



Incomplete contracts and excludable public goods[☆]

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ABSTRACT

We study whether a firm that produces and sells access to an excludable public good should face a self-financing requirement, or, alternatively, receive subsidies that help to cover the cost of public-goods provision. The main result is that the desirability of a self-financing requirement is shaped by an equity-efficiency trade-off: while first-best efficiency is out of reach with such a requirement, its imposition limits the firm's ability of rent extraction. Hence, consumer surplus may be higher if the firm has no access to public funds.

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1. Introduction

This paper studies whether a firm who produces and prices an excludable public good should face a self-financing requirement, or whether tax revenues should be used to cover parts of the costs. If we think of the excludable public good as a bridge, the question that is addressed in this paper can be framed as follows: should the financing of the bridge rely exclusively on tolls, or is there a role for a head tax that every inhabitant of the relevant city has to pay, irrespectively of whether he will cross the bridge frequently or only rarely. Alternatively, if the excludable public good is a network for telecommunications, the question is whether this infrastructure investment must be financed exclusively out of the revenues that can be generated by selling telecom services, or whether there is a role for taxes.

The disadvantage of self-financing requirements is that they induce distortions. Consumers are excluded from the consumption of the public good, even though, because of non-rivalry, admitting them involves no cost. If the firm has no access to public funds these inefficiencies cannot be avoided. By contrast, if tax revenues are available, we can get rid of these inefficiencies.

This observation is a challenge for the literature on public-sector pricing problems in the tradition of Ramsey (1927) and Boiteux

(1956) which is based on the premise that a self-financing requirement is in place. It is subject to a similar critique as the one voiced by Atkinson and Stiglitz (1976) who question the relevance of Ramsey models of taxation in economies with a representative agent. In these models, lump-sum taxes are a first-best solution to the policy problem at hand. Therefore, the Ramsey tax problem is interesting only if lump-sum taxes are assumed unavailable. This makes the characterization of an optimal tax system a somewhat contrived exercise. Analogously, finding an optimal mechanism for the provision of an excludable public good in the presence of a self-financing requirement appears to be an artificial problem.

This paper provides a justification for self-financing requirements. As a main result, it is shown that their imposition may be the optimal reaction to an equity-efficiency trade-off. This trade-off involves, on the one hand, a comparison of the total surplus from public-goods production which is higher if there is no such requirement, and an assessment of the distribution of the surplus between consumers and the producer of the public good, on the other. In particular, the imposition of a self-financing requirement may lead to a higher level of consumer surplus.

This result is derived in a model in which a profit-maximizing firm proposes a mechanism for the provision and financing of the public good. The firm is, in turn, supervised by a policy maker who has to approve the firm's proposal. The policy maker remains ignorant about the state of demand (as shaped by the distribution of public-goods preferences) and supply (as shaped by production costs). However, she has probabilistic beliefs about demand and supply and can therefore assess the expected performance of a mechanism that the firm proposes. Under these premises, the policy maker formulates an optimal rule for

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approving the firm's proposals. We compare two alternatives for formulating such a rule: Rule *A*, a minimal level of expected consumer surplus, so that a mechanism is approved only if it exceeds this threshold; Rule *B*, a reservation utility level, so that every consumer's expected utility has to be larger than this reservation utility level.

We will show that these alternatives can be interpreted as follows: Rule *A* is equivalent to a model where the firm has to deliver an upfront payment in order to become the provider of the public good, and then has to propose a mechanism subject to the requirement of a non-negative level of consumer surplus. In particular, this mechanism may involve lump-sum contributions, i.e., payments which do not depend on a consumer's demand of the public good. Rule *B* is equivalent to a model where, again, the firm has to deliver an upfront payment and then faces a self-financing requirement when producing the public good. This makes it impossible to acquire payments from consumers with no demand for the public good.

In both models, the upfront payment can be interpreted as a tax on the firm's expected profits.¹ Under *B*, setting this tax is all that the policy maker has to do. Rule *B* therefore gives rise to a situation where a firm is subject to a tax on profits and then chooses a mechanism subject to a budget constraint that does not include tax revenue as a source of income. This setup is akin to the public sector pricing models in the tradition of Ramsey (1927) and Boiteux (1956). Under *A*, by contrast, the policy maker grants access to tax revenues provided that the firm delivers a minimal level of consumer surplus. This is akin to a model of procurement or regulation where a firm receives subsidies in exchange for a commitment to meet a certain performance standard. We say that a self-financing requirement is desirable if the expected level of consumer surplus that can be obtained under Rule *B* exceeds the expected level of consumer surplus that can be obtained under Rule *A*.

A comparison of these rules yields the following trade-off. Under Rule *A*, any mechanism generates a first best level of total surplus. However, the expected level of consumer surplus under this mechanism is zero. The only source of consumer surplus is therefore the redistribution of profit income via the tax system. Under Rule *B*, by contrast, consumers not only receive their share of profit income, but are also guaranteed an information rent. The combination of information rents and tax revenues that is possible with Rule *B* may, from the consumer's perspective, be more attractive than the reliance just on tax revenues if Rule *A* is used. At the same time, however, using Rule *B* implies that first-best outcomes cannot be reached.

We will show that the imposition of a self-financing requirement maybe desirable if there is uncertainty about the firm's production costs. Being uncertain about the firm's profitability, a policy maker may shy away from profit taxation because he fears that otherwise the firm may go out of business, so that there would be no public-goods provision at all. This may leave substantial profits to the firm. In this case, the use of Rule *B*, which limits the firm's capability of rent extraction, is more attractive from the consumers' perspective.

This model is based on an incomplete contracts approach in the sense that the policy maker's interaction with the firm is not derived from an optimal plan that is responsive to all conceivable state contingencies. Instead, the firm proposes a mechanism and the policy maker decides whether or not to approve the firm's proposal. This decision is based on a rule that is optimal, conditional on the assumption that the policy maker is uninformed about the current state of demand and supply.²

¹ Such taxes have been considered before in the literature on regulation; see Loeb and Magat (1979).

² The term "incomplete contracts" is used in different ways by different authors. This paper's approach is in line with Hart (1995) who views the absence of a complete contingent planning as the source of incompleteness. Alternatively, Bolton and Dewatripont (2005) summarize contributions to the hold-up problem under the heading "incomplete contracts". That said, having incompleteness in one way or another is necessary for the result that a self-financing requirement à la Ramsey (1927) and Boiteux (1956) may be desirable. Trivially, the mechanism proposed by a benevolent policy maker with full commitment power yields more consumer surplus if it is possible to violate such a requirement.

This approach admits two different interpretations: First, in some cases the rules analyzed in this paper may be viewed as descriptive of real-world institutional settings. For instance, if we think of TV channels as being excludable public goods, a firm may produce and sell access to this public good without any substantial government interference, and in particular without receiving tax revenues. An alternative, however, would be a national TV channel that is financed by lump-sum contributions and which is subject to stricter performance standards.³ Other examples are streets, highways, or railroads. Such infrastructure can be financed by relying on user fees, or on tax revenue, or a mixture of the two. This paper sheds light on the question which of these alternatives is preferable, under the assumption that the institution in charge of organizing its provision is self-interested and can be monitored only in an incomplete way.⁴

Second, the legal framework for the interaction between a firm and a policy maker may require the use of general rules, as opposed to micro-management by the policy maker. As an example, think once more of a privately-run TV channel. In this context, a policy intervention would have to be based on a legal rule that applies equally to all firms in this business and which cannot be tailored to specific demand and supply conditions.⁵ This implies that any intervention (e.g., a regulation of admissible content, or a regulation of time available for commercials) has to be based on a rule that is incomplete in the same way as Rules *A* and *B* are, namely that it cannot be made fully contingent on all conceivable states of the environment (e.g., whether or not there is a major sports event). Hence, this paper's approach to model government interventions as rules that cannot be made fully contingent on all conceivable states of the economy has a wider scope, and is not limited to situations where the only policy choice is whether or not a firm should receive subsidies.

This can also be seen if we think of the excludable public good as being a regulated natural monopoly – for instance, a telecommunications network – and assume that the policy maker is a regulatory agency. Admittedly, regulatory agencies often engage in micro-management in the sense that they try to make their interventions contingent on current demand and supply conditions. If, say, the owner of the telecommunications network sells access to providers of telecommunication services, the regulatory agency may have to approve the access pricing schedule; and for this purpose it may use information about costs and demand. However, an institutional framework for regulation typically works such that a regulated firm makes a proposal and that the regulatory agency then reacts to this proposal. It seems reasonable to assume that the regulator evaluates this proposal without having access to all the pieces of information that the firm has used. (If the regulator had all the relevant information, she could just prescribe the use of the optimal mechanism, and it would make little sense to let the firm propose something.) But then, the best the regulator can do is to behave optimally, conditional on being imperfectly informed. This does again

³ A further example has recently been provided by the Swiss Poste, a national monopolist, that reported plans to finance mail services not only by charging the senders of mail but also the receivers by means of a lump-sum contribution requested from every household with a mailbox (Baseler Zeitung, 5 December 2009). I am grateful to Jos Jansen for bringing this example to my attention.

⁴ Often this infrastructure is run by the state, as opposed to a private firm. The framework developed in this paper would still be applicable under the assumption that the responsible politicians or bureaucrats may try to extract some of the surplus for themselves. This argument is developed more fully in a companion paper, Bierbrauer (2009), which relates the desirability of a self financing requirement to a policy maker's degree of benevolence.

⁵ To give a specific example for such a legal rule, article 19 in Germany's constitutional law posits that a law may restrict basic rights, one of which being economic freedom, only if it takes the form of a general rule: "Insofar as, under this Constitutional Law, a basic right may be restricted by or pursuant to a law, such law must apply generally and not merely to a single case."

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