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"Public-Private Partnerships as Collaborative Projects: testing the theory on cases from EU and Russia"

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Public-Private Partnerships as Collaborative Projects: testing the theory on cases from EU and Russia

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ABSTRACT

Public-private partnerships (PPP) allow involvement of private parties in the provision of public goods. How does this differ from traditional public procurement? We view PPPs as collaborative projects with information frictions. Typical public procurement contracts tackle the problems of asymmetric information. However, not all projects are contractible; some are not profitable enough to ensure participation of the private partner. This is due, in part, to costly information verification, and in part to the profitability requirements of the private party. We demonstrate what specific features of a partnership can improve feasibility of projects, and thus both provide a justification of PPP as a form of public good provision, and demonstrate how and whether it differs from procurement. We then analyse real life examples of PPP projects from the perspective of optimal choice of contracts, involvement of both partners, and the features that make these PPP arrangements superior to public procurement.

Keywords: public-private partnerships, public finance, contracting

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1. Introduction

Public-private partnerships (PPP) are a popular form of provision of public goods jointly by the state (municipal) bodies and private entrepreneurs. Many definitions are in use, whose focus ranges from legal covenants and regulatory framework to business risks and social benefits (see, e.g., a review by Hodge and Greve, 2007). Opinions on the societal role of PPP range from extremely positive (Lattemann et al., 2009) through moderately critical (Regan et al., 2011) to explicitly negative ones (Coulson, 2005; Siemiatycki, 2011; da Cruz et al., 2013). From the business organization perspectives, PPPs are considered along public provision of services, outsourcing (contracting out) and privatization (Joha and Janssen, 2010, consider either public party, private party or jointly public and private parties carrying the responsibility for the public good provision; Stiglitz (2002) views PPP along privatization and contracting out.). As emphasized by Stiglitz (2002), the main question is what role should be left to the government. In this paper we explicitly study the role of the public party in a PPP, and analyse under which conditions a PPP is socially beneficial, which provides a uniform framework able to accommodate the variety of views above.

Formal analysis of PPP usually resorts to contract theory. One of the issues, rather well studied in the literature, is whether some or all tasks within one, typically infrastructure, project should be delegated to a private partner (Bennett and Iossa, 2006; Martimort and Pouyet, 2008; Maskin and Tirole, 2008; Chen and Chiu, 2010). Such an "unbundling" view neglects contributions by the partners that cannot be defined as a part of the project, for example, improvements in efficiency due to knowledge spillovers through collaboration. Differently, this paper approaches PPP from the perspective of the theory of contracting for collaborative projects (Roels et al., 2010; Kim and Netessine, 2013; Roels, 2014) to identify the specific advantages

brought by a partnership as compared to contracting out and other forms of collaboration between the public and the private sector.

We view PPP as a form of business organization with two specific features: consolidation of private and public resources (consolidated enterprise), and facilitation of co-production through improved communication and other uncontactable benefits. Although we derive the latter property endogenously as a condition for an improvement in the feasibility of socially desirable projects, it conveniently relates to the "partnership" element of the PPP. The interpretation of the term "partnership" varies in the literature (and across disciplines), still most authors would agree that a partnership involves "the closest possible cooperation" (this definition of a "partnership principle" is extensively used in the EU integration policy documents, see e.g. Allen et al., 2005, p.218; Dahl et al., 2014), agreement on objectives (Brinkerhoff, 2002) and different degrees of formality, "ranging from informal, oral understandings to formal agreements" (Erhard and Brigham, 2006, p.4). These three properties suffice to improve feasibility of projects, as compared to typical contracts in presence of information frictions.

Information frictions imply welfare losses due to verification costs. Roels et al. (2010) study the problem of contracting for collaborative services under asymmetric information. They derive optimal types of contracts depending on the elasticity of project outcomes to contributions of the collaborating parties. An important implication of their model is that there exists a set of projects that cannot be implemented because the net profit from them does not cover the reservation utility of the service supplier. Although contract design in public-private projects differs from that in collaborative services, particularly in terms of incentives and liabilities of the parties, the main implications are the same. Yet, a close cooperation with aligned partners' objectives, may reduce information cost and lower the reservation utility, which makes more

projects implementable through a consolidated public-private enterprise if the partnership principle holds.

PPP are thus justified only if (1) a public good cannot be provided by the public sector alone, (2) the system of public procurement fails to ensure the provision of the public good by commissioning it to a private business, and (3) both the public and the private sectors possess comparative advantages in the provision of some resources indispensable for the delivery of the public good. The partnership element ensures a reduction in the reservation utility of the private partner and removal of the (part of) verification costs. To clarify and test the theory, we investigate several cases of real-life PPP projects, with the focus on the combination of the public and private resources, identification of comparative advantages of the partners, and the types of contracts chosen to enable the partnership in each of the cases. We also specify the real-life arrangements that correspond to the partnership principle above.

Based on the theoretical and case-study analysis, our main conclusion is that the "partnership" is indeed an indispensable element that justifies PPP from a social welfare perspective. The forms, in which the partnership principle is implemented, can vary. Institutional arrangements that facilitate the projects that private businesses run with the public sector, exemplify implicit provisions that embody the partnership element. Explicit provisions would include special clauses in the contract. Typically, such a clause would specify the role of the public partner after the procurement stage, for example in what refers to risk sharing or possible modification/variation of the project specification. It follows that in countries with a developed institutional structure that supports private-public cooperation, the benefits of the partnership are available to any consolidated private-public enterprise, which is then rightfully seen as a PPP. In others, special provisions are needed to ensure efficiency gains and to provide a clear distinction

between PPP and other forms of public-private interaction.

2. Consolidation of resources and partnership

Traditionally, public goods are provided by the state, yet this is often criticized for inefficiencies. The state can exploit the efficiency benefits of private business when outsourcing the provision of public goods. With application to the public sector, outsourcing is the delegation of public good provision by the state to an external producer (private business). This gives rise to various outsourcing strategies, depending on how much control would the state exercise over the outsourced business. On the one extreme there is outsourcing to free competitive businesses subject to no more than usual business regulation as applied to all other non-public goods producers. Among other forms, this includes contracting and privatization, which can be seen as, respectively, a sporadic or permanent delegation of the public good provision to the private sector (note that so far this view does not imply anything for the terms and conditions of such a deal between the state and the private business). Another extreme would involve special regulatory provisions such as price (tariff) regulation or even regular monitoring and audit of the outsourced businesses. Price regulation is sometimes seen as a distinctive feature that allows distinguishing between public and private sectors (Broadbent and Laughin 2003). However these forms might be inefficient as well as regulation can limit efficiency, whereas monitoring and audit are costly.

A consolidated public-private enterprise can only be justified if it overcomes the inefficiencies generated by the above-mentioned forms. In order to define a public-private partnership, we need to formulate the following partnership principle: each party is interested in the overall success of the enterprise as well as in the success of the other counterparts. This

principle is consonant with the definition of partnership by Brinkerhoff (2002) who stresses that partners mutually agree on their objectives and rationally divide labour on the respective comparative advantages of each partner. Our focus on partnership is important because (a) surprisingly, there is no clear definition of partnership in the PPP literature, although some definitions of PPP explicitly mention true partnership as a criterion, see definition iv, (b) partnership is often confused with cooperation or collaboration (partnership principle is commonly used in the policy documents on EU integration to denote the closest possible collaboration), and (c) consolidation of resources does not necessarily imply partnership as defined above. In fact, the existing PPP literature does not emphasize the term partnership per se, with rare exceptions (Roumboutsos and Chiara 2010).[1] A consolidated public-private enterprise without a partnership principle can be justified, for example, if the state wishes to enjoy the benefits that would otherwise be delivered through privatization (i.e. the benefits of a free competitive business environment) but for political or strategic reasons does not wish to privatize. In such a case a consolidation of resources is possible through a [subsidized] lease agreement but otherwise there is no distinction between such a consolidated enterprise and a

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[1]In corporate finance a partnership is known as an association "to conduct a noncorporate business", as in Erhardt and Brigham (2006, p.4). They elaborate on this definition further to stress that "partnerships may operate under different degrees of formality, ranging from informal, oral understandings to formal agreements filed with the secretary of the state in which the partnership was formed. The major advantage of a partnership is its low cost and ease of formation. The disadvantages are... (1) unlimited liability, (2) limited life of the organization, (3) difficulty transferring ownership, and (4) difficulty raising large amounts of capital.... under partnership law, each partner is liable for the business's debts". This is in line with our "partnership principle" as unlimited liability of both partners creates incentives to care about the ability of the other partner to meet obligations. Yet when the "other partner" is the state, "unlimited liability" does not seem to work the same way. Therefore we explicitly require that both partners are concerned about the overall success of the project.

usual private business. By ruling out these cases we arrive at the following definition of a PPP: a public-private partnership is a consolidated public-private enterprise that adheres to the partnership principle.

This definition yields most known properties of PPP. Social importance of PPP follows from the fact that public funds are engaged, which can only be justified if they are used to produce public goods. A formal legal agreement is needed to establish such an enterprise and to specify the way in which resources (physical assets, knowledge or labor) are consolidated. The partnership principle ensures risk sharing: all counterparts have incentives to take on risks which they can most effectively manage and delegate the management of other risks to the other parties who have their comparative risk management advantages. Compared to the properties of PPP formulated in the introduction, the above definition only fails to directly incorporate the competitive choice of PPP partners by the state and the size and the length of the project. Whereas the former seems rather an important technical procedure that provides the best match of partners to ensure the partnership principle, the latter does not arise as a pre-requisite for a PPP. We address this issue in the following section.

The above definition of PPP from the business organization perspective provides a sought precise boundary surrounding PPP and in particular supports the commonly accepted view that PPPs are the main alternative to contracting out and privatization (Hodge and Greve 2007). It shares with other studies the classification according to the extent that the tasks, risks and responsibilities of former public service provision are transferred to the private partner (Koppenjan and Enserink 2009), but this classification is now a natural consequence of a more general view on the forms of business organization suitable for the provision of public goods. It also follows that a PPP is desirable when production costs are high (this rules out autarchy),

market barriers prevent free entry (this rules out competitive private business), and monitoring and audit is costly or inefficient (this rules out public and controlled enterprises). PPPs are distinguished from other forms of private sector participation in the provision of public goods by two criteria: consolidation of resources and partnership principle, as summarized in Table 2. This distinction is operational and useful for empirical studies of PPP. By focusing on financial resources only as one dimension and organizational relationship as the other dimension, Hodge and Greve (2007) provide a further distinction between different PPPs. They also refer to Brinkerhoff (2002) to note that the mutuality, i.e. interdependence and equality in decision-making as well as equal benefits to parties constitutes another important dimension. The latter broadly corresponds to our partnership principle.

Table 2. A typology of forms of public goods provision based on consolidation of resources and partnership principle.

		Partnership principle	
		+	−
Consolidation of resources	+	PPP	Outsourcing on lease, Contracting
	−	Contracting	Privatization Public enterprise

In the remainder of the paper we focus on the forms of business organization presented in Table 2 in the following order. We first formally show when a collaboration between the private and the public sector is desirable, thus ruling out privatization and nationalization. Subsequently, we focus on the consolidation of resources to study the feasibility of the public-private projects under typical contractual agreements. Then we turn to the partnership principle *on top* of the consolidation of resources. This allows us to study the benefits that can

arise from the partnership, and more importantly, to formally specify the elements of the partnership principle and to derive conditions when these are socially beneficial. We further discuss whether a project that adheres to the partnership principle but does not involve a consolidation of resources, makes sense from the perspective of social welfare.

3. Optimal contract

The above discussion contrasts PPP and other types of public good provision that involve private sector, along two dimensions: consolidation of resources and partnership. Consolidation of resources reduces the overall cost of their provision, if each party supplies resources which it can obtain at a lower cost than any other counterpart. On the other hand, consolidation of resources requires collaboration, which may be costly, for example due to the need to coordinate actions, or to monitor the actions/contribution of the partner. If the cost of collaboration does not exceed the savings achieved through the reduction in the overall cost of resources, consolidation and collaboration offer cost-efficiency. In this section we assume that the public and the private partner collaborate on a joint project. Depending on the information and other costs, such a collaboration will not always be optimal, and hence some projects will be unfeasible. We will further demonstrate the benefits of the partnership that can improve the feasibility of the projects.

Our setup is similar to the basic model of contracting for collaborative services suggested by Roels et al. (2010). Their focus is on the co-production between the vendor and the buyer of the service. Involvement of the buyer improves the value of the service, which acts as an incentive for the buyer to co-produce. The main issues that arise with regards to services, are the verifiability of the vendor's and the buyer's inputs, as well as the uncertainty of the value the buyer will derive from the service. With regards to typical public goods, their value is rather

deterministic; in most cases they are linked to material objects (buildings, infrastructure, facilities etc.). For this reason our focus is mainly on the structure of incentives, which differs from that implementable in services. In particular, inputs are usually verifiable, yet the costs of their verification may differ, implying different types of optimal contractual arrangements for different projects.

3.1. Consolidation of resources

Consider a project that requires two [sets of] inputs denoted by x for the contribution of the public party and y for that of the private party, and generates a (social) value of $V(x, y)$. The costs of inputs are $c_x(x)$ and $c_y(y)$ respectively, increasing in their argument. Denote with U the reservation utility, i.e. the lowest payoff that the private partner prefers to the outside option of not entering the project. If the project is run by the private partner only, it does not generate enough profit to cover U, otherwise we would deem the project implementable through the private sector. The involvement of the public party is justified by its ability to provide resource x at a lower cost than faced by the private partner.

Theoretically, both partners can provide any resources, although literature usually underlines efficiency gains expected from a collaboration of a public body with a private partner, suggesting managerial skills as one of the sought private resources. To provide an example that informs our model, the cost advantage of the private partner could refer to labour and material cost, as well as to the cost of intellectual capital and efficient management, all of which are denoted as a single set of resources y in our setup. One can think of y as a single package of inputs, and $c_y \cdot y$ as the total price of it; in a similar way, a typical lot in a public procurement auction or tender would specify the whole package to be purchased, leaving the decision with regards to the resources actually needed for its provision, to the bidders. The total cost of

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providing resources y is distinct from the total payoff t to the private partner; the latter also needs to cover the reservation utility and in general depends on the type of contract chosen.

3.2. Contract design

Parties contractually agree to deliver inputs x and y as optimally chosen for the particular project. The public party can verify the input of the private partner at cost $\phi_y(y)$. Similarly, the public party may be required to report on the delivery of the agreed input x, which incurs information (reporting) cost $\phi_x(x)$. This latter cost may be associated with a need to provide hard evidence in the court of law upon a request by the private partner. This setup leaves all information costs with the public party. Redistributing them between the partners will not affect the final result, as whenever the private partner bears information costs, these are included in the remuneration t.

If any of the parties provides less resources than contractually agreed, they are subject to penalties: R for the private partner and G for the public party. Penalty can be non-pecuniary, associated with the loss of reputation and foregone future profit opportunities. We assume that R is limited by the value of physical assets that belong to the private partner (bankruptcy value), and G is also bounded from above, $G < \overline{G}$. The harshest penalty that can be imposed on a public partner is the exhaustion of their reserves and the dismissal of the relevant public managers. A recent example of a penalty paid by a public partner as a monetary transfer to the private party would be £30m paid by the Norfolk County Council to Cory

Wheelabrator Consortium for abandoning the the Willows incinerator project at King's Lynn in the UK.[2] In terms of our model, this corresponds to the event "project not delivered in full", with the public party delivering less resources than agreed. The specific "resource" in question here is the approval of the project going ahead and securing the state funding for it (the main reason for abandoning the project were 92% local citizens voting against the project and the subsequent withdrawal of the £169m government grant). The penalty for the council splits into £19m from current reserves and £11m from future savings, implying a longer lasting burden for other local project and a reputation damage.

The contract is designed by choosing public and private inputs x and y, remuneration t, and the verification mode. For the latter we introduce binary variables δ_x and δ_y which take a value of 1 if it is the public or the private partner's input respectively that the parties agree to verify. Insufficient delivery of the verifiable input triggers penalty sanctions, hence information disclosure coupled with the penalty is reflected in the liabilities of the parties in a typical contract. It is usually costless to include liabilities of both parties in a paper document. Given this, the choice of δ_x and δ_y in our model can be seen as establishing firm beliefs of the parties with regards to who of them will *actually* be monitored or should credibly report on inputs provided.

It is further assumed that the actual value of the project $V(x, y)$ is freely observable by both parties. Three types of contract are concievable: if either $\delta_x = 1$ and $\delta_y = 0$, or $\delta_x = 0$

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and $\delta_y = 1$, only public or private input respectively is verified; with $\delta_x = \delta_y = 0$ neither input is verfied. A contract with $\delta_x = \delta_y = 1$ is suboptimal since knowing $V(x, y)$ and one of the inputs reveals the other input at no cost. The latter emphasises, in particular, that mistrust between the parties, that results in their beliefs that there is a need to monitor actions of each other, leads to a suboptimal outcome, as in equilibrium less resources will be provided in total, yielding a lower value of the project. The payoff to the private party thus depends on the inputs, the output and the verification mode: $t = t(x, y, V, \delta_x, \delta_y)$. The public partner then solves the following:

$$\max_{x, y, \delta_x, \delta_y} V(x, y) - c_x(x) - \delta_x \cdot \phi_x(x) - \delta_y \cdot \phi_y(y) - t(x, y, V, \delta_x, \delta_y) = \Psi(x, y, \delta_x, \delta_y) \qquad (1)$$

$$\text{s.t.} \quad t(x, y, V, \delta_x, \delta_y) \geq c_y(y) + U, \qquad \text{(IR)}$$

$$R \geq c_y(y^*) - c_y(y), \qquad \text{(IC-P)}$$

$$G \geq c_x(x^*) - c_x(x), \qquad \text{(IC-G)}$$

$$x^*, y^* \in \arg\max \Psi(x, y, \delta_x, \delta_y)$$

Here the individual rationality constraint (IR) ensures that the private partner is compensated enough to cover the cost of resources and the reservation utility, and incentive compatibility (IC) constraints (IC-P and IC-G) ensure that neither of the parties have incentives to deviate from the agreed contributions: penalties exceed any potential savings from deviations.

Proposition 1. If there exists a mechanism that reveals $t^* = c_y(y^*) + U$ then an optimal contract with verification of the private input ($\delta_x = 0$, $\delta_y = 1$) sets the remuneration to the

private partner at $t(x, y, V, 0, 1) = \begin{cases} 0 & \text{if} \quad y < y^*, \\ t^* & \text{if} \quad y \geq y^*. \end{cases}$

PROOF: Setting $t^* = c_y(y^*) + U$ ensures IR is met (binding) in the optimum. IC-P is

met if $R = \max[c_y(y^*) - c_y(y)] = c_y(y^*) - c_y(0)$ since y^* is known, c_y increases in y, and

$y \geq 0$. Since c_y is unknown we can use inequality $c_y(y^*) + U > c_y(y^*) - c_y(0)$ to set $R = t^*$ to

meet IC-P. The resulting payoff, if the contract is violated, is then $t = t^* - t^* = 0$. **QED**

Even if y is verifiable, the cost function c_y and the reservation utility U are not. For

this reason, the above proposition assumes that $t^* = c_y(y^*) + U$ is known. This requires a price

revelation mechanism when designing the contract, for example a bidding/auction or a tendering

phase. The penalty on the public partner in this case does not play any role, as it is the input of

the private party that is verified. This type of contracts is *input-contingent* (IC-contract) and

encompasses various agreements where the private party is paid either on the hourly basis or

exactly for the specified contribution to the overall project, yet not conditioned on the success of

the project as a whole.

Proposition 2. If there exists a mechanism that reveals $t^* = c_y(y^*) + U$ then an optimal

contract that obliges the public partner to disclose and verify information about its inputs ($\delta_x = 1$,

$\delta_y = 0$), sets the remuneration to the private partner at

$$t(x, V) = \begin{cases} 0 & \text{if} \quad x \geq x^* \text{ and } V < V(x^*, y^*), \\ t^* & \text{if} \quad x \geq x^* \text{ and } V \geq V(x^*, y^*), \\ t^* + G & \text{if} \quad x < x^*, \end{cases}$$

and penalty G on the public partner at $G = \overline{G} \geq c_x(x^*) - c_x(0)$.

PROOF: If $x \geq x^*$ and $V < V(x^*, y^*)$ then necessarily $y < y^*$. If $x = x^*$ and $V \geq V(x^*, y^*)$ then necessarily $y \geq y^*$. For these two cases the proof is the same as for proposition 1. As the private partner has no incentives to provide more than y^*, the equilibrium provision is $y = y^*$. In equilibrium $x = x^*$ as the public party has incentives to reduce costs $c_x(x)$. For this reason setting $t(x, V) = t^*$ if $x \geq x^*$ and $V \geq V(x^*, y^*)$ is optimal. If $x < x^*$, then necessarily $V < V(x^*, y^*)$ as the private partner provides only $y \leq y^*$ in equilibrium. The input of the private party cannot be verified but transferring penalty to the private party is the cheapest mechanism to ensure the private party is convinced the public party has been penalised. For the same reasons as in the proof of proposition 1, the level of the penalty should be set at $G = c_x(x^*) - c_x(0)$, but the cost function c_x cannot be credibly reported to the private party, therefore G is set at the highest possible level to ensure that IC-G is met. **QED**

In our model, there is no specific mechanism to determine the optimal penalty on the public partner. Paying the private partner t^* compensates for foregone profits, independent of how much resources were actually delivered, however this may be insufficient to meet IC-G. The transfer of $\overline{G}$ to the private party is the cheapest available mechanism to ensure that the private party is convinced the penalty was actually imposed. This type of contracts is output-contingent (OC-contract), and as follows from the proposition, it is indispensable that if the public party conditions payoffs to the private side on the success of the overall project, the public party itself should be accountable and provide credible information about its inputs. This would also require that all inputs of the public party are clearly specified in the contract. In both cases with input verification, the contract presumes a fee that is fixed at the moment of signing the contract: the

amount $t^* = c_y(y^*) + U$ is the agreed compensation for the inputs, plus the premium to cover the reservation utility.

Proposition 3. A contract that does not require verification of inputs specifies the payoff to the private partner by a bonus rate $b > 0$ and a fixed fee of $s = U$: $t = bV + s$.

PROOF: If inputs are not verified, parties face double moral hazard, in which case the optimal (second-best) contract is as above, see, e.g., Bhattacharya and Lafontaine (1995). It only remains to establish that $s = U$. Neither s, nor U are known to the public party, both are a part of remuneration to the private party, determined at the negotiation stage. In the limit, with zero private contribution and zero outcome, the payoff to the private party is exactly the surcharge (premium) it requires for taking part in the collaborative project, even if no further effort is required. In the fixed-fee contracts such a surcharge equals to U (see propositions 1 and 2) and in the PB-contract it equals to s. As both denote the same participation premium, which does not depend on the type of the contract, we obtain $s = U$. **QED**

The contract in the last proposition is performance-based (PB-contract). Roels et al. (2010) discuss properties of the optimal bonus rate b in the context of co-production in services. In the context of public-private projects, the emphasis is on the possibility to link the remuneration to the private party to the social value generated by the project. Concession is one example: the private party operates an infrastructure object and derives profit from payments by the end users. In this case, the higher the social value of the object, the more intensively it is used, and the higher is the payoff to the private party.

3.3. Choice of contract and feasibility

A project is feasible if parties agree to implement it by entering one of the above contractual agreements. This requires that the social value V generated exceeds costs (including verification costs) and the reservation utility of the private partner. The choice of the optimal contract is based on the comparison of the total surplus they generate. To do this, from this point on assume that $V(x,y) = \mu x^\alpha y^\beta$, $c_x(x) = c_x \cdot x$, $c_y(y) = c_y \cdot y$ (this assumption is identical to Roels et al., 2010) and that $\phi_x(x) = \phi_x \cdot x$ and $\phi_y(y) = \phi_y \cdot y$ (this assumes that the cost of input verification is linear in the input, and it does not cost a penny to reveal that one of the parties did not contribute anything). With this in mind, for fixed parameters δ_x and δ_y that determine the type of the contract, re-write (1), substituting for $t(x,y,V,\delta_x,\delta_y) = c_y(y) + U$, to obtain

$$\max_{x,y} \mu x^\alpha y^\beta - \left(c_x + \delta_x\phi_x\right)\cdot x - \left(c_y + \delta_y\phi_y\right)\cdot y - U \qquad (2)$$

This holds for both types of fixed-fee contracts. Maximisation of this Cobb-Douglas-type function is a standard exercise, with first-order conditions ensuring $\alpha \cdot V = \left(c_x + \delta_x\phi_x\right)\cdot x^*$ and $\beta \cdot V = \left(c_y + \delta_y\phi_y\right)\cdot y^*$ for the optimal combination of outputs x^* and y^*. This allows one to re-write the objective function as $\Psi_{FF}\left(\delta_x,\delta_y\right) = (1-\alpha-\beta)\mu x^\alpha\left(\delta_x,\delta_y\right)y^\beta\left(\delta_x,\delta_y\right) - U$, where $x\left(\delta_x,\delta_y\right)$ and $y\left(\delta_x,\delta_y\right)$ are optimally chosen for the given type of contract $\left(\delta_x,\delta_y\right)$ (asterisk dropped to improve readability). From here one straightforwardly obtains that $\Psi_{FF}(1,0) > \Psi_{FF}(0,1)$ if and only if $\left(x(1,0)/x(0,1)\right)^\alpha > \left(y(0,1)/y(1,0)\right)^\beta$. In this notation $x(1,0)$ is the optimal public input in the OC contract, and $x(0,1)$ in the IC-contract (similarly for $y(0,1)$ and $y(1,0)$). Ratio

$x(1,0)/x(0,1)<1$ measures the effect of the contract choice on the amount of public resource contracted (a requirement to verify input x makes it more expensive than without verification, for which reason, *ceteris paribus,* $x(1,0)<x(0,1)$); similarly for input y. It follows that if resources of both parties have identical provision and verification costs, it is the sensitivity of the project to these resources that determines the type of the contract: OC-contract is preferred to IC-contract if and only if $\alpha < \beta$. This is because, for example, choosing a contract that incurs verification cost for resource x reduces the optimal amount of this resource that will be contracted for the project (due to higher cost), which affects the final value of the project, yet the impact is smaller if the project has lower sensitivity to this resource. The following proposition establishes the result more generally.

Proposition 4. The fixed-fee contract contingent on output (OC) dominates the fixed-fee contract contingent on the private party's inputs (IC) if and only if

$$\left(\frac{c_x}{c_x+\phi_x}\right)^\alpha > \left(\frac{c_y}{c_y+\phi_y}\right)^\beta \quad \text{or, equivalently,} \quad \frac{\alpha}{\beta} < \frac{\ln\left(1+\frac{\phi_y}{c_y}\right)}{\ln\left(1+\frac{\phi_x}{c_x}\right)}.$$

PROOF: Standard maximisation of the profit generated by the Cobb-Douglas production technology $\mu x^\alpha y^\beta$ with factor costs as above, yields factor demands

$$x(\delta_x,\delta_y)=\mu^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{c_x+\delta_x\phi_x}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{c_y+\delta_y\phi_y}\right)^{\frac{\beta}{1-\alpha-\beta}}$$

and

$$y(\delta_x,\delta_y)=\mu^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{c_x+\delta_x\phi_x}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{c_y+\delta_y\phi_y}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}.$$

As discussed above, comparing the values of the objective function for contracts OC

and IC is equivalent to the comparison of $(x(1,0)/x(0,1))^\alpha$ and $(y(0,1)/y(1,0))^\beta$. Substitution yields the first result. By taking logarithms of both sides and re-arranging, we obtain the equivalent representation. **QED**

It follows that the decisive criteria for the choice between OC and IC contracts are the factor elasticities α and β, and the cost of information verification relative to the factor costs, ϕ_x/c_x and ϕ_y/c_y. For example, a complex bridge would incur higher cost of resources (per unit) than a road because a bridge would involve many rather unique solutions, while constructing a road involves a repetition of rather standard approaches. At the same time, it is easier to verify the quality of the bridge and the resources actually used by parties, as it is one localised object, while it is more expensive to monitor the actual provision of resources at each kilometer of the road. For these reasons, the $\phi/c-$ ratio is expected to be lower for the bridge and higher for the road. The higher the sensitivity of the project to the private input, or the higher is the relative verification cost for the private input, the more likely is the OC-contract to dominate the IC-arrangement.

The following proposition compares the benefits from fixed-fee contracts with those from the PB-contract.

Proposition 4. Performance-based contract dominates fixed-fee contracts if and only if

$$\left(\frac{1-\alpha}{1-\alpha-\beta}\right)^{1-\alpha-\beta}(1-b)^{1-\beta}b^\beta > \max\left[\left(\frac{c_x}{c_x+\phi_x}\right)^\alpha,\left(\frac{c_y}{c_y+\phi_y}\right)^\beta\right]$$

PROOF: The optimisation task differs from that under fixed-fee contracts as the

objective function of the public party $(1-b)\cdot\mu x^{\alpha}y^{\beta}-c_x\cdot x-s$ does not depend on the costs of

provision of y, and therefore the public party chooses x for any given level of private input.

The private party separately maximises profit $b\cdot\mu x^{\alpha}y^{\beta}-c_y\cdot y+s-U$ for any given level of

public input x. The first-order conditions thus turn into $\alpha(1-b)\cdot\mu x^{\alpha-1}y^{\beta}=c_x$ and

$\beta b\cdot\mu x^{\alpha}y^{\beta-1}=c_y$ respectively. The value of the objective function in the optimum is thus

$\Psi_{PB}(0,0)=(1-b)(1-\alpha)\cdot\mu x^{\alpha}y^{\beta}-s$, and the factor demands are:

$$x_{PB}=\mu^{\frac{1}{1-\alpha-\beta}}\left((1-b)\cdot\frac{\alpha}{c_x}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(b\cdot\frac{\beta}{c_y}\right)^{\frac{\beta}{1-\alpha-\beta}},$$

and

$$y_{PB}=\mu^{\frac{1}{1-\alpha-\beta}}\left((1-b)\cdot\frac{\alpha}{c_x}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(b\cdot\frac{\beta}{c_y}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}.$$

This yields

$$\Psi_{PB}(0,0)=(1-b)(1-\alpha)\cdot\mu^{\frac{1+\alpha+\beta}{1-\alpha-\beta}}\left((1-b)\cdot\frac{\alpha}{c_x}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(b\cdot\frac{\beta}{c_y}\right)^{\frac{\beta}{1-\alpha-\beta}}-s,$$

which is to be compared with

$$\Psi_{FF}(\delta_x,\delta_y)=(1-\alpha-\beta)\cdot\mu^{\frac{1+\alpha+\beta}{1-\alpha-\beta}}\left(\frac{\alpha}{c_x+\delta_x\phi_x}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{c_y+\delta_y\phi_y}\right)^{\frac{\beta}{1-\alpha-\beta}}-U.$$

Since $s=U$ by proposition 3, for the OC-contract we obtain $\Psi_{PB}(0,0)>\Psi_{FF}(1,0)$ if

and only if

$$(1-b)(1-\alpha)\left((1-b)\cdot\frac{1}{c_x}\right)^{\frac{\alpha}{1-\alpha-\beta}}b^{\frac{\beta}{1-\alpha-\beta}}>(1-\alpha-\beta)\left(\frac{1}{c_x+\phi_x}\right)^{\frac{\alpha}{1-\alpha-\beta}},$$

which delivers the result. Similarly for the IC-contract. **QED**

By the above proposition, performance-based contracts with the bonus rate $b = \beta$ offer maximum advantages as this maximises the term $(1-b)^{1-\beta}b^{\beta}$ on the left-hand side. In Roels et al. (2010), PB-contracts are found optimal for projects with $\alpha \approx \beta$, for which the bonus rate should be optimally set at around 50%. For $\alpha + \beta \approx 1$, the two results coincide, yet our result is not based on the optimal bonus rate. Instead, it claims that the PB-contract is more likely to dominate IC and OC contracts, if the optimal bonus rate is close to $b = \beta$; other rates can be optimal for projects with different α and β, yet these would be less likely to dominate IC and OC contracts. The concession example above stresses that the bonus rate in public-private projects is effectively determined by the stream of income generated by the project over years. In this case our result stresses that the private party's share in this stream should depend on the sensitivity of the project outcome. The effect of a variation in b on the optimality of performance-based contract is highlighted in figure 1. In particular, an increase in the bonus rate, although improving incentives for the private partner, does not necessarily imply a better overall performance of the project as compared to the same project run under a fixed-fee contract.
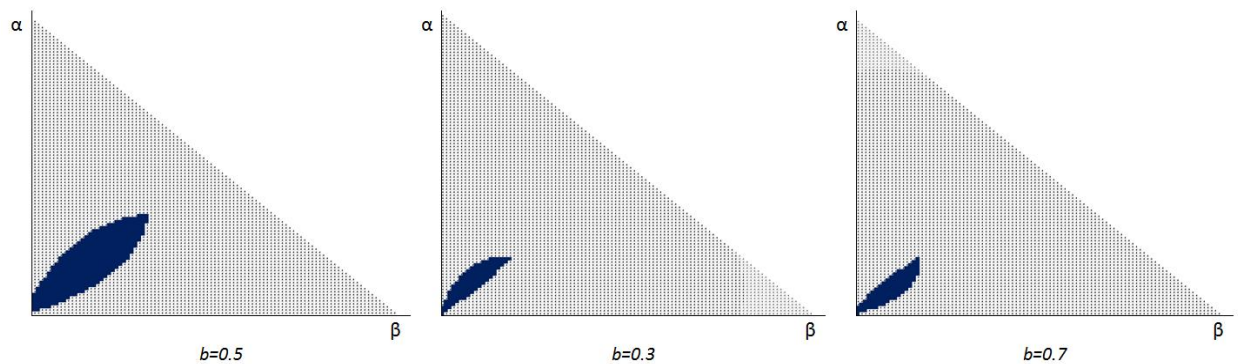

Figure 1. Comparative statics for optimal PB-contract: bonus rate effect. For projects

$V(x,y) = \mu x^\alpha y^\beta$, the dark area is the set of parameters (α, β), for which a performance-based contract with $b = 0.5, 0.3$ and 0.7 dominates fixed-fee contracts if production costs are $c_x = c_y = 0.1$ and information costs are $\phi_x = \phi_y = 0.1$.
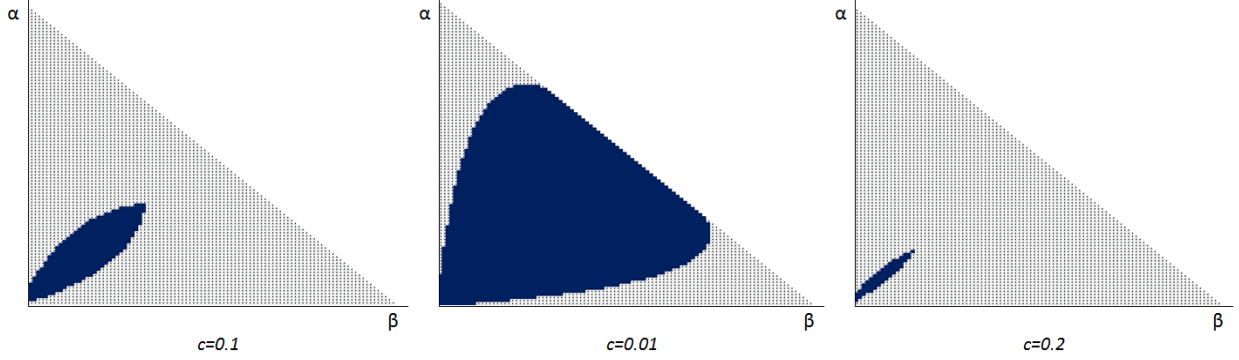

Figure 2. Comparative statics for optimal PB-contract: costs effect. For projects $V(x,y) = \mu x^\alpha y^\beta$, the dark area is the set of parameters (α, β), for which a performance-based contract with $b = 0.5$ dominates fixed-fee contracts if production costs are $c_x = c_y = c = 0.1, 0.01$ and 0.2, and information costs are $\phi_x = \phi_y = 0.1$.
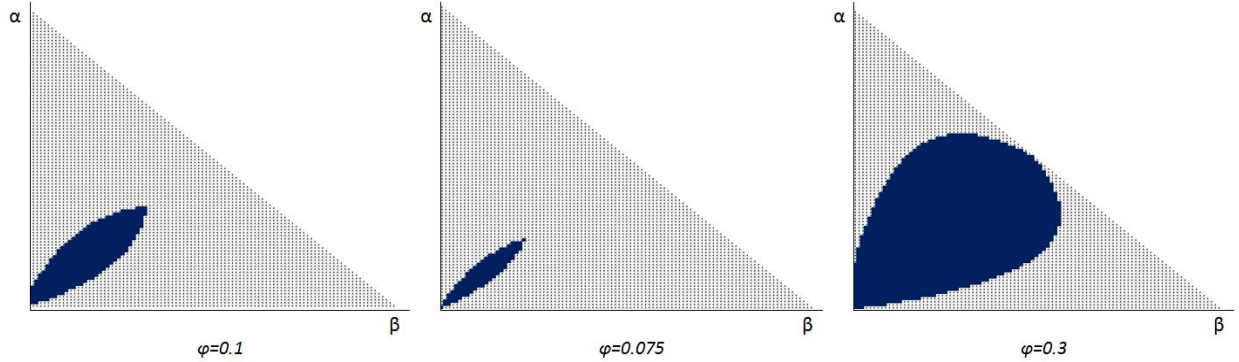

Figure 3. Comparative statics for optimal PB-contract: information costs effect. For projects $V(x,y) = \mu x^\alpha y^\beta$, the dark area is the set of parameters (α, β), for which a performance-based contract with $b = 0.5$ dominates fixed-fee contracts if production costs are $c_x = c_y = c = 0.1$ and information costs are $\phi_x = \phi_y = 0.1, 0.075$ and 0.3.

Similarly, figures 2 and 3 show the effects of production and information costs on the

optimality of the performance-based contract. With higher information costs, the performance-based contract is more likely to dominate the fixed-fee contracts, which is intuitively clear because the cost of verification/reporting is a welfare loss that can be avoided with a performance-based contract. Interestingly, the cheaper the production, the larger the set of projects for which a performance-based contract dominates fixed-fee contracts (for $c_x = c_y = 0$, the performance-based contract always dominates). This is due to the effect of the relative information cost: a decrease in the production cost makes verification/reporting relatively more expensive, and hence fixed-fee contracts less attractive.

3.4. Role for partnership

Not all projects are feasible even if contracts are optimally designed. If the total surplus from the optimal contract is below U then it is impossible to contract the private party, and thus the project is deemed infeasible. The set of these projects is shown in Fig. Fig. Infeasible projects. Note that these projects can still be socially desirable.
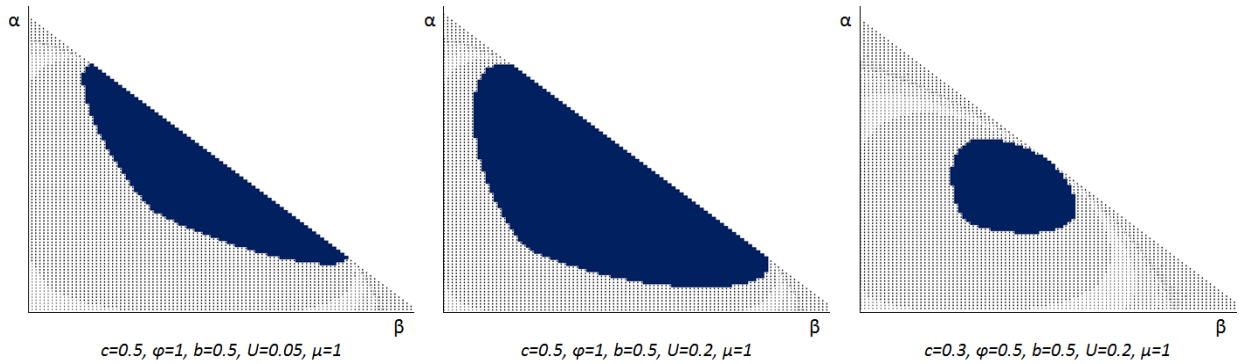

c=0.5, φ=1, b=0.5, U=0.05, μ=1   c=0.5, φ=1, b=0.5, U=0.2, μ=1   c=0.3, φ=0.5, b=0.5, U=0.2, μ=1

Figure 4. Infeasible projects. For projects $V(x,y) = x^\alpha y^\beta$, the dark area is the set of parameters (α, β), for which the maximum profit generated through optimal contracts does not suffice to cover the reservation utility of the private partner U.

Two properties are remarkable in figure 4: (1) a reduction in the reservation utility shrinks the set of infeasible projects, and (2) cost reduction has a similar effect. In the figure, the bonus rate is set at $b = 0.5$, consistent with the optimal level for performance-based contracts in Roels et al. (2010). As this is close to the optimal rate, the feasibility of the projects via contracting cannot be improved by changing the bonus. If partnerships offer advantages in terms of a reduction of information costs, production costs, or the reservation utility, this will improve feasibility of projects.

For example, the public partner can provide guarantees to improve the chances of the private partner to obtain finance from the financial sector. These guarantees may be implicit, as the private partner is paid by the public one, yet they may improve the creditworthiness of the private partner, who would be able to obtain funding at a lower cost. This can, however, work in the opposite direction, if the public partner itself suffers from an insufficient funding and is thus regarded as unreliable.

As another example, in 2000, in the UK HM Treasury and the private businesses (with the public partner owning 51% of the enterprise) established jointly Partnerships UK, the PPP aimed at a provision of consulting to the public and private parties that consider forming a PPP themselves. Partnerships UK dissolved in 2011, with its activities replaced in part by the Treasury (through its infrastructure projects department, Infrastructure UK) and another PPP, Local Partnerships, aimed at assisting the projects with local governments. A help of this type in the formation of new businesses, exemplifies yet another contribution of the public sector that does not explicitly enter contractual agreements, yet has an effect on the reservation utility, and hence on the feasibility of the projects.

The comparative statics in figure 4 can be formalized by considering a reduction of the reporting/verification cost, $\phi_x^{PPP} < \phi_x$, or $\phi_y^{PPP} < \phi_y$ and a decrease in the reservation utility of the private partner, $U^{PPP} < U$ arising through an intensive collaboration with the public partner. Denote with Π_j the profit resulting from a project contracted through a fixed-fee ($j = FF$) or a performance-based ($j = PB$) contract, and Π_j^{PPP} –profit from a similar project within a similar contract but with special provisions ensuring the above reduction in costs and reservation utility.

Proposition 5. If the partnership ensures that either of the following holds: (1) $U^{PPP} < U$, (2) $\phi_x^{PPP} < \phi_x$, or (3) $\phi_y^{PPP} < \phi_y$, then there exist projects (α, β) unfeasible under standard contractual arrangements but feasible under the partnership:

$$\{(\alpha, \beta) : \max \Pi_j < U^{PPP}\} \subset \{(\alpha, \beta) : \max \Pi_j < U\}.$$

PROOF: It is easy to check that $\phi^{PPP} < \phi$ and $U^{PPP} < U$ ensure $\max \Pi_j^{PPP} > \max \Pi_j$ for any α and β. The rest follows from $\max \Pi_j < \max \Pi_j^{PPP} < U$: all elements of the first set are also elements of the second one, but not vice versa. The proof follows from $\max \Pi_j < \max \Pi_j^{PPP} < U^{PPP} < U$, which holds for any α and β.

The reservation utility can be viewed as the sunk cost plus a premium (the difference between the actual remuneration and the actual costs to provide the required input) that the private party requires to take part in the project. The sunk cost, for example, would include the startup cost, the application cost, the cost of overcoming bureaucratic obstacles, etc. (not to mention bribery). The premium is a compensation for potential inconveniencies of dealing with the public body (e.g. due to internal inefficiencies, delays in decisions, need to adhere to multiple requirements and codes of best practice, etc., all of which is usually referred to as *red tape*). In a

partnership, the sunk cost decreases because of the cost advantage of the public partner, and the premium decreases because of the improved incentives of the public partner. Not the least, one of the reasons for the premium to decrease is in the potential reputation gains for the private partner.

The reduction in information cost can be due to co-production: the closer the collaboration, the more obvious is the input of the counterpart. Co-production is often associated with knowledge spillovers, and observed, for example, in knowledge-intensive services (Doroshenko and Vinogradov, 2011), yet parties should be *willing* to closely co-produce and be *open* to exchange knowledge. These two conditions are less unlikely to be contractible. Besides, public bodies are known to be involved in the co-production to a lesser degree than private firms, at least in what regards knowledge-intensive services (Doroshenko et al., 2013).

In the above we considered three types of contracts: (1) two with a fixed-fee to the private partner, conditioned either on the successful implementation of the project, or on the actual input if verifiable, and (2) with a performance-based remuneration to the private partner. All of them exist in the private sector and therefore are not specific to public-private cooperation. Moreover, the type of contracts alone cannot help distinguish public-private partnership from outsourcing (part of) public good provision through public procurement. Yet, complemented with provisions that ensure a reduction in the reservation utility and information and production costs, which are distinctive features of partnerships, they are able improve the allocation of resources. The latter justifies public-private partnerships from the perspective of improving social welfare.

4. Examples

The above three types of collaborative contracts between the public and the private

partners are quite common in practice. This framework explains examples of government buildings in the Netherlands (IC-type PPP contract) and roads construction in Finland (concession, PB-type contract) from the Introduction. Note that due to economies of scale, in large projects costs per unit are typically lower than in smaller projects. A building exemplifies a rather unique project of a smaller size than, for example, a highway. The input of the private partner can be relatively easily verified: the construction site is accessible, usually in an urban location, for which reason performing regular monitoring is not problematic. Architecturally, large buildings, especially in a central location, are rather unique, which implies relatively high production costs per unit of input. Therefore verification costs relative to the provision costs are rather low, and PB-contracts are less likely to be optimal. An IC-contract is more likely to be optimal for this type of projects, as public input is less specific, and the sensitivity of the outcome to it is rather low. In contrast, large-scale projects like motorways offer opportunities for a reduction in costs per unit through the economy of scale argument, and in particular through a rather routinized repetition of standard actions at each segment of the road. However the length of the project site makes private partner's inputs less observable, suggesting higher input verification costs. As predicted by the comparative statics in the previous section, concession is more likely to be optimal in this case. The same logic works in the cases below.

4.1. Performance-based contracts in waste management[3]

Case 1: Energy from waste project in Suffolk, UK

Description: 25-year, £1-billion private finance initiative (PFI) waste management contract between Suffolk County Council and SITA UK. Includes £185-million incinerator in Great Blakenham (Suffolk, UK), a combined heat and power (CHP) plant, with the capacity to burn up to 269,000 tonnes of residual waste a year and generate enough electricity for 30,000 homes. [1]

Public party contribution: The Great Blakenham site (in the ownership of the Suffolk Council) is on lease to the private partner for a peppercorn rent for the whole duration of the project, and will revert to the Council on expiry of the contract or earlier termination [3]. Minimum guaranteed tonnage (170,000 tonnes a year). Government grant of about £200 million over 25 years, to contribute towards the running costs [2]

Private party contribution: finance, technology, building facilities, management. £180 million Incinerator funded by SITA UK; at the end of the contract, the facility will be owned by Suffolk County Council [2]. Private party outsourced activities to other subcontractors, for example, architecture and design of the building to Grimshaw.

Liabilities of the public party: payments for insufficient waste delivery; penalty if project plans withdrawn. Credibility of penalties is evidenced by a similar project in nearby

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[3] Sources used: [1] Kane A. (2014) "Great Blakenham incinerator comes online", *Resource*, 4 December 2014, available online at http://resource.co/article/great-blakenham-incinerator-comes-online-7008; [2] Suffolk Energy From Waste website, http://www.suffolkefw.co.uk/the-facility/facts-and-figures; [3] Suffolk County Council (2010) Final Business Case: Application for the private finance initiative credits, Department for Environment, Food and Rural Affairs Waste Infrastructure Delivery Programme, Suffolk Council Cabinet Meeting of 7 September 2010, Appendix A, available at http://committeeminutes.suffolkcc.gov.uk; [4] Suffolk County Council (2010) "Energy from waste project", Scutiny committee meeting of 18 September 2013, Evidence Set 1, available at http://committeeminutes.suffolkcc.gov.uk; [5] SITA (2012) "Experience with EfW project procurement in UK", available at http://www.ir-foundation.com/wp-content/uploads/2013/01/B2-Frederic-Aguesse.pdf.

Norfolk, initiated under the same conditions (and subject to the same government regulation), that has been withdrawn by the public party and resulted in penalties paid to the private partner (see example in Section 2.2). Minutes from the council's meeting evidence discussions of the logistic schemes to enable meeting targets on waste delivery. The risk of not meeting the waste volume target is confirmed by estimates that "UK's residual waste treatment capacity will exceed supply in 2017/18" [1].

Liabilities of the private party: penalties for broken deadlines, failure to meet standards; business risks, except for the risk of insufficient waste delivery.

Sensitivity to contributions: First phase of the project (plant construction) is more sensitive to the contribution of the private party. The second phase (waste processing) is equally sensitive to contributions of both parties, as energy generation depends on the waste collection, as well as on the technology implemented and the quality of materials used in the construction of the waste processing facility.

Optimal contract: PB-contract, because the sensitivity to both contributions is rather equal. Information costs are high (e.g. it is impossible to verify technology employed without specialized knowledge). If the first phase (plant construction) was unbundled from the second phase, a fixed-fee output-contingent contract would be optimal for the first phase as it is highly sensitive to the contribution of the private partner, and the information cost (verification of the quality of the plant) is high. Due to the high information cost at the first stage, bundling it with the second stage is optimal, as it removes at least one information verification stage, and introduces incentives for the operator to ensure the necessary quality of the facility.

Actual contract: PB (concession). The private party derives profits from waste processing fees, depending on the amount of waste processed, as well as from energy generation.

The public party shares profit from energy generation (if exceeds target).

Partnership element: close co-operation, as evidenced by minutes of the Council's Scrutiny committee [4]. Assistance evidenced by the record-breaking short project approval time. The Council and the Community Liaison Group established by the Private Partner, jointly hold meetings with local community to update on progress and address issues arising. Although identification of the construction site is usually on the private partner [5], in this case the site was suggested by the Council from the beginning (and accepted by all four bidders at the procurement stage) [3]. The latter reduces risk of proposal being rejected on the basis of suboptimal choice of site (translates in the reduced reservation utility in the model).

Evidence of success: CHP opened on time and on budget [1]. Architectural award for the building. Civil Engineering award for the overall project. [2] Successful operation scheme allowing to accommodate extra waste delivered from Norfolk after closure of several sites there. Average electricity generation 570 MWh per day (daily data available from http://www.suffolkefw.co.uk); this exceeds predicted energy generation of 225 MWh per day (converted from a figure of 80 000 MWh a year, [6]).

Other remarks: the ownership of the facilities is transferred to the public party after 25 years; associated risks (worn off facility, amortization costs, need in modernization) are on the public party. Budget forecasting does not go beyond 25 years, and does not consider these costs.

Case 2: Waste processing in Krasnokamsk, Perm Krai, Russia[4]

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[4] Sources used: [1] "Musornye Voiny: epizod vtoroi" ("Waste wars: episode 2"), Krasnokamskaya zvezda, 29/06/2011, available online: http://media-office.ru/?go=353494&pass=0d6a1671b8ea281e5a5c42263bbb6610; [2] Bumatika official webpage http://new.bumatika.ru; [3] "V Permi zarabotal kompleks po avtomaticheskomu razdeleniu musora" ("Waste separation facility launched in Perm", e-newspaper NeSekretno, 15/11/2013; available online http://www.nesekretno.ru/social/18155/v_permi_zarabotal_kompleks_po_avtomaticeskomu_razdeleniu_mus; [4] Glushkov A. (2013) "Est takaya professia – musor sortirovat" ("The profession to sort waste"), e-newspaper

Description: Solid household waste (SHW) processing at Bekryatinsk site (Krasnokamsk, Perm Krai, Russia). From 2008, the Bekryatinsk landfill site is under the management of the private partner «Bumatika», selected through a competitive procurement procedure. The initial contract is for 10 years. The waste management scheme includes a waste sorting facility launched in 2008 (the only one in Perm Krai at that time) and fully operating to day, with a capacity of 30 tonnes of SHW, capable of separating 18 fractions of SHW. Estimated investment value – RUR 38,5m (approximately £1m in 2008). Total planned investment – RUR 100m. The size of the site –16,7ha. Apart from the sorting facility, the operator introduced modern technologies and equipment of waste compaction and ground densification, reducing water pollutions and simplifying future re-cultivation [1, 2]. In November 2013, Bumatika launched the second sorting facility, which is available to local university researchers for experimental studies in waste processing. Altogether, the project includes collection, transportation, storage, sorting and processing of SHW [3, 4].

Public party contribution: land (peppercorn rent), monopoly waste processing right in the Krasnokamsk area (where the site is located), red-tape reduction, monitoring of the

ProPerm.ru, 06/11/2013, available online: http://properm.ru/news/society/69365/ ; [5] "Bumatika: kompleksnyi podhod v ekologii" ("Bumatika: a complex approach in ecology", Business Class, 27/06/2011, available online: http://vm1547.vps.agava.net/?go=2281733&pass=0cd5668fe7a83700c3f42c350872b367; [6] "Innovatsionnaya Bumatika" ("Innovative Bumatika", Business Class, 10/10/201, available online: http://www.business-class.su/news/2010/10/11/76872; [7] Romanova A. (2012) «Musornyi Veter» ("Wind of waste"), Krasnokamskaia Zvezda, available online: http://www.raionka.perm.ru/krasnokamskaya-zvezda/?page=news&id=5214 ; [8] Bykova A. (2014) «Musornoe delo» («The Waste Business»), Zvezda Newspaper, 17/06/2014, available online: http://zwezda.perm.ru/newspaper/?pub=13635; [9] Shishkina O. (2014) "Nedohodnye othody" ("Unprofitable waste"), *Metragi*, 10(43), 52-55; [10] "Pusk mosorosortirovochnogo zavoda v Kransokamske otkladyvaetsia" ("The launch of the waste sorting facility in Kranokamsk delayed", Business Class, 19/06/2008, available online: http://www.business-class.su/news/2008/06/19/12329; [11] Efremova (2011) "Prokurature ne udalos osporit…" ("The prosecutor's office failed to challenge"), Kommersant-Prikamie, 11/01/2011, available online: http://www.kommersant.ru/doc/1565579; [12] Zusman E. (2013) "Sudebnaya Praktika po koncessiam v regionah" ("The court practice on concessions in the regions"), presentation, VEGAS-LEX, Moscow, available online http://www.gosbook.ru/node/84273; [13] Suhanov V, and M. Strugov (2015) «Moskva poshla v othod» («Moscow is going to waste»), Kommersant-Prikamie, 07/03/2015, available online: http://www.kommersant.ru/doc/2682802.

ecological situation in the region.

Private party contribution: finance, technology, facilities, maintenance, management.
[5, 6]

Liabilities of the public party: no evidence of formal liabilities (penalty sanctions) of the public party. Legal sanctions for improper usage of public (municipal) assets if property rights not clearly defined. Evidenced by court proceedings investigating the property rights and procedural regularities of setting the rental price in this case [7].

Liabilities of the private party: regulatory sanctions if standards not met, business risks; penalty if project is not delivered; the public party has the right to terminate the contract.

Sensitivity to contributions: the project is sensitive both to the private and to the public contribution. The private contribution ensures the quality of facilities, including environmental aspects, and partly the waste collection (apart from Bumatika, there are other collectors in the region who deliver waste to the processing facilities of Bumatika). The public contribution affects the amount of waste collected and processed [5, 8]. Unresolved issued with property rights and lease agreement caused a delay with the launch of the facilities [10].

Optimal contract: PB-contract, because the sensitivity to both contributions is comparable and rather high. Information costs are relatively high (e.g. verification of timely waste collection).

Actual contract: PB-type, similar to concession. The private party derives profits from waste processing fees, paid by other waste collecting companies, who are paid by households for the collection of waste. Additional profit is derived from sales of recyclable waste fractions. [11, 12].

Partnership element: Assistance from the local administration in promoting separation

and collection of waste: subsidies to businesses that separate waste, popularisation of waste separation. The private partner confirms the local administration is interested in and contributes to achieving the objective of improved waste management in the region [9].

Evidence of success: The project is still running. A second plant is launched in 2013. RUR 168m (£2.5m) reported revenue and RUR 2.4m (£34 000) net profit in 2013 [13].

Other remarks: the lease agreement between Bumatika and the local authority expires in 2019. From 2014-15 there is a surge in the competition in the market for SHW processing in Perm Krai. This creates additional business risks. In 2015 Bumatika has been reportedly acquired by Eco-Systems (Moscow), a company that aims at a consolidation of smaller SHW processing enterprises in the Perm Krai [13].

4.2. Fixed-fee contracts in traffic and road safety management[5]

Case 1. Intelligent Traffic Systems in Essex (UK)

Description: As of 2008, Essex had 7500 km of roads and 785,000 registered cars, travelling over 11 million vehicle kilometres annually. Traffic levels were estimated to grow by 2% per year. County's objectives were to improve the reliability of journey times for car users

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[5] Sources used: [1] Siemens (2006) News release of 19 December 2006, available at http://www.siemens.co.uk/traffic/pool/documents/press_releases/2006/siemens_essex_contract_91206.pdf; [2] ECC (2006) "Summary Of Decisions Taken At The Meeting Of The Cabinet Held At County Hall, Chelmsford On 24 October 2006", Essex County Council; [3] Traffic Technology Today (2012) "SA2000 JV achieves 100% success", published July 25, 2012, available at http://www.traffictechnologytoday.com/news.php?NewsID=41380; [4] Siemens (2010) News release of 21 April 2010, available at http://www.siemens.co.uk/traffic/pool/documents/press_releases/2010/final_retrofit_programme_in_essex.pdf; [5] Burr R., L. Saville (2008) "Using ITS to deliver the network management duty of the traffic management act and improve journey time reliability for road users", paper presented at the ITS World Congress, November 2008, New York, available at http://www.atkinsglobal.com/~/media/Files/A/Atkins-Global/Attachments/sectors/roads/library-docs/technical-journal-2/its-and-the-traffic-management-act.pdf; [7] ECC (2004) "Contract 2000 Review: Report by Cabinet Member for Highways and Transportation", 27 January 2004; [8] ECC (2006) "Traffic Control and Information Systems Contract: Report to the Highways and Transportation Policy Development Group", 16 March 2006.

(increase journey time reliability to 95%) and reduce average journey times (reduce journey times by 1% across the board) [5]. To achieve these objectives, a partnership contract SA2000 between Siemens/Atkins and the Essex County Council (ECC) was signed in 2006 for the period until 2013 [1]. Although formally this contract was announced as starting in 2006, the actual start of the partnership dates back to 2000, when the initial contract with a total value of £7m was signed until 2013. Interruption and refreshment of the contract in 2006 is due to programme restructuring on the public side [2]. SA2000 manages the design, supply, installation, maintenance and operation of Intelligent Transport Systems (ITS) in Essex and is responsible for keeping traffic moving. [3]

Public party contribution: At the *pre-tender stage*: funding, specification of needs: "…the development of the new contracts [needs to be] properly resourced and evaluated prior to going to tender. It is proposed, therefore, to establish a dedicated multi disciplinary team of staff to deliver the new contracts … some external resource will be required to support internal staff and it is proposed to secure experts from the industry to both provide advice and guidance, and also a resource to meet workload demands. This can be met from existing budgets. The intention is that that the wider industry and our existing partners will also be engaged in this process." [7]

At the *post-tender stage*: the county operates Essex Traffic Control Centre, involving Essex Police, Highways Agency, Regional and National Traffic Control Centre as stakeholders. The Centre is the main focus for congestion management: (1) acts as the control room for monitoring the network and implementing intervention strategies in response to planned and unplanned incidents, and (2) provides travel information and advice to the public relating to journey planning. Example of intervention includes changing timings on signal controlled junctions when they "lock up" due to heavy volumes of traffic. [5]

Private party contribution: Technology, installation, maintenance of equipment, data collection and processing.

Liabilities of the public party: n/a.

Liabilities of the private party: the contract can be terminated, as exemplified by the review of the original contract of 2000 in 2006 with a note that despite good partnership with contractors was formed, there is need for improved contract control and better financial management because "the added value expected from the "partnership" has not materialised to the extent expected" [7].

Sensitivity to contributions: High sensitivity to private input (equipment needs to properly work). High sensitivity to specifications of needs by the public party at the pre-tendering stage (wrong specifications result in underperformance) but relatively low sensitivity to public input (and low input) and post-tendering stages (although changes in public preferences post-tendering may result in contract termination).

Optimal contract: fixed fee IC-type. The input of the private party (equipment installed and working) is verifiable at a relatively low cost. The input of the public party (Traffic control centre) to the overall objective of improving traffic and reducing accidents is less visible despite website with live data, radio broadcasting, as it also involves proper and quick response to congestions and accidents, which are more difficult to verify.

Actual contract: IC-contract: "the payment mechanism is a combination of actual cost, tendered rates and time" [7].

Partnership element: long-term relationship, involvement of the private party at the tender preparation stage (see the pre-tender public party contribution above), increased involvement of the public party at the post-tendering stage. "Siemens and Atkins work with the

council to develop a strategic plan to develop such technologies". Contract not terminated despite programme restructuring. New "retrofit" programme to replace traffic signals with Siemens LED technology started in 2010 as a sign of continuing relationship [4]. Additional stimulus for the public party (ECC) through the Local Area Agreement (LAA) with the Department for Transport in 2006 to deliver improved journey time reliability across the Essex road network. This agreement included an element of pump-priming and, on successful achievement of the targets, significant reward funding of nearly £3m [5]. Maintenance cost on SA2000 contract reduced through on-road advertising by an additional agreement with Siemens [6]. "To ensure a strong partnership" regular meetings between the parties take place [7].

Evidence of success: 100% success against Operational Performance Indicators (OPIs) and Key Performance Indicators (KPIs) in 2011/12, up 27% since 2010/11. The OPIs and KPIs measure various factors, such as: delivery to time and budget; reducing congestion; and lowering the incidents of people being killed or seriously injured on the county's roads [3].

Other remarks: The input of the public partner is unbundled from the private input; therefore the contract refers mainly to the contribution of the private partner. Generally, this creates risks of insufficient cooperation and low benefits from a partnership, which was the case at the first stage of the project, from 2000 to 2006. These risks were remedied by the developed relationship and improved incentives for the public partner.

Case 2. Traffic and road safety management in Tula Region (Russia) [6]

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[6] Sources used: [1] Tender, project and selection documentation provided of the Regional Ministry for Transportation and Roads, http://transport.tularegion.ru/transp/konkurs/skd/; [2] Information agency Tula News, http://www.newstula.ru/fullnews_112661.html; Regional Ministry for Transportation and Roads of Tula Region, Press Release of 02/12/2015 . http://www.admportal.tula.ru/presscenter/press-release/press-release_22854.html; [4] Report of the Minister of Transportation and Roads of Tula Region, Alexander Kamzolov, to the meeting of the regional government on 07/12/2015, http://tulasmi.ru/news/216966.

Description: the local authority in Tula has formed a partnership with a private partner to develop, install, and service speed and red light cameras on roads. The objective of the project is to improve safety on roads by registering violations of the highway code. Through appropriate penalties on drivers, this should lead to a reduction of accidents and injuries. The project is for the period of 2014-2020, with a funding of RUR 475m (approximately £8m in 2014). The Regional Ministry for Transportation and Roads provides open access to all relevant documentation, from the call for proposals, tendering documentation to the protocols of the meetings to select the private partner. [1]

Public party contribution: Identification of locations, putting in force legislative acts necessary to implement this project, coordination of the interaction of all parties involved, financing of the Operator (a special entity appointed to collaborate with and monitor the private party) [1]. The police department is responsible for the identification of drivers who violate the Code, and imposing penalties on them.

Private party contribution: Finance, design, construction works, supply and installation of the equipment, servicing and maintenance [1].

Liabilities of the public party: "as specified by applicable laws" [1].

Liabilities of the private party: Penalties: violation of the agreed overall deadline or termination of the agreement is fined per month of delay at a rate of 0.01% of the maximum amount of investment; delays with intermediate targets fined at RUR 30 000 (approximately £500) per day [1].

Sensitivity to contributions: The project is sensitive to the quality of equipment supplied and its proper installation (private party contribution), which depend on the timely

approval of connections to electricity lines, coordination with municipalities and other parties involved (public party contribution). The overall objectives (safety on roads) are even more sensitive to the public input as failing to properly identify and impose fines on drivers violating the Code would significantly reduce the effectiveness of the system for the safety on roads.

Optimal contract: IC-contract. The input of the private party (cameras installed and working) is verifiable at a lower cost than the input of the public party (using cameras to penalize speeding and dangerous manoeuvring on roads), IC-contract is also optimal even for higher levels of sensitivity of the project to the public input.

Actual contract: Fixed-fee input-contingent (IC). The public party uses the system on lease from the private partner, with a buy-out of the system from the private party at the end of the lease agreement. If the system has to be dismantled due to road construction/extension/maintenance works, all expenses of the private party are paid in full.

Partnership element: close cooperation. A special entity (Operator) is created to ensure day-to-day communication and decision-making. The parties agree to form a Commission to coordinate activities.

Evidence of success: The system operates since 2014 with 33 elements running and 55 installed by that time [2]. By 2015 all 90 elements were running [3]. In 2015, the Minister reported a reduction of the number of accidents by 12% as compared with 2014, which includes 24 less people killed and 329 less people injured in traffic accidents [4].

Other remarks: Similarly to the previous case of Intelligent Traffic Systems in Essex (UK), the delivery of the system is unbundled from the public input (identification and prosecution of violations). The risks of insufficient cooperation are partly remedied by explicitly introducing an Operator for day-to-day decision-making and agreeing to form a Commission for

regular meetings. At the same time, the lease agreement contains the buy-out arrangement as an option for the public partner, which might have a positive effect on incentives for both parties. On the one hand, it creates risks for the private partner and incentives to raise the lease payments in order to lower the buy-out price. On the other hand, the private party is incentivized to demonstrate high quality and usefulness of the system, to ensure the buy-out option is realised by the public party, which, in turn has incentives for closer cooperation and monitoring under higher lease payments.

5. Conclusions

We have based our considerations on the aspects of PPP that most definitions have in common: provision of public services and some form of cooperation between the state and the business. Our task was to specify this form of cooperation and the exact contribution of a partnership. To do this we have analyzed five possible forms of business organization (autarchy, private enterprise, public enterprise, controlled private enterprise and consolidated public-private enterprise) suitable for a production of public goods. A combination of this analysis with the review of commonalities in the existing approaches to PPP proved useful in deriving a generalized definition of a public-private partnership as a consolidated enterprise of the state and the private business in which a partnership principle holds: parties are interested in the success of their respective counterpart. Importantly, this alignment of interests is distinct from the incentive compatibility implied by contractual constraints.

The above approach also proved useful in identifying the conditions under which a particular form of business organization dominates other forms in the provision of public goods. In presence of production costs individual production (autarchy) is strictly dominated by other

forms. A public enterprise is a dominant solution as long as managerial incentives within the enterprise guarantee internal efficiency. Otherwise a private enterprise is strictly preferred for efficiency reasons. In turn, this is dominated either by a regulated (controlled) private business to ensure consumer protection from excessive market power of privatized natural monopolies or by a PPP if monitoring cannot efficiently combat moral hazard.

To elaborate this idea further and delimit the role of consolidation of resources and that of the partnership principle, we focused on public-private enterprises from a perspective of contracting. Consolidation of resources is a powerful mechanism that enables projects that would remain infeasible without such a cooperation between the public and the private sector. Social gains are due to relative cost advantages, yet some projects remain infeasible due to information frictions. Consolidation of resources can be achieved through standard contracts, like outsourcing on lease. There can be some gains from co-production, especially in terms of transaction cost reduction, yet the effect of a partnership is distinct. A partnership is built upon the willingness to support the counterpart, on top of contractual obligations embodied in the incentive compatibility constraints. Apart from reducing the information cost, it also creates other benefits like the red tape reduction, speed up in decision-making, and reputation gains. Although it can be argued that a reduction of information costs can be achieved through an improved co-production, the feasibility of the projects can be further improved in a partnership. Besides, a further reduction of information costs in a partnership as compared to consolidated enterprises, increases the social surplus thus making partnerships a dominating form of business organization.

The forms, in which the partnership principle is implemented, can vary. Institutional arrangements that facilitate the projects that private businesses run with the public sector,

exemplify implicit provisions that embody the partnership principle. Explicit provisions would include special clauses in the contract. Typically, such a clause would specify the role of the public partner *after* the procurement stage, for example in what refers to risk sharing or possible modification/variation of the project specification. Although the optimal contract specifies a penalty on the public partner to ensure incentive compatibility, institutional environment (high credibility of the state) can rule out the need for such a penalty in the actual contract.

We conclude with a remark on the apparent "agreement to disagree" on the definitions of the PPP. The disagreement mainly stems from the features embodied in the partnership principle, as we have formulated it. Yet, as we have shown, the partnership principle does not need to be specifically formulated in the agreement between the public and the private party. It turns out that in countries with a developed institutional structure that supports private-public cooperation, the benefits of the partnership are available to any consolidated private-public enterprise, which is then rightfully seen as a PPP. In particular, this implies that any contract that "by default" refers to a public-private cooperation, like a concession to provide public goods, should be regarded as a PPP. In other countries, just a consolidation of resources does not suffice to see the collaboration of the public and the private party as a true partnership, and hence more efficiency can be gained through an implementation of the partnership principle.

References

1) Alchian, A. A., H. Demsetz (1972) "Production, Information Costs, and Economic Organization" American Economic Review 62, pp. 777 - 795.
2) Australian Government (2006) Public Private Partnerships: Contract Management. Commonwealth of Australia: Department of Finance and Administration.
3) Bennett J., E. Iossa (2006) "Building and managing facilities for public services," Journal of Public Economics 90, pp. 2143--2160.
4) Bettignies, J.-E. de, and T.W. Ross (2009) "Public--private partnerships and the privatization

of financing: An incomplete contracts approach," International Journal of Industrial Organization 27, pp. 358--368.

5) Bos, D. (1991) Privatization: A Theoretical Treatment. Oxford: Oxford University Press.

6) Bovaird, T. (2006) "Developing new forms of partnership with the "market" in the procurement of public services" Public Administration 84, pp. 81-102.

7) Brinkerhoff, J. M. (2002) "Assessing and improving partnership relations and outcomes: a proposed framework." Journal of Evaluation and Program Planning 25, pp. 215-231.

8) Broadbent, J., R. Laughin (2003) "Public private partnerships: an introduction," Accounting, Auditing and Accountability Journal 16, pp. 332-341.

9) CEDR (2009) "Public Private Partnerships", Conference of European Directors of Roads, May 2009; http://www.cedr.fr / home / fileadmin / user_upload / Publications / 2009 / e_Public_private_partnerships_(PPP).pdf

10) Chen B.R., Y.S. Chiu (2010) "Public--private partnerships: Task interdependence and contractibility," International Journal of Industrial Organization 28, pp.591--603

11) Coulson, A. (2005) "A plague on all your partnerships: theory and practice in regeneration." International Journal of Public Sector Management 18, pp. 151-163.

12) Doroshenko M., D. Vinogradov (2011) External benefits from knowledge intensive business services: evidence from Russia, in W.Ganz, F.Kicherer, A.Schletz (eds.) Productivity of Services Next Gen - Beyond Output / Input, RESER 2011 Conference Proceedings, Hamburg, Fraunhofer IAO

13) Doroshenko M., E. Shadrina, D. Vinogradov (2013) KIBS for public needs, presented at the 2nd International EIBURS-TAIPS Conference on Innovation in the public sector and the development of e-services, Urbino, Italy

14) Edwards, P. J. Shaoul, A. Stafford, L. Arblaster (2004) "Evaluating the operation of PFI in roads and hospitals," London: Certified Accountants Education Trust.

15) Ehrhardt, Michael C., Eugene F. Brigham (2006) "Corporate Finance: A Focused Approach", 2nd edition, Thomson South-Western.

16) European Commission (2003). Guidelines for successful public-private partnerships. Brussels: Directorate General Regional Policy.

17) Fehr Ernst, Klaus M. Schmidt (2006) "The economics of fairness, reciprocity and altruism - experimental evidence and new theories", in Klom S.-C. and Ythier J.M., eds, "Handbook of

the Economics of Giving, Altruism and Reciprocity", Vol. 1, Elsevier, pp. 615-691

18) Fourie, F.C.v.N., P. Burger (2001) "Fiscal implications of public-private partnerships." South African Journal of Economics 69, pp. 147--168.

19) Friend, J. (2006) "Partnership meets politics: managing within the maze." International Journal of Public Sector Management 19, pp. 261-277.

20) Gray, J. (2002) "Going private: a $20bn shake-up." Australian Financial Review 11, pp. 52-53.

21) Hodge, G.A., C. Greve (2007) "Public-Private Partnerships: An International Performance Review." Public Administration Review, pp. 545-558.

22) Hopp E.I., P.W. Schmitz (2010) "Public versus private ownership: Quantity contracts and the allocation of investment tasks," Journal of Public Economics 94, pp. 258--268.

23) Hurst, C., E. Reeves (2004) "An economic analysis of Ireland's first public-private partnership." The International Journal of Public Sector Management 17, pp. 379-388.

24) Iossa, E., G. Spagnolo, M. Vellez (2007) "Contract design in public-private partnerships," Washington: The World Bank, 2007.

25) Joha, A. M. Janssen (2010) "Public-private partnerships, outsourciong or shared service centres? Motives and intents for selecting sourcing configurations." Transforming Government: People, Process and Policy 4, pp. 232-248.

26) Joyner, K. (2007) "Dynamic evolution in public-private partnerships: the role of jey actors in managing multiple stakeholders." Managerial Law 49, pp. 206-217.

27) Koppenjan, J., B. Enserink (2009) "Public-private partnerships in urban infrastructures: reconciling private sector perticipation and sustainability." Public Administration Review, pp. 284-296.

28) Lattemann, C., S.Stieglitz, S.Kupke, A.-M. Schneider (2009) "Impact of PPPs to broadband broadband diffusion in Europe." Transforming Government People, Process and Policy 3, pp. 355-374.

29) Martimort D., J. Pouyet (2008) "To build or not to build: Normative and positive theories of public--private partnerships," International Journal of Industrial Organization 26, pp. 393--411

30) Maskin E., J.Tirole (2008) "Public--private partnerships and government spending limits," International Journal of Industrial Organization 26, pp. 412--420.

31) Nisar, T.M. (2007) "Value for money drivers in public private partnership schemes." International Journal of Public Sector Management 20, pp.147-156.

32) Pitt, M., N. Collins, A. Walls (2006) "The private finance initiative and value for money." Journal of Property Investment and Finance 24, pp. 363-373.

33) Roels G., U.S. Karmarkar, S. Carr (2010) "Contracting for Collaborative Services," Management Science Vol. 56(5), pp. 849-863.

34) Roumboutsos, A., N. Chiara (2010) "A strategic partnering framework analysis methodology for public-private partnerships," Journal of Financial Management of Property and Construction 15, No 3 (2010): 235-246.

35) Stiglitz J.E. (2002) "New perspectives on public finance: recent achievements and future challenges," Journal of Public Economics 86, pp. 341--360.

36) Tsybine, A. (2003) Revisiting the Public Interest in Private Water. Los Angeles, CA: Reason Public Policy Institute.

37) Van Ham, H., J. Koppenjan (2001) "Building public-private partnerships: assessing and managing risks in port development." Public Management Review 4, pp. 593-616.

38) Vickers, J., Y. Yarrow (1991) "Economic Perspectives on Privatization." Journal of Economic Perspectives 5, pp. 111-132.

39) Vining, A.R., A.E. Boardman (1992) "Ownership versus Competition: Efficiency in Public Enterprise." Public Choice 73, pp. 205-239.

40) Wettenhall, R. (2007) "ActewAGL: a genuine public-private partnership?" International Journal of Public Sector Management 20, pp. 392-414.

41) Allen, D. (2005) "Cohesion and the Structural Funds", in H. Wallace, W. Wallace and M.A. Pollack, "Policy-Making in the European Union", Oxford University Press.

42) Dahl H.M., J. Eurich, K. Fahnøe, C. Hawker, G. Krlev, A. Langer, G. Mildenberger, and M. Pieper (2014) "Promoting Innovation in the Social Services: An Agenda for Future Research and Development", Report on INNOSERV project, University of Heidelberg