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The Regulatory Asset Base and Project Finance Models

An Analysis of Incentives for Efficiency

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Abstract

Governments world-wide have sought value for money by augmenting the traditional approach to public infrastructure delivery and management by introducing private capital. Two well established platforms for private capital participation are the Regulatory Asset Base (RAB) Model and the Project Finance Model (broadly termed PPPs). This paper reviews available evidence on the efficiency in delivery and operation of major infrastructure of each platform relative to the traditional approach. Overall the basic concern with the RAB model is that its application might lead to excessive capital expenditures, to strategically inflate the base on which the return is being calculated. By contrast, given the complexity of PPP projects and the inherent uncertainty associated with such long-lived contractual commitments, it is questionable whether competition leads to efficient outcomes. Both approaches have some potential advantages and this paper investigates, whether it is meaningful to merge them.

Table of Contents

Boxes

Figures

Tables

Introduction

Investment in infrastructure is important for productivity and growth, for future generations as well as today. A recent study by McKinsey compiled multiple sources of information on the so called "infrastructure gap", estimating the needs at USD 57 trillion over the next 30 years (Dobbs et al. 2013). Almost half of this amount is in the transport sector. Despite the inherent difficulties in accurately estimating it, the infrastructure gap in clearly large.

The traditional approach to investing in infrastructure relies on governments using its revenue (either from taxes or borrowing) to finance the design and construction of new or upgraded infrastructure. Although the design and construction can be procured through competitive tenders from private firms, the traditional model relies on continued government ownership and operation once construction is completed.

In recent decades, many governments have responded to limitations of the traditional model by seeking increased private sector involvement in the funding, financing, delivery and operation of infrastructure. The two primary challenges with the traditional model driving this change are:

- difficulty in finding sufficient government finance, either because of weakness in tax revenue or a reluctance (or inability) to increase government borrowing
- evidence (or policy preference) that government ownership and operation of infrastructure assets results in worse price and/or quality outcomes compared with the private sector.

This paper explores the two primary models through which private sector involvement has been introduced into the financing, delivery and operation of infrastructure: the regulatory asset base model (RAB) and the project finance model (or Public Private Partnerships, PPP).

In the RAB model, private (or corporatised state-owned) companies act as the infrastructure manager: they own, invest in and operate infrastructure assets. The infrastructure manager receives charges revenue from users and/or subsidies to fund its operations and recoup investment costs. The infrastructure manager would behave much like a natural monopoly in the absence of regulation – setting prices too high in an attempt to earn "super normal" profits. An economic regulator is therefore established to provide efficiency incentives and to cap prices, revenue or rates or return received by the infrastructure manager to improve social welfare. Efficiency incentives aim to mimic the incentives that would be faced by the market if it were competitive. The efficiency gains in this case arise primarily through the interaction between the regulator and the infrastructure manager "during the contract".

In the PPP model (also termed Private Finance Initiative, PFI, in the UK) of public infrastructure delivery, the government calls for tenders for a contract for a single infrastructure project. These contracts commonly take the form of a Design-Build-Finance-Maintain-Operate (DBFMO) contract. The contract gives the successful private consortium responsibility for all aspects of project financing, delivery and operation for periods often spanning decades. The contract sets out how the consortium receives revenue: either from the government in the form of a periodic "availability payments", and/or direct from users. (The latter case is associated with demand risks that are generally beyond the scope of this paper.) The efficiency gains in this approach are primarily determined at a single point in time: by competition between the bidders for the contract (*ex-ante*).

These two approaches could be considered as two diametrically opposite solutions to the same challenge of infrastructure financing, delivery and management. The sharp distinction made here serves to allow analysis. In reality competition between investors in the RAB model also serves to provide an incentive to efficiency, at least at the outset. Similarly, a DBFMO contract need not be entirely devoid of incentive regulation[1]. In between the two basic approaches, there are also other alternatives, which take various forms, from management contracts to other types of concessions. These are not discussed in this paper.

The central advantage of RAB is that in developed economies it offers one of the lowest costs of financing, only marginally above that of government bonds. At the same time, incentive regulation can provide adjustable high powered incentives for operational efficiency during the life of the infrastructure. One of the bigger challenges of RAB is incentivising efficient capital expenditures, which is a problem that appears to be more adequately solved in PPPs. These are well established for delivering projects on-time and on-budget; however, the cost of financing PPPs is substantially higher than for RAB, and the PPP contract is considered to be relatively rigid during the operations phase.

The question this paper asks is whether it is feasible and desirable to merge the advantages of both approaches – the low cost of finance and continuous incentives for operational efficiency in the RAB, with efficiency in infrastructure delivery of the PPP – in a single model? To attempt to answer the question, the paper first reviews the available empirical literature and assesses the infrastructure delivery and operation performance of the traditional model (section 3), the RAB (section 4) and PPP (section 5) approaches. We then discuss whether there is room to combine any elements of the two models, which would lead to an improved infrastructure delivery and management vehicle (section 6). Section 7 concludes.

This paper was originally published as “The Regulatory Asset Base Model and the Project Finance Model: A comparative analysis“ (ITF Discussion Paper 2015-5) in February 2015. Feedback on the complex issues raised in that earlier paper has prompted us to improve and streamline the structure for enhanced presentation of the material and better accessibility of the conclusions. Daniel Veryard has been added as co-author to reflect his valuable input. Comments on an earlier version by Darryl Murphy, Frederic Blanc Brude, Daniel Loschachof, J.L. Guasch and Marian Moszoro are gratefully appreciated.

1 Around the world region specific differences may induce confusion. A concession is a specific term in civil law countries. In common law countries however, projects that refer to discrete pieces of infrastructure are also referred to as concessions, although they could be better described as BOT type projects.

Methodology

This paper compares the relative performance of three alternative models for delivering and operating infrastructure in capital-intensive network industries: 1) traditional procurement, 2) regulated asset base (RAB) and 3) project finance (PPP). We assess these models by examining and comparing their performance in the available empirical literature and economic theory.

The paper focuses on capital-intensive network industries (e.g. road, rail, utilities) as they have elements of natural monopolies that make investments candidates for each of the delivery models of interest. An important aspect of these industries is that demand is mainly an exogenous factor for the infrastructure manager. Nevertheless, the paper assumes the basic incentive structure is the same in any project finance PPP and thus draws on available evidence also from other sectors where relevant.

To demonstrate the scope of the analysis, a project life-cycle can be divided into five stages, each with its own considerations:

- **Project selection** (outside the scope of this study) – which markets should be served? What service capacity should be built? Which service technologies should be provided to the users (e.g. light rail versus bus rapid transit)?
- **Quality and delivery approach** – which materials, techniques and technologies should be applied in construction? What quality of asset should be built? Will life-cycle costs be minimised (for a given service output)?
- **Delivery efficiency** – how well can specified capital projects be delivered, without excessive cost overruns and delays? How well are the risks of delivery estimated and managed?
- **Operational efficiency** – given the assets available, can the operator produce a given output at low cost? Can the service contract be re-negotiated easily at low cost to government?
- **Operational flexibility** – to what extent are prices, quantities and service levels locked in or flexible? What costs are incurred by governments if they wish to make changes during the operational period?

Only the first of these life-cycle stages is not considered in this study. This is because in two of the delivery models under consideration, project selection has generally been decided *ex-ante* (before any delivery contracts have been tendered) regardless of whether a project is desirable or not. Only in the RAB model is project selection within the scope of the delivery framework itself. Infrastructure managers are involved (with the regulator/state) in the selection and procurement of projects, but this aspect of the RAB model cannot be compared with the other models which rely purely on government project selection decisions.

Decisions made during phases two through four determine which party bears the various delivery and operational risks. This risk allocation in turn influences the incentives for performance and can have a significant influence on the cost of financing. The assessment of models considers these points in terms of the returns required by private participants and the resulting value for money for government.

The traditional model baseline

The term "traditional" describes something that has remained more or less unchanged through time as an established method. The dominant method of major infrastructure *procurement* has remained unchanged for decades, while the processes and technologies for infrastructure planning and delivery have progressed. This section explores the traditional approach to delivery and operation of major network infrastructure.

Infrastructure delivery using the traditional model

The traditional model is a contract structure where the phases of design and construction are tendered to private companies, either separately (Design-Bid-Build or DBB contracts) or bundled (a Design and Build or DB contract). The spending on public infrastructure is financed with public funds or through government borrowing.

Quality and delivery approach

The planning, building, and operation phases are commonly each performed by different entities in the traditional model. In such a setup each actor "leaves the scene" after his engagement is completed, hence limiting incentives to consider future consequences of decisions in each of the phases[2]. This makes the implementation of life-cycle cost optimisation principles difficult.

Equally importantly, the sponsor (the public entity), which should have the incentive to minimise life cycle costs, is also subject to political short termism. Politicians have an incentive to "cut the ribbon" for as many projects as possible, without considering future cost of this infrastructure. This leads to the procurement of lower quality infrastructure than might be suggested by life-cycle minimisation.

Delivery efficiency

In large projects, traditional procurement involves the public sector entering into a cost-plus contract[3], which has three main consequences for delivery efficiency:

- The public sector retains most of the risks of cost or time overruns.
- The public sector also retains the possibility of changing the scope of the project during construction with relatively small transaction costs. This flexibility also creates moral hazard by making it easier for the public sponsor to conceal the true cost/benefits during the project selection stage (Flyvbjerg et al. 2002).

2 In traditional procurement the Design and Build procurement resolves part of the problem with regard to incentives, but it would still be inferior to a contract that also bundles the operations phase.

3 In this paper we apply the term cost-plus contract as opposed to fixed price/fixed date of delivery contracts. Cost-plus contracts offer a weak guarantee *ceteris paribus* to the investor that the project will be delivered for the contracted value, including the design and build contract. The fixed price/fixed date of delivery contract involves a TLS (Total Lump Sum)/turnkey contract, with a comparably strong guarantee to the investor, that the contract value will not be exceeded (provided of course, that the investor does not change the content of the project).

- A large number of potential contractors can participate during the bidding stage, including participants that would be unable to accommodate major risks.

A large body of literature assesses the on-budget cost performance of the traditional infrastructure project delivery *ex post*. The relevant part of the literature focuses on construction contract performance where cost performance is measured against the contract price (Blanc-Brude and Makovšek 2013 include a literature review). On this measure, systematic cost overruns for road infrastructure are found to average below 9% under the traditional approach[4].

Infrastructure operation under the traditional model

Operational efficiency

Once infrastructure is delivered, its management and operation is traditionally transferred to a state-owned infrastructure manager. The challenges typically faced in the operation phase include poor performance incentives and an under-recovery of efficient life-cycle costs.

Infrastructure managers share several characteristics with natural monopolies (sunk costs that limit new market entrants, economies of scale and scope, etc.). Accordingly, they are not subject to adequate competitive pressures that would provide incentives to innovate or reduce costs. For example, within large monopolies unions organise more easily and can exert considerable power on the company and its owner (Salinger 1984, Rose 1987, Hendricks 1977). In a related point, Savedoff and Spiller (1999) explain how the threat of government opportunism leads publicly owned companies to protect their cash flows against interventions (e.g. by hiring too many employees or granting excessive benefits).

State-owned infrastructure managers tend to under-recover efficient life-cycle costs due to government short-termism or “time inconsistency” (Helm 2009). Government short-termism stems from voter expectations: voters appreciate a low upfront price with little concern for the consequences for the distant future generation from running down the asset. Persistent lack of renewals can eventually lead to (non-linear) excess current maintenance requirements, which entail even higher expenditure than before.

Effectively the incentives for efficiency are dependant solely on how well the state performs its corporate governance function.

Operational flexibility

The advantage of the traditional model during the operational phase is that the government has direct (or indirect) control over prices, quantities or service levels. If economic or technological conditions differ to those that were expected when an infrastructure investment was made, the government is able to implement changes without any contractual penalties or without costly or time consuming renegotiation procedures.

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4 A related, but separate, part of the literature measures performance against “decision to build” estimates that are made earlier in the project life-cycle (i.e. during the “project selection” stage, e.g. Flyvbjerg 2002, 2003; Odeck 2004; Cantarelli 2012a,b; Makovšek et al. 2012). This literature finds that transport infrastructure costs between 8% and 40% more than is estimated initially.

An adjustment in the national transport policy for example may require a change in the infrastructure development plans. In roads or railways for example, demand on each section of the network affects demand on the other links. If a major part of the network was managed by different PPPs a more radical change in the network would require a renegotiation with all the PPPs that would be affected by the new policy.

Assessment of the traditional model

Under government ownership, infrastructure is financed with public funds or through government borrowing, which has a lower cost than private financing[5]. The government also has greater flexibility to respond to changes in future circumstances without contractual penalties and complicated renegotiations.

Against these advantages, the main challenges for the traditional model of infrastructure delivery and management is the weak incentives to maximise a project's value across delivery and operation (including a lack of certainty of on-going funding).

Towards private participation

In economics it has long been theoretically argued, but only recently empirically established, that the performance of the private ownership *in a competitive market* is superior to public ownership (Meginson and Netter 2001). In recent decades, some countries have aimed to apply this success of private ownership to network industries. However, the natural monopoly characteristics of many network systems (sunk costs, long lived assets and externalities) mean a simple application of private ownership would lead to multiple market failures. As such, some form of government intervention remains necessary to achieve socially optimal outcomes. For instance:

- Setting the appropriate investment allocation – Helm (2009, 321) notes that it is ultimately the state that decides on the overarching objectives of expenditure programmes, including public infrastructure.
- Externalities – It is impossible for the investor to directly capture positive externalities and to monetise them and he will not voluntarily be held liable for the negative externalities. Addressing both would be in the interests of society.
- Sunk costs – because investments in large physical infrastructure are sunk, it is unlikely that private investors would commit to investments where there is a risk of expropriation. Participation of private capital in infrastructure delivery and management in such circumstances is not possible in the long run. To make it possible, a credible commitment by the government is necessary.

The next two sections present two approaches that have evolved to introduce more private sector involvement in network infrastructure development – the RAB under incentive based regulation and the PPP. A brief description of each approach is followed by the analysis of the delivery and operation dimensions as above.

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5 This issue is partly addressed in the PPP section. However, an in-depth discussion of whether this is ultimately the case is outside the scope of this paper.

The Regulatory Asset Base model

The previous section summarised that capital-intensive network industries have many characteristics of natural monopolies, which imply that the development of fully fledged competition is not possible. While the traditional approach to this challenge is government ownership and control, many countries have introduced various types of economic regulation with the aim of improving the efficiency of this form of delivery, an d in some cases, to enable greater private sector involvement.

Ex-ante price controls are considered the strongest form of economic regulation as it presumes some form of market failure exists.[6] *Ex-ante* price controls have been introduced into a range of capital-intensive network industries, such as railways, electricity transmission, water supply and treatment. These are industries where natural monopoly characteristics are strongest, so full competition is unlikely to ever emerge.

There are three main types of *ex-ante* price controls – price caps, revenue caps and rate of return regulation. With the price and revenue caps, the regulator must estimate the efficient cost of providing a service for the next regulatory period (price review period) and allow the regulated company to recover that cost through user charges, if it meets the efficiency target. Similarly, rate of return regulation allows the infrastructure manager to collect revenues that allow it to earn a return on its assets up to a designated cap.

All of the *ex-ante* price control approaches rely on being able to determine the capital and operating costs that the infrastructure manager is allowed to recover from its customers. There are two main approaches to calculating this efficient cost of service provision. One is the regulated asset base (RAB) or building block approach, and the other is a forward looking approach (e.g. Long Run Incremental Cost, commonly applied in telecommunications). This paper focuses on the RAB approach as representative of the economic regulation approach to infrastructure delivery and operation.

Overview of the Regulatory Asset Base model

The Regulatory Asset Base (RAB) concept emerged in UK to provide assurance to investors in privatised network utilities by setting out the principles for the calculation of price caps (Stern 2013). The RAB model was developed to value existing assets as a part of the privatisation process in the UK (rather than the delivery of stand-alone major investments). The RAB model itself does not preclude any particular form of ownership for the infrastructure company – its assets can in principle be privatised or remain in public ownership. The RAB simply assesses the value of the assets used in the performance of a regulated function. In practice, it is an accounting number that reflects the value of past investments into network infrastructure.

An economic regulator aims to set the RAB such that financial capital values are maintained[7] (and current cost accounting is applied where sensible). More specifically, financial capital

6 Other "lighter" forms of economic regulation involve pricing rules (preventing the dominant operator from abusing its market power, as for example in telecommunications or postal services) or an application of transitory measures (e.g. non-discrimination clauses, price monitoring), where the market is deemed competitive, but one operator still has significant market power.

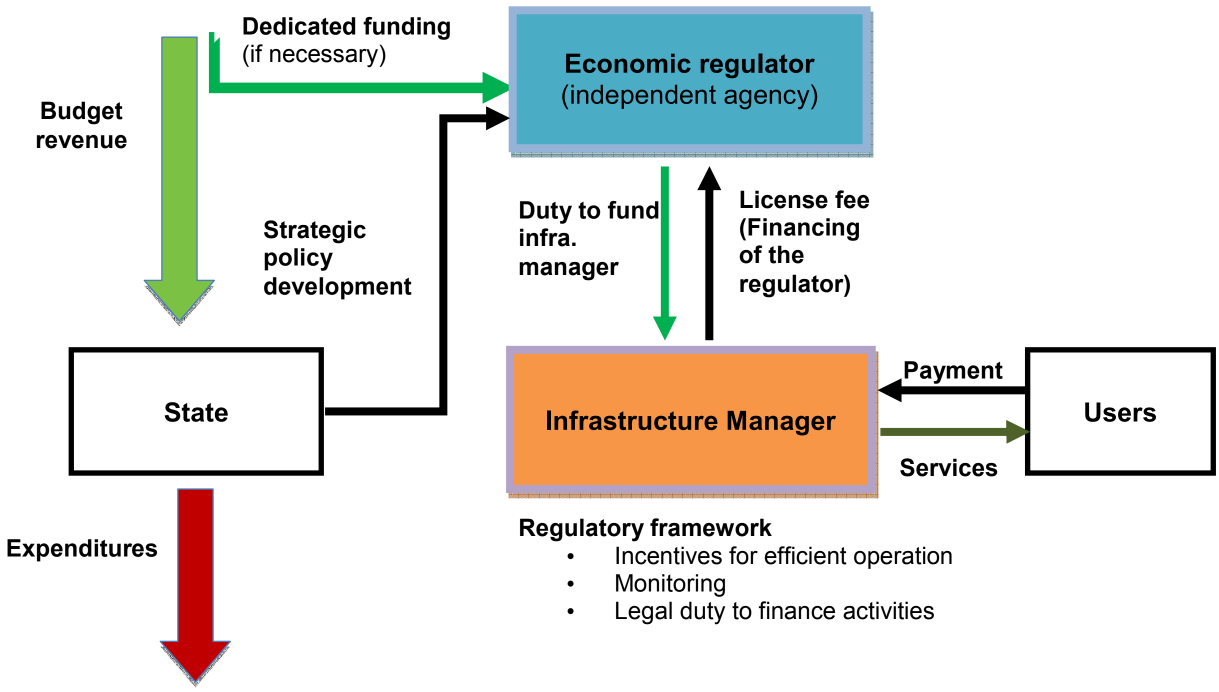
7 An alternative is physical capital maintenance (maintaining the productive capacity of assets).

maintenance requires that the monetary or market value assets be preserved through time (taking into account price growth over time). Current cost accounting ensures that a realistic replacement value is taken into account in estimating the current value of long-lived infrastructure. Together, the two concepts are applied to guard against hidden expropriation. The regulator must also allow the infrastructure manager to recoup other legitimate costs. Regulated revenue should therefore allow the recovery of:

- New investments into new infrastructure (investments that increase the RAB).
- Depreciation (loss of value of existing assets).
- Operating and maintenance costs (costs of running and preserving the assets).
- Financing cost (the cost of equity and debt, including an appropriate reward or return).

The regulated return to investors is based on the value of RAB (the value of "investment" on which the return is made) and WACC (the combined rate of return on equity and debt), while the operating costs are recouped on a pay-as-you-go basis. In terms of legal execution, the RAB model involves the granting of a license to the infrastructure manager that specifies its rights and obligations. On a basic level, the regulator accepts the duty to fund the infrastructure manager (directly or through user charges), provided the latter delivers the services agreed. An example of the model is presented in the figure below.

Figure 1. An Regulatory Asset Base structure example



Source: Authors.

The RAB is a concept that can be embedded in different regulatory frameworks, with more or less powerful incentive regimes. The incentive regimes are the subject of a vast theoretical and empirical literature covering generic as well as sector specific contributions issues. Joskow (2008) provides a good overview of the economic theory principles behind incentive regulation. These principles have been embodied in different regulatory traditions in different geographical locations (e.g. in Australia, continental Europe, UK, US).

We next compare the implications of the RAB model with the traditional model in terms of delivery and operations.

Infrastructure delivery using the RAB model

The RAB approach generally allows all capital expenditure to be recovered (Frontier Economics 2010). This might suggest there are challenges to the efficiency of the RAB model of infrastructure delivery with respect to getting the investment quality and delivery right. The next subsections explore the evidence.

Quality and delivery approach

Under incentive based regulation, the investment plans (and the revenue required to finance those investments) are negotiated between the regulator and the network manager. (Alternatively, the investment plans can be seen as the result of an iterative game between the regulated company's idea and the regulators perception of the actual needs). In any case, it is the information asymmetries between the two parties that make it very difficult for the regulator to establish with any precision the amount of investment needed to deliver a given output.

This arrangement can result in "capex bias" where the regulated infrastructure manager prefers a capital expenditure solution to an operating expenditure one[8]. This is because the regulated entity gains more financially from pursuing capex solutions (where it is able to earn a rate of return) than opex ones (where it recoups only the original expenditure). The bias can also result from the opex regulation (benchmarking) regime being perceived as "tougher" than the capex regulation regime. This problem has been identified by the stakeholders in the regulatory process (including the regulated companies themselves (OfWatt 2011)). However, to date, no empirical evidence has been found to support the claim[9].

The perception of a capex bias has prompted regulators to consider adjustments to regulation frameworks. For instance, the UK has considered "totex" regulation, where the capex and opex are targeted as single category, as well as 11 other options (OfWat 2011, 46). However, it is not clear whether the incentive of capex bias can be fully removed.

The RAB model is likely to deliver superior life-cycle investments compared with the traditional model. In the RAB model with incentive based regulation, design, construction, and operation are

8 For example, investing in a campaign to raise the awareness of consumers with regard to water pollution instead of building a new water treatment plant. The former would be recorded as operating expenditure and the later as capital expenditure.

9 The concept is similar to the commonly known Averch-Johnson-Welisz effect, which suggested an incentive to invest excessively in the capital assets as well. Its primary proposition states, that if a regulated firm is required to choose an output price to earn no more than an allowed rate of return, based on the level of installed capital, the firm will choose a capital-labour ratio which is higher at a given output level, than it would have been the case without regulation. However, a recent review of found there is no or very little evidence to support its existence either (Law 2014). If these results are accepted and one also accepts that a capex overspending incentive nevertheless exists, then a potential explanation would be that there must be other incentives present, which offset the capex bias.

bundled, so gains from building high quality infrastructure upfront would accrue to the regulated company itself.[10]

Delivery efficiency

The procurement of new or improved infrastructure in the context of regulated network industries is normally subject to general competition legislation. In practice, traditional procurement models (the Design-Bid-Build contracts) or more advanced approaches, such as performance contracting or alliancing may be employed. Current procurement practices and approaches of regulated companies in network industries are not extensively surveyed in the literature. However, NERA (2004) reports most utility companies in the past in the UK relied on subcontracting and/or in-house provision.

A central part of the economic regulation framework is ensuring that network manager's capital works are delivered at efficient costs. To target capital cost efficiency, regulators employ targets that mean the regulated company earns rewards for meeting/undershooting the investment target at a given level of output, or is penalised for missing the target.[11] To assess the efficiency of expenditure, regulators have at their disposal a number of tools, from benchmarking analysis, historical trends, to cost modelling techniques, among others. Full scrutiny of the capital spending (e.g. detailed engineering audit on most projects) is generally not applied, due to the regulatory burden it would imply, but regulators do track asset quality measures.

The regulator's oversight of capital cost efficiency has its limitations. For instance, regulators are never able to determine what part of any cost overruns, measured against the contract price or compared to earlier estimates, was efficient or justified. Costs for benchmark projects can vary substantially. To illustrate, Bain (2010) notes that for the road sector notes that outturn costs for resurfacing a dual 3-lane motorway by the British Highway Agency varied from £0.24 million to £0.70 million per km. Thus, while the instruments mentioned above are helpful, they nevertheless cannot completely address the information asymmetry between the regulator and the regulated company.

Moreover, the risk of capital spending being adjudged to be excluded from the RAB might be perceived as a disincentive to investment from the private owners. It would therefore not be surprising if a strong safety margin were applied to the regulator's efficiency targets (in the past a pass-through model was in place in the UK, where all capex cost was included in the RAB; NERA 2004). This erring on the side of cost inclusion provides further potential arguments against the cost efficiency achievable under the RAB model.

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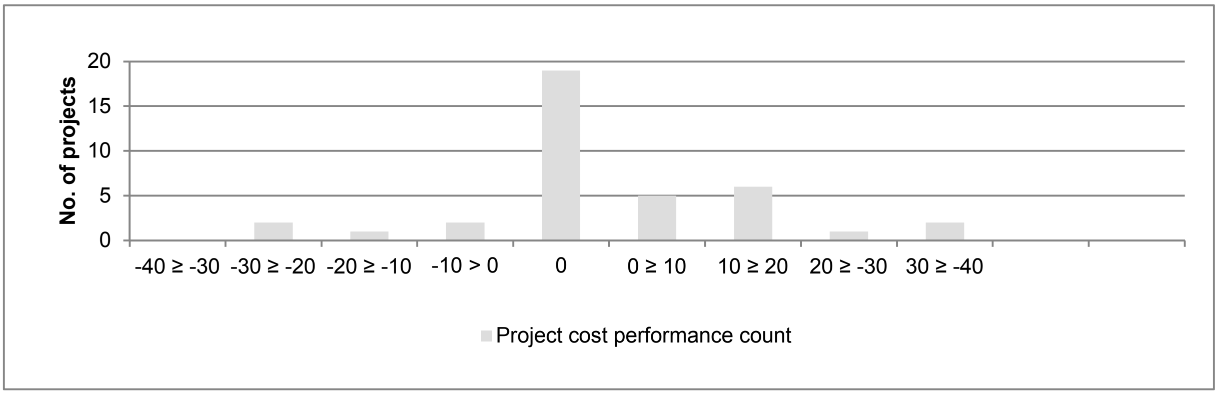
10 Some potential caveats to this finding are: 1) that the interest of current investors might also be of short duration; 2) buyers of existing assets might have difficulty assessing the quality of past investments and their influence on future operating cost; and 3) the regulator should not set the capex efficiency (savings) target too low, or else the regulated company would invest insufficiently in the infrastructure and substitute the meeting of current regulatory capex targets (avoiding the penalties) for lack of operational efficiency in the future.

11 Menus of options may be applied. For example the regulated company may choose between a higher capex allowance with lower retention rate and a lower capex allowances with higher retention rates. In effect, companies, that believe they will have higher capex requirements that the regulator forecasted, can choose a higher capex allowance, but the penalty for overspending above the allowance – i.e. overshooting the target will be higher.

Unfortunately, the paucity of publicly available data[12] limits our ability to assess the extent to which the argued limitations of the RAB model actually inhibit infrastructure investment delivery performance in regulated industries. A rare example for the regulated sector is the study of Sovacool et al. (2014), which provides some data for the electricity transmission sector in terms of on time and on budget delivery (Figure 2)[13]. They found cost overruns reported on 40% of the 40 surveyed projects, which gives an average systematic cost overrun of 2.2%, or a total impact of USD 162 million, against the estimated spend of USD 4.174 million.[14] The performance of the RAB in this context compares favourably with findings in the transport sector under traditional procurement, where the average overruns were 9% (Blanc-Brude & Makovsek 2013).

Figure 2. Cost overruns in electricity transmission projects in the USA in 2013



Source: Sovacool *et al.,* 2014.

Infrastructure operation under the RAB model

Operational efficiency under incentive based regulation is generally considered to be superior to state owned companies without regulation. Privatisation under regulation can still further lead to efficiency improvements. However, challenges can arise in translating cost savings into improved social welfare and in adapting infrastructure to changing market conditions.

Operational efficiency

Under the RAB incentive regulation framework, the approach towards operational expenditure efficiency incentives is similar to those for capex expenditures (setting of targets, with penalties or rewards for meeting them) but more straightforward.

12 The lack of data is perhaps surprising given there should not be any business confidentiality considerations, public money is implicitly involved, and the depth of the literature on traditional public procurement (see section 2).

13 We note that the data set involves measuring a cost overrun against the budget as opposed to measuring against the procurement contract. In terms of construction risk, what is more relevant is the cost overrun, measured against the winning bid, which is a strongly related but different measure.

14 If the penalty for missing the capex target were very strong and the regulated company would incur a significant cost overrun on some projects, it could attempt to reduce spending on the others, in spite of possible life cycle costing inefficiencies in the future, to avoid being penalised immediately.

In the UK and elsewhere, the RAB is embedded in an RPI-X price cap regulation. The “X” reflects a measure of inefficiency, which the regulator determines and applies on the annual allowed price growth (RPI). The inefficiency adjustment is reset in regular price review periods, which typically last five years or more. This adjustment for inefficiency also introduces a risk that the regulated company will not be able to recover its full operating costs if it does not perform its function efficiently.

The determination of the X-factor for opex is in principle subject to the same caveat as incentivising the efficiency of capex (i.e. a safety margin in setting targets), though the consequences of inadequate incentives are more immediate and obvious than in the case of capex (e.g. a drop in service quality or eroded financial results of the company). For the same reason the information asymmetry challenges in this case are potentially smaller.

Operational efficiency is related to ownership, and there is a substantial volume of literature available on the effects or privatisation, which focuses predominantly on performance of utilities (electricity distribution, water supply and sanitation), and less on transport. Gassner *et al.* (2009) provide a literature review for industrialised and developing countries, which shows increases in efficiency, work reduction and other measures of better performance. Under what circumstances these improvements translate into better social welfare outcomes is not fully resolved, particularly for developing and post-transition economies (Estache and Rossi 2002; Andres et al 2006; Andres et al 2013).

The question of better social welfare outcomes, however, may be critically related to having a proper regulatory regime in place. More recent studies, such as Estache and Rossi (2010) explored a representative sample of 220 electric utilities from 51 development and transition countries and showed that the establishment of a regulatory agency did contribute to the increases of efficiency (and hence social welfare outcomes) and was robust to the effects of firm ownership. In addition, the performance of private regulated companies was superior to the performance of state owned regulated companies.

In the specific context of the RAB in an incentive based regulation framework, Parker (2004) notes that regulation and privatisation in the UK, led to increased efficiency and reduced customer prices as shown in the table below, with two controversial exceptions: the water and rail sectors.[15]

15 In the water sector the regulatory system was considered lax until 1999. After 1999 many regulatory changes took place that led to a significant increase in the efficiency of water supply companies (Erbetta and Cave 2007). Certain water supply firms faced financial exhaustion, in part due to inappropriate regulation (Helm 2008). In the railway sector the results are also unclear. A study of a railway infrastructure manager Railtrack painted a mostly positive picture of the system’s efficiency up until the period between 1999 and 2001, when three railway accidents happened (Pollitt and Smith 2002). Later research seemed to show that, statistically, the safety standards did not decrease as a result of privatisation (Evans 2007). However, in reality there was no RAB, an insufficient overview over the condition of the assets, and inadequate management within Railtrack, which prompted the railway regulator to write an almost a thousand page report on deficiencies with recommendations, just before the accidents. The government called for a strong tightening of safety, imposing huge financial burdens on the company which led to its bankruptcy and return to de facto state ownership.

Table 1. Employment in price changes in Great Britain network industries around privatisation

Industry	AT privatisation Number of employees, (year)	AFTER privatisation Number of employees, (year)	Change in user prices % real[1] (time of study)
Electric power distribution	127 300 (1990/1991)	66 000 (1996/1997)	-25 to -34% (1990-1999)[2]
Telecommunications (British Telecom)	238 000 (1979/1980)	124 700 (1999)	-48% (1984-1999)[3]
Gas distribution	92 000 (1986)	70 000 (1994)	-26% (1986-1997)[4]

Notes: (1) The figure is relative to the general price level, meaning the nominal drop was even greater.
(2) Measured in England and Wales.
(3) The decrease can also be attributed to technological progress and, indirectly, an increase in competition as a result of privatisation.
(4) In the original text, "2.6% per year," which would amount to 26.6% in 11 years; rounded down.

Source: Parker, 2004.

The evidence regarding privatisation of regulated network industries is not as clear cut as in the case of competitive markets in the overview of studies in Meginson and Netter (2001). But the studies that are available suggest that privatisation on a platform of effective regulation can have superior social welfare outcomes when compared to state-owned enterprises.

Operational flexibility

An element of the RAB model that is implicit in the traditional model is the flexibility of the contractual framework to negotiated changes. The RAB model under price cap regulation essentially represents a regulatory contract in the form of a licence – with a string of renegotiations (price reviews).

A former chairman of the UK rail regulator, Chris Bolt argued that in terms of practical legal execution, a licence allows for greater possibilities for modification than a formal contract (Bolt 2007, 19). In practice there is a possibility for the regulator to refer a case to the Competition Commission if changes to the licence cannot be agreed. An essential part of the apparent adequacy of the process is that it is clearly defined what is repaid and what is put at risk and in principle and the organisations involved are independent from the government. The credibility of this process depends on the government's capacity to respect their independence.

Other value for money considerations for the RAB model

The financing cost at which the infrastructure manager can borrow money is suggested as one of the advantages of this approach. On the other hand the returns or the reward of the investors has faced much scrutiny and has attracted considerable academic and consulting attention.

Cost of debt financing

The cost of debt financing under the RAB model appears to be higher than under the traditional model, though not substantially. For instance, in the UK regulated utilities incur costs of debt financing only slightly above the cost of government bonds. Recent estimates put this cost at around

1 percentage point above 10 year government bonds (see Box 5.1 in the next section). The low cost of financing also implies that credibility (or indeed predictability) of contracts between governments and the infrastructure managers is relatively good in the UK[16].

When the RAB is an effective commitment device, renegotiations of regulatory contracts seem not to have immediately obvious adverse effects (such as the ex-post higher costs of finance, which would signal some kind of expropriation).

Estimating the appropriate returns to capital

Another central tenet of the RAB model is application of an appropriate overall rate of return on capital that the network manager is allowed to make, i.e. the weighted average cost of capital (WACC). This part of the regulatory process is also typically negotiated between the network manager and regulator, with estimates made by the regulator typically covering a range of values.

The importance of "getting the WACC right" lies in the incentives that come with this number. If the regulatory allowed rate of return is greater than the company's true cost of capital, then the firm will substitute capital for the other factor of production and vice versa.

Regulators in the UK and Australia, for example, acknowledge their inability to accurately estimate this parameter, and in practice tend to err on the upside and apply WACC values substantially above the midpoint estimate of the range (Frontier Economics 2014). The reason for this is that the social welfare cost of underestimation of this parameter is argued to be greater than the overestimation, as applying a WACC that is too low could lead to underinvestment (Dobbs 2011). The recent UK experience gives some evidence of this bias in practice: for the Bristol Water determination, a range of 3.8% to 5.0% was estimated, and 5.0% was adopted; for water networks in England and Wales, the range was 2.9% to 5.4%, with 4.3% adopted; for Stansted Airport, the range was 5.2% to 7.5%, with 7.1% adopted (Frontier Economics 2014).

An alternative solution to the risks of underinvestment from underestimating the WACC is to apply a two-tiered WACC ("the split cost of capital") (Helm 2008, 2009). This approach recognises that different components of investment (capex that is already there versus new capex) may have materially different risks[17]. Separate returns for the existing RAB and for major new capital projects could lead to a more efficient allocation of risks among investors, customers, and tax payers (e.g. a higher WACC for new investment). The concept is not without challenges (QCA 2014; Cooper 2012; NERA 2013), but some regulators are investigating whether it is possible to make use of it in more accurately determining the single WACC (which implicitly blends the risks related to existing RAB and new infrastructure projects).

16 Compare this with the example of the French gas industry: "in September 2012, the French government announced that retail gas prices to individuals and small businesses would rise by 2%, even though CRE, the French energy regulator had stressed in the Journal Officiel that the increase was insufficient and the increase to individuals to ensure cost recovery should have been 6.1%. GdF-Suez may have a RAB, but it clearly did not act as an effective commitment device in this case" (Stern 2013).

17 Helm (2008, 2009) has also argued that a single WACC potentially over compensates investors for the risks associated with the RAB. Due to the way the WACC is estimated by some regulators, it can create room for arbitrage. In the past this enabled owners of the infrastructure companies to extract value from the companies, by increasing the gearing of the company through financial engineering. The actual returns were thus (for a time) over and above the "allowed" revenue. This was not an insurmountable regulatory problem; however, its current status is outside the scope of this paper.

At present it is not immediately clear what the net effect of the incentives outlined above is for capital expenditure, i.e. whether there is a bias for too high or too low investment, nor is there any empirical evidence available to support either view.

The Public-Private Partnership model

The previous section illustrated the workings of an approach where a monopoly infrastructure provider faces incentives from an economic regulator, which mimics competition. Improvements of operational efficiency, compared to the traditional model are well established. The outcomes of incentives in capital expenditure efficiency are however less clear. The Public-Private Partnership (PPP) model has a higher cost of financing and aims to achieve efficiency improvements through competition for the contract. This section reviews the workings and evidence on the efficiency performance of the Public-Private Partnership (PPP) model for infrastructure delivery and operation.

Overview of the PPP model

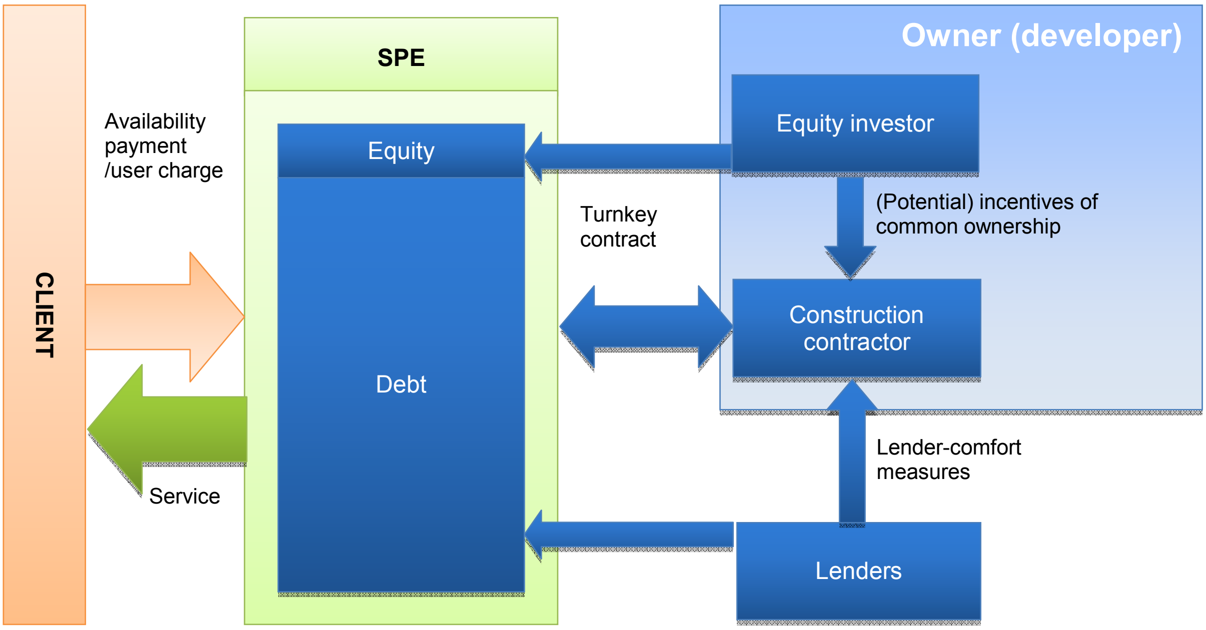
PPPs involve the financing of long-term infrastructure, industrial projects and public services using a financial structure where project-specific debt and equity are paid back from the cash flow generated by the project. PPPs can cover a wide range of other arrangements, including management infrastructure concessions, though our paper covers only infrastructure project delivery and subsequent infrastructure operation in network industries.

The essential feature of the PPP is the creation of a project company – a Special Purpose Entity (SPE). The SPE enters a long-term contract with the procuring entity to deliver and operate the infrastructure. We focus here on the specific case where the SPE is a private company. The project company is almost exclusively financed with debt, with equity of the shareholders representing a minor part (commonly around 10%). The shareholders may include financial investors and also firms involved in project delivery and operation, as in the example in figure 3 below.

The main features that distinguish PPPs for infrastructure project delivery and operation from traditional infrastructure procurement can be summarised as:

- Service focus: the public-private agreement defines an output specification, i.e. what service the project is meant to deliver, as opposed to what the project is (the input). PPPs commit the public sector to pay the SPE a pre-agreed income, provided the required service delivery and quality criteria are met. Alternatively the public sector can commit by granting the SPE the right to collect revenues from the use of infrastructure .
- Bundling: all procurement phases from design to operations are bundled in one long-term contract (e.g. the Design Build Finance Maintain Operate contract), which reduces the public sector's coordination role.
- Risk transfer: lenders typically require a fixed-price and date-certain turnkey construction contract. The public sector therefore effectively transfers the majority of the risks to the construction contractor.

Figure 3. An example of a PPP model for infrastructure delivery and operation



Source: Authors.

Governments have pursued the expected competition and efficiency incentives that flow from these main features of PPPs. The expectations above are also in line with the theoretical models (e.g. Iossa and Matrimort 2012). The remainder of this section assesses whether the expected advantages have been observed in practice and whether any weaknesses have emerged.

Infrastructure delivery using the PPP model

A central challenge in assessing the performance of the PPP model is the bundled nature of the overall contract. This makes it difficult to compare the single price (or stream of cash flows) paid under a PPP contract with the costs of a series of unbundled contracts (and on-going operating performance) under the traditional model. Limited accessibility of data (in traditional or PPP procurement) further hampers the comparison. The remainder of this section considers the available evidence.

Quality and delivery approach

Blanc-Brude *et al.* (2006) found that for 227 road projects in the EU, the ex-ante construction cost of PPP-contracted roads were substantially above the cost of those procured traditionally. Makovšek (2013) showed that the costs for PPP-contracted road projects are actually also substantially above those under traditional procurement, even when cost overruns are accounted for: an indicative 19% cost premium for PPPs was estimated. Daito and Gifford (2014) show, that the same cost premium in the US road projects is 64%.[18]

18 This point is usually ignored in Value for Money assessments, when comparing the cost of the public and the private alternative.

The higher construction cost of PPP-contracted roads compared to traditional procurement could be explained by the PPP partner choosing to invest in higher quality infrastructure. This decision would be efficient if it reduced future maintenance costs and so optimised the lifecycle cost of the project. However, this explanation does not account for the premium in the US being so much greater than in the EU (given that the nature of road construction cannot be substantially different on the two regions). Moreover, there is little evidence to support the notion that PPP companies actually do invest in more expensive infrastructure to optimise life cycle costs (or conversely, that this is systematically not the case in traditional procurement). On a declarative level there is a widespread embrace of life-cycle cost optimisation principles in PPPs in UK (Meng and Harshaw 2013), but there are practical obstacles to its execution[19]. In an ex-post engineering study, the UK National Audit Office found that PPP hospitals were not built to a higher standard than traditionally procured hospitals (NAO 2007) and these would be subject to the same expected incentives as any other PPP.

Therefore, the higher *ex-ante* construction cost under PPP infrastructure contracts is not explainable only by higher quality infrastructure that might be predicted from incentives for life-cycle cost optimisation. We return to this issue in section below.

Delivery efficiency

Once a contract has been signed between the government and the SPE, PPPs have generally been found to outperform traditional procurement models for *on-time* performance in Great Britain (NAO 2003; NAO 2009) and Australia (Allen Consulting Group et al. 2007).

Relatively few studies have directly examined the *on-budget* construction cost performance of PPPs. One study reports an average performance of on-budget delivery of a 4.3% overrun measured against the "contractual commitment" estimate (Duffield et al. 2008). But this in itself is not surprising, since the public sector still predominantly relies on "low powered" cost-plus contracts, while the PPP model relies on (fixed date, fixed cost) turn-key contracts. That cost-plus contracts with few incentives to reduce cost will be outperformed by turn-key contracts is consistent with economic theory (Laffont and Tirole 1993).

There is no large volume of traditionally financed infrastructure procured through turn-key contracts, so as to compare the PPP performance with the public sector procurement on a level playing field. There is evidence that the cost performance of the traditionally financed Design & Build contract (where the two phases are bundled) can display superior performance in terms of on budget delivery (whereby the DB contract form still involves less powerful incentives than the turn-key form), when compared to separate traditional DBB contracts (Ellis et al. 2007).

19 The study inferred the critical success factors from a survey with 52 responses (1) contractual obligation and client driven optimisation; (2) good awareness and understanding of LLC; (3) encouragement of LLC through competitive bidding; (4) integration of all key stakeholders into WLC; (5) early involvement of construction and FM teams in the design process; (6) well-established procedures and methodologies; (7) reliability and accuracy of data; and (8) regular monitoring the implementation of LLC. In the study lack of data and contractual incentives were also often cited as a cause for the failure of the LCC

Infrastructure operation under the PPP model

The PPP model is argued to deliver cost and quality advantages the traditional model during operation through competition between bids before the start of the project.

Operational efficiency

For most infrastructure PPPs, prices are locked in with the contractual arrangement that was sealed, when the winning bidder was selected. Other than through the initial competitive process, there is no in-depth scrutiny of the operating costs of the PPP.[20]

There is no research available that assesses the operational performance of PPP infrastructure projects against a privatised regulated network industry operator or a state owned operator. But because the private partner is profit driven, it is reasonable to assume that these projects are operationally efficient.

The relevant question is whether this efficiency is necessarily passed to the users, i.e. whether superior social-welfare outcomes are achieved relative to government operation. This question will be unresolved until a sufficient number of PPP projects run their course and an *ex-post* analysis of their life-cycle cost (and benefits) will be possible.

In principle, an availability payment PPP model (where SPE revenue from the government is subject only to meeting service availability and quality measures) is very similar to incentive regulation (where the regulated company's revenue from users is subject to meeting the targets of efficiency and service quality). However, a weakness of PPPs compared to the RAB approach is the lack of tools for the public sector to share gains from efficiency savings during the operational phase of the project.

Operational flexibility

Long-term contracts are by their nature incomplete. Thus renegotiations may be an inherent component of any long-term contract, including PPPs. In infrastructure PPPs, renegotiations have been found to be widespread (Makovšek *et al.* 2015).

Economists have not reached a consensus on the net impact of contract renegotiations in PPPs on value for money. The literature can be broadly split into two main positions. In one, the renegotiations are viewed as having a negative impact by reducing the *ex-ante* efficiency gains from the bidding process. Guasch (2004) reports that the majority of PPP contracts in developing nations (managed by the World Bank) had been renegotiated within two years of the contract signing, predominantly to the benefit of the private partner. Conversely, opportunistic behaviour by the public party is also possible, which induces the risk of expropriation and increases the cost (due to the risk premium for expropriation) for future projects. The second position is that renegotiations are a helpful mechanism to respond to a changing environment under incomplete contracts (Saussier, 2014). It is impossible to foresee every eventuality over the next 20 years, so having this flexibility is valuable particularly if it

20 By contrast, some UK PFI contracts include a mechanism that gives the public and private participants the opportunity after five or so years to renegotiate the prices of services relative to observed market rates (NAO 2007). This approach is typically only applied to services that can be expressed in simple terms, such as cleaning or catering. Core services, such as infrastructure maintenance in network industries, are more complex and cannot be simply "market tested".

does not weaken the ex-ante commitment of the bidders or influence the future expectations of investors.

A recent review of the causes and incidence of renegotiations around the world (Makovšek *et al.* 2015) found that renegotiations are not limited to countries with weaker institutional structures. Predominantly, renegotiations result from the strategic behaviour of the public or the private contractual partner or both. Governments have considered and put in place a number of measures to address renegotiations that undermine the economic purpose of the PPP. Some measures involve the distancing of the PPP contract management from the government and the introduction of an independent PPP regulator, which could deal with contract renegotiations in a transparent and systematic manner. However, in a country with a large PPP portfolio the diversity of contracts and contracted entities in a given country are likely to make the information, skill requirements and costs of a PPP regulator prohibitive.

Part of the problem of renegotiations is that public authorities have tended to prefer overly detailed and prescriptive contracts to attempt to reduce the potential consequences of unexpected events or behaviour of contractual parties (House of Commons 2012). Nevertheless, some PPP contracts in the UK have proven to be moderately flexible, with some renegotiations being executed NAO (2008). More recently, modest savings have been achieved by the public partner in renegotiated PPP contracts (NAO 2013). However, these savings are normally not the result of changes in core services and do not resolve the challenge of not being able to scrutinise operating costs, as described in the paragraphs above. That being said, contract renegotiations are generally not seen as a problem in the UK to the same extent as elsewhere (Makovšek *et al.* 2015).

Renegotiations of a PPP contract are invariably less structured than in a RAB model, primarily because there is no economic regulator directing the process. Contract adjustments may be perceived by the investors as an additional risk to be accounted for in future bid prices. As such, the possibility of renegotiations can affect the cost of financing, depending on the ex-ante bargaining power of the investors, and the derived expectation that the contract will be upheld, renegotiated to their benefit or loss.

Other value for money considerations for the PPP model

Cost of debt financing

Debt makes up the large majority of the financing of most infrastructure PPPs (Yescombe 2014). The financing cost of PPPs in UK is substantially above the cost of the government debt and the companies operating under the RAB model. Although estimates vary, an 8.5% cost of PPP financing was illustratively estimated in 2011 by the House of Commons (2011, 16), when the government cost of borrowing in the UK was 4%. Before the financial crisis, PPP financing was estimated at 2.4 percentage points above government costs (PWC & Franks, 2002). These estimates are relevant for UK PFI models, which do not involve demand risk. Where demand risk was included, the additional financing cost would be substantially higher.

Box 1 uses recent market data to compare the cost of finance across three infrastructure delivery and operating models.

Box 1. Cost of financing in RAB and a PPP

To give a sense of magnitude, a regulated utility in the UK would typically have a rating of A and PPPs are typically structured to achieve BB+ or BBB- (EIB 2012) or BBB (Yescombe 2014) on the Standard & Poor's rating scale. Damodaran (www.stern.nyu.edu/~adamodar/pc/ratings.xls; accessed 7 May 2014) suggests A rated debt attracts a spread above a 10 year government bond of 1.00% points. In comparison, a BB+ rating would require a spread of 2.75% points and a BBB rating 1.75% points. Experience suggests that PPPs only achieve an A rating 10 years after financial close (Moody's 2014).

Risk and return considerations for bidders

The PPP derives its efficiency in construction and operations through the competition for the contract. However, the transfer of risk can be expected to decrease the number of potential bidders for the construction and delivery of a given project. Lenders require strong insurance against construction risks taken on by the SPE/construction contractor. These lender comfort measures include liquidated damages for delay and performance, a full completion guarantee, and retainage.

Big projects and large risk transfers can only be accommodated by firms that can manage them (Blanc-Brude 2013). Evidence from 86 PPPs in the UK suggested that on average there were three bidders for each contract, and in a quarter of the sample, there were fewer than three bidders (Zitron 2006). This relatively low number suggests that the risk transfer and/or contracting complexity may limit the number of bidders participating in PPP processes.

PPP bidders essentially compete over the pricing of the risks to be accepted through the contract (as well as construction costs and techniques). To the extent that bidders do not have perfect information on what is involved in the construction of the project or what will happen in the next 20 or more years of its operation, bids will include a risk (aversion) premium. Competition among bidders is supposed to reduce this risk adjustment to an efficient level. However, some recent research suggests this is not necessarily the case.

High ex-post returns to PPPs, as well as the high *ex-ante* construction costs observed, provide evidence against the argued efficiency of PPPs in terms of risk pricing. The UK NAO (2012) showed that expected blended equity IRRs[21] are substantially above those agreed at financial close in two-thirds of the 118 surveyed PFI contracts. Vecchi *et al.* (2013) showed a similar finding for PFI hospitals in the UK, where on average the blended equity IRR was 9.3% points (with min 4.5% and max 17.4%) above the average financing cost for these kinds of projects (i.e. the WACC). They suggest that the main reasons for the higher ex-post IRR is the use of cover rates[22] and lack of competition in the bidding phase.

21 The equity stakes plus the subordinated portion of debt in the SPE end up in each sponsor's balance sheet. The remuneration for these investments is represented by the blended IRR of the SPE. Since sponsors must assess whether or not the project will increase the wealth of their shareholders, they will compare the blended equity IRR with their respective WACC (in simplified terms, WACC is an opportunity cost for an investor for a given type of project/industry). If this difference is positive, the project is economically attractive for each of the sponsors (Vecchi et al 2013, 248), with the expected earnings above average.

22 Cover rates refer to internal corporate hurdle rates, which are higher than those that would be derived from capital benchmarks and are reflective of the company's (manager's) risk aversion and investment policy.

This “excess return” made by SPEs in PPPs compared to a traditional model could reflect the construction risks borne by the construction company, the risks borne by the SPE during the operational phase of the project over several decades, or both. A further challenge is establishing whether these excess returns to SPEs are reflective of additional risks borne (i.e. a “fair” risk premium) or whether they reflect supernormal returns. The supernormal returns could be due to a lack of bidder competition and/or alternatively due to bidders attempting to price unquantifiable risk (uncertainty) inherent in the structure of the PPP contract.

Discussion

The RAB and the PPP models both employ a contractual structure that helps resolve the time-inconsistency problem with regard to infrastructure investment. A potential weakness of the RAB based approach is the difficulty in establishing proper benchmarks and incentives for an efficient delivery of infrastructure. There is also a need for an economic regulator. The challenge of the PPP model is that it faces fewer incentives to deliver efficient social welfare outcomes and is potentially less flexible during the operational phase. In addition, PPPs have a much higher cost of finance than the RAB.

Overall the basic concern with regard to RAB in this paper is that the approach might lead to excessive capital expenditures, thus slowly increasing the base on which the return is being calculated. In the case of the PPP, the complexity of the projects and the long-period of contractual commitment and uncertainty mean that it is doubtful whether competition will deliver efficient and low cost investments. Put differently, in the case of the PPP, the basic concern is the required returns, and potentially the base.

Currently available evidence seems to suggest that the concern relating to the PPP returns and capex risk premiums by the construction companies are of a much greater magnitude than the perceived capex bias in the case of the RAB model. This capex premium in a PPP arises due to risk aversion and transfer of construction risk through fixed price/date contracts. If a regulated company were to use the same contracting approach, the same capex premium would be expected (for the transferred construction risk).

The capex bias in the RAB model results from the regulated company trying to construct assets to a quality standard above that suggested by life-cycle costing optimisation or with cost overruns. The role of the economic regulator is to attempt to curtail such excesses. An additional function of the regulator in the RAB model is to provide operational efficiency incentives to the infrastructure manager. PPPs lack such operational efficiency incentives during the long lives of the assets, with contractual changes generally only coming at a price to government.

In general, although it is clear in terms of efficiency that both approaches can outperform the traditional model (primarily through the reduction of excessive employment), there is no research available that directly compares the *ex-post* performance of the RAB model against the PPP.

Some researchers have considered how to expand the application of RAB principles in the financing of infrastructure, or how to combine the strengths of the RAB and the PPP models. For example, Helm (2009, 2010, House of Commons, 2011) discusses the idea of “RAB finance”, where the SPE would build the project, i.e. the construction phase would be delivered as a PPP, and at completion the regulator would decide which part of the cost is “efficient” and accept the asset into the RAB. This would enable the refinancing of the construction phase loan with the (much lower) required return on the RAB.

Under such a model, one way to help start the construction and execute the refinancing would be through the establishment of a national infrastructure bank[23] that would channel the funds from

23 The bank’s role would be to match savings (largely pension and life funds) with investments in infrastructure projects such as those currently included in the PPP (PFI) contracts. The bank would

institutional investors. This logic could actually extend to a range of projects or a network, which would allow cross subsidisation across projects, and regulation during their operation, but that is actually rephrasing what the RAB model already is. A (regulated) company is a multitude of projects, running simultaneously, cross-subsidising each other and diversifying risk internally.

Suggestions made to date primarily focus on the RAB as a vehicle to lower the cost of financing, and do not go into greater detail with regard to incentives in either approach. A slightly adjusted approach, could introduce the efficiency of infrastructure delivery from PPP into the regulated RAB, without losing the efficiency incentives during operation.

Project RAB finance

It was noted in previous sections that in the infrastructure delivery phase within a PPP framework one of the key determinants of good delivery performance is that the construction risk is fully transferred via the fixed price/fixed date contract:

- There are multiple lender protection measures overlapping with ownership (money at risk) incentives.
- The due diligence of lenders potentially has a beneficial effect on the quality of project delivery and management (but there is no empirical evidence to support the necessity of this aspect in light of other incentives for delivery efficiency).

Both characteristics of the two points above would be met if existing regulated companies themselves established an SPE for the delivery of a large new project. It would then be financed by:

- a majority of equity from the regulated utility, raised through corporate finance channels (e.g. through corporate bonds)
- debt from lenders to ensure the due diligence as in the PPP
- a small participation of the construction contractor in the SPE's equity, the same as it would be the case in the PPP to meet the money at risk criterion (Figure 4).

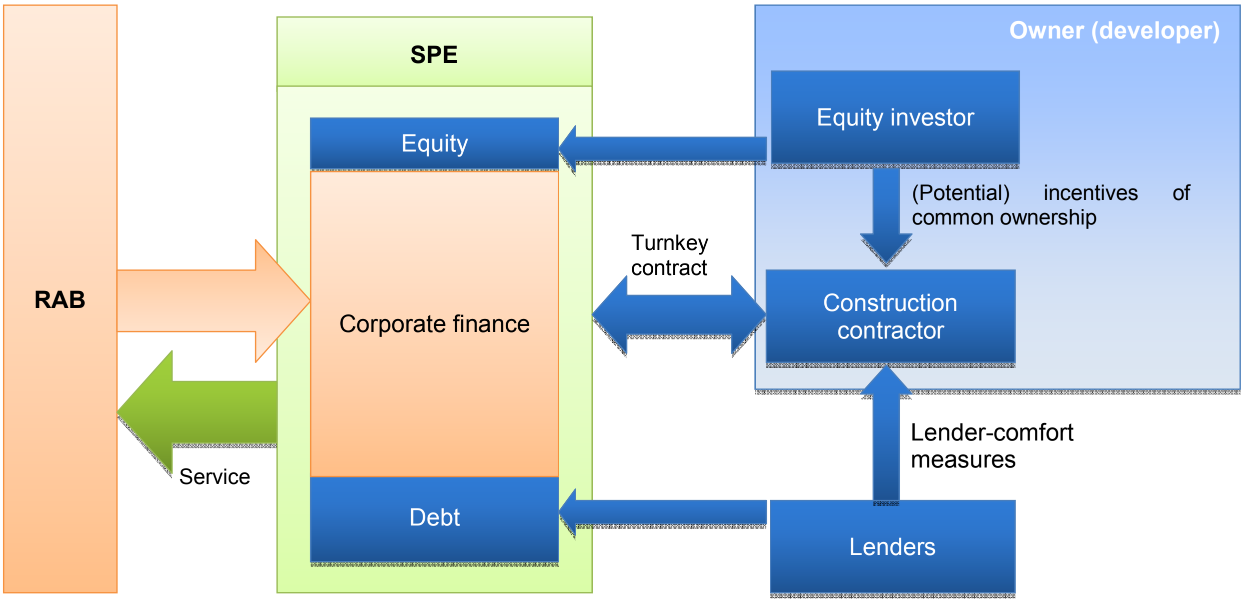
Once the construction phase is finished, the regulated company would buy out other shareholders from the SPE and lenders and merge the assets into its existing RAB. The SPE would in this way become just a temporary vehicle to imitate the incentives from a PPP for the delivery of infrastructure, and would be re assimilated once the infrastructure is delivered.

The efficiency outcomes of such a setup would be easier to observe for the economic regulator, since the responsibility for any potential cost overruns (apart from force majeure) could be clearly and transparently allocated (e.g. scope changes during construction would clearly be the responsibility of the regulated utility).

Under this arrangement, the incentives for asset life cycle optimisation would still be present and the cost of finance would be minimised, due to the corporate financing through the RAB.

"buy" completed projects, put a RAB wrapper around them, and then sell them onto the pension and life funds.

Figure 4. An illustration of the Project RAB finance during construction



Source: Authors.

The structure above assumes a replication of the PPP incentive structure during the construction phase. It is an open question, if this is actually necessary. As noted above and in our review, the efficiency incentives for the construction contractor are many and overlap. Potentially, a similar risk transfer to the construction contractor and the use of fixed price/fixed date contract, with an arrangement, where his money would be at risk (e.g. like retainage) could possibly be achieved without the SPE, with a construction performance contract only. In that way transaction cost would be further reduced.

Summary

The main findings of the overview of concepts and empirical literature are summarised below.

Table 1. Characteristics of alternative infrastructure delivery and operation models

Analysis element	Financing/management models compared		
	RAB (Incentive based regulation)	PPP	Project RAB finance (Incentive based regulation)
Project delivery			
Quality and delivery approach	Challenged regulated company has strong incentive to consider future cost of operation risk of capex bias	Adequate SPE has a strong incentive to consider the future cost of operation	Challenged (same as RAB)
Delivery efficiency	Challenged rough target to be achieved in terms of on budget/time delivery some part of cost overruns passed on to the user	Adequate incentive present – if risk in project delivery is not efficiently managed, serious cost overrun /delay reduces SPE profit (may become unviable)	Adequate (same as PPP)
Project operation			
Operational efficiency	Adequate regulator exerts an efficiency incentive on the regulated company through detailed monitoring and periodic price cap reviews	Challenged no economic regulator means that social welfare outcomes are determined at time of bid, which implies some inefficiency over the long run	Adequate (same as RAB)
Operational flexibility (renegotiations)	Adequate periodic price reviews are a series of contract renegotiations within a clearly defined framework	Challenged contract renegotiations do not occur within a clearly defined framework renegotiations typically involve costs to government	Adequate (same as RAB)
Other value for money considerations			
Cost of debt finance	Low	High	Low
Compensation to equity holders	Challenged limited risk transfer for construction allows for a strong competition; performance contracts and full risk transfer also possible; over-estimated WACC may give equity bias	Challenged returns possibly too high (uncertainty, low competition); full construction risk transfer in conjunction with reduced competition between risk averse contractors leads to higher base cost	Challenged (same as PPP)

The Project RAB finance solution proposed above appears to offer superior incentives to the traditional PPP. No examples of this exact approach have been encountered in practice, though a similar project is currently in development, The Thames Tideway Tunnel[24].

24 The Thames Tideway Tunnel (http://www.thamestidewaytunnel.co.uk/) is a £4.2 billion project in London, addressing a growing problem of tens of millions of tonnes a year of sewage spills into the river. In the project the tunnel would be built as a PPP and placed into a RAB after construction, becoming the subject of the same incentive regulation as the water utility company (Thames Water Utilities Ltd), which will charge for it.

The approach is not without limitations. In the network industries, where the Project RAB finance could generally be regarded as the preferred solution (for example, in utility networks, transport networks and elsewhere), it might not be applicable to projects of all sizes and complexity. The risk insulation in the latter case being the primary reason why project finance is used by private companies.

If the new project is very large in size and subject to considerable risk, then it could adversely impact the investment rating of the company investing in the SPV, which may be unacceptable. This would have probably been the case for The Thames Tideway Tunnel, which at the estimated £4.2 billion represented almost half of the regulated asset base of the utility company that could have sponsored the project.

Conclusion

This has reviewed the empirical literature of two approaches to involving private finance in infrastructure delivery and operation: the RAB (under incentive regulation) and the PPP model. The area of focus is network industries, with some characteristics of natural monopolies, where the demand is beyond the infrastructure manager's control. Both approaches were compared against the traditional model, where the state procures and operates the infrastructure. The distinctive difference between RAB and PPP is that the former derives its efficiency through the competition with the regulator, while the latter does so through the competition for the contract. Our focus was on incentives and efficiency.

Overall the review finds that private participation has a strong ability to deliver value for money beyond that delivered by the traditional model. However, there are concerns with respect to each model.

The RAB is argued to lead to excessive capital expenditures (aimed at slowly inefficiently increasing the asset base on which returns are calculated). The primary challenge is therefore the information asymmetry between regulator and infrastructure owner. While this argument is theoretically sound, the empirical evidence suggests this is either of an insignificant magnitude, or at that regulatory monitoring is effective in curtailing this bias.

PPP contracts that bundle delivery and operations for complex projects over long periods of contractual commitment embed considerable uncertainty for prospective bidders and the government counterpart. While the creation of a "one shot" PPP contract can be seen as a significant advantage for government, it also creates major challenges. The risks and uncertainty transferred to the private sector can limit bidder numbers and raise the cost of finance (and required rate of return) for those who do bid. PPPs also lack frameworks for encouraging operational efficiency or for renegotiation of changes later in the contract's life. Each of these aspects can detract from the value for money for governments that engage in PPPs.

Solving the challenges of the PPP model tends to bring us closer to the RAB model, e.g. establishing a regulator to manage contract renegotiations and benchmarking performance across a range of PPPs. But if a country has a large portfolio of PPPs, this would be expensive to implement. Instead, our findings suggest a relatively simple adjustment of the RAB model that incorporates the advantages of PPPs in infrastructure delivery. This hybrid approach, which we dub "project RAB finance", may offset the vulnerability of the RAB model in the infrastructure delivery phase, while possibly retaining the benefits in the phase of infrastructure management and the low cost of finance of the RAB model.

For most transport modes, the infrastructure assets are already in place (national road, rail networks) so an option may be to put the existing network into a RAB under a newly created infrastructure manager. Performance/risk sharing contracts could then be used to deliver new infrastructure, without project finance.

The conclusions from this analysis must be considered to be tentative. This is because there are major shortfalls in the data available to support detailed analysis of the effectiveness of the various aspects of the different models. A basic question that cannot yet be answered definitively is whether fixed price/fixed date contracts are at all an efficient way of delivering major infrastructure projects:

do the incentives for better management of the construction risk offset the lack of knowledge about the risk, the risk premium and the potential lack of sufficient competition?

At a time when many countries and organisations, including international organisations like the OECD, are promoting and facilitating private sector involvement in infrastructure development, the questions about what form this involvement should take are critical. While we have been able to draw some tentative conclusions, improved data and further research is required to better understand how the preferred balance between the structure of the model, risk allocation, efficiency incentives, cost of finance, and the objectives of the regulator, is influenced by project characteristics.

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