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To Allot or Not to Allot Public Services in Europe ? An Incomplete Contract Approach

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Abstract

Using an incomplete contract framework, we analyze the consequences of allotment in public procurement, which has been introduced by the European Directive 2004/18/EC. We evaluate the impacts both on price and quality of public services provided under public procurement. Our results show that when the quality of the service depend on non-contractible efforts made by the operators, allotment does not maximize the joint payoffs of the public and private parties (i.e. the total surplus), but mainly benefits to public authorities.

JEL Codes: K12, L33, L22, L24.
Keywords: Public procurement, Allotment, Incomplete Contract

1 Introduction

Public procurement accounts for a substantial share of total government expenditure. The World Bank estimates that this spending represents between 12 and 20% of the GDP in developed countries, and may be even higher in developing countries.[1] In the European Union, in 2007, they are estimated at 16.6% of EU GDP.[2] The efficiency and quality of procurement processes are central for how much citizens will benefit from government spending. In this context, legal reforms in Europe have developped over the last decade to increase the quality of public procurement and to reduce its cost for the public authorities. One of these significant reforms is the introduction of allotment in the awarding procedures for public procurement (Directive 2004/18/EC of the European Parliament and of the Council, Point 9 of the Preamble). In this paper, we aim to evaluate the consequences of this reform both on prices and on the quality of the services delivered under public procurement: Does allotment lead to lower prices? What incentives do private operators get to increase the quality when managing only a small share of a public service? What is

[1] Source: World Bank
http://web.worldbank.org/wbsite/external/countries/menaext/extmnaregtopgovernance
[2] http://europa.eu/policies-activities/tenders-contracts/index-fr.htm

the net impact of allotment for the users of the service?
Allotment can be defined as the horizontal segmentation of public works and services into different lots that can be awarded to different private operators. The Directive 2004/18/EC states that "in view of the diversity of public works contracts, contracting authorities should be able to make provision for contracts for the design and execution of work to be awarded either separately or jointly".[3]
Allotment is now widely observed in Europe: One of the first experiences dates back to the 1985 *Transport Act* allowing to divide the London bus network into several routes. Since then, bidders can submit bids on any number of routes and route packages. Other illustrations can be found in the French Official Journal dedicated to public procurement (*Bulletin d'annonces des marchés publics*): for instance, a recent call for tenders deals with some works to perform in September 2011 in the *Musée d'Orsay* in Paris, mentionning that those works are divided into four lots.[4]
The introduction of allotment in awarding procedures for public procurement aims to foster competition. Dividing proposed acquisitions of public works and services into reasonably small lots aims to permit offers on lower quantities than the total requirement, and then to increase the competitive pressure during the tender. Indeed, proposing lots makes the participation of small and medium enterprises easier. They would not have enough financial and operational capacities to bid and operate the whole market otherwise. For instance, in 2006, 17 operators were awarded one or several routes of the London bus service (Amaral et al. [2011]).
The impact of the number of bidders during a competitive tendering on the final price paid by the public authorities has already been widely documented in the economic literature.[5] However, few has been done to assess the impact of allotment both on prices and quality. This is all the more difficult as the quality of public goods and services is often regarded as "non-contractible": public authorities can hardly describe in details all aspects of the services they want, which explains the fear that quality could be sacrified in the name of profitability.
This is worrying since the quality of public goods and services has strong consequences on the economic growth (Barro [1990]), which explains the concern of public authorities to provide private operators with sufficient incentives to care for quality. For a growing number of public services, the quality is not only a matter of standard requirements to meet, but depends on the non-contractible efforts made by the operator during the execution of the contract, such as his ability to come up with innovative approaches of the service (Daniels and Trebilcock [2000], IPPR [2001]). This need to innovate for quality often justifies the involvement of private operators in the management of public services.[6]

[3]The transcription of this directive in the European national legislations has been progressively made (through the legislative decree n° 163 of April 2006 in Italy, the 2006 new Public Procurement Act (BVergG 2006) in Austria, the German Ordinance on the Award of Public Contracts (*Vergabeverordnung - VgV*) revised in 2009, the Law 30/2007 in Spain, and the Article 10 of the new French *Code des Marchés publics* in 2006).

[4]www.e-marchespublics.com/annoncemarchepublic125112153.html

[5]This *competition effect* expected thanks to a higher number of candidates during the competitive tendering has been analyzed in Gomez-Lobo and Szymanski [2001] or in Brannman et al. [1987]. Other papers show that a large number of candidates could also increase the price, because of the *winner's curse effect* (Milgrom [1989], Hong and Shum [2002]), or because of *ex post* opportunistic renegotiations (Guasch [2004]). We will discuss these effects in section 5.

[6]HM Treasury [2003] states "[t]he public sector defines the service to be delivered, but it is for the private sector partner to decide how to deliver it, drawing on its own innovation and experience. This provides

This attention paid to innovations in public services aims to create a good business environment, as underlined in the report "Creating an Innovative Europe" (the Aho Report, European Commission [2005]). This report called upon governments to "use public procurement to drive demand for innovative goods, while at the same time improving the level of public services" (European Commission [2005], p.6). This concern has also been mentionned in the 2007 *Guide on dealing with innovative solutions in public procurement* (European Commission [2007]). Then, there is a need to understand how the introduction of allotment in awarding procedures impacts both on prices and on the ability to increase quality through innovations.

To address these issues, we propose a model in an incomplete contract framework (Grossman and Hart [1986], Hart and Moore [1990], Hart [1995]). The assumption of contractual incompleteness is often used to study contracts signed between public and private partners (Hart et al. [1997], Hart [2003], Bennett and Iossa [2006], Hoppe and Schmitz [2010]), mainly because it allows to account for non-contractible quality: public authorities are assumed to be unable to fully specify the quality, or to write verifiable objectives for all possible contingencies. More precisely, we follow here the basic idea of Hart et al. [1997] and assume that, during the execution of the contract, the operator may make some *ex ante* non-contractible efforts to find innovations which improve the quality of the service or reduce its costs. Such efforts are non-contractible *ex ante* but verifiable *ex post*: whilst it is not possible to contract *ex ante* on the delivery of an innovation, once a potential innovation has been discovered, its implementation is verifiable.[7] Then, we extend the framework of Hart et al. [1997] in two directions:

First, we propose a model dealing with public procurement contracts. Public procurement are neither public provision nor privatization (described in Hart et al. [1997]) but "hybrid" structures: a private operator is chosen to provide a public good or service for a contractually-defined period. In our model, we rather focus on the procurement of public services. This describes a situation where a public authority owns a public infrastructure or public assets but contracts out their management to a private operator that is paid by a fixed price. We assume that, due to contractual incompleteness, ownership rights result in control rights: the public authority (as the owner of the facility during the contract period) has the power to decide (and veto) whether any given innovative activity can be implemented.

Second, we consider a public service that can be divided into several parts, so that the public authority can contract with several operators at the same time. Each of these operators manages a part of the service. This allows us to assess the consequence of allotment (when the service is divided into lots) on both prices and incentives to innovate.

When the quality of public services mainly depends on the non-contractible efforts of the private operator, our results show that allotment does not provide the optimal incentives to make these efforts, and choosing not to allot services is more socially efficient. However, under some conditions, allotment allows to increase the payoff of the public authority (by reducing the price it pays). Then, public authorities may have an interest to promote allotment in public procurement procedures, even if it is not an optimal decision, but simply because it allows them to get a bigger share of the surplus. There is then a contradiction between the decision that maximizes the total surplus (*i.e.* the joint payoffs of the public

the private sector with an incentive to develop innovative ways to meet requirements (...)" (Bennett and Iossa [2006], footnote 1.)

[7] This assumption can also be found in Hart et al. [1997] and Bennett and Iossa [2006].

authority and the private operator(s)) and the decision that maximizes only the payoff of the public authority (which is to allot public services). In a context where public authorities have strong financial constraints, this may explain why they use allotment in public procurement.

Our paper can be related to the recent literature on allotment even if it has been little investigated. Amaral et al. [2011] propose an empirical study about the impact of allotment on the prices but do not take into account quality considerations. Morand [2002] deals with allotment, but aims to compare the consequences of both allotment and subcontracting on small and medium-sized entreprises. Focusing on the French railway sector, Leveque [2007] empirically analyzes the potential benefits and drawbacks of allotment, taking into account the consequences on competition and economies of scale. However, he leaves aside the consequences of allotment on uncontractible quality, which is a core dimension of the performance of a public service. In contrast, our paper focuses on the consequences of allotment on both the price paid by the public authority and the non-contractible quality. Moreover, we wonder which party (the public or the private one) benefits the most from allotment. Last, our theoretical results can also be related to the empirical work of Cambini and Filippini [2003]. They analyze the optimal size of services to contract out: using data from the italian bus transportation sector, they show that the best strategy to introduce competition in this industry is a competitive tendering approach for an area of given dimension and not necessarily a route-by-route tendering. However, it seems that the criterion applied by local authorities in Italy is much more related to political issues than to a desire to promote the exploitation of economies of scale and density.

Even if the question of allotment has been little explored, a large part of the economic literature has dealt with contracts between public and private sectors over the last years. Using an incomplete contract framework, some papers (Hart [2003], Bennett and Iossa [2006] and Hoppe and Schmitz [2010]) investigate the question of bundling *vs.* unbundling between the building and operation stages. Thus, they focus on the vertical division of public services, while we focus on the horizontal segmentation. More precisely, these papers mainly compare public procurement to *Private Finance Initiative* (PFI) to wonder which of these two contractual agreements is preferable. We do not explore this question, and take the choice of public procurement for granted. What draws our attention is to know whether the public services under public procurement should be alloted or not. Last, let us also mention that a large part of the literature on public procurement relies on asymmetric information (Laffont and Tirole [1991, 1993]). We rather contribute to the growing literature using the incomplete contracting approach (and assuming symmetric information between the parties) to stress the impact of public procurement on uncontracted-for efforts (such as efforts to innovate). Such a view can be justified to account for the concern of public authorities to find innovative solutions in the delivery of public services, and also because many problems of public procurement are problems of *ex post* adaptations to unforeseen contingencies rather than *ex ante* screening (Bajari and Tadelis [2001]).

The paper is organized as follows: the next section describes the institutional framework about public procurement in Europe, and provides some illustrations. Section 3 presents the general framework of the model. In section 4, we analyze whether allotment is optimal or not under public procurement. In section 5, we investigate the allocation of the surplus between the operator(s) and the public authority under perfect and imperfect price competition. We show the conditions under which the public authority may prefer to allot even if this decision is not the optimal one (*i.e.* does not maximize the joint payoff of the

private party and the public authority). Section 6 concludes.

2 Public procurement contracts in Europe: the institutional framework

In this section, we first describe public procurement contracts and give some illustrations of alloted public services (subsection 2.1). Then, we describe the impact of allotment on prices paid by public authorities (subsection 2.2), and how the quality of the service can depend on innovations in some sectors (subsection 2.3).

2.1 Public procurement: contractual practices

Public procurement refers to acquisitions of goods and services by public institutions. The recent European legislation defines public procurement as contracts that "cover supplies, services and works purchased by the public sector".[8] These contracts are observed in many different areas. In our paper, we focus on public procurement contracts for the provision of public services (rather than acquisitions of goods), such as the provision of urban transport, school catering, waste collection and treatment, or water distribution. During the contract period, the public authority keeps ownerhsip rights on the facility supporting the public service, and on some assets used for the provision of the service. Be it at the local level or at the national level, public procurement is observed in the 27 countries of the European Union to provide public works and services.

The European public authorities can allot public services. We can find a lot of public procurement notices in official government journals that specify that public services opened to competition are divided into lots. Examples are the safekeeping service in the French Island "La Réunion", which is divided into four lots[9], or the municipal school catering in the French municipality Le Luc-en-Provence, which was divided into two lots.[10] In Germany, a public procurement notice for a transport service in the municiaplity Cottbus (notice n°138-229696) has been published in the German Official Journal for public procurement on July 21^{th}, 2011. A fourth example is the competitive tendering for conveyor maintenance services in London that has recently been opened, and two lots are proposed.[11] Other examples about different European countries can be found in the supplement to the Official Journal of the European Union.[12]

The question of allotment is also at stake in the on-going reform for train liberalization in Europe: regional public authorities wonder whether they will award all their train lines to a same operator, or whether they should propose a call for tenders per lot of lines (Leveque [2007]).

[8] *http : //europa.eu/scadplus/glossary/publicprocurementen.htm*

[9] Decision of the *Conseil d'Etat, July 23rd 2010 Région Réunion n°338367*

[10] Notice n°68-065677, published in the French Official Journal for public procurement, April 7th 2005. The contract began in 2005 and ended in August 2009.

[11] Notice n°138-229700, notice published in the British Official journal for public procurement, on July 21^{st}, 2011.

[12] Tender electronic daily: http://ted.europa.eu/TED/browse/browseByBo.do

2.2 Allotment and prices paid by public authorities

We describe here the public procurement awarding procedures and how allotment is expected to impact on the price paid by the public authorities to their private partners. The selection of the private operator[13] is generally made through a competitive tendering. This allows to create competition for the field when competition in the field is not possible. Thanks to the competition between the candidates to win the public procurement contract, the public authority hopes to benefit from low prices. Candidates bid on the price they require to provide the service, which is the main criteria to be awarded the market. This price is the only source of revenue of the private operator, and is paid by the public authority. However, when competition for the field is organized, the number of bidders is not always high: between 2002 and 2005, only one candidate applies in 62,5 % of calls for tender in the urban public transport in France (GART [2005]).
By dividing the good or service to provide into several lots, allotment allows small and medium-sized enterprises to be selected and then increases the number of bidders during the competitive tendering. The following figure illustrates this competitive effect with the case of the London bus transportation. We can see that the higher the number of bidders, the lower the average winning bidding is.

Figure 1: Number of effective bidders and costs per mile in the London bus transport (May 1999-May 2008)

Number of effective bidders per route	Number of auctions	Average bus.miles (10,000)	Average winning bid (£)	Average cost per mile of the awarded contract (£)
1	128	46.99	2,217,554	8.63
2	213	47.24	1,933,647	6.20
3	232	38.20	1,522,683	4.82
4	140	44.14	1,727,877	4.56
5	58	41.84	1,647,772	4.01
6	10	34.15	1,452,628	5.43
7	5	32.25	1,044,786	3.61
8	1	57.97	1,797,000	3.10
9	1	21.53	645,878	3.00
>5	*17*	*36.47*	*1,105,743*	*3.78*

Source: Amaral et al. (2011)

However, the performance of a public service has to be evaluated both on cost and quality criteria. While some qualitative standards can be verifiable (and then contractible), other aspects of quality are hardly contractible in some public services. For instance, the concern for a better environmental protection or the needs to better meet the users' needs call for innovative ways to deliver public services. In the following subsection, we provide some illustrations of how efforts to innovate determine the quality of some public services.

2.3 Quality of public services and innovations

During the execution of a public procurement contract, private operators may come up with innovative ideas to improve the quality of a service beyond the standard requirements.

[13] Very few countries in Europe have the possibility to contract-out towards public agencies. Then, we only focus in this paper on contracting-out towards private firms.

Recent examples are innovations implemented in the waste treatment: some contracts signed with the French company SARP have been renegotiated to add new equipments allowing to extract some metals such as Zinc and Nickel from the waste reception centres and to valorize them. This innovation that was driven by environmental concerns, increases the global quality of the waste treatment.[14] In the car park sector, the firm VINCI Park renegotiated in December 2009 its contract signed in July 2008 with the municipality *Issy-les-Moulineaux*, to implement an innovation for on-street parking. This innovation, called "Pay by Phone" is a new system of payment. Instead of coin payment machines, the users can now pay thanks to their mobile phones, just by recording their car number and the reference of the area where they are parked. This increases the quality of the service since users save time and pay for the exact parking duration.[15] Other examples of innovations in public services come from England: the company Metroline, which is one of the main operators present on the alloted London bus transport won in 2004 the London Transport Award for its innovation IRIS (Intelligent Route Information System). This innovation enables to track buses, inform drivers of their position in relation to other buses on the route, and provide intelligent control messages to drivers. This allows to provide a better quality of service for the users.[16]
Last, in the school catering sector, industries are looking for materials that reduce their carbon footprint, as it is the case for the company Elior and their initiative to transform wastes into compost.[17]
However, let us add that all innovations do not aim to only increase the quality of the service. Some of them try to reduce the cost to provide the service. For instance, still in the school catering sector, some companies have developed central kitchens that enable to deliver pre-cooked food to several units. This innovation reduces costs and enables to produce more meals. However, the taste of food seems to have decreased due to the necessity to cool down and then heaten the food again.[18] This shows that cost-reducting innovations may create some damages on quality.
In our model, we try to account for both types of innovations: those enhancing quality and those reducing cost with a possible damage on quality. We focus on the impact of allotment on the incentives to develop both types of innovations.

3 General framework

3.1 Basic assumptions

Let us note G, a benevolent (local or national) public authority (whom we refer to as "she"), in charge of a public service. We study the case where G chooses to contract out the provision of a public service through public procurement. We assume that the service can be divided into N components: for instance, the service can be urban transportation by bus, and the components are the different routes composing the bus network of the city. Either the public authority chooses not to allot, and to give the N routes to one operator, or she chooses to allot and to give L1 routes to a private operator, and L2 routes to another

[14] Source: http://www.edib.info/site-edib/
[15] https://www.paybyphone.fr/issy-les-moulineaux-ville-innovante-avec-paybyphone/
[16] www.metroline.co.uk/about-us.html?pgid=27
[17] www.elior.com/developpement-durable.aspx
[18] *La restauration des usagers du service public scolaire ou à caractère social en Alsace, Cour des Comptes*, Annual Public Report, February 2006

private operator (L1+L2=N).

In both cases, the public authority and the selected operator(s) are able to write contracts, specifying some aspects of each component of the service to be provided. However, all details are not contracted on in advance, and possible modifications of the assets used to provide the service can be made during the execution of the contract. Then, parties revise the contract *ex post*, once it is clear what kind of modifications can be introduced. In our model, we assume that during the execution of the contract, the operator can make some efforts to adapt the service to the realized contingencies. Such efforts are not contractible *ex ante* but verifiable *ex post*: for instance, even if it is not possible to contract *ex ante* on the delivery of an innovation, once a potential innovation is discovered, its implementation is verifiable and renegotiations may occur. Then, the service is made up of N components and each component $j \in [1; N]$ of the service yields a benefit B_j to the society, and costs the operator C_j to produce. The operator can manipulate B_j and C_j through his effort choices. He can devote efforts to two types of innovations relative to a basic infrastructure: quality innovations (such as the IRIS system discovered by the firm Metroline in The London bus transport sector described in section 2.3.) and cost innovations that reduce the cost of provision but may create an adverse effect on quality (such as the central kitchen system for the school catering sector, described in section 2.3.). We denote the effort to search for quality innovation i, and that to search for cost reduction e.[19] Then, the *ex post* cost (C_j) and benefit (B_j) functions derived from the provision of the component j are the following:

$$B_j = B_j^0 - b(e) + \beta(i)$$
$$C_j = C_j^0 - c(e) + i + e$$

B_j^0 and C_j^0 are positive constants representing the contractible (verifiable) social benefit and cost of the service j; $c(e) \geq 0$ represents the cost decrease implied by an innovation in cost reduction e and $b(e) \geq 0$ corresponds to the adverse effect on quality due this investment in cost reduction. The function $c(.)$ is positive and concave, and the function $b(.)$ is positive and convex. We assume that such investments are always efficient ($c'(e) - b'(e) > 0$). As for $\beta(i) \geq 0$, it represents the increase in quality net of the potential additional cost caused by this increase in quality.[20]

A private operator has L components to manage, $L \in \{L1; L2; N\}$. If $L = \{L1; L2\}$, this means that the service has been divided into two lots (that are lot L_1 and lot L_2). If $L = \{N\}$, then the private operator has all the components of the service, *i.e.* there is no allotment.

Whatever the number L the private operator gets, he can make efforts "e" and "i" and the innovations resulting from these efforts can be implemented on the L components he manages. In other words, these efforts are made once but apply on all the components of the service managed by the private operator. For simplicity, we assume that the impact of innovations is the same for all the components on which they are applied.

As a consequence, the total *ex post* cost and benefit functions for the management of L components become:

[19] We interchangeably call e and i "investment" or "effort"

[20] Assuming that the cost-reducing innovations could be inefficient or that the qualitative innovations produce more costs than benefits would not change our results, since such innovations could not been implemented as shown in footnote 25.

$$\sum_{j=1}^{L} B_j = (\sum_{j=1}^{l}(B_j^0)) + \mathrm{L}[-b(e) + \beta(i)]$$
$$\sum_{j=1}^{L} C_j = (\sum_{j=1}^{l}(C_j^0)) - \mathrm{L}c(e) + i + e$$

The timing of the model is as follows:

- In $t = 0$, the public authority chooses to allot or not a public service, and selects her operator(s) through a competitive tendering.
- In $t = \frac{1}{2}$, efforts e and i are made by the operator(s).
- In $t = 1$, renegotiations may occur and innovations may be implemented on the components of the service managed by the operator(s).

3.2 Default payoffs and renegotiations

As noted in the timing of the game, the parties have to renegotiate the contract at date 1, once they learn the nature of potential quality improvements and cost reductions. Under public procurement, the public authorities own the infrastructure on which the service is based, as well as the core assets needed to provide the service. When innovations are applied on those assets, the private operator cannot implement any innovation without the agreement of the public authority.[21] We also assume that the public authority cannot realize the innovations without the private operator, since these innovations are embodied in the operator's human capital. Then, the private operator is indispensable to the implementation of these innovations.[22] Consequently, the agreement of both parties is needed to implement innovations.
During the renegotiations, we consider that the parties implement the Nash bargaining solution, *i.e.* they split the net gains from innovations according to their bargaining power. We denote $\sigma \in (0, 1)$ the *ex-post* bargaining power of the private manager.[23]

In this model, we focus on the decision to allot or not the service. We first show that allotment does not maximize the total surplus, *i.e.* the joint payoff of the public and private parties (section 4). Then, we show the conditions under which it may increase only the payoff of the public authority (section 5).[24]

[21] These assumptions can also be found in Hart et al. [1997] and Bennett and Iossa [2006]. The allocation of the control rights to the public authority plays here a critical role: it determines the default payoff of the operator by making the agreement of the public authority indispensable.

[22] We could also assume that the private operator is irreplaceable because the cost to find another operator (during the execution of the contract) to implement the innovation would be too high as regards to the cost to deal with the current operator, so that the public authority cannot get rid of the private operator until the end of the contract.

[23] We did not discuss here the source of the bargaining power. The bargaining powers of the parties can be different because the parties' degree of impatience on the outcome of the bargaining is different. Since it is time consuming to negotiate, and time is valuable to the parties, a player's bargaining power is higher the less impatient he is relative to the other negotiator. For a discussion on the determinants of bargaining powers, see Muthoo [1999]. Moreover, we assume that σ does not depend on the number of components the operator manages: a higher number of components may lead to increase the bargaining power of the private operator. But the public authority can also threat not to renew the contract on all these components, and this threat is all the stronger as the number of components contracted out is high.

[24] We call "payoff" the final gain UG for the public authority and UM for the manager, and "surplus" the sum of these payoffs, $S = UG + UM$.

4 The optimal decision: to allot or not to allot?

To determine whether allotment is optimal or not, we solve the game by backwards induction: we first determine the incentives to make efforts "e" and "i" in $t = \frac{1}{2}$, and we deduce whether allotment should be chosen or not in $t = 0$.

4.1 The incentives to make efforts

In $t = \frac{1}{2}$, we assume that a private operator has L components to manage, and is paid a fixed price P_L for the management of his L components. This price results from the competitive tendering at date $t = 0$. As described above, the operator may make efforts to innovate or to adapt the contract to the relevant contingencies. He anticipates that in $t = 1$, he will renegotiate with the public authority to implement these innovations. The approval of both parties is needed, so that in case of failure of the renegotiation, their default payoffs corresponds to their basic contractible payoffs. With an *ex post* bargaining power of $\sigma \in (0, 1)$ for the private operator, the payoffs of the operator (UM) and of the public authority (UG) resulting from the Nash bargaining are respectively:

$$UM_L = (P_L - \sum_{j=1}^{L}(C_j^0)) + \sigma \mathrm{L}[c(e_L) - b(e_L) + \beta(i_L)] - e_L - i_L$$
$$UG_L = (-P_L + \sum_{j=1}^{L}(B_j^0)) + (1-\sigma)\mathrm{L}[\beta(i_L) + c(e_L) - b(e_L)]$$

Consequently, we find the following incentives to invest e_L and i_L:

$$\begin{aligned} e_L &= \arg\max_e UM_L \\ i_L &= \arg\max_i UM_L \end{aligned}$$

The first-order conditions give us the investment level e_L and i_L such as[25]:

$$\begin{aligned} L \quad & \sigma[c'(e_L) - b'(e_L)] = 1 \\ L \quad & \sigma\beta'(i_L) = 1 \end{aligned}$$

From proof n°1 in the appendix , we can establish that:

Lemma 1. *The incentives to innovate under public procurement are increasing in the number of components a private operator manages (L).*

This lemma can be interpreted as follows: when the private operator manages a large number of components of the service, the innovations can be implemented on a large scale. Then, he gets more gains from these innovations and has more incentives to make efforts to search for them.[26]

As a consequence, under public procurement, the total *ex post* surplus reached when an operator manages L components of the service is:

[25] Let us notice that in case innovations would be inefficient such that $c'(e) - b'(e) < 0$ or $\beta'(i) < 0$ then no innovation would be implemented. Then, assuming that the innovations could be inefficient would not change our qualitative results, since they would not be implemented.

[26] The innovation can only be applied on the components managed by the private operator and cannot be implemented on the components managed by the other operator. This is explained by the fact that the human capital of the manager making the effort "e" or "i" is indispensable to the implementation of the innovations resulting from these efforts. Moreover, the operator who discovered the innovations cannot be asked by the public authority to implement these innovations on the lots he is not responsible for.

$$S_L = (\sum_{j=1}^{L}(B_j^0 - C_j^0))+\mathrm{L}(c(e_L) - b(e_L) + \beta(i_L)) - e_L - i_L$$

4.2 The optimal decision regarding allotment

The optimal decision (*i.e.* to allot or not the service) maximizes the total *ex post* surplus. Since allotment leads to a surplus $S_A = S_{L1} + S_{L2}$ and non-allotment leads to S_N, we have to determine which surplus is the highest.

By defining the average surplus function $F(L) = \frac{S_L}{L}$, we can show that this function is increasing in L (see proof n°2 in the appendix), so that $S_N \geq S_{L1} + S_{L2}$. This average surplus function has increasing returns to scale on the efforts to innovate: the average quantity of social surplus per component is increasing as the operator manages a large number of components, since he has higher incentives to innovate. Then, the optimal choice (*i.e.* maximizing the total surplus) in $t = 0$ is not to allot: $L^* = N$.

Proposition 1. *When the quality of public services depends on non-contractible efforts made by the private operator, the choice that maximizes the total surplus is not to allot the service. Allotment in public procurement reduces the incentives to innovate and thus the total surplus.*

5 Allocation of the gains: what drives public authorities' decision

In the previous section, we have shown that the optimal decision is not to allot public services when the quality of the public services depends on the non-contractible efforts made by the private operator during the execution of the contract. In this section, we focus on the choice made by the decision maker, *i.e.* the public authority. We show that depending on the nature of *ex ante* competition (perfect or imperfect price competition) during the competitive tendering, there might be a conflict between the optimal choice and the choice that maximizes the share of the gains the public authority gets. This might change her decision not to allot. To characterize the conditions under which this conflict appears, we explore two scenarios: that of perfect price competition (in subsection 5.1), and that of imperfect price competition (in subsection 5.2).

5.1 The allocation of surplus under perfect competition

Let us assume here perfect price competition (*à la* Bertrand) during the competitive tendering allowing to select the private operator(s) in period $t = 0$. Since *(i)* the parties are able to anticipate *ex ante* their future investment behavior[27], and *(ii)* because of the competitive pressure, the private operators propose a price that just covers their costs, so that their final payoff is equal to zero. This allows us to determine the price paid by the public authority to have the public service provided:

[27] They can anticipate the efforts "e" and "i" even if they cannot contract on them (See Hart [2003], Hoppe et al. [2011]).

$$
\begin{aligned}
UM_L &= 0 \\
&\Leftrightarrow P_L - (\sum_{j=1}^{L}(C_j^0)) + L \times \sigma[c(e_L) - b(e_L) + \beta(i_L)] - e_L - i_L = 0 \\
&\Leftrightarrow P_L = (\sum_{j=1}^{L}(C_j^0)) - L \times \sigma[c(e_L) - b(e_L) + \beta(i_L)] + e_L + i_L
\end{aligned}
$$

This results in the public authority getting all the surplus:

$$
\begin{aligned}
UG_L &= (\sum_{j=1}^{L}(B_j^0)) + L \times (1-\sigma)[c(e_L) - b(e_L) + \beta(i_L)] - P_L \\
&= (\sum_{j=1}^{L}(B_j^0 - C_j^0)) + L \times [c(e_L) - b(e_L) + \beta(i_L)] - e_L - i_L \\
&= S_L
\end{aligned}
$$

Then, under perfect price competition, the optimal decision (not to allot) also maximizes the payoff of the public authority. There is no conflict between the maximization of total surplus, and the maximization of the payoff of the public authority, and the public authority decides not to allot public services.

5.2 Allocation of surplus under imperfect price competition

In this subsection, we explore a second assumption, that of imperfect price competition in period $t = 0$. We assume that the number of candidates participating to the competitive tendering determines the intensity of the competitive pressure, and the prices charged by the private operator(s). The larger the number of candidates, the lower the price the public authority pays. We first justify this assumption (subsection 5.2.1) and then draw its consequences (subsection 5.2.2).

5.2.1 Imperfect price competition in public procurement

By selecting the private operator through a competitive tendering, the public authorities want to create competition for the field, when competition in the field is not possible. However, the number of candidates may vary from one service to another, and in many cases, only few candidates participate in the competitive tenderings of many local public services (GART [2005]). Moreover, numerous empirical studies have shown that an increase in the number of bidders encourages bidders to propose lower prices (Amaral et al. [2011], Gomez-Lobo and Szymanski [2001], Brannman et al. [1987]), so that competition prices (equal to the cost to perform the service) should be obtained only when there are a large number of candidates.[28] Figure 1 in section 2 also illustrates this competition effect in the case of the London bus transport: the bids proposed by the candidates decrease in

[28] Let us also add that some other studies report that an increase in the number of bidders could also lead to higher prices because of the winner's curse effect (Hong and Shum [2002]). This effect mainly appears in common value auctions, *i.e.* a situation where the actual value of the item for sale is the same for everyone

the number of competitors. These empirical results seem to suggest that the so-called "Bertrand paradox" applies in the public procurement sector.[29]

To account for such a competition effect, we now assume that the winner of the competitive tendering gets a price above his marginal cost, *i.e.* the price is equal to the cost to perform the service plus a mark-up. Then, the operator gets a share of the total surplus, which means that his payoff is no longer equal to zero as under perfect price competition. To determine his payoff, we introduce an *ex ante* bargaining power of the operator(s) $\gamma \in (0,1)$ so that the share the private operator gets is equal to a proportion γ of the total surplus. Since the number of candidates is higher under allotment than under non-allotment, we assume that the *ex ante* bargaining power of the private operators are lower under allotment, *i.e.* $0 \leq \gamma^A < \gamma^W \leq 1$, where γ^A is the *ex ante* bargaining power of the winners of the competitive tendering under allotment, and γ^W is his bargaining power when there is no allotment ("W" stands for "*without allotment*").[30]
Then, when the operator manages L components of a service, the price P_L is such that the operator covers his costs and gets a proportion $\gamma^{\{A;W\}}$ of the surplus:

$$\begin{aligned} & UM_L = P_L - C_L = \gamma^{\{A;W\}} S_L \\ \Leftrightarrow \quad & P_L = C_L + \gamma^{\{A;W\}} S_L \end{aligned}$$

where C_L denotes the global cost to manage L components of the service:

$$C_L = \sum_{j=1}^{L} (C_j^0) - L \times \sigma[c(e)_L - b(e_L) + \beta(i_L)] + e_L + i_L$$

5.2.2 Payoffs of the parties under imperfect competition

From the previous subsection, under imperfect price competition, the payoff of the private operator is $\gamma^W S_N$ when there is no allotment, while under allotment, the payoffs of the private operators are $\gamma^A S_{L1}$ and $\gamma^A S_{L2}$.
Moreover, from proposition 1, we can establish that:

$$\begin{aligned} S_N \quad & \geq \quad S_{L1} + S_{L2} \\ \Rightarrow \gamma^W S_N \quad & \geq \quad \gamma^W S_{L1} + \gamma^W S_{L2} \geq \gamma^A S_{L1} + \gamma^A S_{L2} \end{aligned}$$

but bidders have different private information about what that value is. The winner tends to be the bidder with the most overly optimistic information concerning the service or object's value. When a bidder bids only as regards to his private information, this would lead to negative expected profits. Consequently, in equilibrium, we should expect a rational bidder to internalize the winner's curse problem by bidding less aggressively (Milgrom [1989]). Compte [2004] shows that such effect can persist in pure private-value auctions. However, in our model, since the cost to perform the service is observable by all the parties, there is no possibility of winner's curse effect. Then, an increase in the number of bidders should only lead to a competition effect, *i.e.* a decrease in prices (as it has been empirically shown in the case of the London bus transport (Amaral et al. [2011])).

[29] This paradox is that it usually takes a large number of firms to ensure that prices equal marginal costs, while the competition (in prices) between only two firms should theoretically be sufficiently to charge a price equal to the marginal cost. For the theoretical approaches of the Bertrand Paradox, see Cabon Dhersin and Drouhin [2010], Vives [2001], Spulber [1995], Kreps and Scheinkman [1983], Edgeworth [1925].

[30] The higher competitive pressure caused by an increasing number of bidders is also explained in the economic literature in theoretical models assuming private information on the costs of bidders. See McAfee and MacMillan [1987] or Milgrom [1989].

$$\begin{aligned} \Rightarrow \gamma^W S_N &\geq \gamma^A S_{L1} + \gamma^A S_{L2} \\ \Rightarrow UM_N &\geq UM_{L1} + UM_{L2} \end{aligned}$$

This inequality shows that the proportion of the total surplus the public authority has to give up to the private party is higher when there is no allotment than when the service is alloted. This implies that thanks to allotment the public authority saves on the share of the surplus given up to the private party by an amount: $\gamma^W S_N - \gamma^A S_{L1} - \gamma^A S_{L2} \geq 0$.

Lemma 2. *Allotment allows the public authority to give up a lower part of the total surplus to the private party.*

5.2.3 Innovation *vs.* sharing of the gains: the trade-off of the public authority, under imperfect competition

From lemma 1 and lemma 2, we can establish that allotment has two effects:

- Allotment decreases the incentives of a private operator to innovate and then the total surplus
- Allotment increases the proportion of the total surplus the public authority gets

These two effects impact on the payoff of the public authority $UG_L = (1 - \gamma^{\{A,W\}})S_L$, since her payoff depends on the total surplus (S_L) and on the proportion of this surplus given up to the private party ($\gamma^{\{A,W\}}$). We want here to determine the conditions under which the net impact of allotment is positive for the public authority, *i.e.* when her payoff is higher under allotment than without allotment.
Allotment increases the payoff of the public authority when $UG_N \leq UG_{L1+L2}$, *i.e.* when:

$$(1 - \gamma^A)(S_{L1} + S_{L2}) \geq (1 - \gamma^W)S_N$$

$$\Leftrightarrow \quad \frac{1-\gamma^A}{1-\gamma^W} \geq \frac{S_N}{S_{L1}+S_{L2}} \tag{1}$$

The coefficient $\frac{1-\gamma^A}{1-\gamma^W} > 1$ represents the multiplier of the public authority's bargaining power when choosing allotment. Let us denote z this coefficient, such as $z = \frac{1-\gamma^A}{1-\gamma^W}$. This means that choosing to allot the service multiplies by z the bargaining power of the public authority, since it increases from $(1 - \gamma^W)$ to $(1 - \gamma^A) = z \times (1 - \gamma^W)$.

The equation (1) allows us to define a threshold concerning this multiplier. We denote $\bar{z} = \frac{S_N}{S_{L1}+S_{L2}}$ this threshold. Then:

- Whenever $z \geq \bar{z}$, then the public authority has a higher payoff under allotment than without allotment. The increase of her bargaining power caused by a higher number of bidders during the competitive tendering allows her to get a higher share of the total surplus. This positive effect offsets the losses caused by the lower incentives to innovate of the private operator under allotement.
- Whenever $z \leq \bar{z}$, then the public authority is better off without allotment, since the increase of her bargaining power is unsufficient to offset the losses caused by the lower incentives of the private operator to innovate under allotment.

Proposition 2.

- *Under imperfect price competition,*

- *when the quality of the public service highly depends on the non-contractible efforts made by the operator during the execution of the contract, and*

- *when the impact of allotment on the bargaining powers of the parties is strong enough, then allotment is not the solution allowing to maximize the total surplus (i.e. the joint payoffs of the public and the private parties) but benefits to the public authority, by increasing her own payoff.*

5.3 Discussion: What choice for public authorities ?

As a decision-maker, the public authority chooses to allot public services, when allotment increases her own payoff. From the previous subsection, the public authority then decides to allot when $z \geq \bar{z}$, even if this decision is not the optimal one, *i.e.* does not maximize the total surplus (made up of the joint payoffs of public and private parties).

However, this result comes from the fact that in our model, the public authority represents the users of the service. Then, she looks for the solution allowing to maximize the payoff of the users, *i.e.* she allots public services when $z \geq \bar{z}$ even if this decision does not maximize the total surplus because of the lower incentives of the private operator to make non-contractible efforts when the service is alloted (*lemma 1*).[31]
An alternative could be to model the public authority as a benevolent social planner, maximizing the total surplus of both the users and the firms. In this case, the result would be different: the public authority would only care about the solution maximizing the total surplus, and would choose not to allot public services.
Then, our results open the question of how to model public authorities, and what objective function to give to them. Do public authorities represent the users of the service or do they represent the whole society and then care about the benefits of the users as well as the benefits of the firms? Our results highlight that this choice leads to different results as regards to policy recommandations.

Public law may give some elements of answers to this debate. Legal scholars often mention that the goal of public authorities is to represent the "public interest". More specifically, the organization of public services is justified by the concern for the "public interest". However, this notion is vague, controversial and raises many debates (Hantke-Domas [2003]).[32] Its definition varies from one country to another: public interest may be understood as the sum of the individual interests (Smith [1776]), or as the interest of a people as a whole.[33] By considering that the public interest is that of the people as a whole, it seems that the goal of the public authorities is rather to represent and defend the interests of the users of the service, against those of private firms. Then, by considering that

[31] A solution could be to choose the solution that maximizes the total surplus, and then implement redistributive policies. However, this implies to rely on an efficient tax system, and the effect of redistribution could be anticipated by the operators, thus lowering their efforts to innovate.

[32] Let us note that the public interest is a fundamental notion of public law, but few has been written on the economics of public interest and on the economics of public law. See Rose-Ackerman [1994] for a contribution to the economic analysis of public law.

[33] The public interest as the interest of the people as a whole mainly refers to the "general will" as described by Rousseau [1762].

public authorities represent the users, potential conflicts may arise between the solution that maximizes the total surplus and the solution maximizing only the interests of the users.

6 Conclusion

In Europe, public authorities are suggested to allot their public services under public procurement. We show that allotment does not provide the optimal incentives to make non-contractible efforts to increase quality and reduce costs during the execution of the contracts. Then, it is more efficient not to allot public services when their quality mainly depends on those non-contractible efforts made by the private operator.
However, we also show that under some conditions, allotment may allow to increase the payoff of the public authorities (by increasing their bargaining power). Then, public authorities may have an interest to promote allotment in public procurement procedures, even if it is not an optimal decision, but simply because it allows them to get a bigger share of the surplus. There is then a conflict between the decision that maximizes the total surplus (*i.e.* the joint payoffs of the public authority and the private operator(s)) and the decision that maximizes only the payoff of the public authority (which is to allot public services). In a context where public authorities have strong financial constraints, or care exclusively about the users of the service, this may explain why allotment is practiced in public procurement: it mainly benefits to the users of the service represented by the public authority.
In this paper, we focus on the public procurement practices in Europe, but our results may also have some implications for other countries. For instance, the 2001 World Bank report (No. 21823-IN) "Indonesia, Country Procurement Assessment Report, *Reforming the public procurement system*" opens the question of allotment of contracts in developing countries.
Our results may also have implications for the literature on the optimal size of public services. This question is particularly important as regards to other legal reforms promoting the association of municipalities (inter-communalities) or even mergers of municipalities so as to manage public services on a larger scale.[34] Our model suggests that such associations or mergers of municipalities would allow increasing the incentives of the private operator to make non-contractible efforts, but may also decrease the net benefits of the service for the users, since the private operator gets a higher share of the total surplus due to lower competition.
Our paper also calls for several extensions. Future works could focus on the consequences of allotment on prices and quality for different types of contractual agreements between public and private partners. Although the European reform is specific to public procurement, the issue of horizontal segmentation is also at stake for concession contracts, as in the A1 highway in Poland. Another extension would be to include information asymmetries about the private cost of the operators. Allotment would allow public authorities to practice benchmark, and to force them to reveal their private information. Last, we could also include organizational costs in our analysis. Allotment implies to organize separate calls for tenders, which may increase organizational costs. However, such costs may also decrease with the experience accumulated in the organization of call for tenders. In a dy-

[34] Recent references on mergers of municipalities are Hirota and Yunoue [2011], Di Porto et al. [2011], Frère et al. [2011].

namic setting, since allotment increases the number of calls for tenders, public authorities could learn faster.

Appendix

Proof n°1

By the implicit function theorem,

$$\begin{aligned}\frac{d(e_L)}{dL} &= -\frac{(c'(e_L)-b'(e_L)}{L(c''(e_L)-b''(e_L))} > 0\\ \frac{d(i_L)}{dL} &= -\frac{(\beta'(i_L))}{L(\beta''(i_L))} > 0\end{aligned}$$

Proof n°2

Let us show that F(L), the average surplus function, is increasing in L, where L denotes the size of the lot managed by an operator.

$$\begin{aligned}F(L)=\frac{S_L}{L} &= \frac{1}{L}[\sum_{j=1}^{L}(B_j^0-C_j^0)+L[c(e_L)-b(e_L)+\beta(i_L)]-i_L-e_L]\\ &= (\tilde{B_j^0}-\tilde{C_j^0})+(c(e_L)-b(e_L)+\beta(i_L))-\frac{e_L+i_L}{L}\end{aligned}$$

where $\tilde{B_j^0}$ and $\tilde{C_j^0}$ denote the average contractible social benefit and the average contractible cost.
Let us show that F(L) is increasing in L (so that the average surplus function is increasing in the number of components managed by a private operator):

$$\begin{aligned}F'(L)=\frac{d(F(L))}{dL} &= (c'(e_L)-b'(e_L))\frac{d(e_L)}{dL}+(\beta'(i_L))\frac{d(i_L)}{dL}\\ &\quad -\frac{1}{L^2}[\frac{d(e_L)}{dL}L-(e_L)]-\frac{1}{L^2}[\frac{d(i_L)}{dL}L-(i_L)]\end{aligned}$$

$$F'(L)=\frac{d(F(L))}{dL} = (c'(e_L)-b'(e_L)-\frac{1}{L})\frac{d(e_L)}{dL}+(\beta'(i_L)-\frac{1}{L})\frac{d(i_L)}{dL}+\frac{(e_L)}{L^2}+\frac{(i_L)}{L^2}$$

From the first-order conditions defined in subsection 4.1, $(c'(e_L)-b'(e_L))=\frac{1}{\sigma L}$ and $\beta'(i_L)=\frac{1}{\sigma L}$.

$$F'(L)=\frac{d(F(L))}{dL} = (\frac{1}{\sigma}-1)(\frac{1}{L})\frac{d(e_L)}{dL}+(\frac{1}{\sigma}-1)(\frac{1}{L})\frac{d(i_L)}{dL}+\frac{(e_L)}{L^2}+\frac{(i_L)}{L^2}$$

Moreover, from proof n°1, we show that $\frac{d(e_L)}{dL}\geq 0$ and $\frac{d(i_L)}{dL}\geq 0$. Since $\sigma\in(0,1)$, then $(\frac{1}{\sigma}-1)\geq 0$.

Consequently, $\frac{d(F(L))}{L} \geq 0$: the average surplus function is increasing in L.
Since $N \geq L_1$ and $N \geq L_2$, it follows that:

$$F(N) \geq F(L_1) \Leftrightarrow \frac{S_N}{N} \geq \frac{S_{L_1}}{L_1} \Leftrightarrow L_1 \frac{S_N}{N} \geq S_{L_1}$$
$$F(N) \geq F(L_2) \Leftrightarrow \frac{S_N}{N} \geq \frac{S_{L_2}}{L_2} \Leftrightarrow L_2 \frac{S_N}{N} \geq S_{L_2}$$

By addition, $L_1 \frac{S_N}{N} + L_2 \frac{S_N}{N} \geq S_{L_1} + S_{L_2} \geq 0 \Leftrightarrow (L1+L2)\frac{S_N}{N} \geq S_{L_1} + S_{L_2} \Leftrightarrow S_N \geq S_{L_1} + S_{L_2}$.
The social surplus is higher when there is no allotment than under allotment.

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