Competing for Public Sector Procurement Risk

Evidence from PFI School contracts in the UK

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Abstract:

In this paper, we investigate the impact of risk transfer in long-term public-private contracts on firm selection and *ex post* efficiency. We develop a theoretical framework in which we show that, for a certain ideal-type procurement contract in which the public sector procures a contractible service for a fixed price agreed *ex ante*, the outcome of procurement is likely to be *ex post* inefficient i.e. the type of firms that are in a position to enter into such contracts will secure a rent on top of their 'rational cost of risk bearing.' This ideal-type procurement contract is very similar to the kind of contracts used for hundreds of public-private partnership contracts (PPPs) across Europe, and in particular for PFI contracts in the UK. To validate this insight we conduct a short empirical analysis of competition for real-life contracts that are very similar to the ideal type fixed price contracts described in our theoretical framework: PFI schools in the UK. This finding militates for some kind of *ex post* economic regulation of PPP contracts, not unlike that used for regulating network utilities, so that the public sector can benchmark the risks transferred to the firm.

Keywords: Long-term contracts, public-private contracts, risk-transfer contracts, competition and public procurement, schools

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1 Introduction

In this paper, we investigate the impact of risk transfer in long-term public-private contracts on firm selection and *ex post* efficiency. We develop a theoretical framework in which we show that, for a certain ideal-type procurement contract in which the public sector procures a contractible service for a fixed price agreed *ex ante*, the outcome of procurement is likely to be *ex post* inefficient i.e. the type of firms that are in a position to enter into such contracts will secure a rent on top of their 'rational cost of risk bearing.' This ideal-type procurement contract is very similar to the kind of contracts used for hundreds of public-private partnership contracts (PPPs) across Europe, and in particular for PFI[1] contracts in the UK.

The main source of *ex post* inefficiency springs from the endogeneity of the risks transferred, which creates a situation of private information for the firm and makes it difficult for the public sector to know the shape of the cost uncertainty – the risks – it wishes to transfer. Moreover, allowing for the heterogeneity of firm 'type' (skewed distribution of efficiency types and heterogeneous cost of risk bearing) the outcome of PFI-type contracts is likely to be a function of the *ability of firms to minimise their cost of risk bearing* as much as their ability to minimise production costs.

A separating equilibrium in which only the largest firms and the firms capable of investing on a portfolio basis can enter into PFI-type contracts is thus likely, which suggests restricted competition and the survival of the efficient firm's rent to competitive bidding.

Such *ex post* inefficiency matters because the firm's rent is financed with public funds and is thus 'costly' (the shadow cost of public funds). But while it is the obvious responsibility of the public sector to minimize such rents, in practice there is no regulatory mechanism in place to do so after contract award. This finding militates for some kind of *ex post* economic regulation of PPP contracts, not unlike that used for regulating network utilities, so that the public sector can benchmark the risks transferred to the firm.

To validate this insight we conduct a short empirical analysis of competition for real-life contracts that are very similar to the ideal type fixed price contracts described in our theoretical framework: PFI schools in the UK. PFI school contracts are public-private risk transfer contracts under which the firm provides a serviced facility over a 25-30 year period on the basis of a pre-agreed output specification in exchange for a fixed pre-agreed payment, called the *unitary charge*. To deliver this service, this firm is expected to invest upfront in school facilities which it will then operate and maintain for the duration of the contract.

We find that, consistent with our theoretical framework, only larger than average firms enter into PFI contracts and the 'distribution of types' is heavily skewed with only a few large firms capable of winning such contracts. We also find that firms involved in PFI schools engage in 'self-insurance' through portfolio diversification of their equity stakes in PFI contracts, thus minimising their cost of risk bearing further than their size suggests, and that PFI consortia often involve financial institutions which by their nature take a portfolio approach to investment. Finally, we find that concentration levels tend to be higher in the school PFI sector than in the overall UK construction sector and in the UK building and construction engineering sectors.

Section 2 introduces our ideal type public-private risk transfer contract and reviews some salient facts from the literature. Section 3 presents our theoretical framework. Section 4 formulates our hypotheses. Section 5 presents our data and findings and section 6 concludes.

1 PFI stands for 'private finance initiative'

2 A stylized PPP contract with long-term risk transfer

2.1 PFI-type risk transfer contracts: stylized facts

Most public procurement is done using cost-*plus* contracts in which the public sector bears the risk of *ex post* cost overruns (Samuelson 1986; Bajari and Tadelis 2001; Bajari, Houghton et al. 2006). Such overruns are ubiquitous (Flyvbjerg *et al* 2003) and have motivated governments to shift towards risk transfer (fixed price) contracts in procurement. The UK government, for example, highlights cost control as one of the main reasons for the use of fixed price contracts (http://www.hm-treasury.gov.uk/ppp_index.htm).

In effect, when it comes to transferring risk in procurement contracts, real-world public procurement does not allow for the 'second best' dictated by the literature: instead of sharing risk along a cost continuum as theory would suggest, only a more binary choice is opened to the public sector. In the immense majority of cases, the public sector must decide to use one of two routes to procure the public services it requires: either 'full' risk transfer through a long-term risk transfer contract or little or no risk transfer through standard procurement.[2]

By 'full' risk transfer we mean that all 'standard' cost liabilities inherent to delivering a contractible public service are passed on to the firm in exchange for a fixed payment made throughout the life of the contract and agreed *ex ante*, at the time of contract signature.

By 'standard' costs we mean all construction, operation and maintenance costs. Other categories of costs, such as those incurred because of regulatory changes or 'force majeure' events are typically not transferred. The cost of the service provided not being needed (demand risk) is also born by the public sector, which remains responsible for deciding and planning how much public services the polity needs. It remains however that construction, operations and maintenance costs are *fully* transferred since, under such contracts, the public sector only expects to have to pay a pre-agreed fixed sum at regular intervals for given service delivered by the firm.

We limit our analysis to those **public-private risk transfer contracts in which a service is delivered by the firm on the basis of a pre-agreed output specification in exchange for a fixed pre-agreed payment, typically called unitary charge or availability payment**.[3] To deliver this service, the firm is expected to invest upfront in facilities which it will then operate and maintain for the duration of the contract. Contract duration thus has to be commensurate with the facility's economics life, typically several decades.

We choose to focus on this stylized case for the following reasons:

- This type procurement contracts have gained in popularity across Europe and the world, following two decades of experience in the UK, where they are known as **PFI contracts**, and already constitute the majority of long-term risk transfer contracts in the world by number of contracts (Infrastructure Economics 2010).

2 One way to interpret this assumption, bar the fact that it is the most commonly used form of PFI-type contract, is to say that it is too costly to write incentive contracts (risk sharing) and that only a more binary form of risk transfer (full vs. none) may be specified in contract.

3 From the point of view of the public sector, these contracts amount to swapping an unlimited liability (per unit of public service delivered) for a fixed one. In essence, the public sector is entering into a total-rate-of-return swap contract by which it will receive a fixed return (unitary payment over standardized unit of S delivered) and the firm a variable one (the firm's cost of delivering one unit of S over the fixed income received). Note that interpreting PFI-type contracts as a TROR swap also encapsulates the fact that such contracts are 'synthetic purchases' i.e. the property of the underlying asset does not change hands. This is consistent with the immense majority of PFI contracts being the equivalent of leases of the public domain.

- Beyond their empirical relevance, this category of contracts goes to the heart of the issue of risk transfer between public and private sectors to deliver public services: such contracts embody the core mechanism by which public-private risk transfer is supposed to minimize the cost of procurement.
- Our analysis thus excludes those public-private contracts which grant the firm the right to collect tariffs or tolls from users who may or may not use this service. Indeed, transferring demand/traffic risk introduces greater complexity in long-term public-private contracts and, in our view, does not change the nature of the relationship between risk transfer and procurement cost efficiency since demand risk is for the most part exogenous to the contract.

From here, we refer to our ideal-type contracts as **PFI-type contracts** after their very close resemblance with the hundreds of PFI contracts already signed in the UK and beyond.

2.2 PFI-type risk transfer contracts: a principal agent framework

We postulate that the output specification of a public service (S) is reasonably well defined and that the public sector knows how many units of S are needed for the planned investment period. In other words, the public sector knows what public service it wants to procure, how much and output is 'contractible.' The public sector is also understood to be able to verify *ex post* the quality and quantity of each unit of S delivered.[4]

If output was not contractible, as is the case for very large complex infrastructure projects, contract variations (*ex post* changes to specification of outputs, fee schedules etc.) may be *ex post* equilibrium outcomes (Dewatripont and Legros 2005) and cost-*plus* contracts will can dominate fixed price (risk transfer) contracts in efficiency (Bajari and Tadelis 2001).

To procure public service S, the public sector needs to contract with a firm or a group of firms to build, operate and maintain the facilities that deliver these services over several periods. The objective of the public sector is of course to minimize the cost of delivering each standardized unit of S.

The 'life-cycle' cost[5] of delivering S is a statistical lottery $\tilde{\theta}$. Following the Arrow-Lind theorem (Arrow & Lind 1970), the public sector is assumed to be risk-neutral: it is indifferent to the variance of the cost of delivering one unit of S as long as its expected value is minimized. In contrast, firms are taken to be risk-averse and require a premium to be exposed to a cost lottery.

If risk is exogenous, the least risk-averse party should bear most of the risk. The decision by the public sector to us a risk transfer contract to procure S thus presupposes that lottery $\tilde{\theta}$ – the uncertain cost of delivering S – is at least in part **endogenous** i.e. a function of who is exposed to $\tilde{\theta}$ and thus to the incentive scheme implied by the type of procurement contract used. To be worthwhile from the point of view of the public sector, a risk transfer contract should lower E($\tilde{\theta}$) – where E(.) is the expected value operator so that it **more than offsets the risk premium demanded by risk-averse firms to be exposed to lottery** $\tilde{\theta}$.

4 For standardized units of certain types of public services such as schools facilities or standard roads, it is not completely unrealistic to consider that a well-run procurement agency could define a 'reasonably' complete output specification. Conversely, government failure should not be confused with contract incompleteness. In an incomplete contracting world, this is equivalent to the requirement in Hart et al (1997) and Hart (2003) that output specification be easier to specify than input specifications.
5 The total discounted cost of building, owning, operating and maintaining a long-lived asset over the life of the asset.

We know from the literature that as soon as agents attribute different subjective probabilities to future states of the world, *ex ante* and *ex post* efficiency may not coincide (Starr 1973). We can thus formalize the impact of the endonegeity of $\tilde{\theta}$ on procurement contracting as a principal-agent problem.

Principal-agent models typically describe the optimal contract between a principal delegating a task to an agent, while the agent has private information about some aspect θ of the task in question (adverse selection or hidden knowledge), and can decide whether or not to exert effort *e* that can influence the realisation of the task (moral hazard or hidden action). Typically, a contract determines a volume of trade or production *q* by the agent and a remuneration or transfer *t*, which can be a function of a risk sharing coefficient, say α. The fundamental intuition behind the principal-agent framework is that the optimal *t*, α and *q* under asymmetric information may be distorted from their full-information 'first best' because of the agent's strategic use of its private information.

In our case, firms may be of different types (efficient risk managers or inefficient ones) and they may make more or less effort to control risk. Hence the information asymmetry between public sector (principal) and the firms (agents): firms hold *private information* about their expected costs and they may decide to take *hidden actions* to influence the expected value and variance of their costs.

The classic optimal response to an agency situation where the agent has an incentive to misreport his costs is to offer a compensation scheme that gives the agent the minimum information rent (second-best). To achieve this, the principal must devise a "revelation mechanism" i.e. an incentive compatible menu of contracts (Laffont and Martimort 2002:48) which induces agents to reveal their private information (about θ or *e* or both) in exchange for a rent. To keep this information rent to a minimum, output *q* and coefficient α are typically distorted above the efficient level for a task in which the agent would understate his cost and below the efficient level for a task in which the agent would overstate his cost (Mezzetti 1997). Likewise, the degree of risk sharing between principal and agent is distorted to minimise the effect of moral hazard. The agency literature shows that under the optimal second-best contract the principal must trade off allocative efficiency (q^* and α^*) against the costly information rent[6] given up to the agent. Thus under asymmetrical information the volume of trade and risk sharing and the distribution of the gains from trade and risk taking are closely intertlinked (Laffont and Martimort 2002).

We also know from the literature that under long-term contracts for relationship-specific assets, investment decisions are likely to be suboptimal since each party expects the other to renegotiate the contract *ex post* to expropriate the rent of the other (Hart 1995). This creates a problem of *commitment* not to renegotiate on the part of the principal.

While problems of moral hazard and adverse selection in procurement have been extensively addressed in the literature, these issues have often been studied separately. It is, however, recognised in the literature that a general agency model should allow for adverse selection *and* moral hazard as well as the ability for the agent to manipulate mean and variance of its performance under risk aversion (Sung 2005). Indeed, the type of endogenous risk found in infrastructure projects as well as the expectations of the policy maker would fully justify that both mean and variance of the project costs can be manipulated by the agent. Likewise, the

6 In the procurement literature, the information rent is 'costly' from a welfare perspective because of the shadow cost of public funds (the distortion introduced by taxation)

assumption of risk aversion on the part of the agent is important. Without risk aversion the firm only considers expected returns and completely ignores risk.[7]

More or less high-powered incentive contracts address different problems. Typically, the public sector prefers to respond to the hidden action problem with a fixed price contract and to respond to the private information problem with a cost-*plus* contract (Baron and Besanko 1987). However, under both adverse selection and moral hazard, the literature always concludes that 'incentive contracts' (between cost-*plus* and fixed price) should be preferred to pure fixed price or cost-*plus* contracts (Baron and Myerson 1982; McAfee and McMillan 1986). The optimal incentive contract is found to be closer to a fixed price contract than a cost-*plus* one. Indeed, cost-*plus* contracts perform poorly in selecting efficient (low-cost) firms and also fail to incentivise firms to reduce risk.

In a paper modelling a problem of combined adverse selection, moral hazard and a risk-aversion, Theilen (2003) concludes that the agent would always prefer to relax the moral hazard constraint in order to maintain the information rent under adverse selection. In effect, in mixed models with adverse selection before moral hazard, preventing moral hazard hardens the adverse selection problem, and allocative distortions are then greater than under pure adverse selection (Laffont and Martimort 2002).

The rest of the literature relevant to public-private risk transfer contracts yields the following stylised facts:

a) The presence of risk aversion weakens the usual agency conclusions

- With adverse selection and moral hazard, full risk transfer through a fixed price contract is never optimal. Greater allocative inefficiency (lower risk sharing) is required to mitigate the information rent made more costly by risk aversion.

- The pooling of the less efficient types may occur, especially for high levels of risk aversion, which can make it difficult to obtain a separating equilibrium and perfect revelation.

b) Under imperfect competition, the relationship between risk and procurement costs is non-monotonous

- In competitive tenders, risk transfer tends to increase the average price of the winning bid. Unless competition is perfect, this effect tends to increase the expected cost of procurement for the public sector.

- Likewise, very low risk sharing increases expected costs because very little effort is made to reduce costs. The lowest expected cost thus typically corresponds to an 'incentive contract' (as defined above).[8]

c) The relationship between risk transfer and incentives is ambiguous under certain conditions

- If the agent can manipulate the variance of its performance, the relationship between risk sharing and incentives becomes ambiguous i.e. more risk transfer does not necessarily more less effort.

7 Laffont and Tirole show how with noisy cost measurement, the principal agent problem of procurement is left unchanged as long as the agent is risk neutral (Laffont and Tirole 1993:73)
8 Using Canadian procurement data, Baron and Myerson estimate the optimal α to be around 0.6 Baron, D. P. and R. B. Myerson (1982). "Regulating a Monopolist with Unknown Costs." Econometrica 50(4): 911-930..

- Likewise if risk aversion amongst agents is heterogeneous, the power of incentives always decreases with risk aversion but the relationship between risk-sharing and risk aversion is ambiguous since more risk averse agents, while preferring low-incentive contracts, may exert more effort because it reduces the endogenous risk they face. Higher risk aversion thus typically leads to higher effort but also to lower-powered incentives (and thus to lower effort).

These points have been developed in a number of papers focusing on different forms of agency problems with a focus on procurement, competitive bidding and risk sharing.

On the distortions introduced by risk aversion to the standard moral hazard and adverse selection problem (a), see Baron and Besanko (1987), Salanié (1990), Chung (1991), Laffont and Rochet (1998). On risk aversion and pooling equilibria see Laffont and Rochet (1998) and Bontems and Thomas (2003).

On the effect of risk transfer on the level of bids (b), see McAfee and McMillan (1986) and Samuelson (1986).

On the case where agents can control both means and variance of performance (c), see Sung (2005), Guo and Ou-Yang (2006) and Araujo *et al* (2007). On the relationship between the level of risk aversion and the optimal amount of risk transfer see Araujo *et al* (2007) and Jullien *et al* (2007).

Setting our PFI-type contracts within the principal-agent framework, we see that:

- PFI-type procurement boils down to a **binary menu of contracts**: either the firm agrees to full risk transfer of all 'standard costs' or the public sector has to resort to standard public procurement. Under the PFI, the contracting authority compares the cost of the PFI to an estimation of the cost under traditional procurement known as the 'public sector comparator' (PSC)[9]. This corresponds to the attempt by the public sector to induce firms to reveal their costs by simulating what the inefficient type of firm would deliver under a zero risk transfer contract.
- Such contracts also represent a **commitment mechanism** through which the public sector agrees *ex ante* the price it will pay *ex post* and for the whole duration of the contract. Whatever information rent the agent has secured at the time of contract signature is thus guaranteed not to be expropriated by the principal. PFI-type contracts are thus a case of *ex ante* efficiency achieved at the cost *ex post* inefficiency.

The built-in *ex post* inefficiency of PFI-type procurement means that the public sector can only rely on **competition for the risk-transfer contract** (between efficient firms) to minimize the efficient firm's information rent *ex ante*. This as long as competition is imperfect, the **price of risk transfer** between the government and the firm has **two positive components: a risk premium and an information rent**.

9 The 'public sector comparator' is an estimate of the full cost of procuring the service under traditional procurement. It includes capital costs, life-cycle expenditure (maintenance), operating costs and the risk that additional costs might arise which would fall on the shupplier under PFI. British Government advice states: "Comprehensive accounting for risk is required to ensure that valid and informed comparison can be made amongst the bids and between the bids and the PSC." (HM Treasury 2003). In the UK, the PSC is used in the 'value for money' test that is applied when deciding whether to use PFI. If the lowest bid is above the PSC then the service should be procured under a traditional cost-plus contract. Similar methodologies are used for PPPs in the Netherlands, Australia, New Zealand and France, where it is known as 'étude préalable.'

3 Separating equilibrium under a PFI-type contract: from self-selection to self-insurance

The framework proposed in Laffont and Tirole (1993) to describe optimal *interim* contracts[10] is used below to characterise the choice between traditional procurement and PFI-type contracts.

3.1 Moral hazard and socially beneficial effort

First, we must specify more clearly the role played by the 'effort' variable in the moral hazard problem. The main focus of the literature in public-private contracts so far has been to identify the conditions under which the firm might exert effort to reduce costs without jeopardising the quality of public services under incomplete contracts. This is a classic multi-task problem *à la* Holmstrom and Milgrom (1987; 1991) i.e. the trade-off between incentives and the effort exerted towards cost reduction and the extent to which this cost reduction effort can be socially beneficial or damaging (Grout 1997; Hart, Shleifer et al. 1997; Hart 2003; Bennett and Iossa 2006). This problem has also been studied under complete contracting and asymmetrical information (see Bentz, Grout et al. 2003).

While this is an important perspective, it does not allow us to focus purely on the question of the cost of procurement (since there is always a trade-off between cost and quality) and its variance (risk transfer). Hence, in the regulation and procurement literature the assumption is often made that it is always worthwhile to induce the agent to exert effort *e* i.e. the social benefits of effort always outweigh its cost. The question then becomes one of the impact of effort on costs and how worthwhile it is to induce effort at the optimum (Laffont and Tirole 1993; Laffont and Martimort 2002). Under this (strong) assumption, the agency problem thus becomes one of knowing *how much* lower costs can be if the agent exerts effort. In what follows, we make a similar assumption: inducing effort *e* is always worthwhile both in traditional procurement and in PFI-type contracts.

3.2 'Incentives contracts' in the procurement literature

Under the assumption that output is contractable and that effort *e* is always socially desirable, the government's decision to enter into a PFI-type contract boils down to characterising the choice between low- and high-powered procurement contracts.

The choice of the optimal public-private risk transfer contract in the procurement and regulation literature is a function of the assumptions made about which contract parameters can be used by the principal. For instance, most work on regulation assumes that the principal can observe (audit) the cost of the firm *ex post* (it cannot, however, observe the effort made or the 'type' or marginal cost of the firm, just the aggregated total cost). Of course, only when costs can be observed *ex post* can the principal and agent enforce a risk-sharing rule of the type:

$$t = b + \alpha(c - b)^{11}$$

where t is the transfer to the firm, b the firm's bid price and α a risk sharing coefficient (a real number with a range of [0,1]) of *ex post* costs c.

10 The agent knows its type (the expected value of costs) before choosing whether or not to exert effort.
11 This cost sharing rule is proposed by McAfee and McMillan (1986).

In this case, self-selection and the determination of the optimal contract are achieved by giving a cost target to the agent and allowing for the level of effort to 'separate the types.' Typically, the efficient firm takes on more risk, exerts the optimal level of effort and receives a rent, while the inefficient firm shares less risk and is given a cost target which corresponds to a sub-optimal level of effort (Laffont and Tirole 1993; Laffont and Martimort 2002).

If the principal cannot observe costs *ex post,* self-selection is done through the level of output of the firm as in Baron and Myerson (1982). In their paper, the regulator has four instruments to constrain the behaviour of the agent: the price of its output or tariff (paid by end-users), the volume of output, a subsidy to cover the firm's fixed costs and the opportunity to bar the firm from producing (shutdown). In a PFI-type contract however, the price of the output and the subsidy are combined and become the pre-agreed fixed income *t*. Moreover, unlike in Baron and Myerson's model, but in line with previous procurement models *à la* Laffont, there is no scope to reduce output *q* in PFI-type contracts. The principal is thus not in a position to distort output in order to minimise the information rent of the agent.[12] This leaves two instruments for the principal to regulate the contract: shutdown (the Public Sector Comparator or PSC i.e. the 'value for money' test) and *t* the fixed income agreed *ex ante* (the 'unitary charge'). Thus, if costs are not observed and output is fixed, selection is achieved by giving a high-powered contract to the more efficient firm (Samuelson 1986 studies such a case). This is indeed, the PFI model.

3.3 Separating equilibrium, fixed price contracts and 'false moral hazard'

We apply our PFI-type contract to the framework devised by Laffont and Tirole (1986) to describe the relationship between public sector and firm in a risk-transfer contract to procure S. This agency problem is in between a case of *ex ante* contracting (when the agent accepts the contract before she knows her 'type') and one of *interim* contracting (the agent knows its type *ex ante*). Here the agent knows the expected value of her costs but is exposed to a variance parameter, which might make the firm's cost higher or lower *ex post* in a given project. At the project level, the agent is therefore uncertain about *ex post* costs. To keep things simple, we consider that the 'risk universe' consists only of endogenous risks i.e. we ignore risks that might affect cost and are not directly related to the design, construction and operation of the project (e.g. demand or policy changes).

The public sector wants to procure public services and associated maintenance and operations under a long-term contract for a specified quantity of S, a homogenous public service, which is assumed to be easily contractible *ex ante* and verifiable *ex post*. If the agent does not deliver S, he faces a heavy penalty. While this is a long-term contract, a cost sharing rule is pre-agreed and creates a credible commitment mechanism and the game is a case of "false dynamic" (Laffont and Tirole 1993:103). The project costs can thus be estimated as one variable, the *ex post* life-cycle cost *c*, and the contract as a 'global' incentive scheme covering the whole life of the contract. We use the framework proposed by Laffont and Tirole (1993) where $c = c(\theta, e, \ldots) + \varepsilon$ to present the problem.

The *ex post* life-cycle cost function of the project can be written $c = \theta - e + \varepsilon$, where θ is an efficiency parameter so that $c_\theta > 0$ (a high value of θ means higher costs or lower efficiency) and *e* is the cost reducing activity (effort) so that $c_e < 0$ and $c_{ee} \geq 0$ (effort reduces costs at a

12 Thus, every child must have a place in school, every commuter must be able to travel between A and B within a reasonable amount of time, hospitals should accommodate every patient without long queues, etc. in other words, public tolerance for congestion in public services is given and the public sector must procure $q=q^*$. The public sector remains the guarantor of the continuity of public service whatever procurement route is chosen.

decreasing rate). ε is a measure of errors in Laffont and Tirole but can easily be interpreted as the variance of *ex post* costs so that ε is a 'pure' or zero-mean risk or $\varepsilon \sim N(0, \sigma^2)$. This formulation is equivalent to saying that the *ex post* cost of the project is a lottery $\tilde{\theta}$ with mean θ and variance σ^2. Finally, exerting effort is costly and costs $\psi(e)$. In this case, effort e can be equated with upfront design costs aimed at lowering future maintenance costs or 'life-cycle costing'. It is an investment in say, better design, which achieves lower expected life-cycle costs c and costs $\psi(e)$ to implement.

θ is typically drawn from a distribution f on $[\underline{\theta}, \overline{\theta}]$ with $\overline{\theta} - \underline{\theta} = \Delta\theta > 0$. We assume for now that there are only two heterogeneous firms drawn from f, and that S is large enough that the public sector must procure it through both firms i.e. both firms are awarded a contract.[13]

As above the cost sharing rule is $t = b + \alpha(c - b)$ with b the firm's bid price and π, the firm's profit is written $t - c - \psi(e)$. A similar problem with a risk-averse agent is examined in Laffont and Tirole (1986; 1993) and the utility of the agent can be written $U(\pi) = E(\pi) - \tau VAR(\pi)$, where E(.) is the expected value operator and VAR(.) the variance.

With full information, both efficient and inefficient firms would be made to exert effort e^* (it would say so in the contract) and the public sector could extract all surplus. The public sector would then only offer cost-*plus* contracts to all firms to avoid having to remunerate their cost of risk bearing (points A and B on Figure 1).

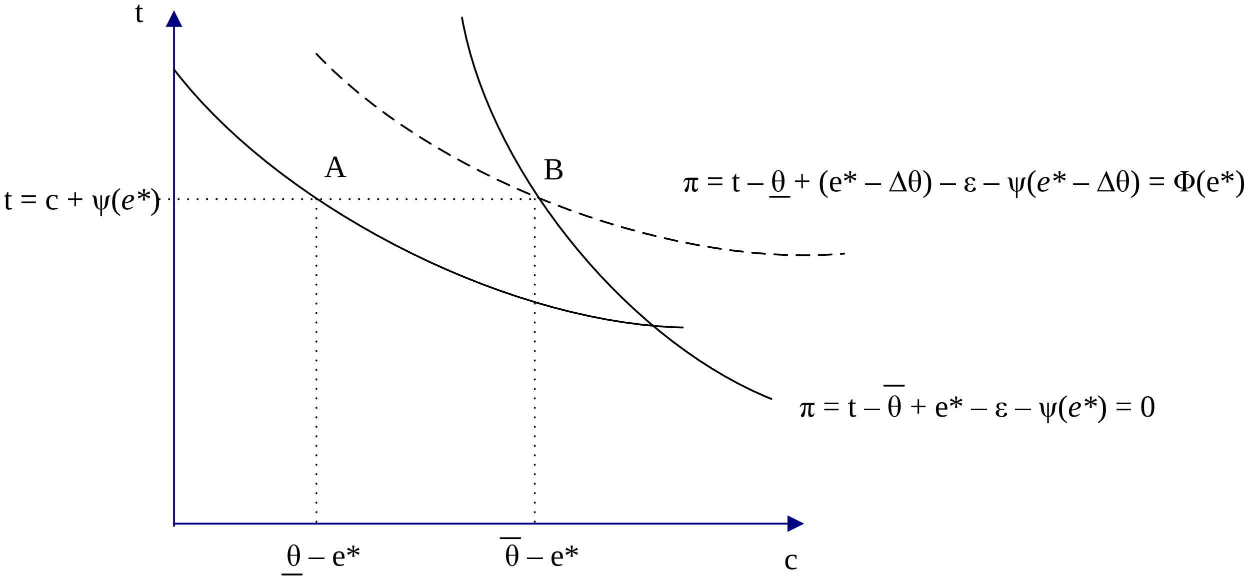
However, this first best is not incentive compatible under asymmetric information: if the public sector does not know the firms' types and does not attempt to separate types by transferring more risk to the efficient firm, the firm of the $\underline{\theta}$ type can simply mimic the $\overline{\theta}$ type when bidding for standard public projects and move from point A to point B on Figure 1 (Fig.1: dashed line). Indeed the efficient firm can exert minimal effort $e^* - \Delta\theta$ and successfully bid for a cost-*plus* contract. The efficient firm would then secure an information rent $\Phi(e) = \psi(e) - \psi(e - \Delta\theta)$.

In the regulation literature, $\Phi(e)$ is a measure of the economy in disutility of effort made by the efficient firm when it is in a position to mimic the inefficient firm. For example, a large construction firm with experience in long-term operating contracts and complex projects could exert effort and deliver a project with the lowest life-cycle cost. Instead, it mimics the smaller firms in bids for traditionally procured projects which it can deliver without effort and at a lower (hidden) cost.

To avoid this situation and improve the cost efficiency of public procurement, the public sector offers a menu of contracts to the two firms, one which is high-powered (risk transfer) and one low-powered. Doing so, the public sector aims to 'separate types' i.e. make the efficient firm reveal its type. We know from the literature that, at the optimum, a distortion of the first best allocative efficiency is required. Incentive compatibility requires that the efficient firm be better off choosing the risk transfer contracts (PFI-type) than mimicking the inefficient firm and only bidding for traditional procurement. Hence, its rent may be quite large and is reduced by minimising the effort made by the inefficient firm. Thus, at the second best optimum, the incentive scheme entails an efficient level of effort and a rent for the efficient type and a suboptimal level of effort and no rent for the inefficient type.

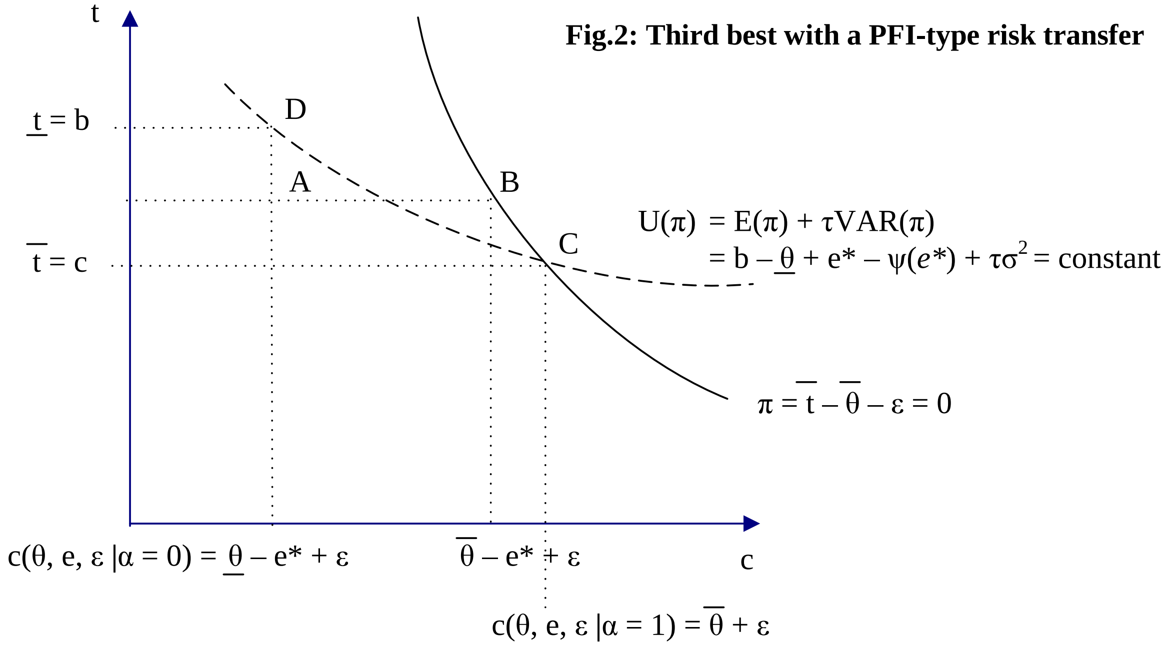
13 An alternative interpretation of this condition is that not all public services are awarded through a private contractor.

Fig.1: First best under full-information



Under asymmetric information, the first best is not incentive compatible i.e. the efficient firm moves from A to B and receives an information rent

Fig.2: Third best with a PFI-type risk transfer



At the optimum the efficient firm chooses the risk transfer contract, makes the optimal effort and receives a rent. The inefficient firm makes zero effort and receives zero rent

Under risk aversion for the agent, the second best would also entail lowering α i.e. transferring less risk to the efficient firm. (see Laffont and Tirole 1993:chapter 2, Laffont and Martimort 2002: chapter 7). However, as discussed above, in public procurement 'incentive contracts' (i.e. $\alpha \in]0,1[$) are seldom used. Instead, the public sector offers the non-linear, PFI-type menu of contracts $\{(\underline{b}, \alpha = 0);(\bar{b}, \alpha = 1)\}$. This menu should allow the public sector to achieve the 'third best': the efficient firm exerts effort and achieves cost savings because it is given the opportunity to be residual claimant to these cost savings and the inefficient firm exerts zero effort. This menu of contracts could be interpreted as the result of a signalling game *à la* Samuelson (1986) in which firms express their willingness to take risk ($\alpha = 1$) and at what price ($\underline{b}$). A direct interpretation of the low-powered contract is that it represents the public sector comparator (PSC).[14]

For the efficient firm to be awarded the PFI-type contract, it must offer $\underline{b} < \bar{b} + \bar{\theta}$. We show a solution graphically on figure 2: the utility of the efficient type is now expressed as an expected profit since under the contract the firm is now 'at risk' (in the upper half both firms received cost-plus contracts and so does the inefficient firm in the lower half). The inefficient firm has now moved to point C, where it receives the transfer t = c (a cost-*plus* contract) and makes zero effort to lower expected costs $\theta + \varepsilon$. The efficient firm moved to D where it receives t = b, its bid price (a fixed price contract) and exert optimal effort e^* to minimise expected costs $\theta - e + \varepsilon$. The efficient firm also receives a positive rent.

Since the agent also faces a cost of bearing risk, in order to 'beat the PSC' the bid price offered by the firm must represent enough efficiency gain to offset its cost of risk bearing and its cost of effort and still be desirable for the principal i.e. below the PSC or zero risk transfer case. This suggests that either efficiency gains must be relatively 'large' compared to the PSC or the cost of risk bearing and of effort must be low for the firm. With a sealed first-bid auction, **the preferred bidder will thus be the firm with the lowest combination of marginal cost θ, cost of effort ψ and cost of risk bearing as defined by τ and σ^2** that also comes below $\bar{b} + \bar{\theta}$ (the PSC).

By imposing a binary choice between fixed-price or cost-*plus* contracts, the principal eliminates the moral hazard problem vis-à-vis the efficient firm. The level and the cost of effort of the agent is fully determined by its choice of contract i.e. it is a case of 'false moral hazard' (Laffont and Martimort 2002) and really boils down to a problem of adverse selection: making the most efficient agent reveal its type or marginal cost $\underline{\theta}$.

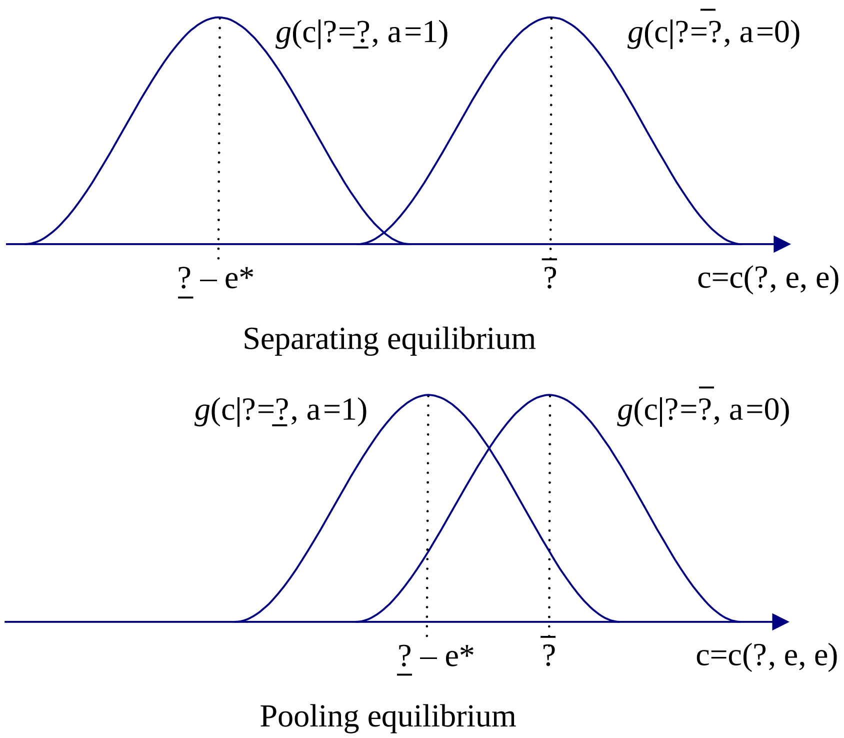
3.4 Pooling equilibrium

With a separating equilibrium as above, each unique pair (b, α) corresponds to a unique (θ, π). Since the *ex post* cost of the firm is a lottery, the determination of a separating equilibrium depends on the shape of the cost *distributions* of each type not overlapping (too much). As illustrated on Figure 3, if the two cost distributions $g(c(\bar{\theta}, e, \varepsilon))$ and $g(c(\underline{\theta}, e, \varepsilon))$ overlap too much, the efficient type always fails to report the fact that it has lower expected costs because, *at the project level*, the variance of costs is likely to be 'like the inefficient type.'

Hence a pooling equilibrium i.e. no firm submit a bid for the PFI-type contract. The lower half of Figure 3 shows that even if the efficient firm would achieve lower expected costs under a risk transfer contract, high cost variance deters the efficient firm from reporting its type.

14 The second contract can be interpreted as the public sector comparator (PSC) i.e. the public sector can estimate the value of $\bar{\theta}$. In this case, the second contract is the equivalent of a 'shutdown' option for the PFI procurement route.

Fig. 3: Expected cost heterogeneity between cost-*plus* and fixed price contracts



3.5 Self-protection vs. self-insurance

We concluded above that under a PFI-type contract, the winning bidder is the firm with the lowest combination of marginal cost θ, cost of effort ψ and cost of risk bearing (τ and σ^2) that also bids below the PSC. In this problem, θ and *e* were the only variables and firms were considered to have similar levels of risk aversion and pure risk ε. However, if the firm is in a position to reduce the variance of costs, or if the level of risk aversion is heterogeneous amongst firms, these new parameters become part of the adverse selection problem.

In the example above and in most of the literature, the cost of risk bearing of the agent is a given and homogeneous and is simply 'passed back' to the principal in the form of a risk premium. But if the cost of risk bearing of the firm becomes partly a function of the firm's hidden action and the firm's private information, the agency problem is greatly complicated. The firm's 'type' is now made of three variables, the cost lottery (θ, σ^2) and risk aversion τ.

Of course, with perfect competition and full risk transfer, the firm should invest optimally in lowering both mean and variance of costs and the 'true' cost lottery and risk aversion would be revealed. However, with PFI-type contracts, the number of firms able to compete for the lowest bid is likely to be small: as discussed below, not only is the number of 'efficient' construction firms likely to be low, but, by design, the discrimination by level of risk aversion is likely to leave only a few *large* firms with a lower than average degree of risk-aversion in the competition.

Say that firms can now choose to engage in both self-protection (minimising the probability of an event) and self-insurance (minimising the consequences of an event).[15] Clearly, if the

15 See Crocker and Shogren Crocker, T. D. and J. F. Shogren (2002). "Choosing Environmental Risks." for a discussion of self-protection and self-insurance in the context of the insurance literature. The possibility of the firm engaging in both self-protection and self-insurance is acknowledged by the policy maker. HMT comments that "value for money is improved by the transfer of appropriate risk as the supplier will be able to reduce either the probability of the specific risks occurring, or the financial consequences if they do occur - or both." HMT (2003a). How to Construct a Public Sector Comparator. London, Her Majesty's Treasury..

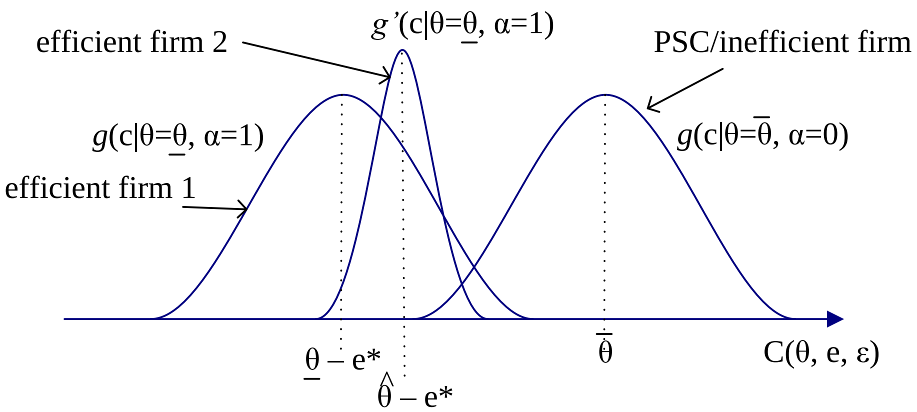
firm can exert effort to reduce the variance of costs it qualifies as self-protection. Likewise, for the firm to reduce the consequence of adverse events through self-insurance, is to lower its coefficient of risk aversion τ.

We first consider the case where τ is fixed but the firm can invest in self-protection i.e. reducing σ^2. Say that the firm can exert effort h so that $\sigma^2 = \sigma^2(h)$ and $\sigma^2_h < 0$ and $\sigma^2_{hh} \geq 0$ (effort reduces variance at a decreasing rate). Of course the firm will be willing to exert effort h when faced with risk so $h=h(\alpha)$. Thus, in the cost function defined above we have $\varepsilon \sim N(0, \sigma^2(h(\alpha))$.

The possibility of 'self-protection' complicates the choice of *e* since the firm can now influence its cost of risk bearing which might prove critical to its ability to win a competitive bid. Without relaxing the hypothesis that effort is always beneficial (i.e. after the cost of effort, net costs are always lower), exerting *e* and *h* might, for example, be mutually exclusive activities: an innovative design might generate lower expected maintenance costs but with a significant variance, whereas a more conservative design might cause higher maintenance costs but with a much smaller spread. The first option thus suggests lower expected costs for the project but a higher cost of risk bearing, and the second option is the reverse. Self-protection thus probably militates in favour of conservative and well known technology choices.[16]

Introducing such heterogeneity in the cost of risk bearing of the firm creates the possibility that the lowest bidder might not be the most efficient firm. As I show on Figure 4, 'efficient firm 2' does not have expected costs that are as low as 'efficient firm 1' but the variance of its costs is much lower (say, it uses a technology that is less economical but has more predictable maintenance costs) and it is likely to be in a position to bid below firm 1 because its 'individually rational' risk premium is smaller.

Fig.4: Heterogeneity in the cost of risk bearing

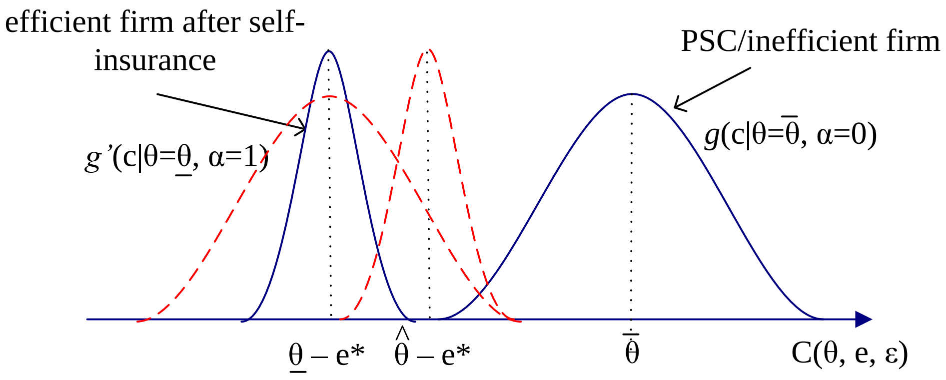


16 Self-protection also militates for quality (e.g. long-life pavement on roads reduces and can even eliminate the cost of maintenance) but here output is contractible so quality is given.

In this case the public sector would give the contract to firm 2 since it offers the lowest risk-adjusted cost 'across the life-cycle.' However, the innovative technology which could have further lowered expected costs is not implemented. This is consistent with empirical evidence, which suggests that technical innovation is seldom seen in PPPs (Thomson and Goodwin 2005; Siemiatycki 2006)

The two-firm case yields a different insight. In Figure 5, two firms compete: an efficient one and an inefficient one. The efficient firm invests in self-protection *h* and now faces a lower cost of risk bearing. The firm can now misreport its type on two counts: the mean of its cost lottery ($\hat{\theta}$ in Figure 4) or its variance or both (e.g. the two dotted bell curve). The possibility of manipulating both variables thus increases the information rent of the firm.

Figure 5: Self-insurance vs. self-protection



Finally, introducing heterogeneity in the risk aversion of the firm (τ) further complicates the adverse selection problem. Firms may have different levels of risk aversion because they engage in self-insurance. For example, a firm may have entered into a large portfolio of contracts to diversify project-specific risks. This form of self-insurance does not affect the project's expected costs or their variance, but the firm with the lowest risk aversion will mechanically have a lower cost of risk bearing than other firms. Under full information, this firm would receive a lower transfer for an equivalent amount of risk in the contract. However, under asymmetrical information, the firm is likely to hide its lower risk aversion and to mimic the high risk aversion firms (e.g. which are not diversified) thus capturing an information rent.

Even if both types of effort are socially desirable, firms can trade off self-protection (reducing the variance of costs) for self-insurance (reducing the impact of the variance of costs). In effect, the preference of the firm for self-insurance over self-protection seems likely. In a theoretical paper, Boyer and Dionne (1983) show that, in the absence of market insurance, agents always prefer self-insurance to self-protection *even if the cost of either is the same*, because self-insurance is more efficient at reducing expected losses.

It follows that when the firm's 'type' has three dimensions (θ, σ^2 and τ) the firm which submits the lowest bid may not be the most efficient but simply the least risk averse (i.e. the biggest) in the sector. Moreover, a self-insurance strategy focused on lowering τ (through diversification) is likely to be cheaper for the firm than self-protection to minimise σ^2.

This suggests that PFI-type contracts are likely to attract and be awarded to firms that can benefit from low risk aversion or successful self-insurance strategies and can then hope to capture the rent of the efficient firm. Thus, selection in PFI-type contracts may be driven more by the ability of the firm to absorb risk than by its ability to reduce it.

If only a few large firms can bid successfully and many projects are procured, the information rent from adverse selection is certain to survive competitive tendering and to be significant.

4 Competition for public sector risk and the rent of the efficient firm: hypothesis formulation

In a classic adverse selection model, the ability of the efficient firm to capture a rent can be eliminated by introducing competition for that rent until adverse selection becomes irrelevant (Salanié 2005). However, numerous authors are sceptical about the ability of the competitive tendering of public works to deliver the best possible price for the public sector. Writing about PPPs, Grout (1997) and Bennett and Iossa (2005) suggest that suppressing the problem of information revelation at the bidding stage may not be without costs.

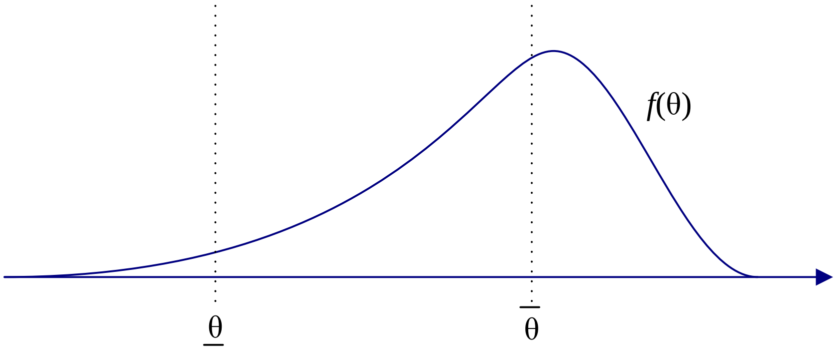
Closely linked to the question of competition is that of the ‘distribution of types’ of agents that may enter into a contractual relationship with the principal. Laffont and Tirole (1993:chapter 7) show that the optimal incentive scheme is not affected by the auctioning of the contract, **but that the size of the efficient firm’s rent is a function of the distribution of firm types.**

How many firms can take substantial public infrastructure project risks? The ‘shallowness’ of the PPP market (S&P and Rigby 2005) is a point frequently made in the empirical literature on PPPs: few companies can endeavour to undertake complex projects like PPPs. Evidence suggests that only a few large international firms can bid for such projects and usually do so as part of a consortium. This is especially the case for projects that combine construction and long-term operation and maintenance phases as well as complex project management and financing structures (House of Commons 2005). Firms capable of winning PPP bids also need to be large because they have to manage and carry risks so that their private cost of risk bearing does not more than offset whatever efficiency gains they can realize compared to traditional procurement.

Furthermore and as we discuss below, PFI contracts require that construction firms invest equity in a project company upfront. While this is often achieved with a combination of equity and subordinated debt and constitutes a way to extract rents from the contract for the firm, these funds are costly for construction firms which tend to have very lean balance sheets. This extra cost to participating to a PFI contract also tends to leave only larger firms in the competition.

It is thus reasonable to assume that even if a lot of firms compete in the construction sector (Langford and Male 1991; Betts and Ofori 1994), amongst the firms that bid for public projects, many are on the inefficient side of the distribution of θ and few on the efficient one (Hillebrandt 1984; Ball 1988). In other words, if f is the probability distribution of θ, then it is likely to have a negative skew (see figure 3.2). Thus, if the market for procuring infrastructure projects is divided between many inefficient firms which cannot reduce the expected value of project’s cash flows below that of the PSC, and a few (maybe just one) efficient firm, then even at the ‘preferred bidder’ stage, the adverse selection problem may well survive.

Figure 6: Distribution of firm types in public procurement



It follows that:

- the two-firm case described above can proxy real-world procurement (S is large and there are few $\underline{\theta}$-firms and many $\overline{\theta}$-firms), and

- in order to make the efficient firm reveal its type and choose to bid for a risk transfer contract like a PPP, at the equilibrium the public sector has to pay an information rent to the efficient firm.

Hence we make the following hypotheses:

Hypothesis 1: Only the largest firms in the construction sector enter into PFI-type contracts

Hypothesis 2: The distribution of firm types resembles Figure 6

Hypothesis 3: Firms involved in PFI-type projects engage in self-insurance

Hypothesis 4: Concentration levels for PFI-type contracts are higher than for traditional procurement

In the next section, we consider these hypotheses in the context of the PFI school programme in the UK.

5 Risk Transfer in PFI School Contracts in the UK

To try and validate our hypotheses, we look at the schools sector because, contrary to many other types of infrastructure, they constitute a more homogenous service which should facilitate direct comparisons between firms.

Indeed, there is a clear requirement that all schools in Britain be delivered to consistent, nationally defined standards both for regulatory reasons (health & safety) and to satisfy an imperative of social equity. Furthermore, school buildings are, *ceteris paribus*, more standard types of infrastructure projects than hospital or prisons which may demand very specific design.[17]

17 e.g. high security prisons vs. juvenile delinquent centres, or the Barts hospital in central London which is also a historic building, or the MI5 headquarter, which is a highly secure building

5.1 The UK PFI School Programme

Context

The Private Finance Initiative was introduced in the UK in 1992. In the first years of the policy, PFI was concentrated in the defence, transport and health sectors and there was very little PFI in schools or other sectors that are primarily the responsibility of local governments. However, schools in the UK require substantial capital funding to redress several decades of under-investment in buildings and facilities and in the late 1990s the central government signalled a strong commitment to improving educational infrastructure through PFI.

Initially, local authorities had weak incentives to engage in PFI: funding for capital investment was allocated by central government according to a distribution formula unrelated to financing method and no requirement was imposed on local authorities to consider PFI. Funding rules were subsequently changed to treat grants from central government for PFI projects, known as 'PFI credits', separately from other funding streams and to remove these charges from revenue capping limits (McCabe 2001: 66).

These changes led to a surge of interest on the part of local authorities. By 2005/6, PFI commitments in England and Wales amounted to over £2.4bn in more than 500 schools through 86 PFI schemes (Audit Commission 2003). Schools account for about one third of local governments' PFI commitments and are the single largest component. We should note that the central government's emphasis on PFI means that most Local Education Authorities (LEAs, the branch of local government responsible for schools) have no real alternative to these schemes if they want to secure capital funding for schools.

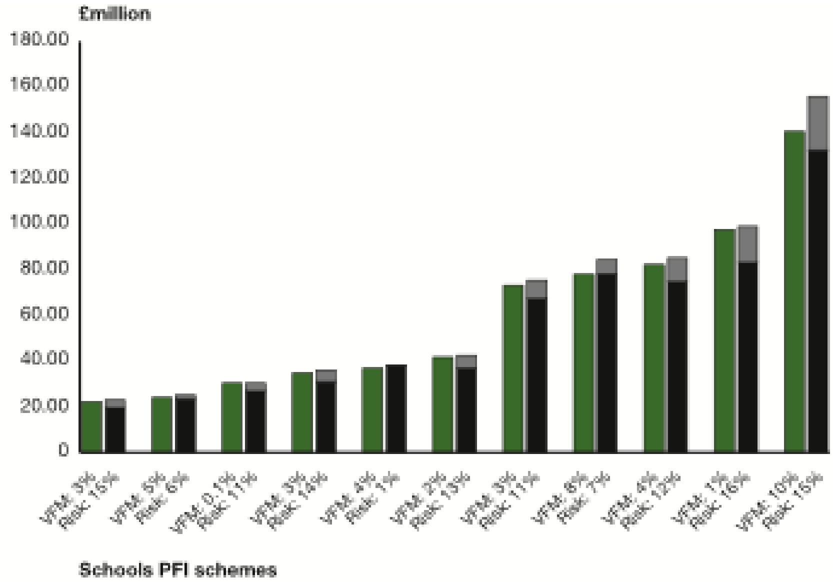
Known issues with measuring risk in the PSC

The PFI process requires the contracting authority to estimate a public sector comparator or PSC, the cost of a similar scheme under traditional procurement including construction, operating and maintenance costs and the value of risks transferred over the life of the contract and to proceed with the PFI only if it the net present value of the stream of unitary payments is less than the PSC. As we discuss in section3, in our theoretical framework this is equivalent to estimating the outcome of contracting with the 'inefficient' firm or the traditional procurement route.

Demonstrating 'value for money' in this way is one of the keys for local governments to secure central government subsidies in the form of PFI credits so local governments have an incentive to make PFI work. As we also discuss in the section 3, the endogeneity of risk in PFI contracts creates a situation of private information about the firm's risks which may be very different than that of the public sector. However, the 'inefficient' firm or PSC is the only benchmark against which the PFI bids are evaluated.

The UK Audit Commission's 2003 report on PFI in schools states, "Without PFI, the opportunity to obtain new buildings or refurbishment would have been lost" (Audit Commission 2003). The lack of a genuine financing alternative gives local authorities strong incentives to make sure PFI schemes do pass the VFM, which was confirmed in the interviews conducted by the Audit Commission with LEAs, teachers and other PFI stakeholders: "Some interviewees claimed that the incentive to estimate on the high side for the PSC in order to obtain the government funding was strong." The authors find that in all but two of the PFI schemes studied, the cost advantage of the PSC depended on the estimate of the cost of risk. They also show that the cost of risk estimate was higher in projects for which the estimated PSC before risk adjustment was lower than the estimated PFI cost (see Figure 7 below).

Figure 7: Cost of risk estimation in school PFI



Source: Audit Commission 2003

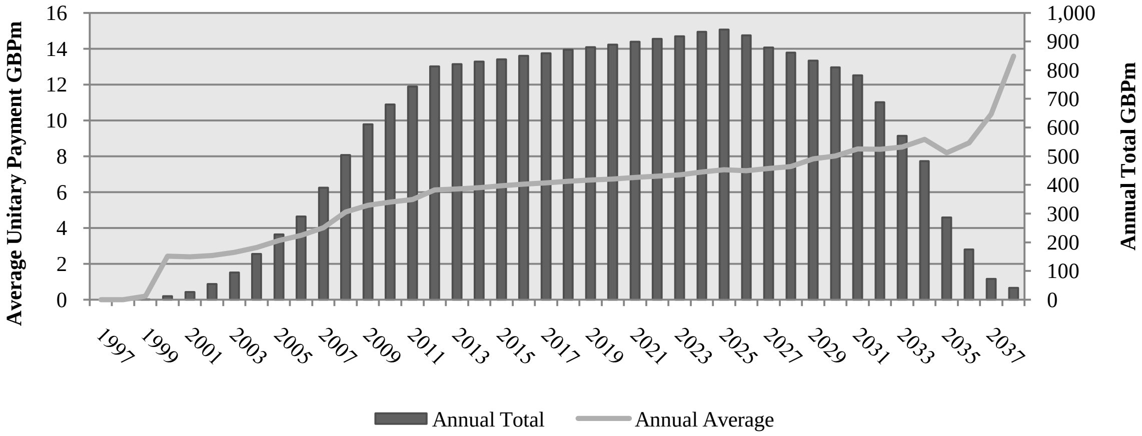
Information on the amount of risk transferred was collected for 18 local authorities in a 2006 survey by the Department for Trade & Industry (DTI 2006). The median 'cost of risk transfer' was equal to 16% of the unitary payment, with a range of 10-18%.

In addition to the incentive issues, LEAs may also find it difficult to construct reliable PSCs because they lack information on costs. As there had been no major investment in school buildings from the mid-1970s to the mid-90s and because of the difference in the level of service being required under the PFI schemes, LEAs are obliged to construct a hypothetical traditionally procured project as a point of comparison. This problem is being overcome gradually as more PFI and non-PFI schools come into operation and cost databases are developed.

Ex ante agreed transfers

Also similar to our ideal type contract, is the commitment to remunerate to the PFI contract at a fixed price called the 'unitary charge' and agreed *ex ante* and for the entire life of the contract. Figure 8 shows the amounts committed by the UK Department for Education to pay under 135 PFI school contracts until 2038: GBP23.4bn.

Fig.8: Average and total unitary charge committed to be paid to 135 PFI school SPVs between 1997 and 2038 by the UK Department of Education as of September 2009



Source: Her Majesty's Treasury, own calculations

5.2 Data

210 PFI contracts were signed in the UK education sector[18] between 1995 and 2010 in total (Infrastructure Economics 2010). Our data is a sample of 181 primary and secondary schools, virtually the population of PFI School contracts signed between December 1997 and April 2010 throughout the UK.

PFI contracts involve the creation of a dedicated project company known as a 'special purpose vehicle' or SPV. This SPV is the entity that enters into the PFI contract with the public sector. It is funded with a combination of equity and debt commonly known as 'project finance.' Equity comes from the project developers (typically construction and operating companies) and other third parties equity providers, while project debt is provided by 'senior' lenders who usually turn to the debt syndication market to bring in numerous other financial institutions. Such financings are highly structured and equity is always the most 'junior' claim in the PFI SPV i.e. equity is the first 'risk buffer' and much more exposed to potential cost overrun problems than debt. It is therefore a reasonable measure of risk-taking by the private sector in such contracts.

Our sample of PFI contracts for schools represents GBP10.8bn of capital investment, of which about GBP1bn is equity. We collect the information described in Annex A from several commercial and publicly available databases.[19] The data is retrieved and aggregated to recreate a picture of the initial equity ownership structure of each SPV. Since we are interested in risk-taking at the onset of the contract, we compute equity ownership for each consortium member at the time of contract signature.[20]

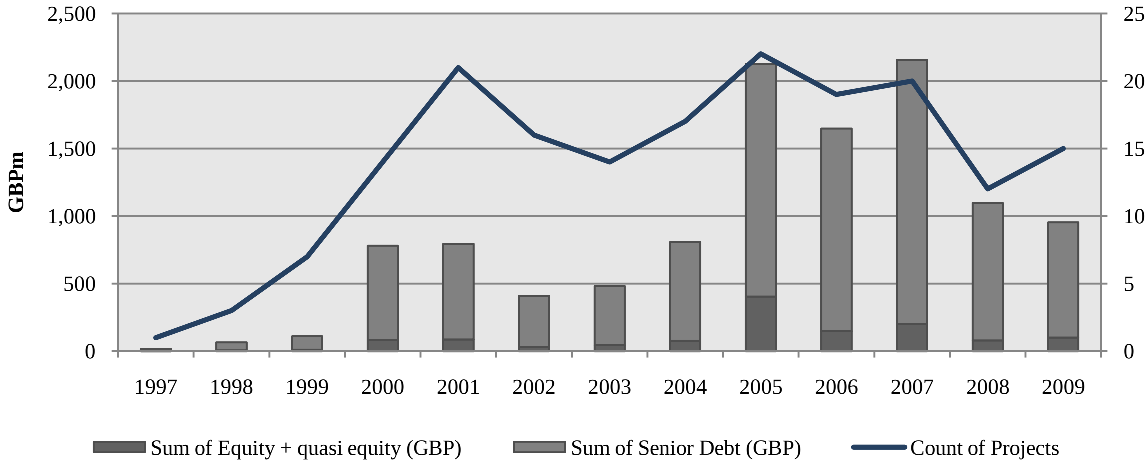
As Figure 9 shows, while average project size and financial structure are affected by the overall state of the loan and private equity markets (slump after 2001, followed by expansion until 2007, followed by a new contraction) there are some strong regularities in the data.

This new sector matured rather quickly after the first projects were tendered in the mid 1990s and between 2000 and 2009, 17 contracts were awarded on average every year. The financial

[18] Including universities
19 Dealogic, Thomson Banker, UK Treasury, Partnerships UK
20 It must be noted that the ownership of these shareholdings may change in subsequent years due to a) construction firms divesting their shares to financial investors – most cases, b) M&A amongst investors or c) the bankruptcy of a given equity holder (e.g. Jarvis in 2004)

structure of the SPVs entering into these contracts corresponds to an average ratio of equity to total capital of 1/10.

Figure 9: PFI school contracts and investment volume



5.3 Findings

Firm type

We identify each of the 91 private firms involved as equity investors in our 181 PFI contracts (list in annex B). After examining the investment structure of the PFI SPVs, we find that PFI school equity is held by two categories of private investors:

a) **Construction firms and operators**: firms that are involved in construction, design and operations are classified as 'non-financial' even if they have a capital investment arm dedicated to investing in large projects. Indeed, this is typical of the 'larger' construction firms that we expect to participate in PFI contracts.

b) **Pure financial investors**: equity investors which limit themselves to providing funds to PFI SPVs (and, in some cases, debt and financial advisory services) are classified as 'financial'

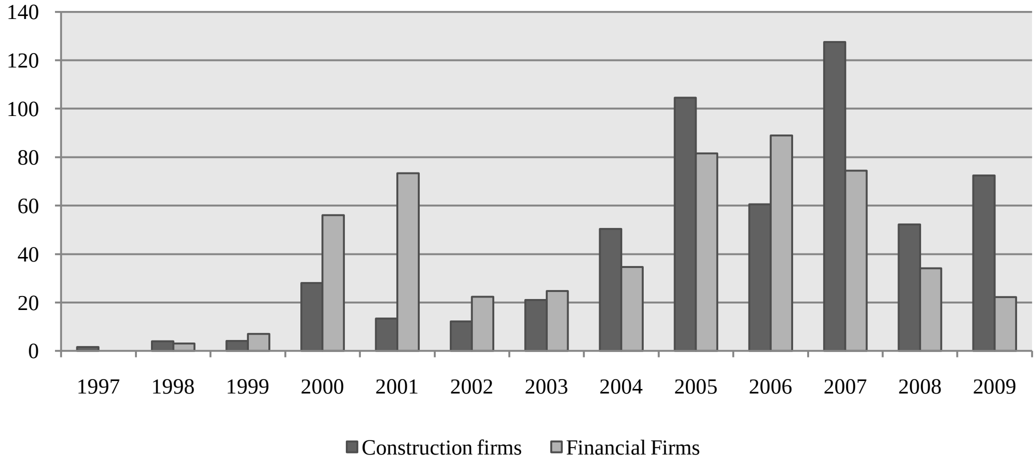
39 out of 91 private entities or 43.5% are pure financial investors while 52 are construction companies. The 39 financial investors can be divided between 24 dedicated private equity investment funds, 10 investment banks and 5 insurance companies.

The other kind of equity holder in PFI contracts is the private sector, albeit always as a minority shareholder. 1.14% of the total equity investment in school PFIs (27 cases) was made by local authorities and 2.33% by the central government's BSFI fund (25 cases). Public sector stakes in individual projects range from 1-10 percent. Public sector investment in school SPVs is first seen in 2002 and became more frequent after 2007.

On average about half of the equity invested in PFI schools at financial close is held by financial firms and the other half by construction companies.[21] The dynamic between financial and construction investors also seems to change over the period, with financial firms taking a larger share in projects before 2003 and construction firms in the subsequent period, as Figure 10 shows.

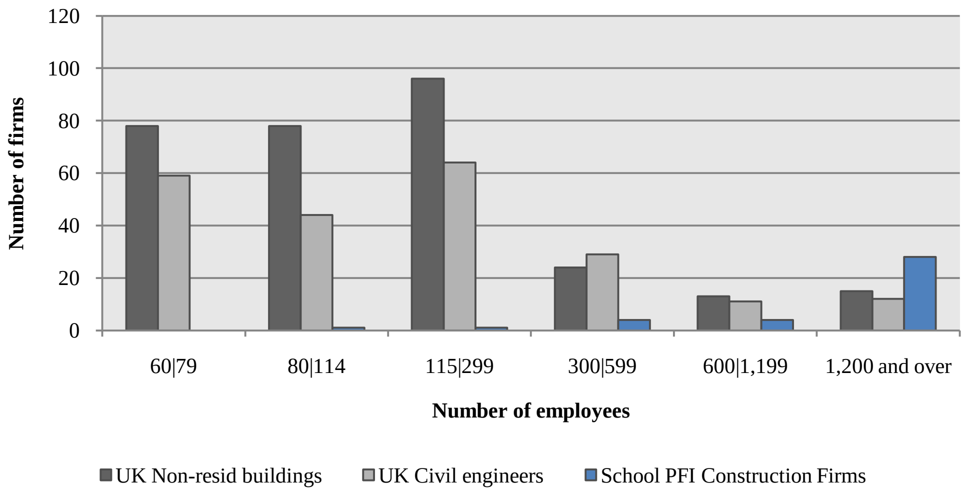
21 We do not track changes of ownership in detail. The HMT dataset does although it is out-of-date. It suggests that construction firms tend to sell their equity to financial firms rather than the reverse or to other construction firms.

Figure 10: Equity or quasi-equity invested at contract signature in 188 PFI Schools in the UK by type of investor (1997-2009)



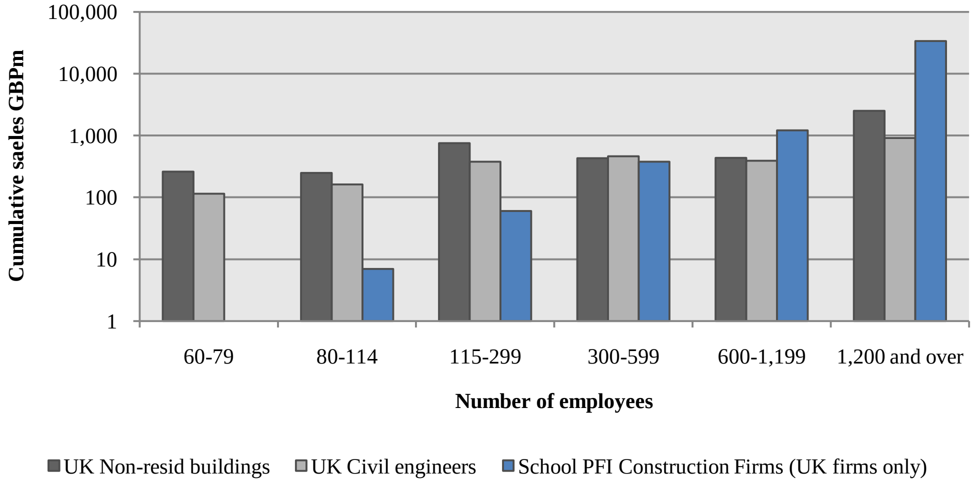
To assess the type of construction firms which enter into PFI contracts, we compare the distribution of non-residential and structural engineering construction firms in the UK by number of employees and by cumulative sales in 2008 (Office for National Statistics 2009) with an estimate of the number of employees and sales for the construction firms involved in our sample of PFI school contracts[22] (Figures 11 and 12).

Figure 11: Distribution of UK construction firms (non-PFI, non-residential and structural engineering) and PFI construction firms by number of employees



22 Collected from firm's websites and annual reports

Figure 12: Distribution of UK non-residential and structural engineering construction firms and of PFI construction firms by cumulative sales (GBPm)



The two populations do not overlap perfectly. Indeed the PFI sample of equity investors includes some facility management firms. However, the majority of the firms in the sample are construction firms specialised in non-residential and structural engineering and we can thus compare them with the equivalent categories in the ONS survey.

Another reason why the population of UK construction firms covered in the ONS survey and the sample of construction firm holding PFI equity do not completely overlap is the presence of a number of non-UK firms in PFI projects. Such firms seldom participate in traditional UK procurement but have been increasingly numerous to enter the PFI market to bid for these contracts. We report the number of employees in the PFI sample for both and UK non-UK firms but restrict the sales comparison to UK firms to ensure accounting consistency.

As Figures 11 and 12 clearly show, the PFI sample of construction firms dominates the UK construction non-residential and civil engineering sectors.

We also look at the number of firms involved in each new contract. Figure 13 shows the number of firms investing equity in PFI schools follows an increasing trend, albeit one tempered by the credit cycle. Figure 13 shows that the average stake of individual equity holders in PFI schools follows a decreasing trend, confirming that risk is spread between an increasing number of firms for each new contract. There is a thus a tendency to pool and spread risk by equity investors in PFI contracts.

This should be seen in the context of the falling number of bidders: a survey by the UK Department for Trade & Industry finds that the number of pre-qualified bidders for PFI tenders falls over time (Davies and Ghani 2006). Similarly, the number of bidders responding to invitations to negotiate has fallen, with most projects receiving interest from 3-4 bidders in 2001/2 compared to earlier projects which had 6-8 interested parties. This may reflect the tendency of the sector towards larger consortia involving multiple equity partners or, as the authors suggest, waning interest in PFI schools after the first round of projects and tighter capacity in the construction sector.

Figure 13: Number of firms investing equity in 188 PFI school contracts by type of investor (1997-2009)

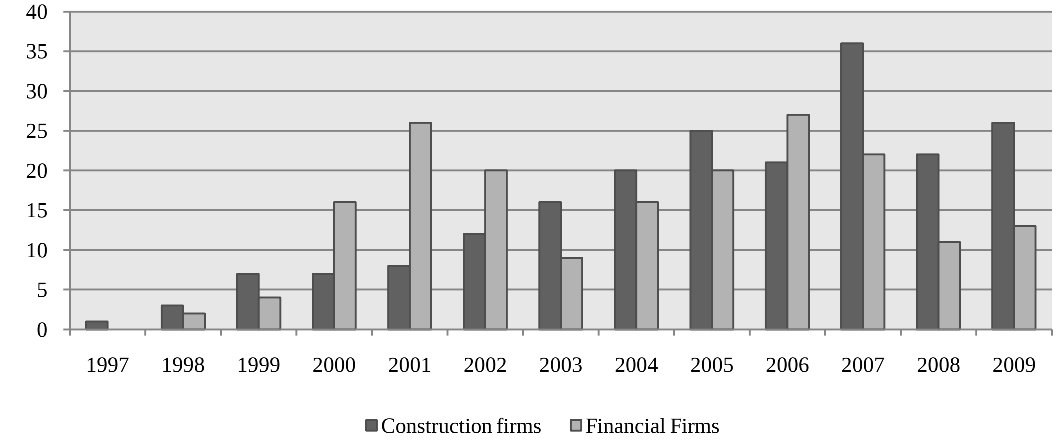
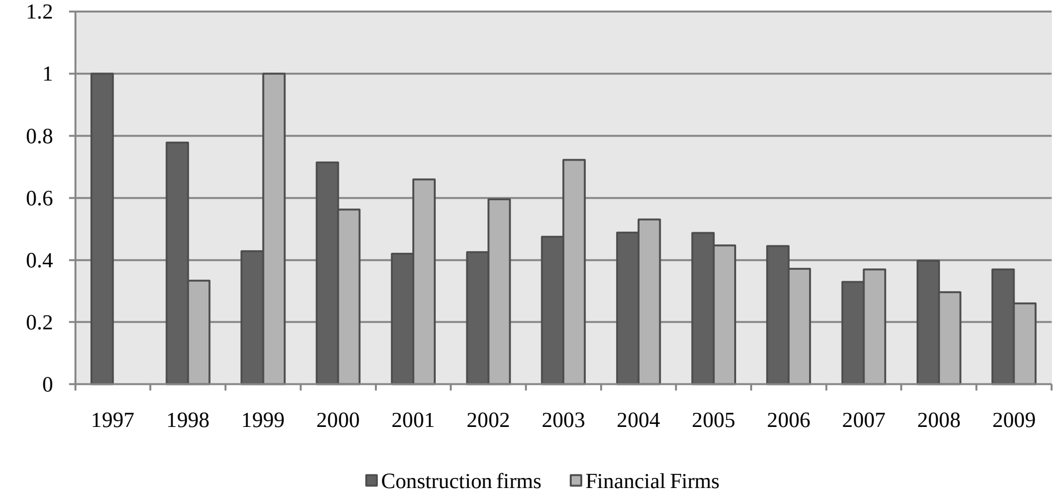


Figure 14: Average shareholding in PFI school project vehicles by firm type (1997-2009)



The PFI firms thus tend to be larger by size and by volume of business. They may also be large foreign firms which is rare in the other segments of the construction sector. Finally the PFI firms enter into PFI contracts in consortia with pure financial investors, which is unheard of in traditional procurement.

Hence, rather than separating two pre-existing 'types' of construction firms, the choice made by the public sector to tender PFI contracts seems to have created a new type of firm, one which is a consortium of large construction firms and pure financial investors.

Self-insurance

If firms wish to self-insure in order to minimise the consequences of the risks they bear, they should invest in a portfolio of PFI contracts. Because risks are mostly project specific, the degree of correlation between the performance of different PFI contracts should be very low.

The private equity funds holding PFI equity are also designed to invest on a portfolio basis. They are thus a source of risk diversification for their co-investors (at the project level).

In our sample a number of construction firms have also acquired a portfolio of equity stakes in PFI contracts. We also know that a larger number of both financial and construction firms have invested in other types of PFI projects, such as hospitals or prisons (e.g. Trillium).

The investor with the most diversified portfolio is the public sector which holds stakes in 52 different contracts, although we should note that this conflates the stakes of numerous local authorities which have considerable autonomy from the centre.

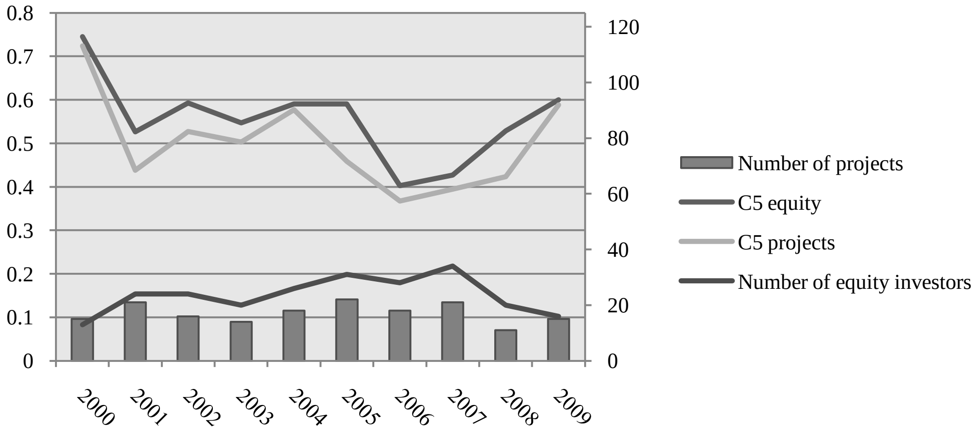
22 private firms (23%) have a portfolio of equity stakes in 5 or more different projects. Together they own 75% of the total stock of PFI school equity. 10 firms have stakes in at least 10 projects, with the biggest private portfolio including stakes in 21 school contracts. 7 out of those 10 are financial firms and 3 construction firms.

Concentration

In general, British construction is not a sector dominated by a few large firms, although very serious concerns have been raised about the anti-competitive behaviour of firms (OFT 2009). McCouglan (2004) shows that the largest 100 private UK contractors together account for about 20% of all economic activity in their sector, in comparison with a C100 ratio of 30–35% for UK manufacturing. In the same paper, it is shown empirically that since the mid-90s the number of entrants to the civil engineering profession has grown rapidly, coinciding with developments in construction technology and greater emphasis on public safety associated with buildings, as well as quality issues and employment practices. However, concentration varies across specialist trades and where entry is less easy and capital more a necessity, concentration is correspondingly higher: constructional engineers is a case in point with a 35% concentration ratio in McCouglan 2004, the highest being scaffolding specialist (56%). Furthermore, effective competition varies over time with the level of spare capacity in the sector.

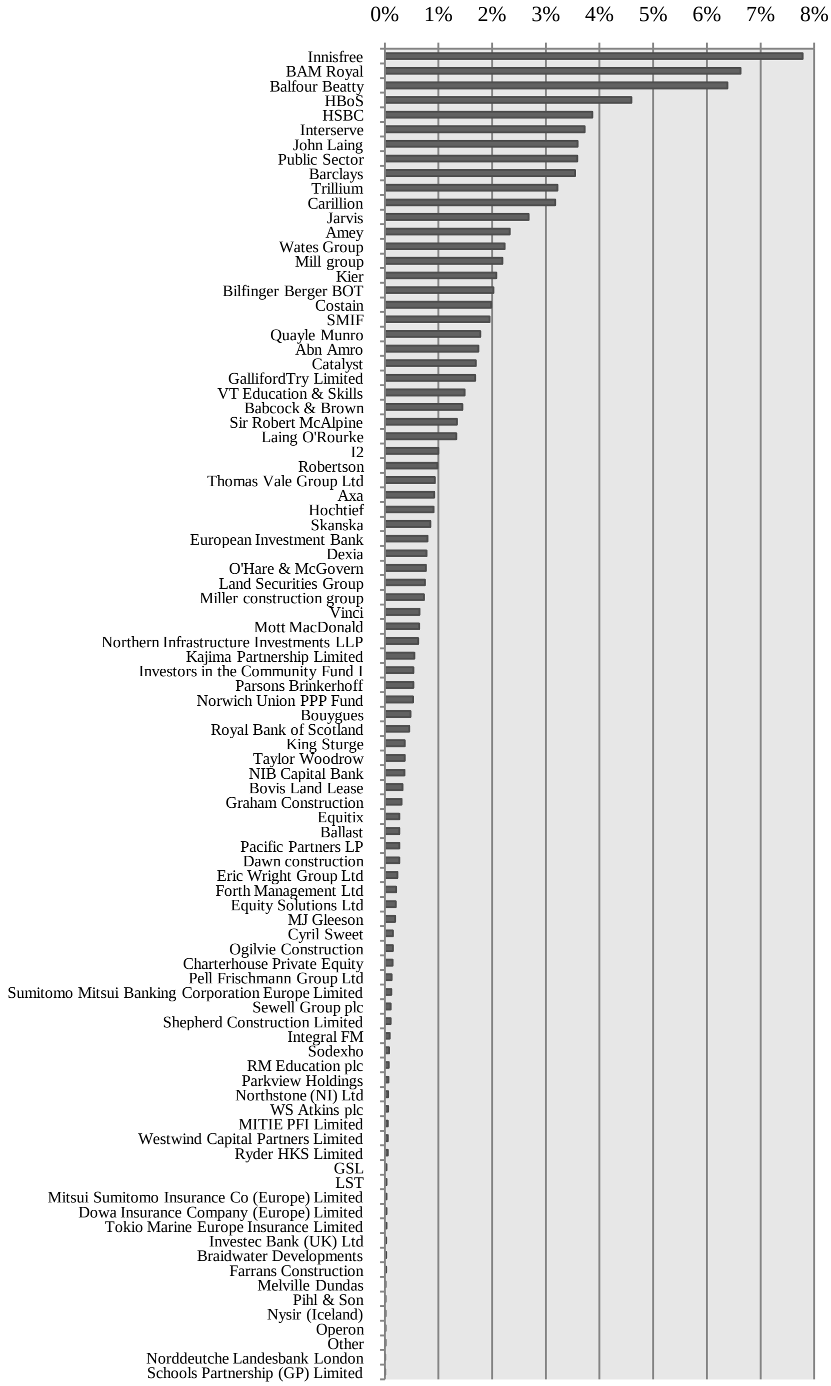
For our sample we limit ourselves with examining C5[23] ratios as the number of firms involved in the sector is small. As discussed above, 22 firms own 75% of the total stock of PFI school equity, and the ten largest owners of PFI school equity own 51% of the total stock. Hence, the C5 ratio for the whole sample is around 30% which signals a certain but limited degree of concentration. In any given year, as shown on figure 14, the C5 ratio oscillates between 50 and 60% i.e. more than half of the equity invested in PFI schools that year are invested by a group of 5 firms. 17 contracts are awarded each year on average between 2000 and 2009. The level of effective competition is determined by how many firms enter PFI contracts in any given year rather than over the whole sampling period.

Figure 15: C5 measures and number of investors 2000-2009



23 C5 is a positive index of concentration, with values closer to unity indicating higher concentration. Traditionally, in industrial organization, a C5 of 70% or more is interpreted as signalling a 'highly concentrated' market. At the other end of the competition spectrum, a C5 less than 10% would signal a highly fragmented market. C5 currently averages 45–50% in UK manufacturing, with the top firm typically having a share of between 15 and 20%. These figures suggest medium concentration and an absence of single firm dominance in the 'average' manufacturing market.

Fig.15: Individual market shares of UK School PFI equity investors



In his 2004 paper, McCouglan finds C5 ratios for the UK construction sector ranging from 5% (all main trades) to 20% (building and civil engineers). While his data pre-dates our sample and ends in 1998, this suggests that a 30% C5 for PFI schools is higher than the level of concentration seen in traditional procurement.

Figure 14 also shows that annual concentration is partly determined by the credit cycle. The period during which access to credit was easier for firms and investors led to lower concentration and a higher number of investors. Conversely, after 2007, the number of firms which continue to invest equity in PFI projects drops and the C5 ratios for these years rise accordingly.

Moreover, the computing of C5 is a measure of concentration using individual firms as the unit and does not take into account the existence of 'relationships' between firms that invest in consortium in SPVs.[24]

6 Conclusions and some policy implications

In this paper, we developed a theoretical framework for long-term public-private risk transfer contracts like the ones used in the UK PFI. We show that as long as competition is imperfect, the cost of transferring risk to the firm is made of both a risk premium and an information rent. This rent is secured for the duration of the contract i.e. several decades.

We also showed that, allowing for heterogeneous firm types, the kind of firms that are most likely to 'beat the PSC' and win such contracts are the ones most able to reduce their cost of risk bearing just as much as they are able to reduce production costs.

We examined the characteristics of a sample of equity investors in 181 PFI Schools in the UK between December 1997 and April 2010. We found that:

- PFI School SPVs are invested at the onset by a combination of construction firms and pure financial investors
- The construction firms involved tend to be the largest ones in the UK and also include large foreign ones
- In a context where the reported number of bidders has decreased over time, the number of investors involved in new PFI contracts tends to increase over the sampling period, while the average equity share tends to decrease.
- PFI equity investors invest on a portfolio basis in multiple PFI school contracts and PFI contracts in other sectors, thus engaging in 'self-insurance'
- C5 ratios are relatively high compared to UK construction industry averages
- Instead of separating efficient from inefficient types of firms to procure new schools, the use of PFI seems to have generated a new type of firm, a combination of construction firms and financial investors and much more internationalised than in the traditional procurement sector.

The UK school PFI sector thus confirmed our hypotheses and the validity of our theoretical framework. The existence of a **permanent rent** for the firms entering into PFI contracts thus seems likely. Such *ex post* inefficiency is problematic from a welfare point of view since PFI unitary charges are financed by the tax payer.

In the absence of sufficient competition, most of the *ex post* inefficiency springs from the fact that the point of reference for the PFI bid price is the PSC i.e. a **view taken on the risks to which the public sector is exposed in traditional procurement and not those to which the firm is exposed under a PFI contract.** The combination of this situation of private information about the risks transferred with the commitment of the public sector not to renegotiate the unitary charge *ex post* make the firm's rent potentially large.

An obvious remedy to this situation is for the public sector to engage in private sector risk benchmarking. This is exactly the kind of issue that 'yardstick competition' in regulated

[24] We intend to study this in a future paper

network industries addresses (Laffont and Tirole 1993). For example, the British water regulator, OFWAT, collects cost data on water company performance and sets water tariffs on the basis of an 'efficiency frontier' determined via an econometric model. PPP projects and the PFI in particular would be very well suited to such benchmarking since hundreds of observations are available (e.g. as well as hundreds of PFI school contracts, the UK has more than 300 PFI hospital contracts.) and the resulting statistical tests of efficiency could be powerful enough to justify the exercise.

Such efficiency benchmarking would allow for continued enforcement of performance after contract signature and may help avoid some of the issues revealed by the UK Audit Commission's report on the first batch of PFI schools which found that on average facility quality was lower in PFI schools and there was no significant difference in time to completion, cost overruns, either construction, operating costs or facilities management costs between PFI and traditionally procured schools. The "cost of ownership," a measure of ongoing maintenance costs, was seen to be higher for the PFI schools than the other schools and that there was no evidence of whole life costs having been taken into consideration in the design of the buildings for the PFI projects: "There is little evidence so far that more investment had been made upfront to reduce longer-term maintenance costs in the majority of the PFI schools reviewed than is usually the case in traditionally funded schools." (Audit Commission 2003: 18). They also found a positive correlation between construction and life-cycle unit costs, rather than a negative correlation as we would expect if the firm was investing more upfront to reduce O&M costs over the life of the contract.

Finally, another interesting finding is the role of the credit cycle in the degree of competition for risk transfer in public-private contracts. We see in the data how competition and concentration are affected by the greater economic and financial cycle. This has important implications for procurement policy. In bad times, when even fewer firms than usual are able to take risk, insisting on procuring public services through risk sharing contracts may have welfare decreasing consequences since the ability of the few firms and banks that are still in a position to bid to extract a rent is increased. This is a potential area for future research.

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Annex A: data collected

Investor Data
equity holder generic name
Financial co (y/n)
Equity share (%)
project 'share' GBPm
Equity share value GBPm
Project Level Data
Financial close year
Total Project Capital Investment (GBP)
Project Senior Debt (GBP)
Project Equity + Quasi Equity (GBP)
Gearing Ratio (Eq/Capex)

Annex B: list of firms holding equity in PFI schools at contract signature

Name	Market Share	Total Equity Invested	Number of stakes
Innisfree	7.78%	£ 83.65	21
BAM Royal	6.63%	£ 71.23	10
Balfour Beatty	6.38%	£ 68.60	9
HBoS	4.59%	£ 49.37	14
HSBC	3.87%	£ 41.57	10
Interserve	3.72%	£ 40.02	13
John Laing	3.59%	£ 38.60	8
Public Sector	3.59%	£ 38.55	52
Barclays	3.54%	£ 38.09	15
Trillium	3.22%	£ 34.57	8
Carillion	3.17%	£ 34.12	10
Jarvis	2.68%	£ 28.80	13
Amey	2.33%	£ 24.99	10
Wates Group	2.23%	£ 24.01	8
Mill group	2.19%	£ 23.54	8
Kier	2.08%	£ 22.32	5
Bilfinger Berger BOT	2.02%	£ 21.76	6
Costain	1.98%	£ 21.29	4
SMIF	1.95%	£ 20.97	5
Quayle Munro	1.78%	£ 19.14	11
Abn Amro	1.74%	£ 18.74	2
Catalyst	1.70%	£ 18.24	4
GallifordTry Limited	1.68%	£ 18.10	4
VT Education & Skills	1.49%	£ 15.96	2
Babcock & Brown	1.45%	£ 15.54	5
Sir Robert McAlpine	1.34%	£ 14.42	4
Laing O'Rourke	1.33%	£ 14.33	3
I2	1.00%	£ 10.72	7
Robertson	0.98%	£ 10.55	4
Thomas Vale Group Ltd	0.93%	£ 10.04	1
Axa	0.92%	£ 9.89	1
Hochtief	0.91%	£ 9.80	4
Skanska	0.85%	£ 9.16	3
European Investment Bank	0.80%	£ 8.58	1
Dexia	0.78%	£ 8.33	3
O'Hare & McGovern	0.76%	£ 8.22	5
Land Securities Group	0.75%	£ 8.03	5
Miller construction group	0.73%	£ 7.86	4
Vinci	0.65%	£ 6.98	3
Mott MacDonald	0.64%	£ 6.87	2
Northern Infrastructure Investments LLP	0.62%	£ 6.66	1
Kajima Partnership Limited	0.55%	£ 5.92	5
Investors in the Community Fund I	0.54%	£ 5.76	2
Parsons Brinkerhoff	0.54%	£ 5.76	2
Norwich Union PPP Fund	0.53%	£ 5.65	3
Bouygues	0.48%	£ 5.16	6
Royal Bank of Scotland	0.45%	£ 4.87	3
King Sturge	0.37%	£ 4.02	3
Taylor Woodrow	0.37%	£ 4.00	1
NIB Capital Bank	0.36%	£ 3.92	2
Bovis Land Lease	0.33%	£ 3.57	2
Graham Construction	0.31%	£ 3.35	4
Equitix	0.27%	£ 2.93	1
Ballast	0.27%	£ 2.92	2
Pacific Partners LP	0.27%	£ 2.89	1
Dawn construction	0.27%	£ 2.89	1
Eric Wright Group Ltd	0.23%	£ 2.51	2
Forth Management Ltd	0.21%	£ 2.26	2
Equity Solutions Ltd	0.20%	£ 2.19	1
MJ Gleeson	0.19%	£ 2.08	2
Cyril Sweet	0.15%	£ 1.62	3
Ogilvie Construction	0.15%	£ 1.62	1
Charterhouse Private Equity	0.14%	£ 1.55	1
Pell Frischmann Group Ltd	0.13%	£ 1.36	2
Sumitomo Mitsui Banking Corporation Europe Limited	0.12%	£ 1.28	1
Sewell Group plc	0.11%	£ 1.19	2
Shepherd Construction Limited	0.11%	£ 1.15	1
Integral FM	0.09%	£ 0.98	1
Sodexho	0.08%	£ 0.86	2
RM Education plc	0.08%	£ 0.81	1
Parkview Holdings	0.07%	£ 0.76	1
Northstone (NI) Ltd	0.06%	£ 0.67	1
WS Atkins plc	0.06%	£ 0.66	1
MITIE PFI Limited	0.06%	£ 0.63	1
Westwind Capital Partners Limited	0.06%	£ 0.63	1
Ryder HKS Limited	0.06%	£ 0.63	1
GSL	0.03%	£ 0.37	1
LST	0.03%	£ 0.37	1
Mitsui Sumitomo Insurance Co (Europe) Limited	0.03%	£ 0.34	1
Dowa Insurance Company (Europe) Limited	0.03%	£ 0.34	1
Tokio Marine Europe Insurance Limited	0.03%	£ 0.34	1
Investec Bank (UK) Ltd	0.02%	£ 0.27	1
Braidwater Developments	0.02%	£ 0.27	1
Farrans Construction	0.02%	£ 0.27	1
Melville Dundas	0.02%	£ 0.19	1
Pihl & Son	0.02%	£ 0.16	1
Nysir (Iceland)	0.02%	£ 0.16	1
Operon	0.02%	£ 0.16	1
Other	0.02%	£ 0.16	2
Norddeutche Landesbank London	0.01%	£ 0.07	1
Schools Partnership (GP) Limited	0.00%	£ 0.04	1