of International Economics, 63, 419–436.

[9] Clark, D.J., Riis, C., 2000. Allocation efficiency in a competitive bribery game. Journal of Economic Behavior & Organization, 42, 109–124.

[10] Fullerton, R.L., McAfee, R.P., 1999. Auctioning entry into tournaments. Journal of Political Economy, 107, 573–605.

[11] Gale, I.L., Hausch, D.B., Stegeman, M., 2000. Sequential procurement with subcontracting. International Economic Review, 41, 989–1020.

[12] Gradstein, M., Konrad, K.A., 1999. Orchestrating rent seeking contests. Economic Journal, 109, 536–545.

[13] Hillman A.L., Riley, J.G., 1989. Politically contestable rents and transfers. Economics and Politics, 1, 17–39.

[14] Kamien, M.I., Li, L., Samet, D., 1989. Bertrand competition with subcontracting. RAND Journal of Economics, 20, 553–567.

[15] Konrad, K.A., 2000. Trade contests. Journal of International Economics, 51, 317–334.

[16] Konrad, K.A., 2006. Silent interests and all-pay auctions. International Journal of Industrial Organization, forthcoming.

[17] Lipton, E., 2005. Deal to replace schools after Katrina is faulted. New York Times, November 11, Section A, Page 1, Column 2.

[18] Moldovanu, B., Sela, A., 2004. Contest architecture. Journal of Economic Theory, 126, 70–96.

[19] Rogerson, W.P., 1989. Profit regulation of defense contractors and prizes for innovation. Journal of Political Economy, 97, 1284–1305.

[20] Shy, O., Stenbacka, R., 2003. Strategic outsourcing. Journal of Economic Behavior & Organization, 50, 203–224.

[21] Spiegel, Y., 1993. Horizontal subcontracting. RAND Journal of Economics, 24, 570–590.

[22] Stein, W.E., 2002. Asymmetric rent-seeking with more than two contestants. Public Choice, 113, 325–336.

[23] Szymanski, S., Valletti, T.M., 2004. First and second prizes in imperfectly discriminating contests. CEPR Discussion Paper No. 4484.

[24] Taylor, C.R., 1995. Digging for golden carrots: an analysis of research tournaments. American Economic Review, 85, 872–890.

[25] Tullock, G., 1980. Efficient rent-seeking. In Buchanan, J., Tollison, R., Tullock, G. (eds.), Towards a theory of the rent-seeking society. College Station, Texas A&M University Press.

CESifo Working Paper Series

(for full list see www.cesifo-group.de)

1597 Petra Geraats, Transparency of Monetary Policy: Theory and Practice, November 2005

1598 Christian Dustman and Francesca Fabbri, Gender and Ethnicity – Married Immigrants in Britain, November 2005

1599 M. Hashem Pesaran and Martin Weale, Survey Expectations, November 2005

1600 Ansgar Belke, Frank Baumgaertner, Friedrich Schneider and Ralph Setzer, The Different Extent of Privatisation Proceeds in EU Countries: A Preliminary Explanation Using a Public Choice Approach, November 2005

1601 Jan K. Brueckner, Fiscal Federalism and Economic Growth, November 2005

1602 Steven Brakman, Harry Garretsen and Charles van Marrewijk, Cross-Border Mergers and Acquisitions: On Revealed Comparative Advantage and Merger Waves, November 2005

1603 Erkki Koskela and Rune Stenbacka, Product Market Competition, Profit Sharing and Equilibrium Unemployment, November 2005

1604 Lutz Hendricks, How Important is Discount Rate Heterogeneity for Wealth Inequality?, November 2005

1605 Kathleen M. Day and Stanley L. Winer, Policy-induced Internal Migration: An Empirical Investigation of the Canadian Case, November 2005

1606 Paul De Grauwe and Cláudia Costa Storti, Is Monetary Policy in the Eurozone less Effective than in the US?, November 2005

1607 Per Engström and Bertil Holmlund, Worker Absenteeism in Search Equilibrium, November 2005

1608 Daniele Checchi and Cecilia García-Peñalosa, Labour Market Institutions and the Personal Distribution of Income in the OECD, November 2005

1609 Kai A. Konrad and Wolfgang Leininger, The Generalized Stackelberg Equilibrium of the All-Pay Auction with Complete Information, November 2005

1610 Monika Buetler and Federica Teppa, Should you Take a Lump-Sum or Annuitize? Results from Swiss Pension Funds, November 2005

1611 Alexander W. Cappelen, Astri D. Hole, Erik Ø. Sørensen and Bertil Tungodden, The Pluralism of Fairness Ideals: An Experimental Approach, December 2005

1612 Jack Mintz and Alfons J. Weichenrieder, Taxation and the Financial Structure of German Outbound FDI, December 2005

1613 Rosanne Altshuler and Harry Grubert, The Three Parties in the Race to the Bottom: Host Governments, Home Governments and Multinational Companies, December 2005

1614 Chi-Yung (Eric) Ng and John Whalley, Visas and Work Permits: Possible Global Negotiating Initiatives, December 2005

1615 Jon H. Fiva, New Evidence on Fiscal Decentralization and the Size of Government, December 2005

1616 Andzelika Lorentowicz, Dalia Marin and Alexander Raubold, Is Human Capital Losing from Outsourcing? Evidence for Austria and Poland, December 2005

1617 Aleksander Berentsen, Gabriele Camera and Christopher Waller, Money, Credit and Banking, December 2005

1618 Egil Matsen, Tommy Sveen and Ragnar Torvik, Savers, Spenders and Fiscal Policy in a Small Open Economy, December 2005

1619 Laszlo Goerke and Markus Pannenberg, Severance Pay and the Shadow of the Law: Evidence for West Germany, December 2005

1620 Michael Hoel, Concerns for Equity and the Optimal Co-Payments for Publicly Provided Health Care, December 2005

1621 Edward Castronova, On the Research Value of Large Games: Natural Experiments in Norrath and Camelot, December 2005

1622 Annette Alstadsæter, Ann-Sofie Kolm and Birthe Larsen, Tax Effects, Search Unemployment, and the Choice of Educational Type, December 2005

1623 Vesa Kanniainen, Seppo Kari and Jouko Ylä-Liedenpohja, Nordic Dual Income Taxation of Entrepreneurs, December 2005

1624 Lars-Erik Borge and Linn Renée Naper, Efficiency Potential and Efficiency Variation in Norwegian Lower Secondary Schools, December 2005

1625 Sam Bucovetsky and Andreas Haufler, Tax Competition when Firms Choose their Organizational Form: Should Tax Loopholes for Multinationals be Closed?, December 2005

1626 Silke Uebelmesser, To go or not to go: Emigration from Germany, December 2005

1627 Geir Haakon Bjertnæs, Income Taxation, Tuition Subsidies, and Choice of Occupation: Implications for Production Efficiency, December 2005

1628 Justina A. V. Fischer, Do Institutions of Direct Democracy Tame the Leviathan? Swiss Evidence on the Structure of Expenditure for Public Education, December 2005

1629 Torberg Falch and Bjarne Strøm, Wage Bargaining and Political Strength in the Public Sector, December 2005

1630 Hartmut Egger, Peter Egger, Josef Falkinger and Volker Grossmann, International Capital Market Integration, Educational Choice and Economic Growth, December 2005

1631 Alexander Haupt, The Evolution of Public Spending on Higher Education in a Democracy, December 2005

1632 Alessandro Cigno, The Political Economy of Intergenerational Cooperation, December 2005

1633 Michiel Evers, Ruud A. de Mooij and Daniel J. van Vuuren, What Explains the Variation in Estimates of Labour Supply Elasticities?, December 2005

1634 Matthias Wrede, Health Values, Preference Inconsistency, and Insurance Demand, December 2005

1635 Hans Jarle Kind, Marko Koethenbuerger and Guttorm Schjelderup, Do Consumers Buy Less of a Taxed Good?, December 2005

1636 Michael McBride and Stergios Skaperdas, Explaining Conflict in Low-Income Countries: Incomplete Contracting in the Shadow of the Future, December 2005

1637 Alfons J. Weichenrieder and Oliver Busch, Artificial Time Inconsistency as a Remedy for the Race to the Bottom, December 2005

1638 Aleksander Berentsen and Christopher Waller, Optimal Stabilization Policy with Flexible Prices, December 2005

1639 Panu Poutvaara and Mikael Priks, Violent Groups and Police Tactics: Should Tear Gas Make Crime Preventers Cry?, December 2005

1640 Yin-Wong Cheung and Kon S. Lai, A Reappraisal of the Border Effect on Relative Price Volatility, January 2006

1641 Stefan Bach, Giacomo Corneo and Viktor Steiner, Top Incomes and Top Taxes in Germany, January 2006

1642 Johann K. Brunner and Susanne Pech, Optimum Taxation of Life Annuities, January 2006

1643 Naércio Aquino Menezes Filho, Marc-Andreas Muendler and Garey Ramey, The Structure of Worker Compensation in Brazil, with a Comparison to France and the United States, January 2006

1644 Konstantinos Angelopoulos, Apostolis Philippopoulos and Vanghelis Vassilatos, Rent-Seeking Competition from State Coffers: A Calibrated DSGE Model of the Euro Area, January 2006

1645 Burkhard Heer and Bernd Suessmuth, The Savings-Inflation Puzzle, January 2006

1646 J. Stephen Ferris, Soo-Bin Park and Stanley L. Winer, Political Competition and Convergence to Fundamentals: With Application to the Political Business Cycle and the Size of Government, January 2006

1647 Yu-Fu Chen, Michael Funke and Kadri Männasoo, Extracting Leading Indicators of Bank Fragility from Market Prices – Estonia Focus, January 2006

1648 Panu Poutvaara, On Human Capital Formation with Exit Options: Comment and New Results, January 2006

1649 Anders Forslund, Nils Gottfries and Andreas Westermark, Real and Nominal Wage Adjustment in Open Economies, January 2006

1650 M. Hashem Pesaran, Davide Pettenuzzo and Allan G. Timmermann, Learning, Structural Instability and Present Value Calculations, January 2006

1651 Markku Lanne and Helmut Luetkepohl, Structural Vector Autoregressions with Nonnormal Residuals, January 2006

1652 Helge Berger, Jakob de Haan and Jan-Egbert Sturm, Does Money Matter in the ECB Strategy? New Evidence Based on ECB Communication, January 2006

1653 Axel Dreher and Friedrich Schneider, Corruption and the Shadow Economy: An Empirical Analysis, January 2006

1654 Stefan Brandauer and Florian Englmaier, A Model of Strategic Delegation in Contests between Groups, January 2006

1655 Jan Zápal and Ondřej Schneider, What are their Words Worth? Political Plans and Economic Pains of Fiscal Consolidations in New EU Member States, January 2006

1656 Thiess Buettner, Sebastian Hauptmeier and Robert Schwager, Efficient Revenue Sharing and Upper Level Governments: Theory and Application to Germany, January 2006

1657 Daniel Haile, Abdolkarim Sadrieh and Harrie A. A. Verbon, Cross-Racial Envy and Underinvestment in South Africa, February 2006

1658 Frode Meland and Odd Rune Straume, Outsourcing in Contests, February 2006