



**Private Investment in
Transport Infrastructure**

Dealing with Uncertainty
in Contracts

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The International Transport Forum

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Foreword

In September 2016, the International Transport Forum (ITF) convened 33 distinguished international experts to form a Working Group “Private Investment in Transport Infrastructure”. The group, which assembled renowned practitioners and academics from areas including private infrastructure finance, incentive regulation, civil engineering, project management and transport policy, was tasked to examine how to mobilise more private capital for transport infrastructure projects by addressing the problem of uncertainty in contracts.

The research effort was designed and managed by Dejan Makovšek of the (ITF) who also wrote this synthesis which presents almost two years’ focused effort by the group. Chaired by Stephen Alchin, Executive Director of Infrastructure Australia, the Working Group brought knowledge from 13 countries to bear on one of the most discussed issues in infrastructure finance and the transport sector specifically. The World Bank and the European Bank for Reconstruction and Development also contributed with their expertise. All Working Group members and participants are listed in Appendix 1.

A series of 17 topical papers complement this report and provide a more in-depth analysis of the issues than is feasible in these pages. Two additional papers were produced as inputs to set the scene for the work of the group. A full list of all Working Group papers is available in Appendix 2.

The Working Group would like to thank the Swedish Transportation Administration (Trafikverket) and SNCF Réseau, France, for their generous funding which allowed the group to address a broader range of topics. The group is also grateful to the Investment Division within the OECD’s Directorate for Financial and Enterprise Affairs for supporting the working group.

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A draft of this report was reviewed at the final meeting of the working group on 8-9 March 2018 in Paris, in which the following members participated: Steve Alchin (Infrastructure Australia, Chair); Heiner Bente (Civity Management Consultants, Germany); Mar Beltran (Standard & Poor’s, Spain), George Chilcott (Department for Transport, United Kingdom); Dan Elliott (Frontier Economics Limited, United Kingdom); Alexander Galetovic (University of the Andes, Chile); Klaus Grewe (Germany/ United Kingdom); Björn Hasselgren (Swedish Transport Administration); Jonathan Kennedy (University College London, United Kingdom); Steve Lomas (Infrastructure and Projects Authority, United Kingdom); Thomas Nielsen (Øresundsbro Konsortiet, Denmark); Aris Pantelias (University College London, United Kingdom); Fernando Penalba (Ministry of Public Works, Spain); Athena Roumboutsos (University of the Aegean, Greece); Kim Smedegaard Andersen (A/S Femern, Denmark); Andrew Smith (University of Leeds, United Kingdom), Jon Stern (City College London, United Kingdom); José Manuel Vassallo (Polytechnic University of Madrid, Spain); Alice Vieillefosse (Directorate-General for Infrastructure, Transport and the Sea, France).

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Executive Summary

Background

This report presents the synthesis of the results of a Working Group convened by the International Transport Forum (ITF) to review current thinking on private investment in transport infrastructure. In particular it examines the ways in which uncertainty affects contracts – in the procurement and management of large infrastructure projects.

Convened in September 2016, the Working Group brought together 33 experts representing 13 countries and two international institutions: The World Bank (WB) and the European Bank for Reconstruction and Development (EBRD). Members of the Working Group comprised renowned practitioners and academics from areas including private infrastructure finance, incentive regulation, civil engineering, project management, transport policy, and other areas.

In addition to this synthesis report, the working group has prepared a series of 17 papers which provide more detailed analyses of specific aspects of the report. Appendix 2 lists the research questions covered in the Working Group Papers, along with the bibliographical information of the titles that address them.

Findings

In most advanced economies the days of monolithic state-owned companies that did everything in-house have passed. The public sector now contracts out most of the work and also uses project companies to manage infrastructure delivery, operation and maintenance. What private investment can achieve should thus be compared with where the public sector is today.

Infrastructure refers to immovable assets. These need to be looked at as distinct from the operations for which they are used. The economic characteristics of infrastructure – high capital expenditure requirements, sunk cost and long lifecycles – make it a less attractive for private investors than investment in operations.

There are many models of private participation in infrastructure projects, but effectively these fall into two main groups. In public-private partnerships (PPPs) competition for the contract drives the efficiency of the project. In the regulatory asset base (RAB) model, monitoring by an economic regulator combined with setting incentives at periodic reviews fulfils this function.

Many views have been put forward with regard to the benefits that private investment could provide for the delivery and management of infrastructure. It could improve cost efficiency, for instance, but it cannot extend government's long-term borrowing constraint. Mobilising private investment cannot close (potential) infrastructure gaps if the underlying problem is funding and not financing. A prerequisite for ensuring sustainable private investment in infrastructure is that it is pursued on the right merits.

Currently, almost all private investment in transport infrastructure occurs through PPPs. These require that investors and suppliers price the risk of the project efficiently, i.e. without making excessive contingencies. The natural response to lack of information about risk or uncertainty is to err on the side of caution and to add large risk premiums. Efforts to establish infrastructure as an asset class seek to counter this by providing more information to investors on the financial performance of (past) projects. For suppliers, however, the problem remains. In a PPP, companies that design, build, maintain and

operate the infrastructure must deliver projects at a fixed price on a fixed date. Yet nobody can know exactly how much the construction or maintenance of a large project will actually cost.

Risk pricing becomes an issue when continuous pressure for efficiency over the life of the contract is absent, i.e. where the efficiency incentives do not extend beyond the initial competition for the contract. This includes all cases where demand for the service facilitated by infrastructure strongly depends on exogenous factors or the project is availability-based (i.e. where private operators are paid periodically if they meet the agreed road quality/service standards) Motorway projects, where demand risk was transferred and availability-based motorways are examples. Conversely, some PPPs can exist in competitive markets and strongly influence demand through their quality/price mix – for instance sea and airports.

Unexpected changes in circumstances not foreseen at contract close also pose a challenge to the PPP model. Systematic renegotiations of PPP contracts may be required over time to provide flexibility. However, the long-term uncertainty inherent in such arrangements can spawn opportunistic behaviour and render renegotiations ineffective. For example, the government may feel the need to change the rules, say because of a fundamental shift in transport technology or in order to address climate change, yet the PPP operator may not be in a hurry to renegotiate. If initially unknowable events affect the bargaining power of the contracting parties over time, either the government or the supplier may find himself in a hold-up situation.

There are partial solutions to risk pricing challenges and potential opportunistic behaviour in PPPs. One way to improve PPPs is to equip suppliers with more information. This implies increased effort in project preparation by the public sector and, by extension, augmented in-house analytical capacity. This would in fact improve procurement performance regardless of the contract format, i.e. in public procurement in general. With regard to the cost-related risk in PPPs, however, no easy answer exists.

The regulatory asset base (RAB) model offers a comprehensive solution to both risk pricing and the need for flexibility over the duration of the project. On the risk pricing side, the regulated company is free to match the infrastructure procurement format to the characteristics of the project. For example, it does not need to subscribe to fixed-cost/fixed-date arrangements as the default option. With regard to flexibility, the legal framework plus the regulator's role, building its capacity over time and collecting performance information provide a much more balanced starting point for renegotiations than in PPPs.

Two commonly cited drawbacks of the RAB model are the challenges of capital expenditure (capex) bias and financial engineering. These can be managed in a transport infrastructure context, however, for transport networks with largely exogenous demands – notably road infrastructure –, the RAB model may be the best long-term strategic option to structure private participation in infrastructure investment. It breaks down the long-term uncertainty into shorter periods, which reduces the risk pricing challenge. Through collecting information about the firm's performance and its renegotiation setup it is better equipped to handle potential hold-up situations than a PPP.

In a broader context, the differentials in the performance of alternative models for infrastructure delivery remain poorly understood. This issue goes beyond the PPP versus traditional procurement question and affects infrastructure contracting in general. Building the right project with the wrong contract design can lead to significantly higher costs than procuring it under a well-conceived framework. Project selection can rely on cost-benefit analysis (CBA). For the procurement phase, no similar tool exists for structured decision support. Collecting better data to improve the understanding of contract performance will be important. First steps in this direction have been made and can form the basis for the development of a Procurement Design Assessment System.

Recommendations

Pursue private investment in infrastructure on the merits of improved efficiency

Empirical evidence shows that private investment can be more efficient, provided that the right institutional and regulatory framework conditions are met. Pursuing it for other reasons, such as keeping the investment off the public balance-sheet, may undermine the primary objective.

Invest more into upfront preparation of projects to reduce inefficient risk pricing by suppliers

Governments should view spending on feasibility studies and project development as an investment for better projects. This includes preparing reliable information to assist all involved on the private side, not only investors. It also implies scenario-based assessment of the impact of long-term events that may bear on the project before the public clients approach the market. Several approaches exist for clients to reduce uncertainty for suppliers through better information. One current good practice is for public clients to prepare an outline design (in a design-and-build contract or a PPP). A fully costed reference design that is detailed in areas where changes are not desired and, less detailed where innovation is one of the examples of how risk pricing by bidders could be improved.

Undertake a comprehensive analysis of how to assist suppliers

Various measures could assist construction contractors to better assess and price construction risk. The same holds in the case of maintenance contractors and other non-financing participants in infrastructure delivery and management. Lack of empirical evidence hampers the analysis of how contract design affects procurement outcomes, and targeted data collection efforts to resolve this issue are essential.

The pursuit of certainty in delivery should be balanced against cost

Treasuries like to see on-time/on-budget delivery, but such performance can come at a disproportionate cost. Of course there will be cases when buying certainty will be justifiable in terms of social welfare. A delay in completing a strategically important transport connection, for example, might entail multiple negative knock-on effects. Buying inefficiently priced certainty for a portfolio of infrastructure projects, however, would be difficult to justify economically. Encouraging broader awareness of the trade-offs between timeliness and cost in governments, industry groups, commentators and the community will help avoid unnecessary costs.

Stimulate innovation through early contractor involvement or alliancing, not public-private partnerships

When public clients face highly complex projects and seek improved technical input, one solution is early contractor involvement. This is a public financing option. The uncertainty of what the eventual cost of that project may be at that early stage does not mix well with the need of private financiers to price the full project risk ex ante.

Avoid transferring demand risk to public-private partnerships if service levels do not strongly impact demand

Transferring exogenous traffic risk for an interurban motorway with little competition for the PPP will only yield a large uncertainty premium. It will not improve project selection and in most current public accounting systems it is not necessary to achieve off balance sheet accounting treatments. Concessions with variable length or availability-based approaches are preferable in these circumstances.

Bundle and cross-fund public-private partnerships to reduce demand risk

In conjunction with risk sharing and variable concession lengths, it may make sense for a public client to transfer demand risk by pooling different PPPs (e.g. tolled roads). This can further reduce the pressures of inefficient risk pricing on a limited group of users and give public authorities additional leverage to use transport pricing not just for cost recovery but to facilitate the efficient use of transport infrastructure.

Adopt the regulatory asset base model where competition is absent or demand not strongly endogenous

The regulatory asset base (RAB) model is an alternative to a PPP for infrastructure projects where demand cannot be managed well or the private operator is not exposed to serious competition. This is a long-term approach to infrastructure investment and management and may take several years to introduce. Motorway networks are a prime candidate. The RAB model does not necessarily rely on user charges for funding. It ensures transparency in terms of full cost recovery and provides efficiency incentives that are normally lacking under public governance.

Introduce a transparent public accounting standard to maximise the value for money of private investment

The International Monetary Fund (IMF) recommends use of the International Public Sector Accounting Standards Board's IPSAS32 standard to determine how public-private partnerships (PPPs) should affect the public balance sheet. This standard improves transparency and will place almost all PPPs on the public balance sheet, including those that transfer demand risk. Neutralising the discussion of whether a project will be included in the public debt or not will give procurement authorities greater leverage in optimising risk and uncertainty sharing between the public and the private side. Public debt considerations at project level and value for money are separate objectives that can be at odds. Focus on the former risks exposing the credibility of private investment to negative reactions from civil society.

Foster competitive markets to achieve cost-effective infrastructure

In policy discussions regarding private investment through PPPs, financing constraints top the agenda. Yet the "competition" for the contract is the first condition for this model to perform. There has been little empirical analysis of the infrastructure contracting market. Our analysis shows that competition in procurement for major infrastructure in the EU, whether via traditional procurement or PPPs, is much less strong than is desirable. Being specific about what should be done would probably require another body of work as large as this one, but acknowledging the extent of the challenge is a start.

Pursue data collection on how contract design affects project outcomes

Better understanding of contract performance is hampered by a lack of relevant data. A useful database would include key characteristics of the procurement approach, of the project itself, and its end cost. This would first allow insight into how construction cost depends on procurement choices. Later, the database could be expanded with maintenance cost to enable a view on life-cycle cost performance and lastly service levels should be included. The International Transport Forum (ITF) has worked with University College London (UCL) to design such a database.

Support the development of an evidence-supported procurement tool

No evidence-supported tool exists that could inform decision makers on the impact of procurement design choices on project outcomes. Research on such a tool is advancing, however, and promising demonstrations have been undertaken. Together, improved databases and an evidence-supported decision tool can pave the way towards a comprehensive Procurement Design Assessment System.

CHAPTER 1

Overview and main messages

Infrastructure is one of the enablers of economic development. Many institutions have noted that present levels of investment in infrastructure are insufficient and put forward their estimates (OECD 2007, 2012; European Commission, 2011; American Society of Civil Engineers, 2013). The Global Infrastructure Outlook produced by the Global Infrastructure Hub (GIH) estimates that spending on infrastructure should increase from the current level of 3.0% to 3.7% of GDP to meet the United Nation's Sustainable Development Goals (SDGs).¹

In the drive for more infrastructure, many governments have turned their attention to private investment. The primary narrative behind this push is that there are huge stocks of private capital available, while public financing capabilities are said to be limited and insufficient. To unlock this potential, policy makers on the international scene have been seeking to engage private financiers alongside multilateral development banks and export credit agencies.

It is not surprising that the focus of governments and intergovernmental organisations has been on resolving the challenges from the viewpoint of investors. On the top of the list is establishing infrastructure as an asset class, as witnessed by the G20's 2018 agenda.² An asset class is essentially a set of investments with similar characteristics and relatively well known risk and return performance on average. It implies that data on past performance is available, which enables investors to assess future similar opportunities.

Uncertainty - the elephant in the room

A defining feature of private investment is a requirement to identify and price the full risks of the project before committing to finance it. A lack of information about risk results in uncertainty to which people are naturally averse. When economic agents do not have enough information about risk, some are too bold and underestimate it, exposing themselves to the "winner's curse" if their bid is successful. Most overestimate risk, however, and set risk premiums higher than they need to be. The winner in this case is the bidder who least overestimates the risk. Less uncertainty leads to more efficient risk pricing.

Without past information the uncertainty for investors increases and with that also their reward and the cost of financing until the level of uncertainty simply becomes unacceptable. Behavioural economics and various pieces of empirical evidence confirm that all actors from investors and lenders to suppliers and insurers are averse to uncertainty (Makovšek and Moszoro, 2018).

Equipping investors with more data on past performance of infrastructure investment will reduce their exposure to uncertainty and improve their risk pricing. Two strongly related aspects of uncertainty, however, have so far received much less attention. They could be called the elephant in the room.

Firstly, looking at investors only provides an incomplete view of the total cost of the risk transferred from the public to the private sphere. Investors transfer some of the major risks they are not comfortable bearing (e.g. construction risk) to design, construction, maintenance and operations contractors. If suppliers face similar issues as investors, they too will price risk inefficiently. When this is so, the base

cost of the initial investment (i.e. the principal) and subsequent services will be much higher than they could be, not just their financing.

Conversely, if suppliers could price their risks better, the total cost of the project would be reduced. The principal of project loans and the interest to be repaid would be smaller, and the business cases of more projects would become viable. A greater number of projects could be delivered for the same overall amount of money. So what can policy makers do to reduce the cost of inefficient risk pricing of suppliers?

Secondly, uncertainty does not only relate to the inability to accurately estimate cost of construction, maintenance, operations, and financing. Beyond risk-pricing challenges at the tendering phase, uncertainty also manifests itself in unexpected events during the contract. A period of slow global growth or declines in real incomes could affect the demand for transport. The transport sector faces technological paradigm changes, for instance autonomous vehicles and shared mobility. Climate change is causing increasingly uncertain weather patterns, with more frequent extreme weather events.

These developments will systematically affect infrastructure. Answers to questions like “What infrastructure will be needed?” and “With what standards will infrastructure need to be built?” may change. These changes will not happen overnight, but for contracts lasting twenty, thirty or more years, they may prove systematically disruptive and require renegotiations. Parts of existing infrastructure may become obsolete.

Where does this put Private-Public Partnerships (PPPs), the dominant vehicle for private investment in transport infrastructure? How can public decision makers reconcile long-term uncertainty with private investment in infrastructure? Who should bear long-term uncertainty in projects, the public or the private sector? More broadly, the significance of uncertainty goes well beyond the considerations of risk pricing for investors. It matters for all public procurement of complex projects. How do we deal with uncertainty to protect the public interest and maximise the value of private investment in infrastructure at the same time?

A roadmap to this report

These questions are addressed in the chapters below. Following this overview, chapter 2 explores the economic characteristics of infrastructure and why private investment in it is difficult. It presents data on the significance of private investment in transport infrastructure in the last 20 years and evaluates the motivations for pursuing private investment in infrastructure, including the claim that private financing could increase the overall infrastructure investment.

Chapter 3 sets out how uncertainty affects contracts. It outlines the ways in which uncertainty can lead to overpriced infrastructure, notably by making risk pricing less efficient and indirectly through negative impacts on competition. An example of rail franchising shows that uncertainty plays a role not only in infrastructure investment but also long-term service contracts. Lastly, the question of whether the public or the private sector should bear the cost of uncertainty is discussed, and what the relative cost of public versus private finance is.

In chapter 4, the report moves towards solutions to the issues identified. It investigates what procurement authorities can do to help suppliers to price risk more efficiently. Options for policy makers are demonstrated using the example of the construction phase where uncertainty is mainly driven by complexity.

Chapter 5 looks at how uncertainty in long-term contracts can be managed. It explores remedies to uncertainty within the existing models used to structure private investment in transport infrastructure (i.e. PPPs). It also offers a rethink of whether other approaches might be more suitable, and in what circumstances. The regulatory asset based (RAB) model is highlighted as an alternative to PPPs.

Chapters 6 and 7 conclude this synthesis report with reflections on a de-risking policy to mobilise private investment and suggestions for practical tools that could help to improve procurement decisions.

In its investigations, the working group focused on the experiences in advanced economies with mature institutions, rule of law and credible commitment to the contract. Less favourable investment environments (e.g. in many developing countries) can undermine potential positive outcomes of private investment in infrastructure.³ This is not to say that the group’s findings and recommendations are not relevant in these cases, but any transposition of the recommendations should be undertaken with caution and possibly supported by additional analysis.

Getting the basics right

The terms “infrastructure” and “infrastructure investment” need to be properly defined before launching a discussion about them. They are often used in a generic fashion in policy circles. Yet private investment volumes are hard to interpret and it is difficult to advise governments without precise definitions.

Infrastructure is one thing, operations on it are another. Infrastructure refers to immovable assets, and these need to be looked at as distinct from the operations that take place on it. Some of the characteristics that make cost recovery in infrastructure investment challenging for any investor are high capital expenditure (capex) requirements, large numbers of users, sunk costs and long lifecycles. These are less pronounced for mobile assets such as rolling stock or aircraft, which makes it potentially easier to attract private investors or create competitive markets.

Private investment in infrastructure takes place in two basic models. Many different forms of private participation in infrastructure exist, among them management contracts, leasing, maintenance and operational contracts. But only two models involve significant upfront private investment, which then can only be recovered over the lifecycle of the infrastructure. These are the project finance public-private partnership (PPP) and the regulatory asset based (RAB) model. In the PPP, the price of the infrastructure and incentives for efficiency derive from competition for the contract or concession. In the RAB model, both derive from periodic negotiations with an independent economic regulator and within a predefined framework of rules. The PPP model dominates private investment in transport infrastructure.

Private investment in infrastructure has so far been concentrated in a few countries among the advanced economies and is not broadly accepted elsewhere. Data limitations prevent a detailed comparison of the flow of private investment in the past compared to public investment, especially on a sectoral level. Nevertheless, the available data allows some important observations. Private investment in transport infrastructure totalled almost USD 1.35 trillion over the period 1995-2016 (in constant 2014 purchasing power parity terms). OECD countries accounted for 50% of the total. This number excludes financial transactions such as refinancing mergers and acquisitions between private parties, which generally inflate commercial indices of private investment.

The data available allow a comparison between public and private investment for the EU only and make most sense for rail and road due to the lumpiness of investment in ports and airports. More than 80% of all private investment was concentrated in only nine countries. It grew until 2010 and slowly declined thereafter. In the best of times, it reached less than 15% of the total, with public investment

representing the rest. The private investment projects contained significant public financial support (grants, guarantees, etc.) that cannot be isolated. The concentration of private investment in some countries reflects the political acceptance of private investment as the key challenge rather than, for example, business environment issues, as is the case in developing economies. The primary challenge of private investment is therefore its acceptability for the broader public.

The main potential merit of private infrastructure investment is efficiency. To win over public opinion, different arguments have been made as to why private investment in infrastructure makes sense. Four of the main arguments in the context of PPPs this report investigates are

- improved productive efficiency (i.e. same service level for less cost);
- improved project selection or allocative efficiency (e.g. investors will not want to build roads to nowhere as they will not be able to recover their money);
- extended borrowing capacity (i.e. the state can increase the level of investment if it is done with private financing); and
- if private investment is foreign there might be additional positive effects.

We find that only the first and the last argument have significant merit.

Private investment can improve efficiency, but where and how should not be taken for granted. Public governance of infrastructure faces a number of inherent challenges with respect to efficiency. Two of the major ones have been a) the incentive to make infrastructure services available as broadly as possible without ensuring full-cost recovery over time (time-inconsistent behaviour) and b) excessive employment in state-owned infrastructure companies.

The empirical evidence from transport infrastructure and beyond supports the proposition that private investment in infrastructure can lead to improved productive efficiency – i.e. lower costs – when appropriate institutional and regulatory conditions are in place. Evidence for this is mainly available for transport operations (sea freight, passenger rail). Both port and airport PPPs responded quickly to the fast growth of containerised trade and increase in vessel size. From non-transport sectors, a strong body of evidence on utilities is available. For the transport sector, where most private investment takes place (notably in road PPPs), no compelling evidence exists that efficiency gains through PPPs have been achieved. The same is largely true also for railway infrastructure.

Transferring demand risk to a PPP cannot improve project selection. The notion that PPPs can prevent roads to nowhere being built by transferring demand risk to the private side does not seem economically defensible. In-depth analysis shows that multiple conditions would need to be fulfilled and that meeting all those conditions is unlikely. One of the main conditions is that the state would need to transfer demand risk systematically. This is not possible for several reasons: The state must choose which projects to involve the private sector in. When a project has political support and decision makers know it is not viable, they are unlikely to opt for private sector involvement in the first place or will provide financial support to make it viable.

The context in which the private sector should bear demand risk is when demand is to a significant extent dependent on its actions (i.e. it is endogenous or subject to competition). For example, in ports and airports demand strongly depends on the price and quality of service. In the ideal case, port terminals compete with each other; the same is true for airports. This is not the case with interurban roads for example. There could be a potential improvement in project selection if the private sector were responsible for planning under public supervision, as with regulated utilities, but this aspect exceeds the scope of our work.

Private financing cannot close the infrastructure funding gap. The flow of private capital into infrastructure projects (i.e. the financing of projects) cannot in itself close the infrastructure gap. Economics and the available literature on public accounting and budgeting are clear on this. A PPP is a financing vehicle (i.e. addresses the question of how to borrow), while an investment gap is a funding problem (i.e. relates to the question of how to repay what was borrowed). A financing solution cannot resolve a funding issue. A major reason why such a proposition continues to be an incentive to use PPPs in many countries is a persistent reliance on accounting standards that do not fully and transparently represent the fiscal implications of PPPs. The upgrading of accounting standards to remove this bias is relatively straightforward. Thus a likely explanation for the insufficient progress in this area appears to be a lack of political will.

Foreign private investment can enhance competition and create positive spill over effects. A large body of empirical evidence from the trade literature of other sectors shows that foreign private investment has a positive impact in terms of competition, knowledge and other spill over effects in the local economy. There is no reason why this would not apply to infrastructure investment.

In the context of procurement and managing infrastructure, the only way private investment could contribute is in the long term through providing quality infrastructure at a lower cost than through alternative procurement options.

Defining the challenge

Uncertainty matters for private investment in three distinct ways: Uncertainty affects how investors and contractors price the risks associated with those projects. It also affects competition between incumbents in a local market and new entrants. Thirdly, where it manifests itself as unforeseen events, uncertainty can lead to opportunistic behaviour by parties to the contract during its execution.

Uncertainty directly affects risk pricing. Standard financial economics assumes the market is able to accumulate information on risk based and on past experiences of investors that compete between each other for opportunities. Eventually so much information is accumulated that no investor can achieve abnormal profits by outsmarting other competitors. This implies the required cost of financing for a project portfolio appropriately reflects its risks and does not systematically overshoot the risk that materialises during the project’s execution. When this is the case risk is priced efficiently, and the efficient markets hypothesis holds. *A key point is that the lack of information on risk leads to inefficient risk pricing, even if there is perfect competition.* This has been the case to date (without perfect competition), and making data available on past financial performance of similar infrastructure investments is what establishing infrastructure as an asset class essentially means.

The same approach cannot be used to address the risk pricing concerns for suppliers (design, construction, maintenance and operations contractors). Experts in risk workshops identify and estimate the impact and probability of individual risk items. On large projects, there can be many hundreds of risks. The opacity of individual projects makes the pooling of such information difficult. Moreover, if any ex post analysis is done on the accuracy of the risk assessments; this information is generally not made public. Governments rarely commission and publish ex post completion reviews on projects. Circumstances like these prevent the accumulation of risk-related information in the same way as happens for investors in capital markets.

A factor that exacerbates construction risk-pricing challenges for contractors is the application of “high-powered’ contracts through which private investors for example effectively transfer the full construction

risk. Multiple protection measures in these contracts ensure on-time/on-cost delivery. These force the contractor to absorb risk and uncertainty and effectively provide an insurance against construction risk. Indicative evidence from road projects suggests the end cost of infrastructure could be up to 20% higher than traditional procurement after cost overruns in both cases have been taken into account.

Uncertainty also directly affects competition, and consequently risk pricing. The more risk we transfer through contracts, the fewer firms may be willing to bid. Not all firms have sufficiently large balance sheets to accept the full construction risk. Also, incumbents in local markets may have an information and experience advantage over new entrants. Less competition will have a knock-on effect on risk pricing. Reducing the uncertainty for new entrants will increase the competition in the local market.

Uncertainty can drive opportunistic behaviour in contracts. The risk-pricing and competition considerations described above affect private investment during bidding. A particularly relevant aspect of private infrastructure investment is the long duration of the contracts. Contracts cannot foresee every possible eventuality and are therefore incomplete. An event that changes the narrative for which the contract was written can change the bargaining power between the public and the private sector and lead to a hold-up situation. Changes in infrastructure utilisation, design and maintenance expectations can arise through changes in the transport-technology paradigm and climate change, for example. These could systematically increase the uncertainty to which long-term contracts are already exposed.

Understanding uncertainty helps to determine how much of it should be transferred to the private sector. Beyond the particular impacts of uncertainty above, the risk-pricing and competition angles taken together effectively determine the total cost of risk transfer from the public to the private sector. In doing so, they help inform the discussion of what is the cost of public versus private finance in infrastructure investment. It is fundamental to the question as to how much risk (and uncertainty) should be transferred by governments to maximise efficiency.

As already noted, the cost differential between the public and the private finance is due to differences in how risk is represented in the public and the private sector. The private sector expresses the risk of expected demand shortfall on a road *ex ante*. In the public sector, tax payers bear the risk when it materialises. If capital markets were perfect, the *ex post* cost of public and private financing would be the same, but it is generally acknowledged this is not the case.

An important distinction between the two is that if taxpayers transfer the risk (and uncertainty) to the private sector they will pay the cost of risk and uncertainty aversion. If taxpayers keep risk and uncertainty, however, they will pay only for the risk that materialises (more specifically, they pay a welfare cost in terms of the variability of the tax burden). Ultimately, it is the uncertainty that is the main driver of a cost differential between the public and the private sector, and the taxation system that gives public finance the edge. This assertion does not change when the marginal cost of public funding is considered.

In summary, the limited empirical evidence available to date indicates that the expectations of what the market could deliver, in particular with regard to suppliers, were overoptimistic. Who can precisely determine a cost of, say, a EUR 100 million project even with the detailed design available? Who can precisely estimate the cost of maintaining an infrastructure asset over the course of 15 or 30 years?

Projects should undergo a risk assessment, and risk-adjusted estimates of costs and benefits should be a foundation for project selection both in the public and the private sectors. How the public and the private sector should allocate and finance risks and uncertainty is a separate question. Understandably, treasuries like to see on-time/on-budget delivery, but it must be also understood that such performance can come at a disproportionate cost. Notably, there will be exceptions, such as when buying certainty

will be justifiable in terms of social welfare. For example, a delay in completing a strategically important transport connection might entail multiple negative knock-on effects. Buying inefficiently-priced certainty for a portfolio of infrastructure projects, however, would be difficult to justify economically.

Competition for major infrastructure projects has been insufficient. Given the relevance of competition for bid pricing, we investigated the state of affairs on the European Union (EU) market of infrastructure procurement. Both the PPP market and traditional procurement were analysed using 2006-16 data in the TED database, which records all tenders in the EU. One of the findings is that the same eight firms bid for major contracts over time and there were few new entrants. Moreover, competition for a project is mostly defined by the structure of the national market (share of EU calls, share of large projects and concentration of top ranking home firms), which translates into the country's attractiveness for top-ranking firms in Europe.

Most existing recommendations for allocating risk and uncertainty have room for improvement. The best available risk allocation recommendations address risk at a sector level but could be further improved or complemented, following our analysis. Nevertheless, governance remains a challenge: an investigation into the portfolio of infrastructure projects in Spain, for example, showed that general recommendations are not always observed (see Appendix 3).

Addressing uncertainty for suppliers

After looking at the implications of uncertainty for private investment, we turn to the question of how public authorities can address the uncertainty faced by suppliers. A comprehensive analysis would include all suppliers. Our approach was to provide a demonstration, illustrating several ways to address the problem in the construction phase.

A PPP increases the risk and uncertainty burden for the construction contractor. For complex projects with high degrees of uncertainty, contract theory recommends risk sharing or negotiations rather than a fixed-price auction. In a PPP, the choice of the construction contract is driven by grantor expectations and lender requirements, with lenders preferring fixed-price arrangements. During the tendering process, contractors face a limited period of time to assess their risk exposure. They therefore tend to use comparatively simple risk assessment processes that lean heavily on the experience of contractors and specialist partners. Much of the risk-pricing inefficiency results from this constraint. Unidentified risks that represent low-probability, high-impact events (for example, encountering a protected species where the infrastructure should be built) are of particular concern.

How a project is treated in accounting terms should not override risk-allocation considerations. Having the right capabilities on the client's side to manage the procurement process in terms of tender timeframe, interaction with suppliers, etc. is a pre-condition in order to engage in design-and-build (DB) or engineering, procurement and construction (EPC) contract delivery. Achieving a particular accounting treatment of an infrastructure project in terms of the corresponding public debt has nothing in common with optimal procurement design. In a sustainable approach to infrastructure procurement these considerations should hold precedence over the accounting treatment. Such an approach would also ensure that risk allocation considerations, which underpin the selected delivery model (DB, EPC, etc.), are driven by project-related factors, such as complexity/uncertainties involved in the project, the capability to support/engage with the bidders and others, and not by accounting conventions which are external to the project.

If a project needs to be off the balance sheet, other measures are still possible to improve outcomes. Beyond sharing the risk with the public sector, several possible measures are practicable that do not adversely affect the public accounting objective. Some examples for ways how the public client can address uncertainty by investing in providing more information are given below.

The public client should develop a fully costed reference design and share it with the contractor, even in a design-and-build (DB) contract. In PPPs – and sometimes in traditional procurement – the DB phases are bundled. However, procurement authorities do not always make reference design available. When it is provided, then generally at an outline level. Investing in a reference design that is detailed in areas where changes are not desired, and less detailed where innovation is the focus, is recommendable. The degrees of freedom allowed in the design would depend on planning conditions, project complexity or any areas the client has particular interests in. Aside from providing the bidders with a clear and measurable output specification, the client should prepare unambiguous functional specifications, which can go a long way in reducing uncertainty for contractors.

Using a competitive dialogue during procurement for large projects can be effective in addressing uncertainty faced by the contractor. The exchange of information during the tendering process will help to reduce uncertainties for the bidders. However, if the tendering process is not well planned and not dealt with as a well-structured project from the public client side, this will adversely impact bid preparation. Setting aside sufficient time for bidders to adequately prepare their bids will avoid excessive time pressure that contributes to risk-pricing challenges on their side.

The client should find ways that enable contractors to commercially rely upon the data provided. It will not be practicable for the client to bear all the liability for all this data, since much of it will have come from third parties. However, the client will in any case be paying for the liability through the price of the winning bidder. He also has the greatest control over the procurement of the data. Therefore, it is the client who should identify competent people or organisations to procure, manage and deliver information for use by the bidders and bear appropriate liability for any deficiencies.

Many projects incorporate some of these measures, but few apply all of them. Yet these suggestions above could be used across the board or by individual procurement authorities. On a bolder note, it might be possible for client groups or pan-industry organisations to share some common external risk analysis with bidders. The way contractors assess risk is not entirely incomparable, and pooling could bring greater objectivity to the process. This could be led and supported by the public sector in a similar way as creating infrastructure as an asset class in partnership with the private sector.

Addressing uncertainty in long-term contracts

Risk-pricing challenges do not occur only in the construction phase but throughout the duration of long-term contracts. Indeed, the longer the contract, the greater is the uncertainty regarding cost (and revenue, if demand risk was transferred). However, long-term contracts do not only exacerbate risk-pricing challenges but also contract incompleteness. The possibility that parties to a contract are unable to foresee a change in circumstances during the next 20 or 30 years increases dramatically. The challenge is no longer the interpretation of what is in the contract but how to deal with what the parties did not include in the contract in the first place.

A manifestation of changes that require an adaptation to the contract is renegotiation. Different international organisations, including the ITF, have produced guidance on what should be renegotiated

and what not. If an exogenous event changes the bargaining power between the parties (and a hold-up event ensues), such guidance is likely ineffective.

The findings in this section deal with the questions: When is it sensible to use competition for a long-term contract, i.e. a PPP? Can we adapt the model in any way to improve outcomes? And, is there a private investment alternative to PPPs?

One option for public authorities to cope with long-term uncertainty is to not pursue private investment. The fiscal situation permitting, an obvious choice is to pursue public investment. The public counterfactual to private investment is no longer monolithic state-owned enterprises. These performed all activities in-house, with its attendant risk of traditional public sector inefficiency. Alternative structures now exist.

The Danish Sund & Belt Holding Company is a state-owned entity that controls three project companies. Each is responsible for the planning, construction and maintenance of one major infrastructure project and has contracted the project development and its maintenance to private firms. Because the holding company recovers its cost from user charges, its obligations are not counted against the Danish public. Other examples that exist across Europe and beyond commonly involve a national motorway company handling a motorway network. With regard to uncertainty the contracts with the private sector in this case are relatively short term. This gives the public client more flexibility and the risk-pricing and opportunistic behaviour issues due to long-term contracting are contained.

Arm's length public infrastructure management companies are not without downsides. There is no external pressure for efficiency hence the firm's performance fully depends on the quality of public governance alone. One of the risks with arm's length public bodies is that if they are mismanaged all their financial obligations could fall back on the public balance sheet.

A PPP can work well if there is continuous pressure for efficiency. When opting for a PPP, an important distinction is necessary as to the circumstances under which uncertainty constitutes a significant risk pricing problem. The private sector should bear demand risk when demand (and therefore the revenues of the PPP operator) is *strongly* dependent on its actions (*strongly* endogenous) or there is competition in the market. For example, when port terminals operate in the same catchment area, users can easily switch between them if the service quality or price is below an alternative service provider. Hence, when inefficient risk pricing is present during the tendering phase the PPP will still be under continuous competitive pressure stimulating efficiency and eroding abnormal rents.

Without such continuous pressure, a PPP will work less well. Inefficient risk pricing becomes a serious issue when continuous pressure for efficiency is not present. The competition for the contract is the single point in time when efficiency incentives are determined and risk has to be priced (i.e. the price of the service to the users or the government is determined). This includes for example user-pays road or rail infrastructure PPPs, availability-based infrastructure PPPs in all sectors (road, rail, schools, hospitals, etc.). In these cases, risk-pricing inefficiency could override the efficiency gains.

Tweaks to the PPP model can only partially address long-term uncertainty. Demand risk should not be transferred when it cannot be managed well. When a PPP is the instrument of choice for a client, the availability-based version is preferable. However, governments under very tight fiscal constraints may still wish to transfer demand risk for short-term budgetary reasons and accounting considerations. A well-known approach is to spread out the demand risk over time using a Present Value of Revenues (PVR) concession. A further option is to pool multiple PVR-PPPs, collect their revenues in a common fund and enable cross-subsidisation (as in a road fund for example). This would increase the diversification of risk across the projects and over time (as different projects can be at different stages of maturity). Such a

solution still leaves the issues of inefficient risk pricing on the cost side and opportunistic behaviour due to exogenous events unaddressed. A more pronounced benefit of this approach, though, is that in addition to the present value of revenues approach it allows more room to pursue transport pricing as means to ensure efficient use of infrastructure.

With regard to unexpected changes in the circumstances for which the contract was written, PPP contracts can be written in ways that provide flexibility. A straightforward option is to include a buy-out clause which gives the public client a right to terminate the contract at a predefined price. Provided the PPP employs a PVR model or is availability based, it is relatively easy to determine the remaining cost to be disbursed to the private party at any single point in time. If the government does not intend to immediately let another PPP in the same area, this option fully resolves the flexibility issue.

An alternative is to renegotiate the contract. A PPP arbiter, to whom the parties defer the decision on how to accommodate the changed circumstances in their contract, can help. The weakness of this approach is that the arbiter, even if it is a permanent body, cannot possess the accumulated experience and information about the performance of the PPP of a fully-fledged economic regulator. Thus, the private-sector partner could retain an information advantage over the arbiter and the government.

The regulatory asset based (RAB) model offers a comprehensive solution in the absence of competitive pressure. A company regulated according to the RAB model addresses risk pricing as well as opportunistic behaviour. In a network such as motorways, the regulated company manages a portfolio of construction projects rather than a single project. It is assessed based on the overall investment performance, which gives it more leverage to vary the contract types according to the project nature rather than to pursue the fixed-price/fixed-date contract as the default option. The company is subject to periodic price reviews that set conditions for periods of several years, which break down uncertainty over the long term. To be effective, an independent economic regulator monitors the performance of the company closely, thus reducing the information asymmetry which is otherwise present in the PPP, where the public client only assesses whether the contract is being fulfilled.

Another potential advantage of the RAB model is that it represents a comprehensive approach to management of network infrastructure. PPPs are traditionally applied to parts of the network (e.g. sections), leading potentially to its fragmentation. Comprehensive changes in transport policy would require systematic renegotiations across all PPP contracts, which could also deter or postpone amendments to national transport policy.

What would a practical application of the RAB model look like? Would the RAB model replace some of the difficulties of the PPP with challenges of its own?

As a long-term strategy, motorway networks might be better suited for a RAB model approach than a PPP. Australia provides a case study for how a RAB model could be applied to a road network. The Australian authorities currently investigate the potential of independent regulation for heavy vehicle use charging under an RAB-type framework. Various organisations have argued that this can deliver benefits to road agencies, taxpayers and road users, such as improved asset management, even if a broader system of road charging does not occur or is deferred for many years. Before adopting a RAB model, Australia would need to resolve several issues. One major point is that so far there is no agreement on a network scale which might be subject to a RAB model. Moreover, asset-related data is not always comprehensive or current, creating uncertainty for any future regulators and any prospective corporatised road agencies.

A separate issue of the RAB model in Australia remains the introduction of some form of road charging. This faces a number of major challenges regarding financial and policy aspects, for example about the

road-service levels that would underpin any ongoing subsidy payments (Community Service Obligation payments) by governments. In concert with potential shifts in taxation and road user charging, the establishment of a road RAB model could provide the foundation for a more durable and sustainable means of funding the maintenance, operation and development of the country's road networks. A start for a RAB model could be a network of national highways or a slightly broader collection of key freight routes, perhaps including certain "first- and last-kilometre roads". Applying a RAB model to these networks would represent a far lesser challenge than other road classes. Many European countries already have a motorway corporation and user charging in place, for example.

Finally, the major technological, economic and climate challenges mentioned earlier present uncertainties for road network owners, regardless of the form of road governance. Nevertheless, the RAB model provides a useful means for managing these challenges by introducing transparency and a sound incentive framework.

Capex bias is manageable in practice. One of the oldest concerns with regard to the regulated model is the issue of capital expenditure (capex) bias. Its different manifestations involve building more and better infrastructure than necessary. One suggested motive was if the regulated rate of return is higher than the cost of finance to the private owners. Following a theoretical proposition of this problem in the 1960s, forty years of empirical research have produced no convincing evidence of this phenomenon. In the 1980s the UK deployed its own price-regulation model, which sought to address this potential challenge, and more recently the system of incentives was evolved further (now known as Totex). A detailed paper produced by the Working Group shows that, given the current state knowledge, capex bias remains a point of attention for the regulators. We concluded however that bottom-up and top-down capital expenditure benchmarking can keep this challenge manageable for transport infrastructure.

In the regulation of financial engineering, the RAB model could take a cue from the PPP model. The approach to regulation and an unprecedented period of low-cost financing has allowed private owners of the regulated company a form of arbitrage. With it, they reduce the equity in the firm and replace it with debt releasing cash to be paid out in dividends. This process has been criticised but is a complex issue. In principle, the arbitrage is not unlike refinancing long-term debt in a PPP with a cheaper one. In PPPs, the sharing of refinancing gains was introduced long ago. The same could be the case with the RAB model if a better regulatory solution is not found.

As far as private investors are concerned, the RAB model is not restricted to user-charge funding systems. Policy makers often associate the application of the RAB model with user charges. However, credible commitment to the contract is independent from whether the funding comes from the users directly or some form of taxation. Far more important is an established institutional framework, a track record of agencies operating without political interference, a credible appeals process and a commitment to ongoing use of the model to promote good behaviour.

Hybrid solutions for private investment in public infrastructure exist, but do not extend the two basic options of PPPs and the RAB model. A leading and recent example is the Thames Tideway Tunnel in London. The construction phase is in a PPP context, after which the constructed infrastructure passes into a RAB regime. A case study showed the authorities did their best to apply existing knowledge of incentive mechanisms and risk sharing within the constraint that the project needed to be off the balance sheet. The circumstances in which this was possible were fairly unique and do not appear to lend themselves to systematically replacing the PPPs or RAB models.

Mobilising private investment, de-risking and uncertainty

The efforts of policy makers to mobilise private investment in infrastructure in advanced economies have focused primarily on de-risking investors. In the aftermath of the financial crisis, there was an initial impression that the financing channels were constrained; hence, ways were sought to address this perceived market failure. When the financing crisis subsided in the EU, private investment was still slow to take off. A natural response of the policy makers was to launch a series of de-risking measures, such as those in the Juncker plan, assuming it was the general, uncertain macroeconomic climate that deterred private investors from investing. An almost complete loss of appetite for taking on demand risk appeared to confirm such an impression.

Using different data sources, we explore the hypothesis that a lack of private investment mobilisation is due to the combined effects of uncertainty aversion of the private sector and three other factors. Firstly, a massive drop in public investment volumes in transport infrastructure signified public funding in general was constrained, which made it difficult to fund availability-based PPPs, which do not bear any demand risk. Simultaneously, the EU's public-debt accounting rules were under revision, which created uncertainty for the public clients, i.e. under what conditions particular PPPs may or may not be considered part of public debt. Lastly, de-risking might have had a bigger impact, assuming there is a large potential of user-funded projects, which the state will not finance. For transport infrastructure, this is unlikely to be the case. In these circumstances, no amount of private investor de-risking would have been sufficient. Moreover, across the board de-risking might adversely affect the efficiency incentives in projects, potentially defeating the purpose of pursuing private investment in the first place. That said, an economic crisis is likely not the best time to try to increase the mobilisation of private investment in infrastructure.

A tool for better procurement design

Throughout our analysis, the working group encountered numerous gaps in the empirical evidence that could help to explain how different contract and delivery models affect project outcomes. Filling these gaps with relevant data would significantly advance the optimisation of procurement design both the theory and practice.

A related aspect to the evidence problem is the lack of an evidence-supported tool for procurement design. While project selection can rely on cost-benefit analysis as a decision-making tool, procurement choices depend on limited guidance and expert judgement. When no clear evidence-based arguments are available to justify specific procurement choices, defending them against political pressure becomes even more challenging. These issues go beyond the question of private versus public investment and guidance would improve project outcomes for all infrastructure procurement.

Notes

- 1 See Global Infrastructure Outlook at <https://outlook.gihub.org> (accessed 13 February 2018).
- 2 See the 2018 Agenda of the G20 at <https://www.g20.org/en/overview-argentinias-g20-presidency-2018> (accessed 13 February 2018).
- 3 For example, the ITF Roundtable on renegotiations in PPPs (ITF 2017a) was launched to study how the pervasive presence of renegotiations, in particular in developing economies, could be addressed. Most of the contract renegotiations (started by the public and, private sectors, or both parties to the contract) were not in the public interest. The reasons were predominantly not unexpected exogenous changes during the life of the contract, but lack of credible commitment to the contract and strategic behaviour before the contracts were entered.

CHAPTER 2

What is the purpose of private investment in infrastructure?

Before we embark on the analysis of uncertainty in contracts and what we can do about it, we need to more precisely define the setting in which our analysis takes place. It needs to be clear what private investment in infrastructure is exactly. It also needs to be clear why private investment should be pursued so that any recommendations we provide on how to deal with uncertainty do not undermine the end we seek to achieve.

Policy makers often use infrastructure and infrastructure investment as generic terms. Moreover, the international policy discussion with regard to infrastructure investment is full of different suggestions about what the private sector can or cannot do and assumes everybody understands the basic terms well. What is (transport) infrastructure – what are its economic characteristics? Why is it difficult to get the private sector to invest? How much does the private sector invest in comparison to the public sector? What are sound motives to foster private investment in infrastructure?

In this chapter we first recall the general economic characteristics of infrastructure. In transport and other sectors infrastructure refers to immovable assets. These need to be looked at as distinct from the operations that take place on it. High capex requirements, large numbers of users, sunk cost and long lifecycles are some of the characteristics that make cost recovery in infrastructure investment challenging for any investor. These are less pronounced for operations, which makes it potentially easier to attract private investors or create competitive markets. We illustrate the characteristics and the distinctions on the rail/road and port/airport cases.

We then provide an overview of different formats of private participation in infrastructure. There are many, but not all imply an upfront investment. It is the latter that implies building new infrastructure, upgrading existing infrastructure or simply changing ownership or privatising to pursue higher efficiency. Under the right circumstances sunk upfront private investment creates one of the most powerful incentives to perform, or the initial investment and the expected return will never be recovered. The term private investment can be a much broader concept (e.g. it can also include acquisitions of already privatised companies), which can create some confusion when analysing private investment flows.

Based on a clear definition of what private investment in (transport) infrastructure is, an overview of the trends in private investment is presented over the past 20 years in developed and developing countries. For the first time the share of private investment in transport infrastructure in the EU is estimated.

Policy makers face a series of arguments for mobilising private investment in transport infrastructure. Private investment, however, is a means to an end and not a goal in its own right. Being clear on what private investment can or cannot achieve means being clear when or for what purpose it is sensible to use it. Equally important, being mindful of the potential benefits helps us to understand later whether the proposed solutions to uncertainty infringe on them. We investigate four of the main arguments: improved cost efficiency (e.g. same service level for less cost); improved project selection (e.g. investors

will not want to build roads to nowhere as they will not be able to recover their money); extended borrowing constraints (i.e. the state can increase the level of investment if it is done with private financing); and lastly, if private investment is foreign there might be additional positive effects in terms of competition, knowledge and other spill over effects in the local economy.

What is infrastructure?

The term infrastructure generally encompasses economic (e.g. transport, telecommunications, electricity, water and sewers) and social infrastructure (e.g. schools, hospitals and social housing). Infrastructure exists in nodes or networks. Roads, railways, electricity distribution and water supply are examples of networks. Any particular section only has a useful function if it is physically linked to other sections, each contributing to the performance of the system as a whole. Other infrastructure exists in the form of nodes or discrete assets (ports, airports, hospitals, etc.), which do not need to be directly linked to other similar assets, although conceptually they form a network as well.

What matters most for economists and investors are the economic characteristics of infrastructure, which can lead to market failures – situations where the market does not lead to efficient results in terms of general welfare. In general, infrastructure:

- Is *excludable*: Access to it can be controlled (on motorways, for example), which is a public good characteristic.
- Is *non-rivalrous*: A single user will not significantly reduce the availability of infrastructure to another user, unless of course the infrastructure is close to capacity. The additional cost of an extra user on the infrastructure is close to zero. This is another public good characteristic.
- Is *capital intensive*: Relatively large investments are necessary to build it.
- *Creates externalities*: These arise whenever an activity, which affects other parties, is not reflected in market prices. If the production of such activities is left to the market, it will produce too much of what is bad for social welfare and too little of what is good. An environmental externality, for example, is air pollution. Social externalities arise in relation to the allocation of infrastructure cost to different social groups.
- Is a *sunk investment*: Decisions to build infrastructure are irreversible from an investment point of view. Infrastructure has no intrinsic market value. A motorway cannot be dug out and sold on, on the market. When there is something to sell, we can only recover a fraction of the initial investment.
- Is *long-lived*¹: The high initial investment means that the cost will need to be recovered over a long time. As such, investment decisions and cost recovery will be subject to long-term uncertainty due to business, political or technological changes.
- Can *affect market power*: When the technology of a service or product involves large capex assets and there is a mass of consumers on the receiving end, there will be economies of scale and potentially scope. These characteristics can make it more economical for a single firm to supply services rather than having more firms competing (Joskow, 2008).

Given these characteristics, one of the main challenges for publicly managed infrastructure in the past has been full cost recovery. It implies that once the infrastructure is built, the cost of the initial investment and the cost of ongoing maintenance and operation needs to be recovered. This objective is

at odds with maximising welfare in the short term. All users may not always be able to afford the infrastructure at a cost that allows full cost recovery (i.e. the average cost). Governments have often sought to maximise the number of users of infrastructure by reducing the user charges or grants from the general budget to marginal cost. At this level, only the wear and tear cost of the additional user is recovered. In practice this has meant not even the full cost of maintenance of the entire infrastructure – not only the part that is exposed to wear and tear from users – could be recovered, let alone the initial investment.²

Unions or state-owned firms perceive such government behaviour as a threat to their viability and pursue strategies to protect their cash flow, for example, by hiring too many employees or granting excessive benefits. (Svedoff and Spiller, 1999) In relation to this argument, a dedicated study for this group by Smith et al. (2018) found indications of an opex bias (i.e. preferring operational to capital solutions) in state-owned railway infrastructure companies in Europe.

What we describe above is also referred to as time-inconsistent behaviour or short-termism by the government (Helm, 2010). It is essentially enabled by a lack of transparency and accountability. The fact that infrastructure is long-lived or does not always immediately show the consequences of insufficient maintenance does not help. This flexibility is not necessarily a bad thing. During economic downturns governments commonly cut back on maintenance and reallocate resources where they are more urgently needed (see Figure 26 in Chapter 6). The trouble is that this borrowing from the infrastructure is generally not subject to public scrutiny and has tended to lead to substantial maintenance backlogs to be dealt with by future generations. One way in which governments have sought to address the challenges of infrastructure governance is through trying to introduce competition and increased private sector involvement. In this context, it is useful to distinguish between infrastructure and operations. The initially cited economic characteristics are more pronounced for infrastructure than they are for operations.

Looking at how markets have evolved in different transport sectors in OECD countries in Table 2 below, one can find examples where competition has manifested in operations only as opposed to cases where operations and infrastructure are integrated. The economic characteristics of assets used in operations are generally less demanding, their lives are shorter, they tend to require smaller initial investments and can generally be moved and sold on the market (e.g. even the large container cranes in ports are not location specific).

When technological or other interdependencies permit it, infrastructure can be managed separately or vertically unbundled from operations. This makes it possible to pursue the creation of competitive markets (e.g. air transport liberalisation) or makes it easier to attract private investment (e.g. Public-Private Partnerships (PPPs) in ports are mainly about terminal operations on existing port infrastructure). This is not to say economic characteristics are the sole driver of how organisation in different transport sectors has evolved.³

The policy debate about mobilising private investment in infrastructure is about markets that have not yet been – and some of them may never be – liberalised. The next section explains the two main principles of how private investment in infrastructure takes place. It also clarifies that not all forms of private participation in infrastructure involve private investment.

Table 1. Transport infrastructure and operations organisation in OECD countries

Sector	Infrastructure	Operations	Operations in relation to infrastructure
Road	Roads, bridges, signalling/traffic control equipment	Freight/passenger road transport	Liberalised and separate from infrastructure management
Rail	Track, switches, bridges, signalling/traffic control equipment	Freight/passenger railway cars, locomotives, motor-rail cars	Diverse organisation models (Integrated and liberalised companies, separate infrastructure and liberalised freight and/or passenger companies etc.)
Air	Airport building, runways, parking lots, signalling/traffic control equipment	Air carriers/planes	Liberalised and separate from infrastructure management
Sea	Pier substructure, break waters, basins, etc.	Terminal operations (ship-to-shore cranes, straddle carriers, warehouse, etc.)	Mostly separated (Farrell, 2012), competition for the contract
		Shipping	Liberalised

Source: Makovšek (2018a).

What is private investment in infrastructure?

The first thing to clarify is that private investment is private financing. It is money borrowed from equity investors and lenders that needs to be repaid or funded. There are multiple sources of financing the infrastructure, but there are only two sources of funding. Infrastructure can be funded by taxpayer revenues or through user charges (e.g. road tolling).

In the broadest possible sense, any form of private finance flows into infrastructure is private investment in infrastructure. This includes state-owned enterprises (SOEs) that own and operate the infrastructure and borrow on the capital markets. It also includes transactions like divestments (privatisation), acquisitions of a private company and refinancing of a debt by an SOE or a private company.

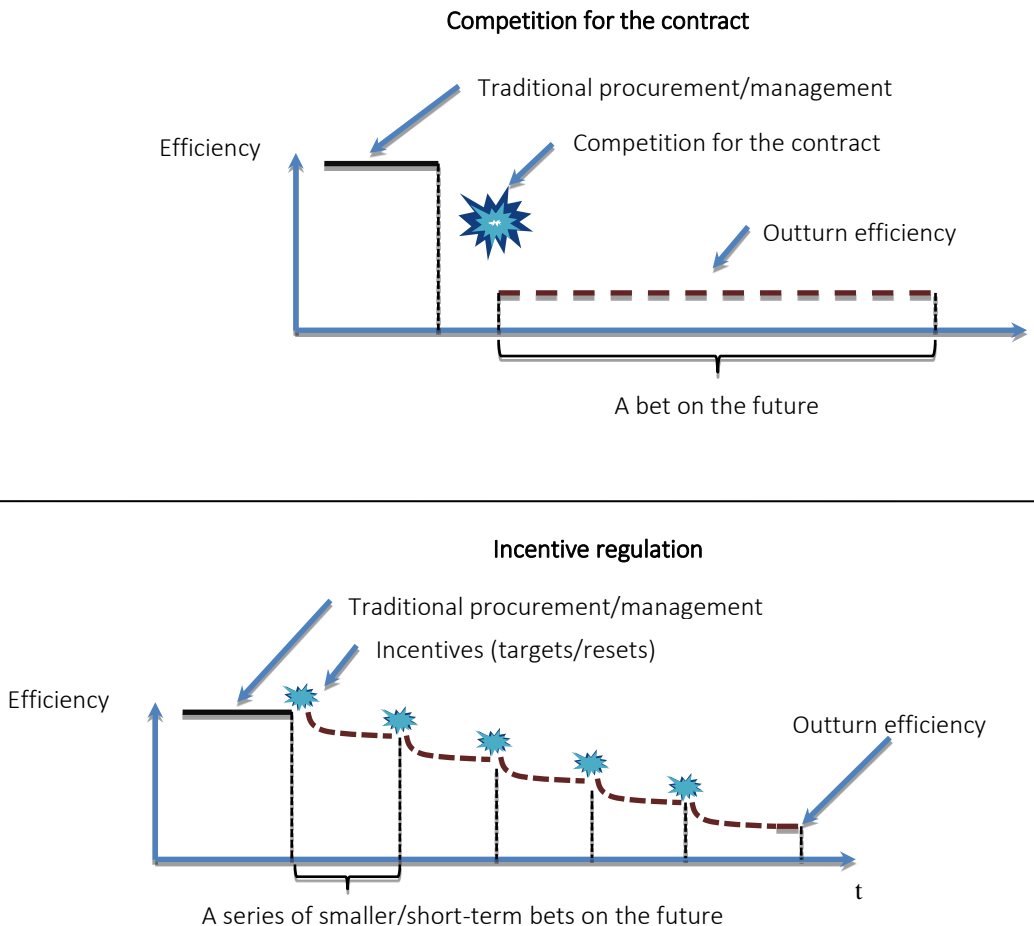
From a policy maker's perspective, the transactions of primary interest are those where private investment leads to improved performance of existing assets due to a change of management from public to private (divestment or concessions) and/or investment into greenfield assets or their rehabilitation. In both cases an initial investment is necessary to acquire existing assets or to build new ones.

The economic characteristics of infrastructure initially represented a challenge to private provision as well. On the one hand, from the moment the investment was made the private investor would need to wait many years to recover the full cost of infrastructure. This exposes investors to long-term uncertainty, where the government might want to impose lower prices to please voters, implicitly expropriating the investor. On the other hand, without government supervision the investor may abuse the market power granted by the infrastructure, reaping monopoly rents at the expense of social welfare. Private investment must therefore take place under a contract, which protects the rights and obligations of both parties.⁴ There are two basic principles of how the public sector engages with the private sector.

The first principle is the competition for the contract. This is the backbone of build-operate-transfer type PPPs. It assumes that the competition between the bidders for the contract will erode any abnormally high rents and provide sufficient incentive for efficiency throughout the duration of the contract. It does not involve any additional incentives from the public side for the duration of the contract. The main role the public sector has is to enforce it. All private investment in motorways and ports has been done through competition for the contract, which is understood to also represent the dominant mode of private investment for airports and railways (see Makovšek, 2018b).

The second is the incentive-regulation approach. In this case an independent economic regulator is established, an arms-length public body agency. An existing asset is privatised and an incentive framework is set up. Periodically, efficiency targets are negotiated between the regulator and the private company (e.g. every five years a price review takes place). The private company is promised an average return on its asset base and receives a penalty if it misses the efficiency targets and a bonus if it beats them. A key responsibility of the regulator is to monitor and supervise the private operator so it can better understand how efficient it is. This strengthens the regulator's bargaining position during efficiency target negotiations. The regulatory asset base model in the United Kingdom is an example of an incentive-regulation approach and is commonly referred to as the RAB model.⁵

Figure 1. Expected efficiency gains in competition for the contract vs. incentive regulation



Both approaches (see Figure 1) have been used on examples of node and network infrastructure. For transport infrastructure, however, the competition for the contract is practically the exclusive model of private investment, with only a few cases of incentive-regulation limited to airports (e.g. Heathrow airport in the UK) and until recently one railway network (Network Rail in the UK, until its nationalisation).

Lastly, although the principles above address private investment in infrastructure, they are not the only forms of private sector participation in infrastructure (PSP). Of the six forms, upfront private investment effectively happens in three: build-operate-transfer (BOT) projects, concessions and full divestitures (see Table 1) (a complete description of all forms is available in Makovsek (2018)). The first and second in particular are used interchangeably and in different contexts in practice. To avoid confusion, we consider BOT and concessions as based on the competition for the contract (hereinafter PPP) and full divestitures as the regulated model (hereinafter RAB).

Table 2. Forms of private sector participation in infrastructure

Characteristics	Forms of public sector participation in infrastructure					
	Service contract (outsourcing)	Management contract	Lease	BOT and variants	Concession	Divestitures (privatisation)
What PPPs encompass						
Scope (discrete piece of network)	Discrete existing assets and network	Normally discrete existing assets	Discrete existing assets (e.g. port terminal) and networks (e.g. water)	Discrete new assets or refurbishment	Existing networks and normally existing node infrastructure (ports/airports)	Existing network and node infrastructure (e.g. ports/airports)
Contract duration	1-3 years	2-5 years	10-20 years	25-30 years	25-30 years	Perpetual/subject to licence
Money at risk ex ante	No	No	No	Yes	Both options (yes or no)	Yes

Source: Thillairajan et al., 2013, World Bank (<http://ppp.worldbank.org/public-private-partnership/agreements>), ADB (2008) (excerpt from Makovšek, 2018a).

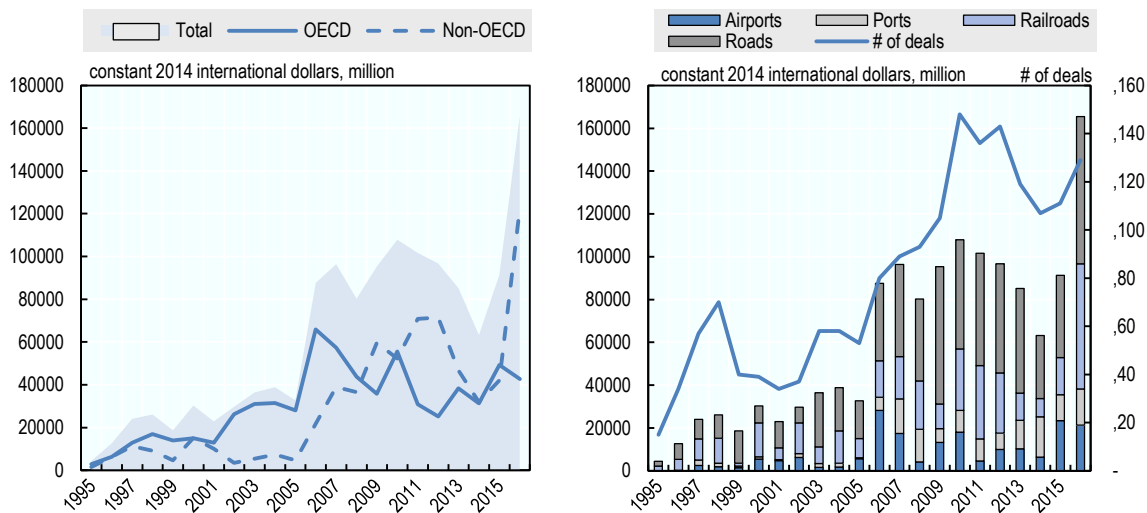
How significant has private investment been?

In line with the definition of private investment in infrastructure we have laid out, Mistura (2018) made one of the first attempts to quantify private investment in transport infrastructure by sub-sectors in a large range of countries, covering investments in 111 economies from 1995 to 2016. In addition, the analysis sought to distinguish domestic from foreign investors to assess how attractive or open individual markets are. To date, evidence-based analysis and informed policy making has been hindered by important data limitations of public statistics systems.

The data consist primarily of project finance transactions (PPPs), which according to Makovšek (2018b) should be representative of the majority of private investment in all four transport modes (rail, road, ports and airports). It should be noted the data reflects total project financial commitments (i.e. the total value of the initial investment). It does not exactly reflect annual expenditures in building the infrastructure (i.e. the flows). Given that most large transport infrastructure takes a few years to build, the true flows would appear as a smoothed-out version of the jagged profile in the figures.

Private investment in transport infrastructure reached almost USD 1.35 trillion (in constant 2014 PPP terms) between 1995 and 2014, of which OECD countries accounted for USD 673 billion, or 50%, of the total (see Figure 2). On a global scale, ten countries concentrate about 62% of investments. The United Kingdom, Australia, United States, Spain, Turkey, Korea and France are responsible for 51% of total investment in OECD countries. China, India and Brazil account for about 61% of total investments in non-OECD countries.

Figure 1. Private investment in transport infrastructure in OECD and non-OECD countries, 1995-2015



Source: Mistura (2018).

In the wake of the Global Financial Crisis (GFC) and the increasing fiscal constraints governments were subject to after 2010, privatisations went up for both groups of countries. From 2011-14, privatisations represented 24% and 36% of the deals in value terms in OECD and non-OECD countries, respectively. In the first group roughly 60% of investments in transport infrastructure came from foreign investors and in the second roughly 36%.

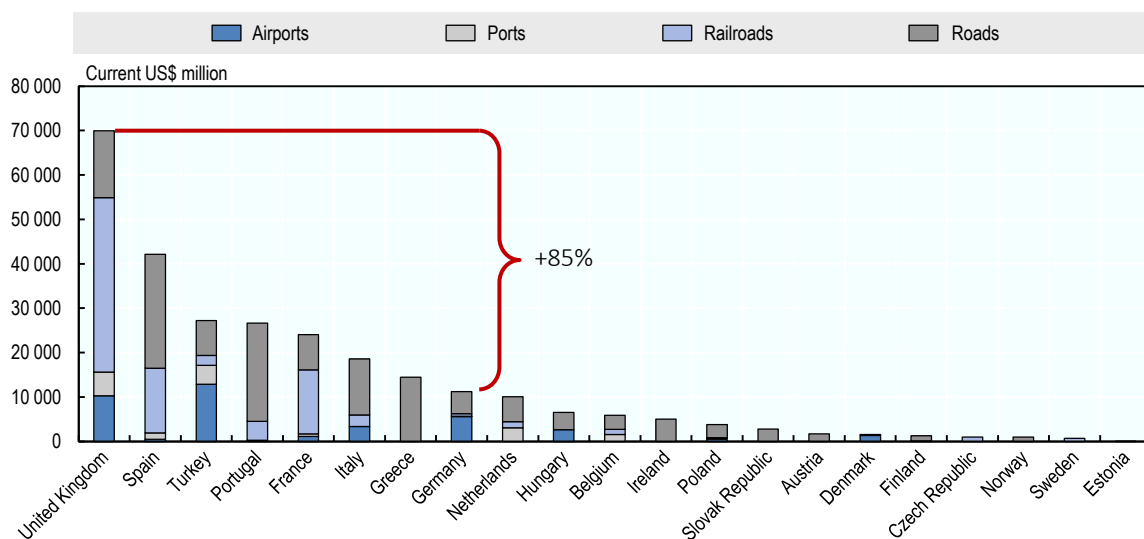
The broad overall volumes of private investment do not tell us much about how significant private investment is compared to public investment. Countries do not report this data on a sector or sub-sector level but do report total public and private investment together. To get a grasp of this, we looked at countries where most private investment takes place (see Figure 3) and compared them with ITF data on total annual expenditures on transport infrastructure (see Figure 4). Data quality and the lumpiness of investment limited this exercise to eight countries in Europe and the road and rail sector, which still represent roughly 90% of the total private investment volumes across the continent.

A key point to consider with regard to private investment values is that the committed amounts (i.e. the full investment of the project) do not include exclusively private finance. PPPs in general can be subject to significant public financial support. This can take multiple forms from upfront government grants and

subsidies to guarantees and various other risk mitigation mechanisms. The true private investment volume can generally be significantly less than the total value of the project. Regardless, even the total project values that included private investment (see the bottom line on Figure 4) reached at best of times 10-15% of the total, with the rest being purely public investment.

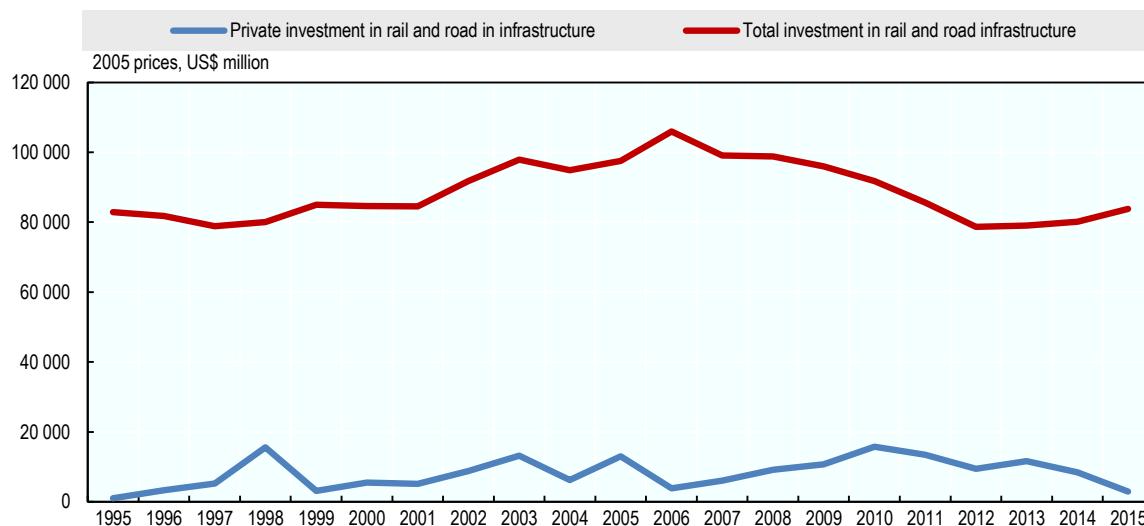
For advanced economies the concentration of private investment in some countries suggests the political acceptance of private investment as the key challenge rather than business environment issues, as is the case in developing economies.

Figure 2. Cumulative private transport infrastructure investment in European OECD countries and by mode, 1995-2016



Source: Dealogic Projectware database; Makovšek (2018c).

Figure 3. Private and total investment in road and rail infrastructure in seven OECD countries, 1995-2014



Note: Data from the UK, Spain, Portugal, France, Turkey, Italy, Germany. Greece not included due to incomplete data.

Source: Dealogic Projectware database, OECD/ITF statistics; Makovšek (2018c).

Why pursue private investment in infrastructure?

Private investment in infrastructure is not an end in its own right but a means to an end. Understanding the merits of private investment in infrastructure can help governments and the industry take defensible positions in the public debate. Moreover, understanding the merits can critically inform the means we choose to mobilise private investment without accidentally undermining the end we seek to achieve.

The reason we seek to transfer some risks to the private sector is because having one's own money at risk creates one of the most powerful incentives to perform. However, pure risk in day-to-day activities is a rarity. There is always some part of uncertainty present. In some cases the private sector is prepared to take the uncertainty and charge for it and in others there may be too much uncertainty, rendering projects unbankable. If we take all the risk/uncertainty away, there will be no private money at risk. The incentive to perform will be weak, but finding private financing for the project will be easy. Any potential policy responses dealing with particular risk and uncertainty, should they be retained, shared or transferred, critically depend on why we seek to mobilise private investment in the first place.

Four common propositions for what private investment in infrastructure can do are:

- Improve cost efficiency, i.e. the same service level for less cost.
- Improve project selection, i.e. investors will not want to build roads to nowhere as they will not be able to recoup their money.
- Extend borrowing constraints, allowing the state can increase the level of investment.
- Foreign private investment may have additional positive impacts in terms of competition, knowledge and other spill over effects in the local economy.

We set out each of these propositions below; more detailed analysis is available in Makovšek (2018b).

Improved economic efficiency

Measuring efficiency gains through private investment is notoriously difficult. It requires comparing the situation after a dose of private investment to a counterfactual, ideally using econometrics. The counterfactual can be a system's own past performance or another system. Researchers most commonly measure cost efficiency, trying to determine whether the cost for producing a particular service level has been reduced. Beyond this complexity an additional challenge is data availability issues. One contributing factor is a general lack of interest in the public sector to pursue ex post analysis of traditionally procured and publicly managed infrastructure (ITF, 2017b). Another is that in engaging with the private sector, governments commonly do not request the necessary disclosure of information in PPP contracts.⁶

We examined the available empirical evidence for road and rail infrastructure, passenger operations, ports and airports. For roads, which represent the largest share of total private investment in transport infrastructure, no compelling evidence exists to argue for cost-efficiency improvements. Most of the evidence pertains to on-time/on-budget delivery. Raisbeck et al. (2010) provide an overview of such literature for transport and beyond. This, however, is an incomplete view since nothing is said about the end cost per unit of infrastructure. There are dozens of studies dealing with different aspects of road PPPs, but a lack of data has inhibited a comprehensive analysis of value for money (one of the sources listing the studies is the online library of PPP research at George Mason University.⁷

In some parts of the world, such as North America, railway companies which finance their own infrastructure exist in competitive markets. When this is not the case railway infrastructure is rarely

privatised, which makes it difficult to draw broad conclusions from cases, which are few and far between. Most empirical evidence comes from passenger operations (i.e. railway franchises). In a departure from a state-owned monopoly in Germany, Sweden and the Netherlands, savings from 20-50% were recorded (Alexandersson, 2009; Alexandersson and Hulten, 2007; van Dijk, 2007).

Private investment in ports occurs primarily in two ways. An existing terminal infrastructure is given by concession to a Public-Private Partnership (PPP), where the private party executes cargo handling operations, or, a BOT-type project is commissioned. In the latter case, the private party builds the terminal superstructure and handles terminal operations on it, and the state provides the infrastructure. The great majority of terminal operations around the world are already PPPs (Farell (2012) cites 70% of global container terminals). Most studies show private investment has led to improvements but they also suffer from methodological limitations. Arguably, the biggest positive impact comes from a reorganisation that splits the function of the port infrastructure management from the terminal operations which are a more attractive form for the private sector to invest in. That said, terminal operations can exist in contexts where there is competition in the market for the same catchment area (to operate well you need to be part of the market; Rodrigue et al., 2011), where it is generally acknowledged state ownership tends to be less successful (Megginson and Netter, 2001).

For airports, over 40% of global traffic is already handled by non-public airports, and the percentage is increasing (ACI, 2016). The evidence on the relevance of ownership for airport efficiency is mixed, with several studies failing to find any impact of private investment (privatisation), and several finding positive effects. It is generally accepted that private ownership is better at extracting value from commercial operations. In airports commercial revenues from non-aeronautical activities represent up to half of total revenue (Graham, 2009).

In summary, we conclude there are at the very least indications that private investment could lead to improved economic efficiency, provided it is executed in an adequate organisational setting and is subject to a regulatory framework to keep any abuse of market power in check.

Beyond the transport sector there is a much larger body of evidence with regard to regulated utilities. Though not always successful, especially in developing countries, much more evidence is available where private investment (privatisation) led to significant gains in efficiency. One of the largest studies (Thillairajan et al., 2013) reviewed 424 pieces of evidence from 67 studies and found that the incidence of positive evidence far outnumbered that of negative evidence.

No improved project selection

Traditional public procurement in advanced economies has been subject to significant challenges with regard to cost overruns and benefit shortfalls. A strong contributing factor has been strategic misrepresentation of estimates to get the projects approved in the project selection phase (Flyvbjerg et al., 2002 is a seminal contribution in this area).

A common supposition with regard to PPPs is that if a private company has to bear the risk of demand for a project, it will exert greater care in assessing the demand estimates. Accordingly, investors would refuse to accept the project if they deemed the expected traffic revenues would be insufficient. This idea is mainly relevant in the context of infrastructure projects in which the private sector cannot seriously affect demand by means other than the price (demand is exogenous).

There is no evidence to confirm this supposition. Four conditions would need to be fulfilled for it to hold:

- A credible commitment to the contract is necessary. The PPP partner needs to bear any cost from the materialised risk that it accepted. While credible commitment has been a challenge in particular in developing economies, it has not turned out to be a significant problem in advanced economies (ITFa, 2017).
- Demand risk would need to be transferred to a PPP in all cases – systematically. Otherwise the state could choose to which projects it would transfer the demand risk and to which it would not. Most road infrastructure is built, however, on the merits of cost-benefit analysis (CBA), taking into account externalities, which go beyond the immediate financial considerations. Such infrastructure needs to be cross-subsidised. If we transfer the responsibility for the CBA to the private sector, then the PPP partner will seek to justify every project so it could build it. This would replace one moral hazard with another.
- A stable appetite to accept demand risk should exist. Investment in infrastructure is considered an anti-cyclical policy measure that should help restart economic growth, especially during economic downturns. Transport infrastructure demand, however, is systematically dependent on economic growth. As a natural result, investors tend to lose their demand-risk appetite during periods of greater uncertainty (Makovšek, 2018c).
- When demand is largely exogenous, such as for roads, and not manageable, it bears a pure-financing premium. For the demand risk transfer to make sense the added cost of financing should be offset by a greater rate of project failure. In Makovšek (2018b), a conservative simulation suggests that this is unlikely the case for advanced economies but may be true in developing ones due to higher rates of failure in project selection.

Of the four conditions, the second and the third cannot be met. A practical challenge is also the inertia in project development. Political expectations are built up when a project is put to the market. Governments and public bodies that have invested in preparing the project will seek to avoid the embarrassment of stopping a project at such late stage. Lastly, while there is no overview available, it is generally acknowledged that almost all PPPs are proposed by governments, and if they are not financially viable they are subject to public financial support. Project selection was, and remains, a challenge inherent to public governance.

No real extension of borrowing constraints

Private investment in principle cannot offset government fiscal constraints. Infrastructure is always paid for by the users through tolls or through taxation. The latter might be general or dedicated (e.g. fuel tax, vehicle registration tax and value capture). This is infrastructure funding. At the moment the infrastructure is constructed, however, a large initial amount of money is necessary, which spreads the burden of repayment over time. This is provided through borrowing or financing.

The financing can come from the government or the private sector (a PPP is a form of financing). How the financing and procurement are done might have different outcomes in terms of efficiency, but let us ignore those to simplify the explanation.

Whatever the source of financing, public or private, the present value of future revenue and expenditures or the fiscal impact of the project is the same. This is true for an availability-based PPP, where the state pays for the service over time, and a fully user-paid PPP, where the state does not pay for the service but forfeits the revenues that would come through the users.

What differs is the accounting treatment of the project in most countries today. A PPP is classified on or off the balance sheet – i.e. reported or not in the public debt. It is generally acknowledged that the option to pursue infrastructure investment but not include the related obligations in the public sector books makes PPPs especially attractive to governments.

This accounting treatment option is also a source of moral hazard: Not recording one's obligations transparently may encourage the government to spend more than it should. It can also push the government to pursue PPPs on the merit of their accounting treatment regardless of their value-for-money characteristics or sway it to sacrifice value-for-money to achieve an off-the-balance sheet treatment.

The International Monetary Fund (IMF) has developed a tool to contain the first threat the Public-Private Partnerships Fiscal Risk Assessment Model (PFRAM), and governments themselves apply prudential limits to exposure from PPPs. The second one, however, can only be resolved by upgrading the related accounting standard to the much more transparent International Public Sector Accounting Standards Board 32 (IPSAS32). This is a relatively straightforward exercise but has generally not been pursued by countries.⁸

For most readers the logic above is quite easy to comprehend when it comes to the availability of PPPs. In their case the state pays an annual availability payment for the service, much as it would for repaying a loan. The money comes from the general budget and reduces the opportunities to pay for other projects. When the project cost can be recovered from users (e.g. motorway tolls), the implication is the same for the government.

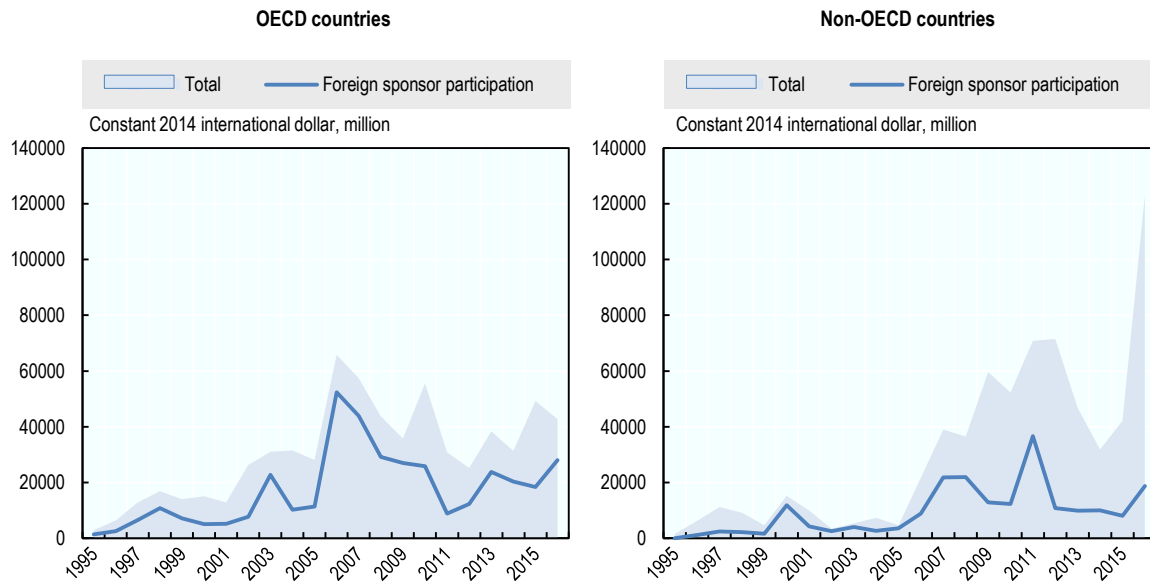
Under the control principle the determining factor is the government controls or regulates what services the private partner must provide with the asset, to whom it must provide them and at what price. A user-funded project is considered as a transfer of the right to collect the revenues. The unearned revenues are considered a liability (i.e. debt) that is progressively reduced as the revenues materialise. Essentially, under the control principle only under privatisation and the Regulatory Asset Base (RAB) model can private investment happen without the related obligations and assets being recorded on the public balance sheet.

Under a risk and reward approach, however, the government could establish arms-length corporations, which would be publicly owned and issue their own debt (with explicit or implicit government guarantee) but be off the balance sheet.

If the government cannot afford to finance the project traditionally, it also cannot afford it as a PPP. Conversely, if the government can afford the project as a PPP, it can also afford to finance it traditionally Funke et al., (2013). As a result, private investment per se cannot close the infrastructure-financing gap or the investment gap. If there is affordability to be tapped into (i.e. a willingness on the part of users to pay), this can be done by the public sector as well. Only an efficiency differential can contribute to an increased fiscal space and that can be used to pursue more investment.

Foreign private investment matters

A large body of empirical evidence from trade literature for other sectors showing that foreign private investment has a positive impact in terms of competition, knowledge and other spill over effects in the local economy. In principle, we see no reason why the same would not apply to infrastructure investment.

Figure 4. Foreign sponsor participation in private investment in transport infrastructure, 1995-2016

Source: Mistura (2018).

The OECD tracks foreign direct investment (FDI), which leads to direct and indirect effects on the local economy. It records flows and value of cross-border transactions related to direct investment during a given period of time, usually a quarter or a year. Financial flows consist of equity transactions, reinvestment of earnings and intercompany debt transactions.⁹ Mistura (2018) shows that in advanced economies foreign investment is significant (see Figure 5).

To be clear, foreign lending to local firms is not foreign direct investment (FDI). Equally, foreign private investment does not automatically imply that the contractor will be foreign as well.

Box 1. Further reading on Chapter 2

Detailed analyses of the issues covered in this chapter are available in these Working Group Papers:

Makovšek, D. (2018a), “What is Private Investment in Transport Infrastructure and Why is it Difficult?”, International Transport Forum, Paris. (Forthcoming)

Makovšek, D. (2018b), “The Role of Private Investment in Infrastructure”, International Transport Forum, Paris. (Forthcoming)

Makovšek, D. (2018c), “Mobilising Private Investment in Infrastructure: Investment De-Risking and Uncertainty”, International Transport Forum, Paris. (Forthcoming)

Mistura, F. (2018), “Quantifying Private and Foreign Investment In Transport Infrastructure”, International Transport Forum, Paris. (Forthcoming)

Also of interest:

Makovšek, D., and M. Moszoro (2018), “Risk Pricing Inefficiency in Public–Private Partnerships”, *Transport Reviews*, 38(3), pp. 298–321. Makovšek, D. and D. Veryard (2016), “The Regulatory Asset Base and Project Finance Models”, International Transport Forum Discussion Papers, No. 2016/01, Paris.

Notes

- 1 The time span for transport infrastructure is over 50 years for roads and 30 for railways (DG Regio, 2008), though recommendations from country to country may differ. Moreover, different types of assets within a network will have different useful lives (e.g. tunnels versus road pavements or railway tracks versus years in many cases (OECD/ITF, 2013). For the purpose of economic and financial evaluations, the recommended useful life is 25 signalling).
- 2 The higher the necessary initial investment, the higher the difference between average and marginal cost. The marginal cost of adding an extra user to a motorway is almost zero.
- 3 For example, historically the railways in Europe and North America evolved in very different ways even though the technology is essentially the same. In the US, for example, eight freight-dedicated railway companies, in which the infrastructure and operations are integrated, operate in a competitive market. They finance and build their infrastructure themselves, with the state only approving the alignment. In Europe the railway system evolved into mixed-traffic systems, pursuing multiple objectives, where competition for the moment remains limited to operations only (i.e. open access on the network is available to any operator) and where margins are generally insufficient for the railway infrastructure companies to finance the infrastructure themselves.
- 4 The existence of a contract is not enough per se. The commitment to the contract needs to be credible, i.e. the parties should not be able to renege on their commitments after the contract has been signed without serious consequences that would deter them from doing so in the first place. Credible commitment to the contract remains a challenge predominantly in developing countries (see ITFa 2017 in the context of PPPs).
- 5 Another commonly used term for private investment in existing assets is concession. Concessions merely define that the right to exploit the assets by the private investor is for a limited period, as opposed to full privatisation. Concessions can be based on either of the above mentioned principles.
- 6 For example, around 80% of the French motorway network is operated by PPPs. However, the Autorité de régulation des activités ferroviaires et routières (ARAFER), the French transport regulator, cannot find out what was the exact cost of different motorway improvements undertaken by the PPP partners because it has no legal means to require them to provide the information. A contract renegotiation would be required.
- 7 See <http://p3policy.gmu.edu/index.php/research/library-of-p3-center-research-beta>
- 8 Interestingly, though, governmental bodies have been known to take a clear position with regard to PPPs and accounting treatment. The July 2017 fiscal risks report of the UK's Office for Budget Responsibility (OBR) cited the use of off-balance sheet vehicles an example of a fiscal illusion.
- 9 See <https://data.oecd.org/fdi/fdi-flows.htm>

References

- ACI (2016), “ACI Policy Brief: Airport ownership, economic regulation and financial performance”, Airport Council International, Montreal, <http://www.aci.aero>.
- ADB (2008), Public-Private Partnership (PPP) Handbook, Asian Development Bank Institutional Document.
- Alexandersson, G. (2009), “Rail privatization and competitive tendering in Europe”, *Built Environment*, 35(1), 43-58.
- Alexandersson, G. and S. Hultén (2007), “Competitive tendering of regional and interregional rail services in Sweden”, *Competitive Tendering of Rail Services*, 165-188.
- American Society of Civil Engineers (2013), “2013 Report Card of America’s Infrastructure”, March.
- DG Regio (2008), “Guide to cost benefit analysis of investment projects”, Structural Funds, Cohesion Fund and Instrument for Pre-Accession, European Commission, Directorate General Regional Policy.
- European Commission (2011), “Stakeholder Consultation Paper”, “Commission Staff Working Paper”, on the Europe 2020 Project Bond Initiative, February.
- European Union (2013), “Regulation (EU) No 1316/2013 Of The European Parliament And of The Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010 3”.
- Farrell, S. (2012), “The ownership and management structure of container terminal concessions”, *Maritime Policy & Management*, 39(1), 7-26.
- Flyvbjerg, B., Holm, M. K., and Buhl, S. L. (2005), “How (in)accurate are demand forecasts in public works projects? The case of transportation”, *Journal of the American Planning Association*, 71(2), 131–146.
- Flyvbjerg, B., M. S. Holm and S. Buhl (2002), “Underestimating costs in public works projects: Error or lie?”, *Journal of the American planning association*, 68(3), 279-295.
- Funke, K., T. Irwin and I. Rial (2013), “Budgeting and Reporting for Public-Private Partnerships”, *International Transport Forum Discussion Papers*, No. 2013/07, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5k46n41mwp6g-en>.
- Graham, A. (2009), “How important are commercial revenues to today's airports?”, *Journal of Air Transport Management*, 15(3), 106-111.
- Helm, D. (2010), “Infrastructure and infrastructure finance: The role of the government and the private sector in the current world”, *EIB papers*, 15(2), 8-27.
- ITF (2017a), *Public Private Partnerships for Transport Infrastructure: Renegotiation and Economic Outcomes*, ITF Roundtable Report, No. 161, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789282108130-en>.
- ITF (2017b), *Ex-Post Assessment of Transport Investments and Policy Interventions*, ITF Roundtable Reports, No. 162, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789282108154-en>.
- Makovšek, D. and D. Veryard (2016), “The Regulatory Asset Base and Project Finance Models”, *International Transport Forum Discussion Papers*, No. 2016/01, OECD Publishing, Paris.

Meggison, W. L. and J. M. Netter (2001), « From state to market: A survey of empirical studies on privatization », *Journal of economic literature*, 39(2), 321-389.

OBR (2017), “Office for Budget Responsibility Fiscal risks report”, resented to Parliament by the Economic Secretary to the Treasury by Command of Her Majesty, July.

OECD (2007), *Infrastructure to 2030: Mapping Policy for Electricity, Water and Transport*, OECD Publishing: Paris.

OECD (2012), *Strategic Transport Infrastructure Needs to 2030*, OECD Publishing: Paris.

OECD/ITF (2013), “Understanding the Value of Transport Infrastructure Guidelines for macro-level measurement of spending and assets”, *Task Force on Measuring Transport Infrastructure Spending and Assets*, April 2013.

Raisbeck, P., Duffield, C. and M. Xu (2010), “Comparative performance of PPPs and traditional procurement in Australia. *Construction Management and Economics*”, 28(4), 345-359.

Rodrigue, J-P, Notteboom, T. and A. A. Pallis (2011), “The financialization of the port and terminal industry: revisiting risk and embeddedness”, *Maritime Policy & Management: The flagship journal of international shipping and port research*, 38:2, 191-213.

Savedoff, W. and P. Spiller (1999), *Spilled Water: Institutional Commitment in the Provision of Water Services in Latin America*, Washington DC: Inter-American Development Bank.

Thillairajan, A., Mahalingam A. and A. Deep (2013), “Impact of private-sector involvement on access and quality of service in electricity, telecom, and water supply sectors: a systematic review of the evidence in developing countries”, London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

van Dijk, H. (2007), “Tendering and Decentralization of regional rail passenger services in the Netherlands (1997–2005)”, *Competitive Tendering of Rail Services*, 127-137.

CHAPTER 3

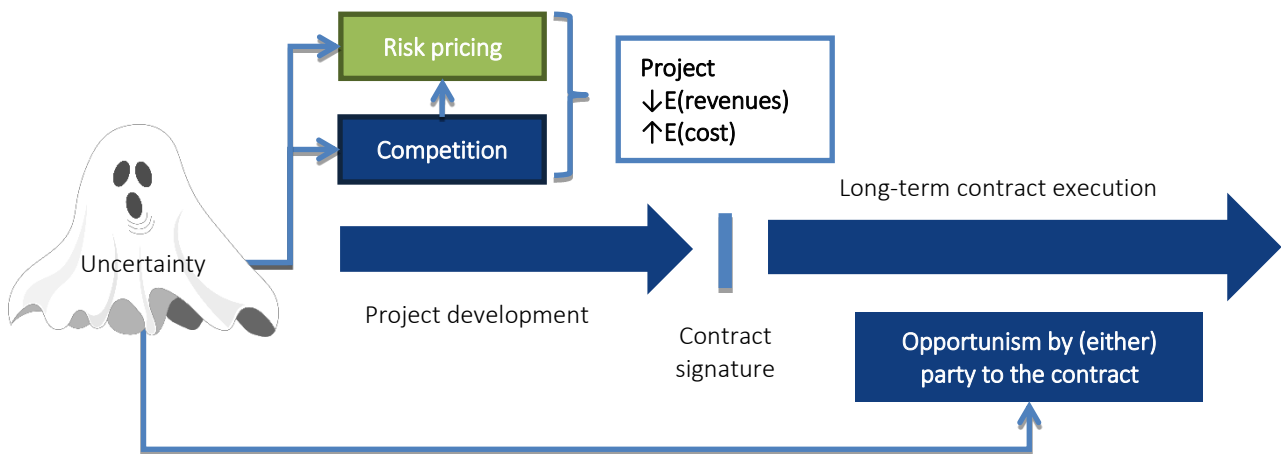
How uncertainty matters for private investment in infrastructure

The earliest discussions about uncertainty in economics go back to 18th century economists David Hume (1738) and Adam Smith (1776). Both saw human knowledge as limited and that humans are not completely rational in their behaviour. In Hume’s words: *“Nothing so like as eggs; yet no one, on account of this apparent similarity, expects the same taste and relish in all of them.”* (Hume, 1772).

In 1921 Frank Knight defined risk as the situation in which the distribution of the outcome in a group of instances is known. He defined uncertainty as when it is “impossible to form a group of instances, because the situation dealt with is in a high degree unique”. In short, Knightian uncertainty can be captured by the phrase “we just don’t know”. However, this view did not define mainstream economics until recently. Later, Ramsey (1926) and De Finetti (1929) proposed that humans can still form subjective probabilities that will eventually lead to an optimal solution provided they are rational and consistent in their beliefs. This view ignores, however, human psychology and the possibility of unknown future events and treats every economic situation as if there is only risk.

In this section, we outline three main aspects through which uncertainty matters for investment infrastructure or more precisely how it affects contracts (Figure 6).

Figure 5. How uncertainty affects private investment in infrastructure



Risk pricing has to do with how economic agents define the price of risk they accept in contracts. The approach of risk assessment and pricing is different depending on who is involved. In the context of infrastructure we use the example of investors (i.e. the capital market) and suppliers (e.g. builders and maintenance operators). Uncertainty affects both. People are naturally risk averse and the presence of

uncertainty in risk estimates disproportionately increases the risk premiums and increases the inefficiency of risk pricing.

The second way in which uncertainty matters is through competition. Local markets can be dominated by incumbents, who have on average better information than new entrants in the market. Providing the markets with more information on general (or other) measures that reduce uncertainty will increase the competition because it reduces the information asymmetry between existing and new players on the market. However, despite the availability of information, which is also promoted through the standardisation of the procurement process, the number of bidders could potentially be adversely affected by contract size, affecting the competition for both PPPs and traditional delivery of infrastructure projects.

Lastly, uncertainty is a driver of opportunistic behaviour in contracts – a core tenet in contract theory. Future climate or technological changes imply a change of circumstances, particularly in long-term contracts. Uncertain events may change the narrative for which the contract was written. This leads to a manifestation of two aspects. First, it is generally accepted that complete contracts that foresee every eventuality cannot be written for complex deals, such as infrastructure, hence a change in the narrative will require a renegotiation. Second, one or the other party in this case may behave opportunistically. A hold-up may occur. How players in principal-agent relationships exploit uncertainty is the cornerstone of contract theory.

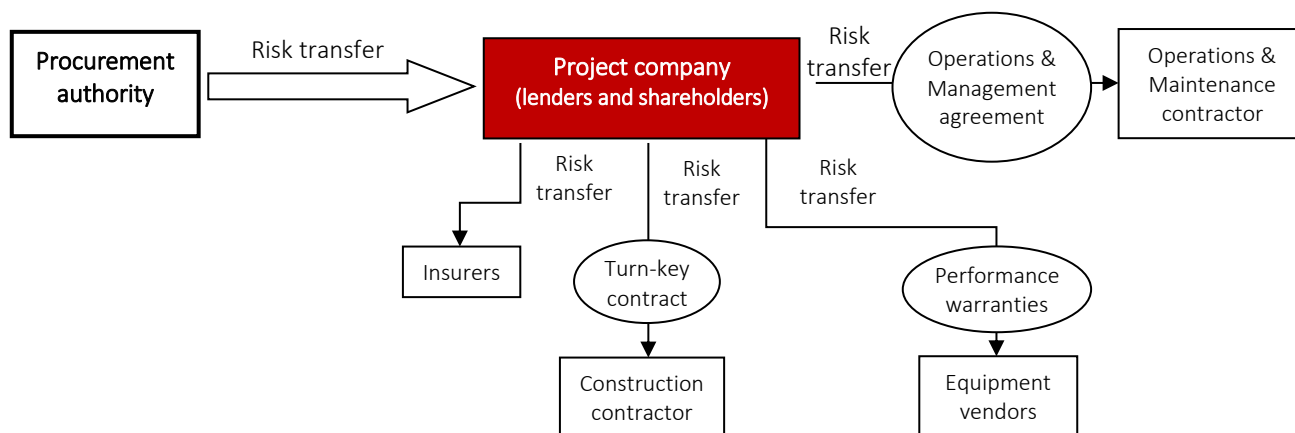
We conclude by synthesising the three aspects on how uncertainty matters for the policy maker in the context of this report and what avenues to pursue in addressing it.

Risk pricing and uncertainty

Before delving in to the discussion on risk pricing, we should first clarify why it is relevant to consider both the capital market (lender/investor) and the supplier level.

Whether it is a Public-Private Partnership (PPP) or a Regulatory Asset Base model (RAB), the risk transferred from the public side is not accumulated by a single private party and priced by it alone. PPPs, for example, are networks of contracts. Apart from financiers, other parties can also be included, such as insurers, design, build, operations and maintenance contractors and equipment suppliers (see Figure 7).

Figure 6. Risk dispersion within a Public-Private Partnership



The upshot is that all those bearing risk should be considered to get a full view of how risk is priced when we transfer it from the public to the private sector.

We set out two related but different perspectives: the capital markets approach and, in the case of the construction industry, the supplier approach.

Risk pricing on the capital markets

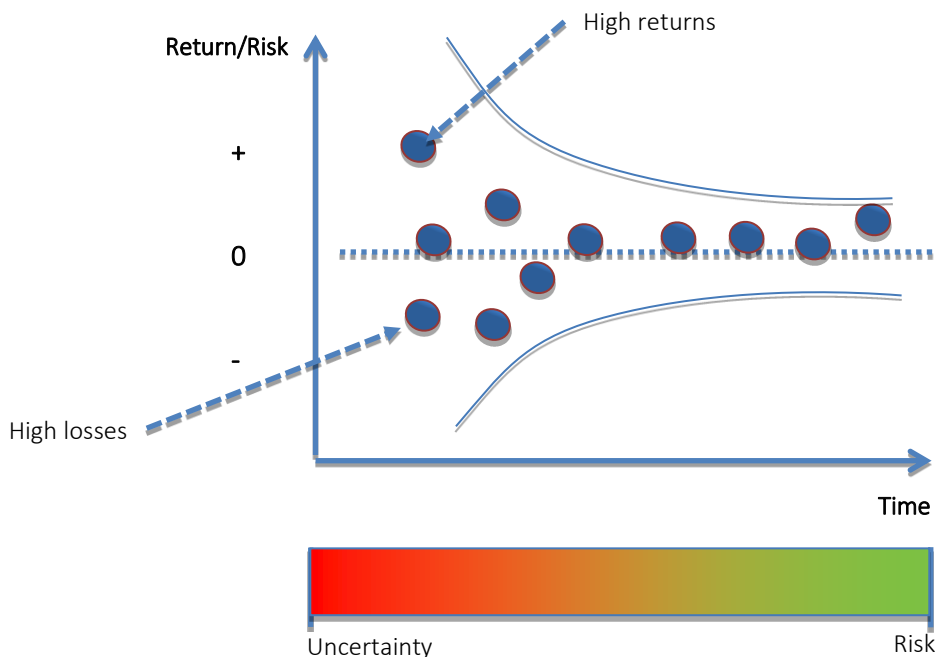
A basic characteristic of risk pricing on the capital markets is that the full risk must typically be expressed *ex ante*, i.e. before the contract is signed. A bank cannot decide to raise the interest rate on a loan when market circumstances change. The bank makes an informed bet based on the information it has. An investment is a bet too.

Modern portfolio theory deals with how to bundle investments and build portfolios on the capital markets to minimise risk and maximise return (Markowitz, 1952). In a portfolio context, what happens in any single investment is not relevant. What matters is what happens on average in all of them.

For a portfolio two types of risk matter – risks that can be diversified and systematic risks.¹ In theory risks that can be diversified are considered less relevant, and the key determinant of the cost of financing is the exposure to systematic risk.

Conventional financial theory assumes that complete information on both risk types can be produced by the market – a world view enshrined in the efficient market hypothesis (EMH) (Lo, 2008). Its workings are represented in simple terms in Figure 8.

Figure 7. An illustration of the efficient market hypothesis concept



Source: Kennedy et al. (2018).

On the left-hand side of the figure above a new market was opened. The first few pioneer investors had no historic performance data to fall back on. The investors compete with each other and make bets. Some investors made abnormal profits, others abnormal losses. However, the performance of these

investments provided experiences to learn from for the next generation of investors, and so forth. Through this process of building on past experience, the accuracy of risk pricing is increasing until all investors on average achieve normal profits (no market exists with systematic losses; such a market eliminates itself).

The EMH holds that through the collective accumulation of experience on a market all uncertainty eventually dissolves into risk. Although, this has not yet happened for infrastructure investment – i.e. infrastructure as an asset class does not yet exist although it is work in progress.²

There is some evidence that asymptotic improvement of risk pricing may take place to some extent for some assets. The EMH, however, remains a subject of discussion between economists and is contested on methodological grounds and, perhaps more importantly, behavioural grounds.

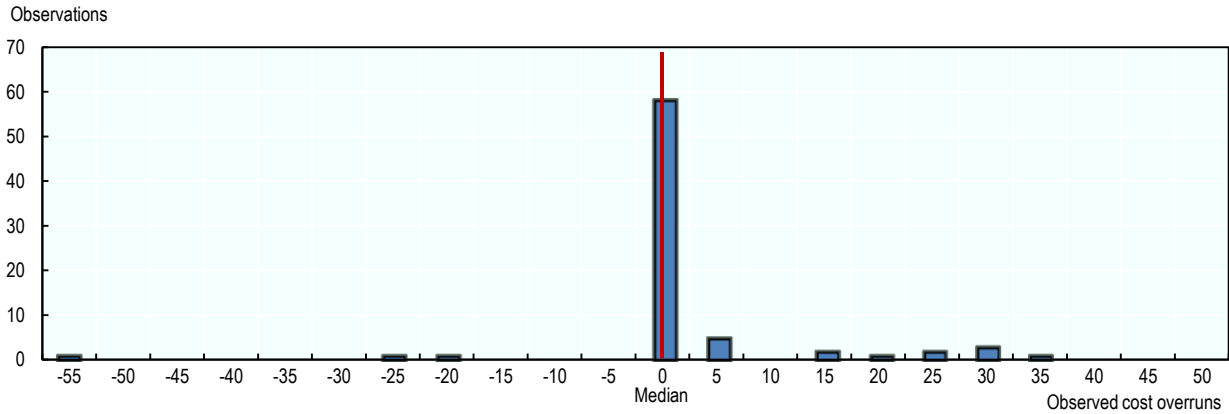
With models private investors and lenders use to assess their risk exposure, the modelling outputs are generally not taken at face value. In practice mark-ups are applied for non-systematic risks (Fama and French, 1992; Jensen and Meckling, 1976; Mehra and Prescott, 1985; Tan, 2007). One proposition why this occurs is that from the perspective of an individual manager's career and income, the performance of a single investment may be important. The manager may, therefore, apply a mark-up as a premium for the non-systematic risk even if this risk is not a material concern to shareholders. It may also be that the decision maker has reservations about the precision of the model output due to the model itself or the completeness of the input information required. The investigation of human decision biases has spawned a vast literature. A classic example comes from Kahneman and Tversky (1984), who identified loss aversion.

Construction risk pricing

For major construction contractors working on large portfolios of projects the same concepts of diversifiable and systematic risk are relevant as outlined above.

Private investment in infrastructure construction in PPPs is typically done through design-build (DB) fixed-price/fixed-date engineering, procurement and construction (EPC) contracts. These reflect grantor expectations, as well as strict lender requirements aiming to preserve the project company (special-purpose vehicle, or SPV) as an empty shell, with minimal residual risk (Demirag et al. 2012). Accordingly, the contractor too must aim to express and price the full risk he expects to be facing ex ante. Indeed, this contract type delivers as promised (see Figure 9). The single available study on the construction risk exposure of investors in 75 major infrastructure project finance deals shows that most of the time these deliver exactly on cost (Blanc-Brude and Makovšek 2014).³ The median risk of cost overruns is zero, which means investors could fully diversify construction risk. The investors and the SPV purchase insurance against construction risk for this type of contract.

Figure 8. Cost performance of construction contracts in project finance projects

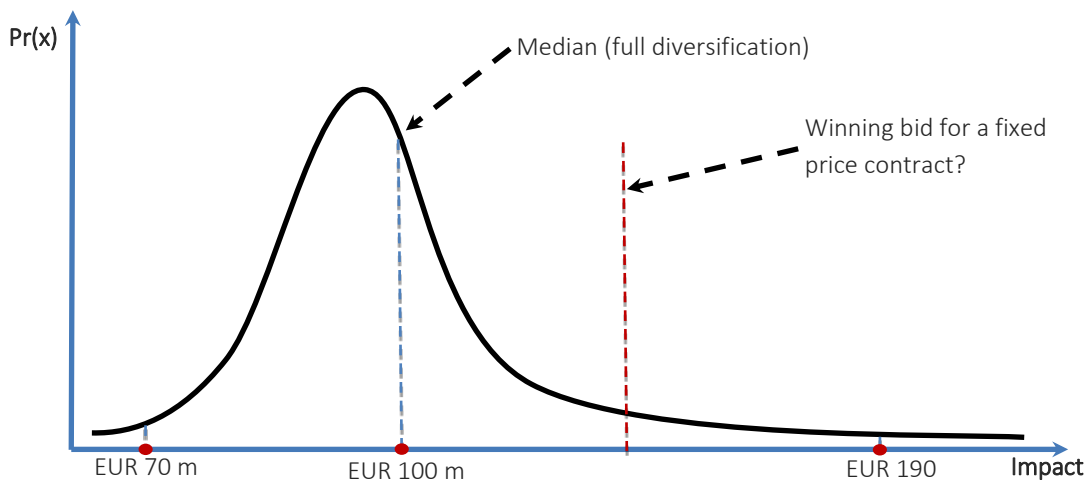


Source: Adapted from Blanc-Brude and Makovšek (2014).

Unlike in the financial sector, risk performance in construction is not collated in vast time series that would match project performance with their characteristics. While partial insights on past project performance may exist, the opacity of major infrastructure projects and the lack of a mechanism to accumulate historical experience in a similar way to financial markets require a different approach to risk assessment and pricing. Construction risk is assessed subjectively through risk workshops, where experts identify risk events and assign probabilities and impacts to them. The perceived risk exposure is then expressed in the form of a contingency, i.e. a mark-up on the base estimate. There is no empirical research available on their ex post accuracy.⁴

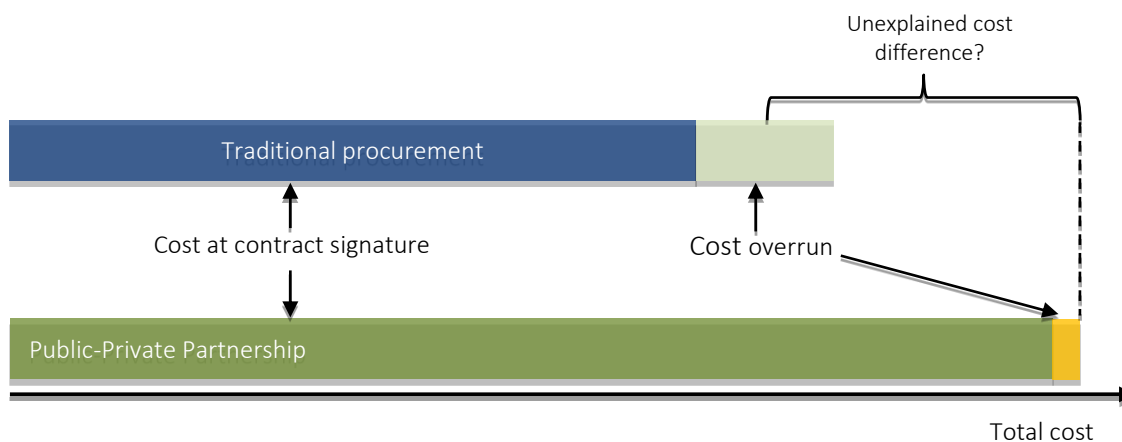
Moreover, complex projects are subject to low-probability high-impact events (Kennedy et al., 2018). In these cases risk distributions are asymmetric with a tail to the right. Figure 10 illustrates the challenge of providing a fixed price on such a risk profile that is not normally distributed. While the figure below may seem clear to the reader, the decision makers and the contract will not have the same benefit in practice due to uncertainty.

Figure 9. Asking for a fixed price for a not fully known and skewed risk profile



Makovšek and Moszoro (2018) suggest that large risk and uncertainty transfers to contractors lead to disproportionate cost differentials between traditional procurement, which does not rely on fixed-price/fixed-date contracts, and PPPs. They develop their argument using motorway projects in Europe, where the design standards are relatively standard and options for innovation limited, i.e. indicative evidence does not support the proposition that the difference is due to a higher quality of infrastructure. In such cases a DB contract may exacerbate the uncertainty challenge because the bidders need to price the project when the final design is not yet complete. Based on indicative evidence a premium of about 20% has to be taken into account for European motorway projects (Figure 11).

Figure 10. The end cost of traditional procurement vs. Public-Private Partnerships in motorway projects



Significant premiums for uncertainty also exist in the context of traditional procurement, where the contract power is lower (the risk transfer is less strict than with PPPs, i.e. the contractor has more room to seek revenues from the client due to variations or other reasons). The example in Box 2 shows a premium twice that of the actual risk exposure, which was known ex post.⁵

Box 2. Uncertainty, infrastructure procurement and low-powered contracts

Considerable time may pass between the actual bid submission and contract completion. Especially if input prices are volatile, contractors need to be mindful of the potential future price variations of resources that affect the cost of their products (e.g. asphalt). As they cannot do much to control these costs, it is a source of exogenous uncertainty. In the US, multiple institutions have applied pass-through formulas for inputs, which were affected by considerable price variability. The Oklahoma Department of Transport (ODOT) applied such a formula for asphalt mixtures (i.e. an oil-related input). If the initial price grew by more than 3%, an automatic corrective payment would be disbursed to the contractor. Between August 2006 and June 2009, ODOT granted a net payment to firms equal to 5.1% of the value of eligible contracted items but received winning bids on average 11.7% lower for the eligible items after the price adjustment introduction.

Source: Kosmopoulou and Zhou, 2014.

To conclude, regardless of the economic agent who is concerned uncertainty has a disproportionate effect on the price asked for accepting it. It can be assumed that this effect would be more pronounced if the opportunities to manage it are limited, which in much of the examples above is not the case.

Maintenance risk pricing

An integral part of the PPP is also an output- and performance-based maintenance contract.⁶ These contracts are based on a specified service level, which was determined at the bidding phase. In this case, too, the contractor has to provide a fixed-price estimate for the prospective maintenance works. During contract execution they will usually receive a monthly lump sum provided the expected service level has been met.

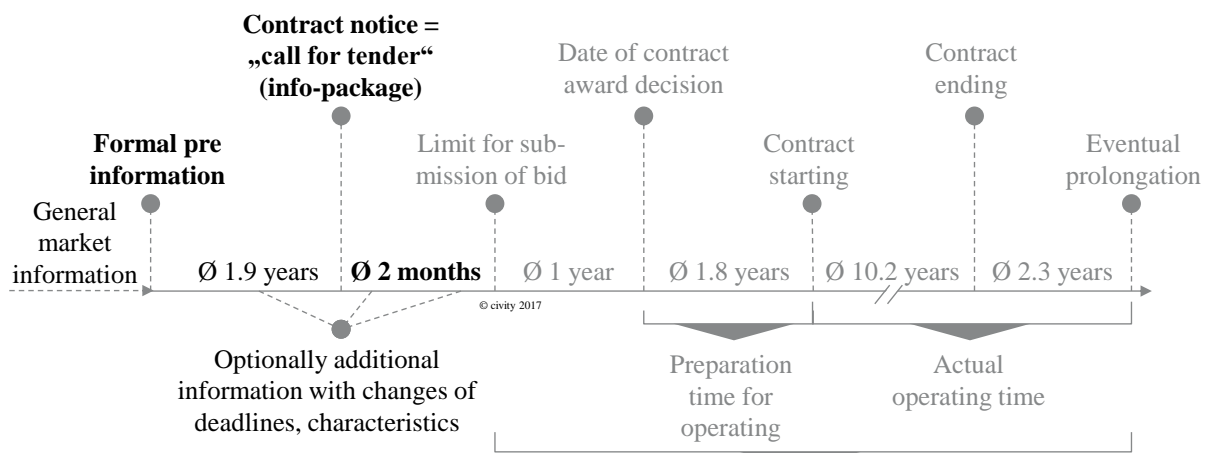
Ideally, the contracts include a cost adjustment formula for unexpected traffic volume growth and unexpected increase of overloading (Zietlow, 2017). Nevertheless, output- and performance-based maintenance contracts transfer a significant burden of risk onto the contractor and include considerable liquidated damages for non-performance (up to 50% of the monthly lump sum times the length of the non-compliant section; (World Bank, 2009).

No empirical data is available on their systematic cost/performance compared to alternatives (i.e. stand-alone performance maintenance contract/non PPP; long-term vs. short-term contracts). It is reasonable to assume the maintenance contractor risk-pricing challenges are similar to those of the construction contractor and become exacerbated with the length of the contract.

Long-term operations contracts also face risk-pricing issues

One of the contributions to the Working Group (Beck et al., 2018) also investigated indications of inefficient risk pricing in long-term operations contracts – railway franchising in Europe, focusing on Germany. In a departure from a public monopoly structure, franchising was able to achieve substantial efficiency gains initially. These were also reflected in the profit rates operators achieved. Over time these were eroded by competition and the presence of cross-border investment from other state operators, which do not seem to have the same profit constraints as private operators, making market entry even more difficult (up to a 3% return on capital invested).

Figure 11. Average time for tendering steps in Germany



2011-2017, Lots = 148

Excluding direct awards & restricted procedures

Source: Beck et al (2018).

Economically obligatory bound to submitted bid **Ø 15 years**

Operators tendering for franchises face multiple exogenous factors that are difficult to manage, where the lowest price represents 90% of the selection criteria weights. The general approach to tendering may further exacerbate these issues. As Beck et al. (2018) illustrate, the bidders have almost two years from

when first notified a tender will take place. During this time bidders can try to build a general view on the market. When the tender actually takes place, however, the bidders only have about 60 days to prepare their bid for a period that in total might last up to 15 years (Figure 12).

In terms of inputs for their calculation, the completeness and the reliability of the information in the contract notice will play a crucial role (one of our major recommendations in Chapter 3 relates to the completeness and reliability of information for the bidders).

The interaction between uncertainty and competition

The previous section explores how uncertainty affects risk pricing directly. The discussion and the efficient market hypothesis assume competition is already as effective as it can be. In this section we explore how uncertainty affects competition.

All firms in the market do not have the same level of information. The incumbents who regularly compete for contracts in a particular region have an information advantage over new entrants. Providing the market with information that would inform the bidding better not only helps the incumbents reduce risk-pricing uncertainty, but it also gives firms looking to enter the market a better starting point. An empirical demonstration of this outcome is illustrated in Box 3.

Box 3. Uncertainty, competition and survivability of firms

In the United States, the Oklahoma Department of Transport (ODOT) changed its procurement policy to publicise the state's internal cost estimates during tendering. This involved not only publishing the total cost estimate for the tender but also more detailed information. The state started revealing its estimate for each component of the project by releasing a set of individual cost estimates for each quantity of material used and each important task involved. As a result, this policy change provides detailed information that can substantially reduce the uncertainty related to common components of the cost. For example, in one case the state can reveal the cost of excavation, which depends on soil conditions, and in another the cost of a specific bridge repair, which depends on the extent of the damage. It was found that the additional information eliminated the bidding differential between entrants and incumbents attributed to informational asymmetries. Secondly, the study argued that firms who used to exit the market relatively soon are now staying 37% longer, while at the median level bidding duration increased by roughly 68%.

Source: De Silva et al. 2009.

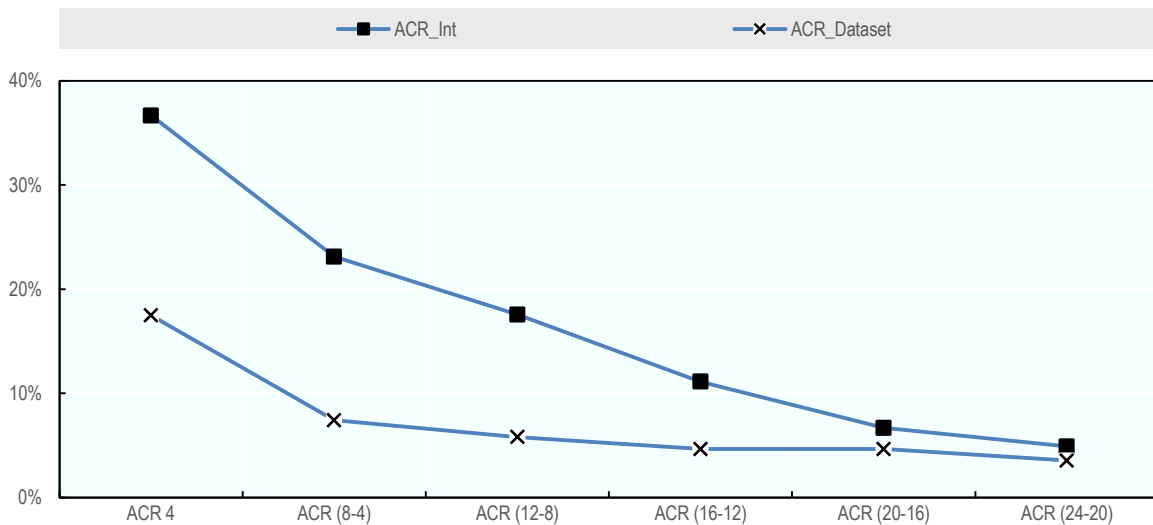
In conjunction with uncertainty, a blunter factor that affects competition is project size. Risk diversification matters for construction firms not only for the capital market. A large project, though, may disproportionately expose the firm or with the lack of information about risk create an impression that this is the case. Blanc-Brude (2013) suggests the transfer of risk deters smaller firms that are unable to absorb or manage it from bidding. In the case of the UK's private finance initiative (PFI) school market, the distribution of bidding firms is skewed towards the largest firms, which also have the most capacity to absorb major risk transfers through fixed-price/fixed-date contracts.

Roumboutsos (2018) tried to measure the effects of contract size on competition for the contract in the European transport infrastructure market over the period 2006-16, looking at project sizes above EUR 10 million.⁷ The study did not find a specific trend. It also could not identify any differences between

traditionally procured projects, where less risk is transferred through contracts, and PPPs, where more risk is transferred. The results, however, provided an immediate explanation why this is the case. Transport infrastructure procurement markets above EUR 10 million are dominated by the same oligopoly of firms (see Figure 13).

The adjusted concentration ratio (ACR) is based on the share of awarded contracts in numbers. The ACR4 below is to be interpreted as what share of all contracts were won by the top four firms; the ACR4-8 adds the next four most successful firms in bidding, etc. The ACR_PPP_2016 line shows the top eight firms in the market win more than 60% of all PPP contracts in the world, excluding the US and Canada. The flattening of the slope to the right suggests a two-tier market where most of the contracts are won by a small select group of firms, while for the remainder many smaller firms bid. The flatter line (e.g. ACR_Int) illustrates what a relative competitive market may look like.

Figure 12. Competition in Public-Private Partnerships and traditional procurement in the EU, 2006-16

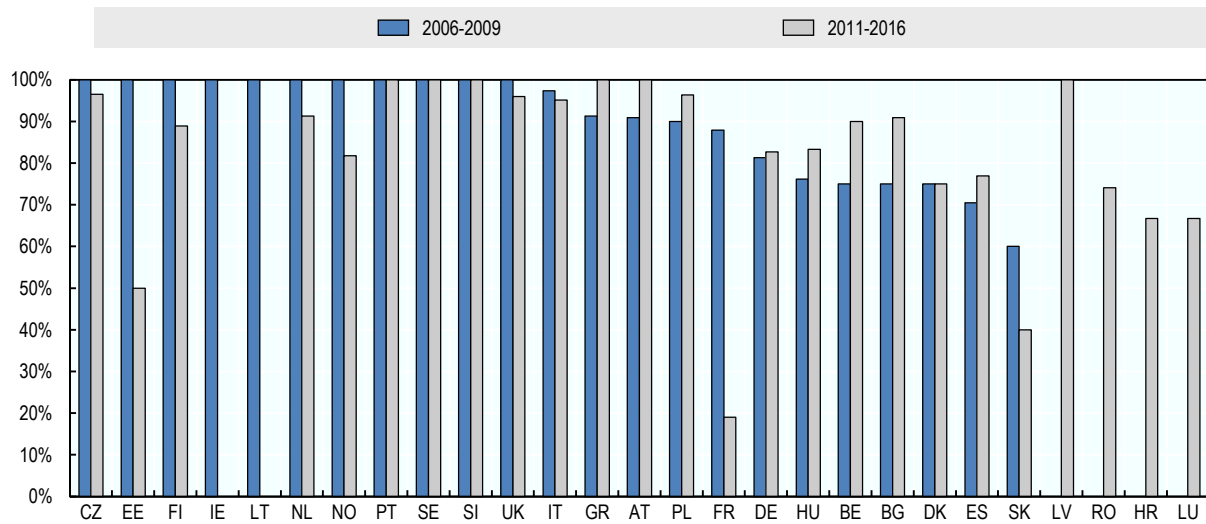


Note : ACR = Adjusted concentration rate

Source: Roumboutsos (2018).

The market is not competitive, and as Roumboutsos (2018) argues, this is not the natural equilibrium of the market but more likely a result of national policies. Indeed, one finding of the study was that the leading firms, who on average are the winning bidders, are more or less local (Figure 14). When competition for the project was significant, the country's attractiveness to bidders was the determining factor.

Figure 13. Contracts awarded to leading contractors in consortia originating from the same country



Source: Roumboutsos (2018).

Uncertainty as a driver of opportunistic behaviour in contracts

The mainstream of contract theory revolves around the opportunistic behaviour of the principal (client) and the agent (contractor) in a setting where one has better information than the other (information asymmetry). Uncertainty in this context is not knowing what the other one knows. The information asymmetry can lead to inefficient outcomes.

Adverse selection occurs when price signals do not lead to an efficient outcome. A classic example concerns the tendering of a contract based on a lowest bid without bidder prequalification or other protective measures. The cheapest bidder might not necessarily be the most efficient one. If due to lack of experience, for example, the lowest bidder underestimates the cost, failure during contract execution might result (a winner's curse). Such an outcome is also possible due to the opportunistic behaviour of the bidder, not only their lack of experience. Opportunistic behaviour has received far greater attention by economists and considered a far more pressing concern in contracts.

Williamson (1975) was one of the first to formally introduce opportunistic behaviour in contracts – contracting parties follow their self-interest in the first place and try to evade agreements in the contract. Two central examples of post-contractual opportunism are moral hazards and hold-ups.

The notion of moral hazard is closely connected with whether the client can observe the effort of the principal or not. It is characterised by one contract party having a hidden agenda. For example, a contractor uses cheaper construction materials to improve his margin, which he knows will affect the long-term cost of maintenance. If the client has no way of monitoring such behaviour, then the contractor has an adverse incentive because he knows he can get away with it. This is why, for example, external supervision is done by the client, design and material standards are developed, etc.⁸

Hold-ups, on the other hand, occur due to prospective change in the bargaining power after the contract is signed due to investment characteristics. Private investment in infrastructure is a classic example. The investment in infrastructure is sunk in the sense that it has no value for anybody else but the client (i.e. the government). After the investment is made the government can change the rules of the game to

implicitly (e.g. raise taxes), or, explicitly expropriate the investor. This is, of course, a simplified example. In reality, in any advanced economy contract rights can be effectively enforced in court. Moreover, such an opportunistic move by the government would give a highly negative signal to prospective private investment, which further enforces the credible commitment of both parties to the contract.

The public side can also be exposed to a hold-up situation. Sunk cost is not the only cause that can lead to hold-up problems. Several asset characteristics exist, known as asset specificity, which can enable hold-ups.⁹ An example of one which exposes the public side is temporal asset specificity (Masten et al., 1991). Imagine a large construction contractor building a transport connection to the venue where the Olympic Games will take place. If the contractor is late, the typical contractual penalties he might face will be far smaller than the international and political embarrassment for the government if the project is not built on time. Hence, the value of timely completion for the government is disproportionately higher than for the contractor. The contractor could carry out a hold-up.

What makes hold-ups a challenge, though, is not what is in the contract but rather what is not. Hold-up situations do not result only due to moral hazard. The world is not static. Contracts may have difficulty accounting for every possible eventuality, so future situations that are outside of the contract may arise (Hart, 1995). An example of a change in the original narrative of a contract is provided in Box 4.

Box 4. An example for a hold-up in a motorway Public-Private Partnership

In 1995, the California Department of Transportation (Caltrans) awarded a 35 year concession for an express lane in a ten-mile segment in Orange County to the California Private Transportation Corporation (CTPC). The tolled express lane had 33 000 daily users and was a financial success for the contractor. In the late 1990s, congestion progressively increased and Caltrans wanted to add a non-tolled lane to relieve congestion. CTPC refused renegotiation and went to court, citing the non-compete clause. After protracted bargaining over four years, a USD 207 million buyback was agreed. The cost of building the express lane was USD 130 million.

This represents a case of hold-up based on so-called temporal asset specificity. Caltrans was under pressure from dissatisfied road users to find a solution fast, while the CTPC was in no hurry. If at the time the contract was signed Caltrans did not project traffic growth above and beyond the capacity of an express lane, the change of traffic flows would represent a change in the narrative.

Source: Engel et al. 2018.

One of the solutions to moral hazard and hold-up issues is vertical integration. In trade, vertical integration implies a merger between two firms. In infrastructure investment, vertical integration implies the bundling of project development phases to prevent hold-up and moral hazard issues from one phase into the next.

A central feature of PPPs is the bundling of design, construction, maintenance and operations. The bundling internalises many of the challenges of the preceding phase affecting subsequent ones (e.g. design errors affecting construction or poor construction quality affecting subsequent maintenance/operations). As a result phase bundling can help reduce the inherent moral hazard and hold-up challenges which may occur when these phases are procured separately. Economists (e.g. Iossa and Martimort, 2015; Engel et al. 2014) have already tried to evaluate the PPP model in the context of contract theory, theoretically proving some of its proposed benefits, such as that of bundling. They have done so in a setting where risk pricing was not considered as a potentially offsetting factor to efficiency gains. Moreover, disruptive exogenous changes during the long-term contracts were not investigated.

The transport sector is facing at least two factors that will manifest over the coming decades, and nobody can exactly predict their timing and impact. Climate change mitigation is already at the centre of the political agenda, and a paradigmatic technology change in transport is on the doorstep. It is clear that neither of these two factors will manifest overnight. However, for contracts lasting 20 or 30 years such changes may prove systematically disruptive. This could affect both the risk-pricing aspects as well as the opportunistic behaviour dimension.

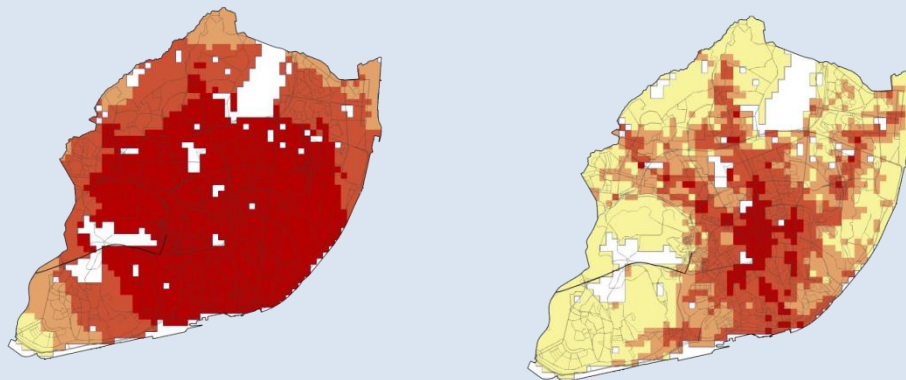
Technology shifts and climate change as drivers of long-term uncertainty for transport infrastructure

In the coming decades, the transport sector may experience systematic changes that may affect both the utilisation of transport infrastructure (i.e. how much and where the traffic flows will go) and what transport infrastructure is (e.g. the advent of smart and autonomous vehicles). Based on its freight and passenger model, the ITF estimates that in the business-as-usual scenario the global growth in passenger and freight flows may grow two- or threefold by 2050 (ITF, 2017c). With the advances in shared and autonomous mobility – and not taking into account other influences such as a potential change in the teleworking culture – the business-as-usual scenario becomes even more uncertain (see Box 5)..

Box 5. The theoretical potential of future mobility solutions in cities

The ITF built a computer simulation to investigate theoretical possibilities of shared mobility. The model is based on data for the city of Lisbon, Portugal. Shared mobility is delivered by a fleet of six-seat vehicles (i.e. Shared Taxis), which offer on-demand, door-to-door shared rides in conjunction with a fleet of eight-person and 16-person Taxi-Buses. These serve pop-up stops on demand and provide transfer-free rides. Rail and subway services keep operating in the current pattern. In the simulations, congestion disappeared, traffic emissions were reduced by one third, and 95% less space was required for public parking. The car fleet needed would be only 3% the size of today's fleet. Although each car would be driving almost ten times more kilometres than currently, total vehicle-kilometres would be 37% less even during peak hours. The much longer distances travelled imply shorter life cycles for the shared vehicles. This enables faster uptake of newer, cleaner technologies and contributes to a more rapid reduction in CO₂ emissions from urban mobility. Figure 15 shows how accessibility of jobs would improve under shared mobility. This implies a change in traffic patterns that would have implications e.g. for road capacity and maintenance requirements.

Figure 14. Accessibility of jobs in Lisbon: Current situation and shared mobility simulation



light = less accessible, dark = more easily accessible

Source: ITF 2016.

Apart from the change in transport technology, a change in weather patterns is another factor that might affect long-term contracts in unpredictable ways. The exhaustive “Adapting Transport Infrastructure to Climate Change” (ITF, 2016) report noted that a changing climate may make our predictions less certain, representing a challenge in infrastructure specification decisions and related maintenance costs.

Box 6. Adapting Transport Infrastructure to Climate Change

Summer temperatures will increase and heat extremes will become more frequent and last longer (e.g. heat-related damage to asphalt pavement – see Figure 15 below). Winter temperatures will become milder, but temperature amplitudes may increase, and swings between sub-zero and above-zero temperatures will occur more often.

Large parts of the Southern lower Northern Hemispheres may become dryer on average. Extreme precipitation events will become stronger and more frequent, even in regions with lower average levels of rainfall. The strength of extreme storms may increase, especially for extra-tropical cyclones and Arctic cyclones. Sea levels will rise, with more frequent wave overtopping and thus contributing to more damaging storm surges. In some instances, sea level rise may permanently flood low-lying areas. Finally, more CO₂ in the atmosphere will accelerate the deterioration of concrete whereas more elevated levels of carbon dioxide in seawater will increase damage to submerged and exposed infrastructure elements.

Figure 15. Heat damage to asphalt pavements: Rutting and cracking



Under a changing climate meteorological and climate parameters can evolve in uncertain ways and thus make the consequences for transport networks more difficult to predict. This uncertainty entails the risk of either over-specification of infrastructure design standards (leading to unproductive investments) or under-specification (leading to asset failure or service degradation). For public authorities tasked with delivering quality transport services or private operators who must realise expected returns for their investors, these are considerable risks, and new models for decision making under uncertainty are required to ensure continued and reliable transport network performance in the face of climate change.

Source: Excerpt from ITF (2016a). Images : W. Burda cc-by-sa (left) ; Oregon Department of Transportation cc-by-sa (right).

Uncertainty and the cost of public versus private finance

So far we have outlined three aspects of how uncertainty matters for (private) investment. It affects the risk pricing of investors and suppliers and the level of competition, plus it can lead to opportunistic behaviour during the contract.

Beyond the particular impacts of the above uncertainty, the risk pricing and competition angles taken together effectively determine the total cost of risk transfer from the public to the private sector. In other words, they inform the discussion of what is the cost of public vs. private finance in infrastructure investment. This is a vital question for risk and uncertainty allocation decisions.

A naive view is that the government has a clear cost advantage because it can issue debt at the risk-free rate. This view ignores that the representation of risk in the public and private sectors is different. For example, in the public sector investors may borrow at a risk-free rate EUR 100 million to build a project, but if there are cost overruns the taxpayers will bear them. In the private sector, the full risk needs to be expressed and priced *ex ante*.

In theory, the two public and the private representations of risk would yield exactly the same result if the capital markets' risk pricing were fully efficient. Economists have concluded (Spackman, 2004) that is not the case for systematic risk, and Makovšek and Moszoro (2018) extend the point to diversifiable or project-specific risk, like construction risk. Even if investors are able to efficiently price risk at their level, this will not be the case for project-specific risk that is passed on to suppliers. They will have to deal with it on a case-by-case basis (see the construction risk-pricing section above).

It then follows that the advantage of the state does not rest on the ability to issue risk-free debt. It comes from spreading the risk among taxpayers, who are forced to bear it. More precisely, because the taxpayers bear risks on a pay-as-you-go basis, they pay exactly for the risk that materialises and not an *ex ante* estimate of risk. In this way they avoid human bias in risk pricing due to fear of uncertainty, on which the private sector approach is based. As Engel et al. (2018) note, this potential advantage is subject to the reasonable administrative cost of bureaucracy and a competent tax policy.

A counter-example to the logic above is the marginal cost of public funding (MCPF). This holds that taxes disincentivise people to work and invest, which represents a social cost. In the EU Cost-Benefit Analysis (CBA) guidelines (Sartori et al., 2014), for example, an MCPF of 1 is recommended, which means that every additional euro of taxation causes an additional EUR 1 of income loss.

In our particular case, MCPF would imply that a cost overrun on a motorway project paid through raising taxes would have greater social cost than a cost overrun, which the private party absorbs but would then be repaid through higher tolls, assuming users perceive those differently than taxes. This comparison is, of course, inadequate. If there are users available to fund the project, the state can spread its higher cost and toll among them. If users are not available, the funding of the project comes through taxation anyway, regardless of whether the project is procured traditionally or through an availability-based PPP.

As we cannot transfer the problem of project selection to the private sector (as discussed in Chapter 1), the responsibility of whether a project has a positive net present value remains with the public sector. Knowing that the funding source is set before the project has started, the key question is then - which procurement mode is more efficient? In summary, the MCPF argument is not relevant to our analysis, i.e. it is out of context.

Given the state has an advantage in the cost of financing infrastructure, a straightforward conclusion is possible with regard to risk allocation (see Figure 17).

Figure 16. How risk transfer affects value for money

$$\text{Transferred risk} \times \text{Efficiency gains} - \text{Transferred risk} \times \text{Price} = \text{Value for money}$$

On one hand, the risk transferred acts an incentive to the bearer to be more efficient. On the other, the need to price the risk ex ante in conjunction with uncertainty leads to inefficient risk pricing. As long as the efficiency gains are higher than losses from inefficient risk pricing, value for money will be achieved. In Chapters 3 and 4 we do not present new evidence on value for money beyond that reviewed in Makovšek (2018b) and Makovšek and Moszoro (2018), which has already been implicitly represented in our exposition so far. We seek to understand what can be done to reduce the (inefficient) risk pricing in the second term of the formula without infringing on the first when a single competition for the contract might be sufficient to achieve a positive outcome.

Current risk allocation recommendations

The World Bank and the Global Infrastructure Hub (GIH) provide some of the most advanced and comprehensive risk allocation and mitigation toolkits to date.¹⁰ These cover a broad range of risks, including design/construction risk, operating risks, demand risk, Force Majeure risk, change in law/political-regulatory risk, expropriation-nationalisation risk, environmental risk, social risk, refinancing risk, currency exchange risk and interest rate risk.

The recommendations focus on protecting first order interest of the lenders (lender concerns) and the client (the procuring authority). They do not explicitly engage in second order consequences of the proposed allocation, in line with what was described so far in this chapter (i.e. how a particular risk allocation might affect the pricing of the supplier or the level of competition for the contract). In short, there is an implicit assumption that the proposed risk allocations can/will be satisfactorily resolved by the market.¹¹

A further question beyond what some of the best risk allocation recommendations tell us is - how close do actual practices in countries compare to these recommendations? No such international review is available, however a high-level overview exists for Spain. This analysis included 41 road PPP projects with a total length of 4 349 kilometres. These represent

- 29 toll road projects,
- 11 shadow toll road projects,
- 1 availability based road project.

The results of matching the risk allocation in these past or still operational projects with the GIH risk allocation matrix are provided in Appendix 2. They show that of 18 risk categories, in six risk categories projects diverged from the GIH recommendations. These included land purchase and site risk, demand risk, Force Majeure risk, political risk, regulatory/change in law risk and disruptive technology risk. These deviations (especially the first two) from what is now recognised as best practice contributed to several concessions going in to bankruptcy. Both the Spanish authorities and the private sector learned from these experiences. They are also a reminder that developing or improving the best practice in any discipline is one task and ensuring its implementation, another.

Box 7. Further reading on Chapter 3

Detailed analyses of the issues covered in this chapter are available in these Working Group Papers:

Engel, E., Fischer, R. and A. Galetovic (2018), “Dealing with the Obsolescence of Transport Infrastructure in Public-Private Partnerships”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Andersson, L. et al. (2018), “Risk Pricing in Infrastructure Delivery: Making Procurement Less Costly”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Makovšek, D. (2018b), “The Role of Private Investment in Infrastructure”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Rouboutsos, A. (2018), “Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Also of interest:

Makovšek, D., and M. Moszoro (2018), “Risk pricing inefficiency in public–private partnerships”, *Transport Reviews*, 38(3), pp. 298-321.

Notes

- 1 Project risk is considered diversifiable when it is independent from events occurring on another project. For example, if the investor cannot precisely assess the ground conditions on a project, then by investing in a series of projects the cost variation will average out. In the case of systematic risk the events across a project portfolio are not independent. Traffic, for example, is correlated to general economic activity. An investor can have a stake in many motorways in a given country without being able to diversify traffic risk away. If the country's economy experiences a downturn, demand on all motorways will be affected as well.
- 2 The first benchmarks have been made available to investors (<http://edhec.infrastructure.institute/>), but the market now needs to use the new information available.
- 3 A PPP is a project-finance deal between a public and private entity. The same kind of structures also exist between private entities, only their purpose is to insulate the sponsoring company from risks that might materialise on the project.
- 4 Another reason why less information on ex post performance is available could be that governments have not fully exploited the possibilities of ex post analysis (OECD 2017).
- 5 The indexing of certain costs in contracts is not an innovation; contract formats such as FIDIC (International Federation of Consulting Engineers) provide for such possibilities. What is of interest here is the difference between actual ex post risk and its ex ante perception.
- 6 Shorter-term performance maintenance contracts are also used in traditional procurement (e.g. procured through a national motorway or railway company).
- 7 The study dataset includes all contract award notices for projects of over 10 EUR million for which information is available. Project size is studied in the range of EUR 10-20 million, EUR 20-50 million, EUR 50-100 million, EUR 100-200 million, EUR 200-500 million and over EUR 500 million.
- 8 The example of adverse selection above could also be recast in a moral hazard context. In this context a contractor might be aware of his upcoming financial distress, which the client does not know, and is bidding below his cost to maintain a cash flow but might fail during contract execution. Alternatively, when the client's contract management is not strict enough, a contractor might bid low but then adopt an adversarial position during the contract execution and pressure the client for additional revenue.
- 9 Examples of asset specificities include: sunk costs (i.e. dedicated assets); temporal specificity; site specificity (e.g. a processing plant next to a mine); physical asset specificity (e.g. a custom-built tool designed for a single purpose); human asset specificity (human skills used in a particular process that takes a long time to develop and is costly to replace).
- 10 For the World Bank see <https://ppp.worldbank.org/public-private-partnership/financing/risk-allocation-mitigation>; <http://ppp.worldbank.org/ppp/overview/practical-tools/checklists> and <https://ppp.worldbank.org/public-private-partnership/sector/transportation>. For the Infrastructure Hub see https://ppp-risk.github.org/risk_category/transport
- 11 For example, the WB/PPIAF risk allocation matrix in regard to construction or operations and maintenance cost overrun risk notes that "the Concessionaire should have based its proposals on properly budgeted estimates."

References

Blanc-Brude, F. (2013), “Risk transfer, self-selection and ex post efficiency in public procurement. An example from UK primary and secondary school construction contracts”, *Revue d'économie industrielle*, (141), 149-180.

Blanc-Brude, F. and D. Makovšek (2014), “How much construction risk do sponsors take in project finance”, EDHEC-Risk Institute.

Dunne, T. et al. (2008), “The impact of public information on bidding in highway procurement auctions”, *European Economic Review*, 52(1), 150–181.

De Silva, D. G., Kosmopoulou, G. and C. Lamarche (2009), “The Effect of Information on the Bidding and Survival of Entrants in Procurement Auctions”, *Journal of Public Economics*, Vol. 93/1-2, pp. 56–72.

Demirag, I. et al. (2012), “The diffusion of risks in public private partnership contracts”, *Accounting, Auditing & Accountability Journal*, 25(8), 1317-1339.

Engel, E., Fischer, R. D. and A. Galetovic (2014), “The economics of public-private partnerships: A basic guide”, Cambridge University Press.

Fama, E. F. and K. R. French (1992), “The cross-section of expected stock returns”, *The Journal of Finance*, 47(2), 427–465, <http://dx.doi.org/10.1111/j.1540-6261.1992.tb04398.x>.

Hart, O. (1995), *Firms, Contracts, and Financial Structure*, Oxford University Press.

Holmstrom, B. (1979), “Moral hazard and observability”, *Bell Journal of Economics*, pp. 74–91.

Hume, D. (1738), *A treatise of human nature*, The Project Gutenberg EBook, www.gutenberg.org, accessed 26 December 2017.

Hume, D. (1772), *An enquiry concerning human understanding*, The Project Gutenberg EBook, www.gutenberg.org, accessed 26 December 2017.

Iossa, E. and D. Martimort (2015), “The Simple Microeconomics of Public-Private Partnerships”, *Journal of Public Economic Theory*, 17: 4–48, <http://dx.doi.org/10.1111/jpet.12114>.

ITF (2016), “Shared Mobility: Innovation for Liveable Cities”, *International Transport Forum Policy Papers*, No. 21, OECD Publishing, Paris.

ITF (2016a), *Adapting Transport to Climate Change and Extreme Weather: Implications for Infrastructure Owners and Network Managers*, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789282108079-en>.

ITF (2017c), *ITF Transport Outlook 2017*, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789282108000-en>.

Jensen, M. C. and W.H. Meckling (1976), “Theory of the firm: Managerial behavior, agency costs and ownership structure”, *Journal of Financial Economics*, 3(4), 305–360. [http://dx.doi.org/10.1016/0304-405X\(76\)90026-X](http://dx.doi.org/10.1016/0304-405X(76)90026-X).

Kosmopoulou, G. and X. Zhou (2014), "Price Adjustment Policies in Procurement Contracting: An Analysis of Bidding Behavior," *The Journal of Industrial Economics*, 62(1), 77–112.

Kosmopoulou, G. and X. Zhou (2014), "Price Adjustment Policies in Procurement Contracting: An Analysis of Bidding Behavior," *The Journal of Industrial Economics*, 62(1), 77–112.

Lo, A. W. (2008), "Efficient Markets Hypothesis", *The New Palgrave Dictionary of Economics*. Second Edition. Eds. Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan, 2008.

Markowitz, H. (1952), "Portfolio selection", *Journal of Finance*, 7(1), 77–91.

Masten, S., Meehan, J. and E. Snyder (1991), "The Costs of Organization," *Journal of Law, Economics and Organization*, 7: 1-25.

Mehra, R. and E. C. Prescott (1985), "The equity premium: A puzzle", *Journal of Monetary Economics*, 15(2), 145–161, [http://dx.doi.org/10.1016/0304-3932\(85\)90061-3](http://dx.doi.org/10.1016/0304-3932(85)90061-3).

OECD (2017b), *Ex-Post Assessment of Transport Investments and Policy Interventions*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789282108154-en>.

Sartori, D. et al. (2014), *Guide to Cost-Benefit Analysis of Investment Projects, Economic appraisal tool for Cohesion Policy 2014-2020*, European Commission, Brussels.

Smith A. (1776), *Wealth of nations: an inquiry into the nature and causes of the wealth of nations*, Prometheus Books, New York.

Spackman, M. (2004), "Time discounting and of the cost of capital in government", *Fiscal Studies*, 25(4), 467–518.

Tan, W. (2007), *Principles of project and infrastructure finance*. Routledge.

Williamson, O. (1975), *Markets and hierarchies: analysis and antitrust implications*, The Free Press, New York.

World Bank (2009), *Procurement of Works and Services under Output- and Performance-based Road Contracts and Sample Specifications*, The World Bank Washington, D.C.

Zietlow, G. (2017), "Performance-Based Road Maintenance Contracts – Reference Note", CAREC Transport Knowledge Series Draft as of March 2017, <http://www.carecprogram.org/uploads/docs/CAREC-Transport-Knowledge-Products/PBC-Reference-Note.pdf>.

CHAPTER 4

Managing uncertainty for suppliers during construction

A Public-Private Partnership (PPP) implies the transfer of construction risk to the contractor to the fullest extent possible. The delivery on budget and on time is essential for the investors because they have to establish what the cost of the project will be at the time the contract is signed. There is no recourse. Money spent in excess of the contracted amount is money lost. The main contingency must therefore be carried at the level of contractors, who have to offer a fixed price for their services.

Uncertainty transferred to contractors may provide them with problems but also opportunities. If the uncertainty pertains to something they can manage, this gives the contractor the responsibility and therefore room to deal with it in the best way possible. On the other hand, developing a solution under the pressure of time and perhaps pricing one that is not fully developed increases the contractor's risk-pricing challenge. If too much uncertainty is transferred, the risk pricing may become so inefficient as to not offset any efficiency gains. Where is the optimum? Does reducing the uncertainty always have to imply that we also reduce the responsibility and therefore the space contractors have to be innovative in finding solutions? Is risk sharing the only way of reducing the uncertainty for the contractor? How can we be more mindful about uncertainty in construction contracts?

Answering these questions would be easier if more empirical evidence existed, for example on the performance of infrastructure construction contracts that transfer different extents of risk. While a patchwork of academic research exists, no overview is available, especially not by types of infrastructure.

The solutions proposed in this chapter are not exhaustive; however, they show a direction, which policy makers should explore more fully.

After discussing what constitutes construction risk outlining the basic delivery models available, this chapter identifies four interrelated factors that exacerbate inefficient risk pricing for the contractor and drive excessive risk contingencies rather than efficiency. These revolve around the state transferring too much responsibility to the private sector, private investor requirements for certainty, available time to prepare bids and the availability and reliability of information the state provides contractors.

We then provide a full set of propositions for what governments can do when procuring through PPPs or otherwise to reduce the risk-pricing inefficiency of the contractors. These are broadly captured by the statement that the state should invest significantly more resources into preparing tenders and seek to introduce some collaborative elements of contracting, such as joint-risk registers. A key step to facilitate the effectiveness of such measures would be to build and maintain strong in-house capacity for these purposes. As far as infrastructure procurement is concerned, a lean public sector may not be in the taxpayers' best interest.

We continue by highlighting the case of Femernbaelt in Denmark, where many of these propositions have been applied in practice. The approach to the EUR 7.1 billion project represents the outcome of accumulated experience on the country's two other fixed links, retained within the same organisation. In less complex projects an approach without or with fewer elements of collaborative contracting may be used, but the recommendation for the government to invest heavily in its homework remains.

We conclude with a brief overview of a more recent trend in the procurement of complex projects. Increasingly collaborative approaches like Early Contractor Involvement and Alliancing are gaining traction in response to highly uncertain or complex projects. The jury on their comprehensive effectiveness is still out, and for the moment they are not suitable for private investment involvement.

What is construction risk?

Construction risk in terms of cost overruns and delays is a concern for investors or clients. For the contractor it is a consequence. Risks for the contractor come from potential events during the design and construction phases as a probability of deviations from expected outcomes. The sources of risk include the following factors:

- client/owner behaviour
- the community
- the contractual and design (omissions/interface/changes)
- the economics
- the environment (including the project environment and stakeholders)
- the finances
- force majeure
- the political and regulatory frameworks (including permits and approvals)
- project governance
- technical aspects
- technology
- third parties (sub-contractors/suppliers).

The scope of risks projects face is not static over time. Rather, projects grew in size and complexity (Flyvbjerg, 2014). They also face increasingly complex operating environments. For contractors, third party regulations, community engagement, and environmental safeguards, rather than technical considerations, are increasingly perceived as foremost risks, particularly in large urban projects. For example, less than a quarter of the cost of London's GBP 16 billion Crossrail project was spent building new tunnels and stations, with the balance going towards asset replacement and protection, environmental safeguards, land and building purchases and demolition.

Additionally, contractors face methodological challenges in identifying, prioritising, quantifying and pricing risks. In particular, although there is variance across industries, contractors tend to rely on individual or team experience rather than objective data and scientific processes to identify and price risk, in turn increasing the likelihood of subjective bias.

What are then the factors which determine the level of uncertainty contractors will face when setting their prices and schedule? All else being equal, contractors facing greater uncertainty will build in greater contingencies into their fees relative to contractors facing more certain conditions.

The delivery model is the main challenge

A PPP based on an engineering procurement and construction (EPC) contract represents one configuration of the available approaches to contracting works and services. We outline the broad spectrum of the delivery models below to provide some perspective to the reader where this approach stands in comparison to the others.

A client's choice of how a project will be delivered has a key bearing on a contractor's risk-pricing task. The choice involves defining three aspects. First, the delivery model must define the scope of works to be included. Will it be a traditional approach, where design, construction and maintenance are procured separately? Or are they bundled?

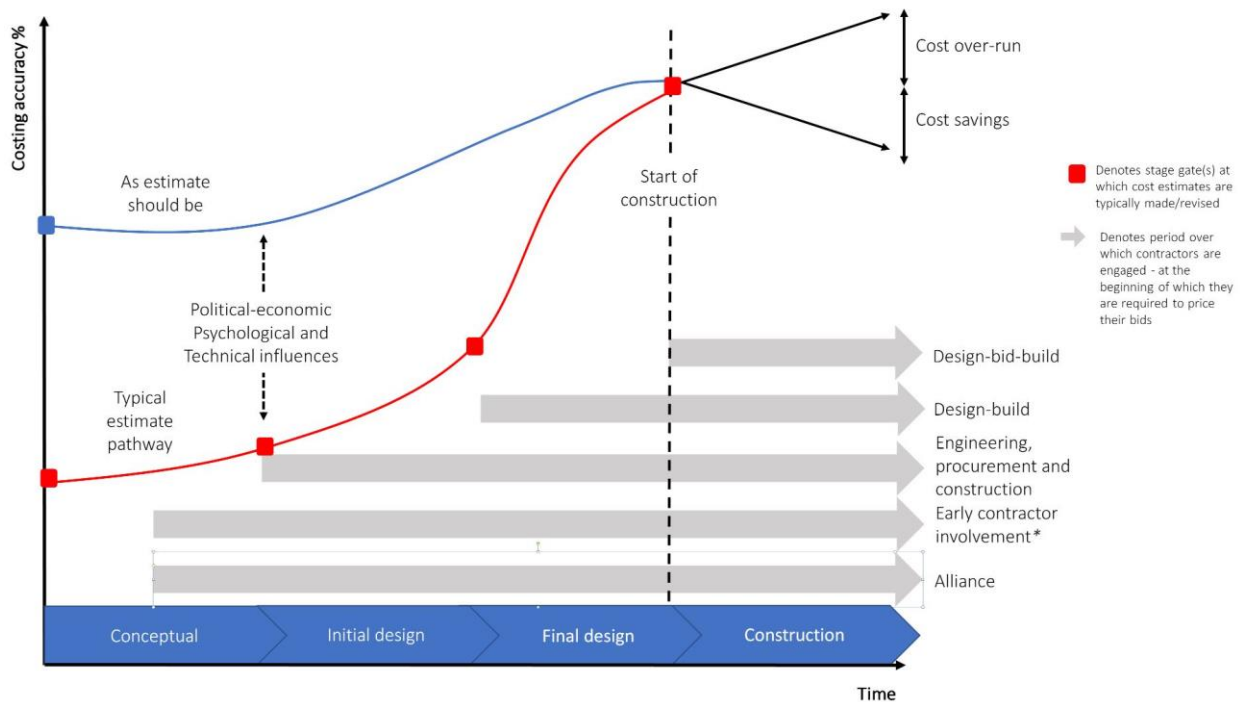
Second, a delivery model must also define how much risk will be allocated to the private party and how strictly the contract power must be defined. Will contractors have any recourse in terms of unexpected costs? Or will it be necessary for them to express their full costs in advance? A cost-reimbursable/cost-plus contract represents the least demanding end of the spectrum for the contractor and the turn-key/fixed-price contract the most demanding one. Figure 9 in Chapter 3 captures the single piece of empirical evidence on how effective these contracts are in project finance/PPP projects; they provide investors with almost complete protection from construction risk.¹

Finally, the delivery model must specify how contractors get included in the process of developing a design. The common approach in procurement has been adversarial and primarily based on competition. The bidders are provided with the rules (i.e. the winning criteria) and inputs. Each then develops their bid autonomously with no significant involvement of the client. Collaborative approaches to procurement are a relatively recent development. Based on pre-selection, one or a few bidders will be involved earlier in the process, but each will collaborate with the client to develop their own solution (as in the Early Contractor Involvement (ECI), for example). For the moment collaborative approaches are generally incompatible with private investment in infrastructure, and we address them briefly at the end of this section.

The broad differences between basic delivery models in terms of scope and time at which the contractor is involved are illustrated in Figure 18. In Design-Bid-Build, the client (public authority) develops or procures a detailed design. In the two other cases, Design-Build and PPP/EPC, the contractors have to develop their design and price it in the tendering process. In collaborative contracting the bidder and the client develop the design jointly.

An important characteristic that affects contractors' uncertainty is the level of design detail that is available when they are bidding. The difference between the red and blue lines illustrates how cost estimation accuracy evolves as the design matures. In Design-Build and EPC contracts, contractors enjoy greater control over design and construction methods. On the other hand, they absorb cost (and time) estimation risk, the assumption being that competition can ensure an efficient risk-adjusted price. If Design-Build or EPC contractors have to bid, however, at a stage when the detailed design is not yet available and their ability to develop detailed design is subject to multiple constraints, this will significantly affect contractors' exposure to uncertainty.²

Figure 17. Evolving estimation accuracy over the project life-cycle



* In ECI models, contractors do not price for construction until the second stage, which commences once a design is well developed (typically stage 2 comprises a restricted DB tender).

Source: Kennedy et al (2018); adapted from Samset (2008); Samset and Volden (2016).

Having provided the general overview of the sources of construction risk and delivery models, we now turn to specific issues of risk pricing in PPPs and address them.

What drives inefficient risk pricing for suppliers

Four interrelated factors can exacerbate inefficient risk pricing by the contractor and drive excessive risk contingencies rather than efficiency:

Excess transfer of risk

Clients relying on EPC contracts in PPP seek to transfer too much risk. Despite an excellent on-time and on-budget performance of EPC contracts in PPPs, the contractor faces three main challenges in trying to assess and price risk.

For one thing, there is no upside risk in a fixed-price contract. It is always helpful to remember that while transferring a lot of risks may lead to a much higher price for the client, underestimating their probability and impact could lead to bankruptcy for the contractor. Moreover, many risks a client wants to transfer cannot be fully mitigated or handled by the contractor. A contractor can usually fully handle technical construction risks. However, risks related to delayed and/or missing approvals or interfaces with third parties can only be controlled to a limited extent. In most countries third-party agreements and approval requests can only be signed off by the client himself. Contractors are aware of these risks but are not

really able to quantify them accurately. As a result, they will either add a huge contingency on top of the project or try to offload these risks by legally challenging the contract from the beginning.

Not least, it is not the identified risks that matter but the ones that have been overlooked. Indeed, common risk management practices are usually able to identify the obvious risks, such as ground risks, financing, political decisions, etc. Major projects nowadays can handle these successfully. Projects are impacted by small unidentified risks, resulting in years of delays and overspent budgets (Box 8 provides a real-life example).

Box 8. An energy project in Germany as an example of ecological and third-party interface risks

The project, valued at circa EUR 500 million, involved construction of a 50-kilometre high-voltage power line, a section of which was to be constructed underground.

Initial risk analysis identified two broad risks pertaining to the section of the pipeline: swampy ground conditions and the need to engage and negotiate with multiple landlords, as well as transport and utility infrastructure providers. It was perceived that both risks were easy to mitigate. For example, further ground analysis would enable the contractor to tailor its build approach to suit the site conditions, while third-party interface risks could be mitigated by building sufficient negotiation time into the delivery schedule.

However, more detailed analysis undertaken at the early design phase revealed 86 specific risks, a number of which related to ecological requirements in major project planning approvals (“Planfeststellungsbeschluss”). One such requirement related to the felling of trees and migration of a bat colony to an alternative nearby habitat, a process which could only be undertaken between the months of November and February due to the bat nesting season. As a requirement of planning approval, this process needed to take place one year before construction could commence. Its successful and timely completion also relied on third parties, such as when negotiating access to land.

Due to its long implementation timeframe and bearing on planning approval, such a minor component of a project can result in significant risk for a contractor. More specifically, a contractor would have to commence the process of habitat relocation two years ahead of construction despite client expectations that construction commence within months of the contract being awarded. Uncertainty is further compounded by the reliance on third parties.

This highlights how if relatively small and non-technical project components are not foreseen and addressed upfront by clients, they can translate into significant costs and time variability for a contractor.

Source: Kennedy et al. (2018). Disclaimer: The working group is not in any way criticising the continuous ecological functionality measures. They are necessary to protect the environment and do not hinder projects. The particular project under consideration merely has to take them into account and deal with the corresponding demands.

A contributing factor behind wanting to transfer too much responsibility to the private sector may be a drive towards a leaner public sector, which also implies a loss of in-house capacity (Eriksson 2018).

Lender requirements

Lender requirements increase the pressure on contractors in PPPs. In the context of transferring too much risk from clients, strict lender requirements in privately financed projects lead to further time pressure on the contractor. Lenders require a high degree of certainty in the cost estimates, as they too face no upside risk. The reporting and compliance requirements imposed on the contractor through the

lender's technical advisor in a PPP can represent a significant governance and timing constraint within an already highly congested bid programme.

Information availability

The contractors do not always receive sufficient and reliable information. Bidders must process large quantities of information with a team that is typically mobilising as other bids reach completion and resources become available. Information also changes, for example, through protracted clarification questions or updated studies, which may cause bidders to delay certain decisions until there is greater clarity. In this context, both the availability and relevance of information represent a main cause of uncertainty for bidders and can lead for information to be overlooked or considered too late to be useful.

This in turn translates into an increased dependence on client-sourced information. However, the extent to which bidders can rely on information provided by clients and their third-party advisors is often limited; for example, it can be provided for information only purposes, where the client bears no responsibility if it proves incorrect. Given the time constraints bidders face, providing them with distilled information rather than offering a paper dumping exercise is equally relevant.

Bid preparation

Ensuring sufficient time for bid preparation is essential for efficient risk pricing. When bid processes are too short or when they are subject to unscheduled delays or uncertainty about their timely completion, risk pricing will be affected.

As a general principle, a longer bid timeframe translates into lower levels of uncertainty for bidders and reduced risk allowances. It follows that time constraints increase uncertainty, due to the reduced opportunity to gather accurate information and, if under a bundled delivery model, refine designs. It can also impact the depth of quantitative risk analysis that can be undertaken.

Conversely, uncertainty also increases when bid processes are unexpectedly prolonged or subject to the threat of discontinuation. For example, threats of discontinuation are also likely to result in personnel being moved to other projects, from which it may be difficult to extract them if a bid process restarts.

Delays, particularly at the awarding stage of a project, also introduce risks relating to environmental and planning approvals. For example, a delay of several weeks can trigger delays of six months or more for environmental surveys or construction activities, forcing a reprioritisation of construction activities at best and overall programme delay at worst.

The availability of sufficient information and time above can have a further knock-on effect on the risk assessment approach. Risk assessment methodologies and risk scoring vary between projects, leaving the senior management without an objective basis on which to compare risks and identify potential similarities or errors between projects. To a large extent, this reflects the difficulty in comparing projects and the associated lack of objective statistical data even when comparisons can be made. Again, in part this can be traced back to a general lack of political will to pursue ex post analysis on infrastructure projects.

Given that contractors work under time pressure and with access to limited data that tends to change, they must calculate the likelihood and consequence of a multitude of risks identified. In turn, assessment methods are simplified to meet timing constraints, increasing the reliance on individual experience. As a

result, opportunities to reduce uncertainty and contingencies through more comprehensive assessments and data collection are foregone.

Reducing risk pricing inefficiency in the construction phase

A series of measures can address the challenges for contractors highlighted above. This section summarises the main points. A full exposition is available in Kennedy et al. (2018).

Design clarity and flexibility

Under design-build (DB) and engineering procurement and construction (EPC) PPP delivery models, clients should at a minimum produce a fully costed reference design before the tender is issued. At the moment the general practice is to provide an outline design only.

Greater design clarity and increased contractor innovation are not necessarily a zero-sum game. Rather, clients can provide contractors with greater design clarity, in turn reducing uncertainty (e.g. permit approvals), while preserving scope for innovation in medium-sized projects. In major projects the competitive dialogue approach can foster development solutions, limited competition and costing at a detailed design stage.

The reference design can be more detailed and limiting in certain areas and provide different degrees of freedom to innovate in others. This will depend on planning conditions, project complexity or any areas the client has particular interests in. The client should set a bid timeframe that enables bidders to evaluate it and identify opportunities to further improve it, potentially by also considering a competitive dialogue phase ahead of final bid submission. Bidders can then be allowed to change, replace and/or take specific parts of the reference design as they see fit, as long as it is clear they also take responsibility for the design sections which they did themselves or amended.

Having the right capabilities on the client's side to manage the process in terms of the tender timeframe, interaction with bidders, etc., is a pre-condition in order to engage in DB or engineering, procurement and construction PPP delivery.

Follow established principles, consider joint risk management

Clients should follow established risk allocation principles. In defining which risks a contractor should bear, a key objective should be containing the cost of risk rather than a narrow view of maximising incentives through risk transfer. As a practical example, greater consideration should be given to the retention of permit risk, for instance, by ensuring the necessary permits are in place prior to the awarding of a contract and the tender process, depending on permit expiry dates. This would serve to reduce the risk of the contractor suffering delays after a project is awarded and incurring penalties for events that may in reality be outside of their full control. It also recognises that permit-issuing authorities often lack the resources to respond to multiple bidder enquiries.

Clients should also consider the benefits of joint risk management. Development of a joint risk register, where all parties involved in the project map their risks against potential mitigations and their costs, may provide significant benefits. In particular, this process can assist in identifying which party is able to mitigate or manage a given risk at the lowest possible price, thereby lowering the combined cost of risk

across a project. Moreover, this can help inform clients as to the risks for which it is in their interests to mitigate ahead of the tendering process, i.e. risks the client can control or bear at lower cost.

Requiring contractors to more systematically identify, quantify and explain factors driving up risk premiums may also assist efficient allocation, with clients better able to see cost drivers, negotiate changes and identify potential mitigations. However, as outlined, before additional tender requirements are placed on contractors, clients should fully assess their cost implications versus their expected benefits.

Evolve risk management and provide better information

Clients should evolve their risk management approach to reflect the growing complexity and evolving risk profile of major project delivery. For contractors, uncertainty increasingly stems from third-party interface or approvals (including from the community), rather than the conventional technical considerations of delivery. In other words, premiums are being driven up by risks which may seem small in isolation, but which are closely inter-linked and have significant domino-like effects.

It follows that in order to target uncertainty at its source client risk management approaches must also evolve. Specifically, clients must look beyond the major risk categories (e.g. design) and increase their attention to the finer details. This will require a more granular and bespoke approach to risk identification and allocation and a greater upfront focus on the mitigations that can be put in place ahead of construction and potentially ahead of tender commencement.

Equally, *clients should facilitate improved information provision*. As a general principle, clients should prepare and provide as much contextual information as possible before a tender process begins.

The political and economic imperative to deliver a project as soon as possible creates a natural tension between project advancement and appropriate preparations. Nevertheless, careful consideration of the information required before inviting contractors to tender is likely to result in a smoother procurement process and a better price. It may be desirable to engage with potential contractors at an early stage to outline the project and proposed delivery approach and seek feedback on information requirements.

A basic principle is to identify the information that requires a specialist, would take a bidder a long time to obtain or is likely to be needed by all bidders regardless of their chosen solution.

A further salient point is organising and signposting any information to be shared ahead of its release rather than dumping it all in a virtual data room. A major frustration of contractors during the bidding phase is sorting out useful from non-useful information under constrained timeframes.

Improve data reliance and its application

Clients should facilitate improved data reliance. Improving data reliance for contractors is an obvious opportunity to improve pricing efficiency. For clients, this means that large premiums stemming from data-related risks are not ultimately passed on by contractors in their final bid price.

It may not be practicable or sensible for clients to bear full liability for all data provided. However, clients generally have greater control over data procurement and a greater capacity to identify competent people or organisations to procure, manage and deliver information for use by bidders. Clients may also have a greater capacity to bear risks relating to data deficiencies.

Both the public and private sectors should improve data harnessing and application. It is not possible for all events to be definitively assessed for statistical patterns, however, there is clear scope to improve

risk-pricing methodologies and, relatedly, to better harness and apply historical data. This will serve to strengthen the scientific basis underpinning risk analysis, as well as instil greater objectivity in pricing decisions.

While governments have a leading role to play in this regard, responsibility also extends beyond government to include clients and their industry organisations.

Tender programme, bid timeframes and specifications

Clients should set out and follow a clear tender programme. In recognition of the duration and dependencies of key tasks, client teams should run the tender as a project in its own right, with contingency and project management measures built in to ensure adequate resourcing, proper planning and deliverability on budget and time.

Clients should ensure reasonable bid timeframes. Clients need to carefully consider the experience of their own organisation and that of other public bodies in procuring projects of similar scale and complexity before committing to a programme of work.

Clients should develop clear functional specifications and set out in clear and measurable terms what functionality the project is to achieve. This is likely to include a mix of mandatory (“must have”), targeted (“should have”) and desirable (“could have”) requirements, depending on the degree of flexibility allowable.

Ambiguity, trade-offs and predictability

Clients should minimise ambiguity in tender financial requirements. Setting out clear financial requirements for the project and the tender enable bidders to understand what is required of them from an early stage. This is particularly the case for formulae affecting the financial models of bidders, such as price indexation. It can be time-consuming and introduce risks of hidden model errors where clients make frequent changes to their financial formulae or the architecture of the model.

Clients should more fully consider the cost, time and risk implications of bid requirements. In bid processes clients need to more precisely weigh up the additional tender requirements that are placed on contractors for the benefit that these requirements provide. For example, a tendency exists for clients to require bidders to include significant design or assessment work for issues of relatively small consequence, with the associated risks of distracting parties from more significant issues.

Clients should provide clarity on the trade-off between value and cost in bid assessments. A lack of clarity on the trade-off between value (i.e. client and user benefits) and cost (i.e. funds required to deliver it) can increase bidder uncertainty and reduce innovation. For example, a client may emphasise innovation and quality outcomes in tender documentation but then base their award decision overwhelmingly on the lowest price.

Finally, clients should consider what is reasonably predictable over the full term of the contract. Even over the construction phase the duration may be sufficient to call the predictability of some input cost into question. If the prices of some inputs are fluctuating (e.g. oil and a link with asphalt products) and cannot really be controlled by the contractor, their variability should be passed through back to the client through a formula.

Strong in-house capacity is a must

A major facilitating element to all propositions above is strong in-house procurement capacity. In the absence of this, governments can compensate to an extent with hired consultants or external advisers. However, their remuneration could still be capped, limiting the range of experience that can be hired. Advisors could also move on to different clients after the completion of a project, thus requiring constant replacement, which takes time and may lead to different levels of support as their skills may vary.

A more strategic approach would be to develop strong in-house capacity. Some governments have developed special private and public expert bodies to support public bodies while engaging in procurement. To attract the relevant level of expertise, employees in these bodies are not constrained by public-servant pay schemes.

In the United Kingdom the Infrastructure and Projects Authority (IPA) is the government's centre of expertise for infrastructure and major projects. It is a public agency reporting to the Cabinet Office and HM Treasury. IPA provides in-house expertise in infrastructure, project delivery and project finance. Many of its experts have worked both in the public and the private sector and have an understanding of both sides and their challenges.

The Sund & Baelte Partner A/S is an engineering consultancy company in Denmark. It is part of the publicly owned Sund & Baelte Holding. Its capacity was built through supporting the delivery and financing of the Danish mega projects. It provides a similar set of services as IPA, with the addition of technical supervision and distinction, which it also employs in supporting projects beyond those for the Danish state (i.e. the company is also active on the market). Similar institutions with a different scope of activity exist in other countries as well.

A good practice example: The Femernbaelt project

A real-life example enshrining much of what we propose is the Femernbaelt Link. The Femernbaelt Link is a EUR 7.1 billion tunnel between Denmark and Germany, designed to provide more crossing capacity and save an hour in crossing the straight.

The client first organised an industry day where it sought to raise interest and provide potential contractors with the expected approach the project and procurement. It then published the tender for a Design and Build Contract and pre-selected several bidders. The bidders were then provided with a detailed reference design. Over the next year and a half they were involved in a competitive dialogue. Where the contractor picked up a portion of the design to provide a different solution, he became liable for it, and where the design remained as initially proposed, the client remained liable. Through interaction with the client each contractor developed its portion up to the detailed design level before submitting a final bid. This process lasted for a year and a half. Contractors also received compensation for the cost of participating in a long bidding process and investing in their bid, which was not guaranteed to win.³ In addition, a joint-risk register was established, which enabled clients to get a better view of which risks they should self-insure and which risks should be transferred to the contractor, i.e. the focus was on best value rather than full-risk transfer.

In this particular example, the contractors have been provided with upfront information and an initial detailed reference design. They were not required to develop the entire design from the ground up (usually only an outline is provided) but could focus only on the parts which they thought they could improve. Moreover, their solutions were developed in a collaborative approach that still provided for

some level of competition. Hence, despite a detailed reference design being made available, innovation and optimisation were still enabled.

Table 3. Femernbaelt project phase snapshot

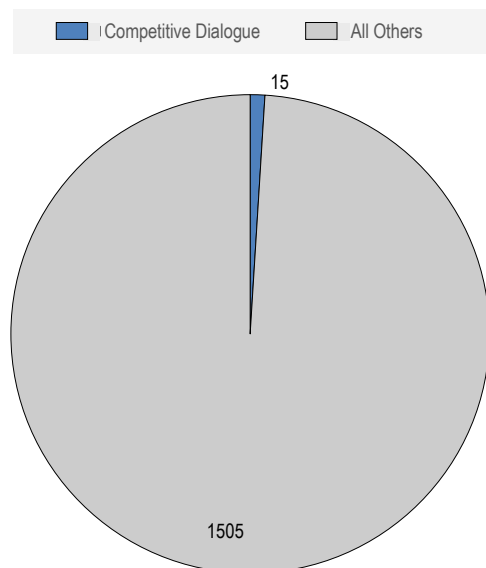
Project phases	Date
Industry day	March 2012
Introduction meeting	August 2013
Submission of the civil work contracts (stage 1)	September 2013
Pre-bid conferences and site visit (stage 1)	November 2013
Technical bids (stage 1)	April 2014
Dialogue (phase 1)	May – Sept. 2014
Submission of the civil work contracts (stage 2)	October 2014
Technical and priced bid (stage 2)	December 2014
Dialogue (phase 2)	January – March 2015
Indicative bid (stage 3)	May 2015
Adjusted bid (stage 3)	September 2015
Signing of conditional civil work contracts	May 2016

Source: Andersen (2018).

The competitive dialogue approach is a compromise between competition with no serious involvement on the side of the client in the bid preparation and a collaborative approach, where full collaboration occurs with a single pre-selected bidder.⁴ The competitive dialogue is merely a process platform, while the decisions to share the risk register, develop a detailed reference design and such are separate decisions. Not all project sizes will merit this approach, which entails heavy transaction costs for the public side compared to other competition-based approaches. Where clients are uninformed, competitive dialogue contributes to the lack of clarity and complexity in tender documentation. It can lead to a lengthier and hence more expensive bid process that adds to contractor overheads. Despite it being introduced more than 10 years ago, its use seems exceptionally scarce. From the data available in the European electronic tendering database (TED), only 15 transport infrastructure projects reported using competitive dialogue out of 1 505 projects which reported the method of procurement (Figure 19). Clearly not all projects will be suitable for this method, but many larger ones in view of the challenges with uncertainty and risk pricing should be, which makes the number 15 strikingly small.

A dedicated EPEC report using a survey covering the 2007-09 period suggested 60% of the respondents arguably used the competitive dialogue in PPPs, though its focus was not on transport specifically.

A caveat to collaborative approaches is collaboration benefits are not automatically achieved (Eriksson et al. 2018). In fact, it seems very challenging to reap all the potential benefits of collaboration, and all actors therefore need to continuously improve their processes, routines and capabilities for managing collaborative projects. In line with this argument, it seems critical to establish routines for inter-project learning and knowledge sharing, which largely was absent in the studied projects.

Figure 18. The use of competitive dialogue in transport infrastructure procurement in the EU, 2006-16

Note: Projects above EUR 50m.

Source: Based on data in Roumboutsos (2018).

The above is not to say that a collaborative approach based on competitive dialogue should be used indiscriminately. It is an illustration of measures that can be undertaken to reduce uncertainty on the contractor's side. Many of them will be useful when the procurement is based on competition exclusively, in which case the efforts of the public side will be focused on doing the homework before the tender is actually published.

Uncertainty and evolution in contracting

How is contracting evolving to take account of uncertainty? In large-scale projects which are not repetitive, do not have well established design solutions and could benefit from some innovation, traditional procurement strategies based on competitive tendering and extensive control may be less effective.

Recent studies (Gransberg et al., 2013; Koppenjan et al., 2011; Williams, 2005) accordingly advocate that complex projects need new types of project management practices, promoting flexible management of change by collaborative teams rather than ex ante planning and control by a project manager. Relational contracting based on collaborative procurement strategies may therefore be more suitable to enhancing collaboration and the flexibility to manage unforeseen events in complex projects.

Two approaches that go beyond the collaborative design-build (DB) contract illustrated in the Femernbaelt case are Early Contractor Involvement (ECI) and Alliancing.

The ECI approach has an advantage in terms of faster delivery times and the greatest chance of securing an innovative solution. At the same time, it significantly reduces the potential benefits of competition. If the ECI approach is applied and a technical solution superior to traditional procurement is not produced, the loss of value for money will be significant. Alliancing is used in a similar context of projects facing high

uncertainty. In this case the alliancing partner is chosen based on their references. The project cost is distilled in collaboration through the design process, negotiating targets (i.e. prices) until the design is completed and a final target price is determined. During construction the contractor and the client share the savings if costs come out under the target or overruns if they come out above.

Figure 19. The characteristics of Early Contractor Involvement and Alliancing

	Broad structure	Implications for client	Implications for contractor(s)
Early Contractor Involvement (ECI)	<p>Typically involves a two-stage process, with clients engaging a limited pool of contractors to work alongside designers, followed by a competitive design-build (DB) stage</p> <p>Mostly used where conditions are highly uncertain or when considerable innovation is required</p>	<p>Facilitates upfront consideration of constructability, minimising design and interface issues, while preserving client control</p> <p>Facilitates greater contractor input to cost (and time) estimation</p> <p>Reduces pre-implementation timeframes, relative to a design-bid-build (DBB) approach</p> <p>Potential reduction in (effective) competition given delays and transaction costs should client decide to open bidding to the wider market</p>	<p>Lengthier period of involvement means increased bid costs (which could prove unrecoverable if contractor is unsuccessful at stage two), though there is less competition</p> <p>Risks of pricing a bundled scope of works (i.e. design completion and construction) remain due to stage two tender</p>
Alliancing	<p>Clients and selected contractors jointly prepare project scope and target cost and agree a shared risk/reward mechanism (cost incentive)</p> <p>Parties are bound by open-book accounting, no blame/no dispute policy and unanimous decision-making</p> <p>Project functions – transcending planning, design and construction – are integrated through a joint project management board</p> <p>Mostly used where conditions are highly uncertain and/or complex</p>	<p>Minimises conflicts/disputes between parties</p> <p>Difficulties incentivising contractors to reveal efficient target costs</p> <p>Limitations to the extent of (meaningful) risk share, given contractor exposure is capped while client exposure remains open-ended</p> <p>VfM highly dependent on client capability</p>	<p>Limited avenues for legal redress, owing to “no dispute” clauses means uncertainty</p>

Source: Kennedy et al. (2018).

In the absence of more available evidence, how and whether these approaches provide superior value for money on a portfolio level, their use remains subject to expert judgement. For the moment they are considered as incompatible with private investment. The basic reason is that the private investors (i.e. the lenders) require high certainty both in terms of the expected cost to be financed as well as tried and tested solutions (Eriksson et al. 2018), while both of these models are intended to either drive innovation or include incentives to share the outcomes in projects with high uncertainty.

In one recent example, the Thames Tideway Tunnel, an alliancing structure was merged with private investment. As discussed in the next chapter, in the context of hybrid private investment models the circumstances were rather unique. Moreover, the alliancing approach above was transformed to yield outcomes similar if not the same as a fixed-price contract would.

Box 9. Further reading on Chapter 4

Detailed analyses of the issues covered in this chapter are available in these Working Group Papers:

Eriksson, P. E. et al. (2018), “Collaborative Infrastructure Procurement in Sweden and the Netherlands”, Working Group Paper, International Transport Forum, Paris (forthcoming)

Kennedy et al. (2018), “Risk Pricing in Infrastructure Delivery: Making Procurement Less Costly”, Working Group Paper, International Transport Forum, Paris (forthcoming)

Vincentzen, L. and K. S. Andersen (2018), “Risk Allocation in Mega-Projects in Denmark”, Working Group Paper, International Transport Forum, Paris (forthcoming)

Notes

- 1 There are several variants in between that can be mixed with different scope arrangements. These are outlined in Kennedy et al. (2018).
- 2 No overview is available for advanced economies, but for developing ones the PPIAF’s (2016) PPP Certification Guide states: “The procuring authority does not normally provide significantly detailed design, technical information, or even technical information that is warranted. In practice, this means that as soon as the tender requirements are well known, the private party must start from scratch in obtaining its own technical information”.
- 3 This is generally an uncommon practice though it has been used in different countries mainly as an incentive for competing (European PPP Expertise Centre, EPEC).
- 4 Note that this approach is not limited to Europe and can be found elsewhere though under a different name (e.g. Bill 693 of the State of Pennsylvania in the US; see Hoezen et al., 2012).

References

- Andersen, K. S. (2018), “Connecting regions - The benefits of the fixed links for Denmark”, Presentation at the 4th meeting of the ITF Working Group on Private Investment in Transport Infrastructure: Dealing with Uncertainty in Contracts, 8-9 March, Paris.
- EPEC, “Procurement of PPP and the use of Competitive Dialogue in Europe: A review of public sector practices across the EU”, European PPP Expertise Centre, http://www.eib.org/attachments/epec/epec_procurement_ppp_competitive_dialogue_en.pdf
- Flyvbjerg, B. (2014), “What You Should Know About Megaprojects and Why: An Overview”, *Project Management Journal*, April/May 2014, <https://ssrn.com/abstract=2424835>.
- Gransberg, D. et al. (2013), “Project Complexity Mapping in Five Dimensions for Complex Transportation Projects”, *Journal of Management in Engineering*, 29(4), 316-326.
- Hoezen, M., Voordijk, H. and G. Dewulf (2012), "Contracting dynamics in the competitive dialogue procedure", *Built Environment Project and Asset Management*, Vol. 2 Issue: 1, pp.6-24.
- Koppenjan, J. et al. (2011), “Competing Management Approaches in Large Engineering Projects: The Dutch RandstadRail Project”, *International Journal of Project Management*, 29(6), 740-750.
- PPIAF (2016), *The APMG Public-Private Partnership (PPP) Certification Guide*, <https://ppp-certification.com/ppp-certification-guide/acknowledgements>.
- Rouboutsos, A. (2018), “Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe”, Working Group Paper, International Transport Forum, Paris.
- Samset, K. and G. H. Volden (2016), “Front-end Definition of Major Public Projects. Theoretical insights and conflicting practices”, Norwegian University of Science and Technology, https://brage.bibsys.no/xmlui/bitstream/handle/11250/2437547/Concept_majorPublicProjects_WEBVER_SJON.pdf?sequence=1.
- Samset, K. (2009), “Projects, Their Quality at Entry and Challenges in the Front-end Phase”, in Williams, T. et al. (eds.), *Making Essential Choices with Scant Information Front-End Decision-making in Major Projects*, Palgrave Macmillan, UK.
- Williams, T. (2005), “Assessing and Moving on From the Dominant Project Management Discourse in the Light of Project Overruns”, *IEEE Transactions on Engineering Management*, 52(4), 497-508.

CHAPTER 5

Dealing with uncertainty in long-term contracts

In the previous chapter we focused on the example of the construction phase, which is relatively short-term and where uncertainty is driven by the project's complexity. The challenges are less about incomplete contracts and resulting opportunistic behaviour and more about risk pricing efficiency and how much uncertainty the contractor should bear. To the extent that much of the construction risk is manageable, our analysis focused on how to reduce the uncertainty by providing more information to the contractor or by reducing the power of the contract, in other words, sharing the risk.

Due to opacity in long-term contracts unknown unknowns are part of the risk-pricing aspect. As with construction, it is equally difficult to estimate long-term maintenance cost or revenues for that matter. On top of these challenges, climate change and changes in the substance of the infrastructure we need due to disruptive technological change were raised as two examples in Chapter 2. The unknown unknowns here are not whether, for example, technology will continue to progress rapidly. It is the dynamics and the exact impact on the existing infrastructure that is unknown. Nobody can produce information on this. Next to the risk-pricing issues, therefore, incomplete contracts and related opportunistic behaviour come to the forefront.

In response to the issues identified we proceed in several steps.

We begin by clarifying who should in principle bear exogenous risk in projects, extending our earlier exposition on the relative cost of public vs. private finance. This also allows us to determine when a PPP might be a good solution and when an alternative might be needed.

A basic, and perhaps radical, solution to deal with private investment and long-term uncertainty is to not pursue it. We showcase what is the public sector alternative to private investment in infrastructure in advanced economies and on what the private investment approaches must seek to improve.

We then offer several options to governments intent on using PPPs in circumstances which we deemed not the most favourable for this model. Solutions to address revenue uncertainty already well known (risk sharing, Present Value of Revenues concession). What is more challenging is the inefficient risk pricing on the cost side and retaining flexibility for the government in a long-term contract that avoids a hold-up by the private party. A partial solution is cost indexing to address risk-pricing inefficiency on the cost side and bail-out clauses to terminate the contract at a pre-agreed cost. Neither is a complete solution.

A more comprehensive solution to the issues the PPP model faces is the utility regulation model. However, it raises new challenges. A case study of its potential introduction on a motorway system is presented to showcase the steps necessary in implementing such a system.

We then look at concerns commonly occupying policy makers regarding the performance of regulatory asset based models. Two represent potential perverse incentives as a side effect of regulation: capex bias and financial engineering issues. Another one is the perception that regulated models must necessarily be funded by the users. We reflect on all three.

Lastly, we examine a case of a hybrid between the PPP and RAB, the Thames Tideway Tunnel in the UK. The aim is to understand whether there is merit in pursuing hybrid solutions as well.

The need for continuous incentives in long-term contracts

Achieving efficiency in long-term contracts requires continuous incentives. In Chapter 2 we highlighted two kinds of uncertainty that matter in long-term contracts. One comes from the opacity of the activities the public sector is transferring to the private, when the price needs to be set in advance. Our example was uncertainty driven by project complexity during construction. Another example is maintenance: Who knows what exactly the cost of maintenance will be over the course of ten or more years? The other comes from unknown unknowns that might happen during the execution of the contract but for which the contract did not provide, which may lead to a hold up problem. We chose to use the examples of paradigmatic change in technology and climate as illustrations.

In the same chapter we pointed out that the state has an advantage over the private sector in pricing uncertainty, hence it matters that one does not transfer uncertainty or risk that is unmanageable (exogenous). Were that the case, the private sector would only charge an inefficiently priced risk premium with no efficiency gains to offset it. The examples of construction and maintenance both represent activities whose outcomes can be managed by the contractor's actions. However, as said above he is unable to efficiently price the two activities in advance. Hence, beyond the obvious point above, a more serious question is: when is manageable uncertainty in long-term contracts a problem?

A single competition for a long-term contract will be insufficient to offset the contingencies resulting from inefficient risk pricing. This approach might work well where continuous incentives to be efficient also follow during the life of the contract. These would erode any abnormal rents and provide continuous pressure for efficiency. PPPs for port terminals and airports represent two such examples.

The continuous incentives during the life of the contract can come from the fact that the actions of private operators can strongly affect the demand for their services. In an ideal case this will come from competition in the market. For example, it is generally recognised that port terminal operators and airports can exist in competitive markets, serving the same catchment area. ITF (2015), for example recorded a price elasticity of -1 for a port in the North Adriatic. This implies the ports are price takers but can attract more traffic through offering better quality service.¹ Competition between airports and carriers has also been long-established (Dessner et al. 1996).²

Other than in a competitive scenario some (weaker) continuous pressure for efficiency may also exist when a single port or airport has a monopoly on a catchment area, though this is considered less ideal. Even though the port or airport may be the only one in the area, the constraint comes through the willingness to pay on the part of the carriers or shippers servicing the port or airport. For example, if a remote airport's infrastructure service is not of sufficient quality or the price is too high, the carriers will simply not choose to service it, because they cannot make enough money. On the other hand, if unregulated, the airport operator could also be making large monopoly rents. In summary, the primary consideration here is the ability to impact demand through actions taken; the market structure (competition or monopoly) is a secondary one (Hasselgren 2018).³

In cases where continuous pressure is lacking, a single competition for the contract may not do the trick in a long-term contract. This would be in all cases where demand is largely dependent on exogenous factors, such as road and rail infrastructure (i.e. it is relatively inelastic to service quality). An example would be a new road section or bridge that saves the users a lot of time compared to alternatives.⁴

For transport infrastructure, service quality is generally considered contractible (quality can be defined and measured well).⁵ Consequently, in these cases, present value of revenues (PVR), availability or performance-based contracts might be preferred to demand-risk transfer.

In summary, inefficient risk pricing is the first source of efficiency loss. It is the default outcome in case the risk is unmanageable and depends on persistent incentives when it is manageable.

When there is no continuous pressure there is a second source of efficiency loss, which comes from the loss of flexibility. Whether the existing technology is obsolete, traffic flows have changed or a repurposing of the space on which the infrastructure is built is necessary, there will be situations which will not be foreseen in the contract and lead to a lock-in for the public sector. Moreover, if private partners feel they have a better bargaining position, they may not want to renegotiate or terminate the contract under reasonable conditions. The efficiency loss in this case occurs due to delays in upgrading the infrastructure and/or from the disproportionate compensation the public side may have agreed to.

The two questions that we need to address are then:

- What can we do when manageable uncertainty in long-term contracts is a problem?
- Can we retain flexibility in contracts when engaging with the private sector without efficiency losses due to opportunistic behaviour?

These two issues are addressed below in several progressive steps. As highlighted, our focus is exclusively on situations where demand for the private sector is primarily exogenous, i.e. there is no continuous pressure for efficiency from the market.

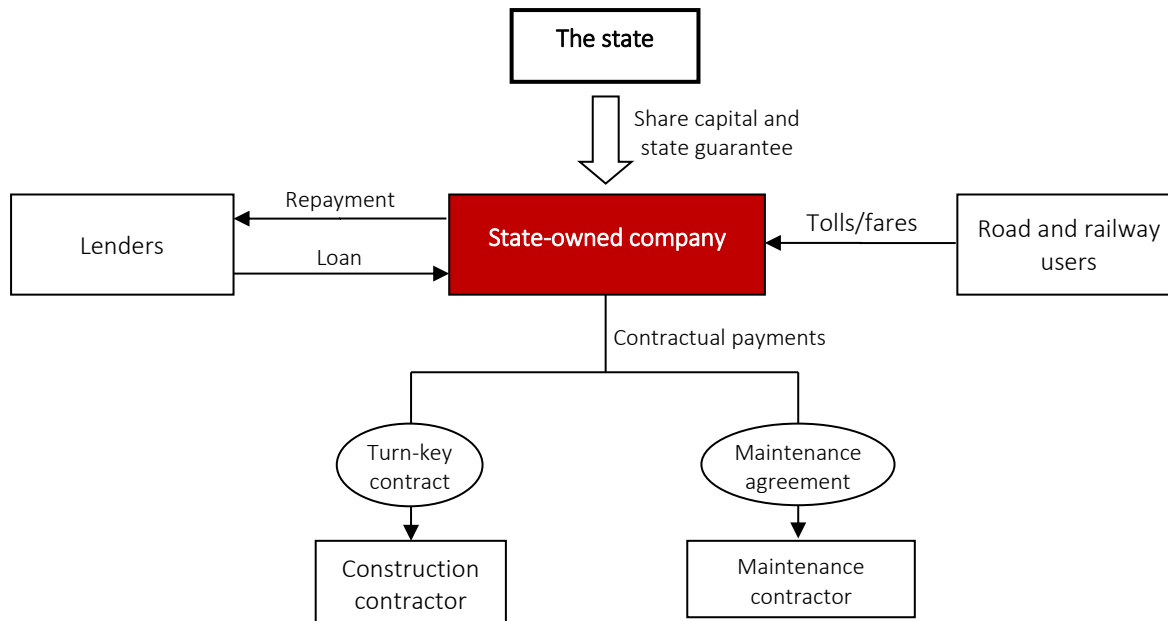
Public infrastructure management as an alternative to private investment

An obvious choice that cannot go undocumented and addresses both types of uncertainty problems is to pursue public investment. The public counterfactual to private investment is no longer monolithic state-owned enterprises. These performed all activities in-house, with the attendant risk of traditional public sector inefficiency.

The standard in advanced economies is state-owned enterprises (SOEs), which manage the infrastructure. Examples of companies managing the road or railway infrastructure networks are common: ASfiNAG in Austria, Highways England in the UK and NDS in Slovakia for motorway infrastructure.^{6,7} How functions are organised in such companies differs from case to case. Generally speaking, activity planning, asset management and traffic control remain in-house. The construction of new infrastructure or upgrades of existing infrastructure, as well as short- and medium-term performance maintenance contracts are usually subject to public tendering.

This model is also used for the execution of dedicated projects. The Danish Sund & Baelte Holding Company is an SOE that controls three project companies. Each is responsible for the planning, construction and maintenance of one major infrastructure project (Table 3 provides a basic overview). The works and maintenance are contracted out to the private sector, while the traffic control function remains with the project company.

Figure 20. An illustration of risk dispersion within a Public-Private Partnership



Denmark felt a fundamental challenge with respect to the funding of its mega projects would be that if they were included in the general budget and annual discussions, there would be a risk of stop-go decisions. This is not only because the general budget of the state is subject to annual negotiations on priorities between different stakeholders, but also because political decision-making may not be flexible enough to deal with potential project changes along the way (Holm and Nielsen 2018).

Table 4. Three mega projects managed by the state-guaranteed model

Milestones	Storebaelt	Øresund	Femernbaelt
Political decision to build	1987	1991	2008
Start of construction	1988/89	1995	2020
Total length (coast-to-coast)	18 km	16 km	18 km
Commercial start of operation	1997/98	2000	2028
Debt at opening (2017 prices, bn EUR)	6.8	3.4	7.4
Repayment period	34 years	33 years	36 years

Source: Holm and Nielsen (2018).

Despite a state guarantee provided for the debt of the holding company, Femernbaelt remains off the balance sheet under the current Eurostat accounting provisions (other similar firms that generate more than 50% of its revenues commercially can do so).

Potential variations in the traffic flows do not immediately require an intervention by the owner in the form of a capital injection. They can be absorbed in the form of adjustments in the repayment period, i.e. the users bear the cost uncertainty in the same way as would be the case in a present value concession (Engel et al. 2018). Indeed, this is the case for all publicly managed infrastructure.

Aside from the low cost of financing (the holding pays a 0.10-0.15% liquidity premium on the risk-free rate during the last bond issue), the positive characteristic with regard to uncertainty is that:

- The contracts with the private sector are not subject themselves to balance sheet considerations, which provides more room to pursue value for money.
- The contracts with the private sector in this case are relatively short term. This gives the public client more flexibility, and the risk pricing and opportunistic behaviour issues due to long-term contracting remain limited.

The state in this case can also retain control of a number of strategic decisions in the project, for example, the tender strategy and fixing toll charges. In fact, in the Storebaelt project the government has intervened twice to reduce tolls and lengthen the repayment period due to social-welfare considerations.

In addition, a particular feature of the Danish approach to the construction contract has been extended into the first several years of operation. This was done to try to emulate some of the life-cycle commitment a construction contractor arguably should have in a PPP. It remains to be seen whether this was useful or necessary.

Nevertheless, arm's length public infrastructure management companies are not without downsides. There is no external pressure for efficiency, hence the firm's performance depends on the quality of public governance alone. The risk with arm's length public bodies is that if they are mismanaged, their entire financial obligations can fall back on the public balance sheet. Indeed, companies themselves note that a stable political environment plays a crucial role for the special-purpose vehicle (SPV) to operate efficiently on a year-to-year basis (Holm and Nielsen 2018).

The question with regard to private investment is how the case above could be made even better.

Partial solutions to long-term uncertainty in PPPs

Having first focused on the issue of inefficient risk pricing, we turn our attention to revenue risk. In the second part of the section, we look at flexibility.

So far, we have established that in principle governments should not seek to transfer demand risk, when it is mainly dependent on exogenous factors and cannot be managed well by a private operator. Road infrastructure is a prime example. As laid out earlier, demand risk transfer is also not necessary to satisfy the less transparent public debt accounting standards to which governments normally subscribe. Availability-based PPPs achieve the same objective, and tolls can still be collected.

Nevertheless, governments in the past have often transferred or tried to transfer revenue risk to the private operator. They may have had immediate practical reasons to do so, for example, a reduced fiscal capacity or unwillingness to absorb any contingent liabilities from traffic variations.

Revenue and long-term cost variation

Some partial solutions regarding revenue and long-term cost-variation are already in use. When the private sector is willing to accept demand risk, its cost will be borne by the users. This will have no immediate fiscal consequences for the government. The cost of inefficient risk pricing, however, will represent a social welfare loss borne by the users, reducing their affordability to buy or fund other services. Moreover, the debt-servicing requirements and the need to secure a high return and other characteristics that drive revenue expectations in project finance will add to the cost that needs to be recovered from the users.⁸

Ultimately, the PPP implies the need to regulate monopolistic power and requires setting up rigid contracts with price ceilings, indexing them to inflation. The characteristics described and the fact that user perceptions and externality values change over time likely place the PPP revenue pricing model at odds with the objectives of efficient pricing of infrastructure. These involve a variable charge depending on congestion, a higher charge for more polluting vehicles, etc. (Vasallo 2018).

Hence, if the revenue risk is transferred or shared with the private sector the question is not only how to minimise the first order social cost to the users but how to accommodate the broader objective of efficient infrastructure pricing, which has wider social welfare implications.

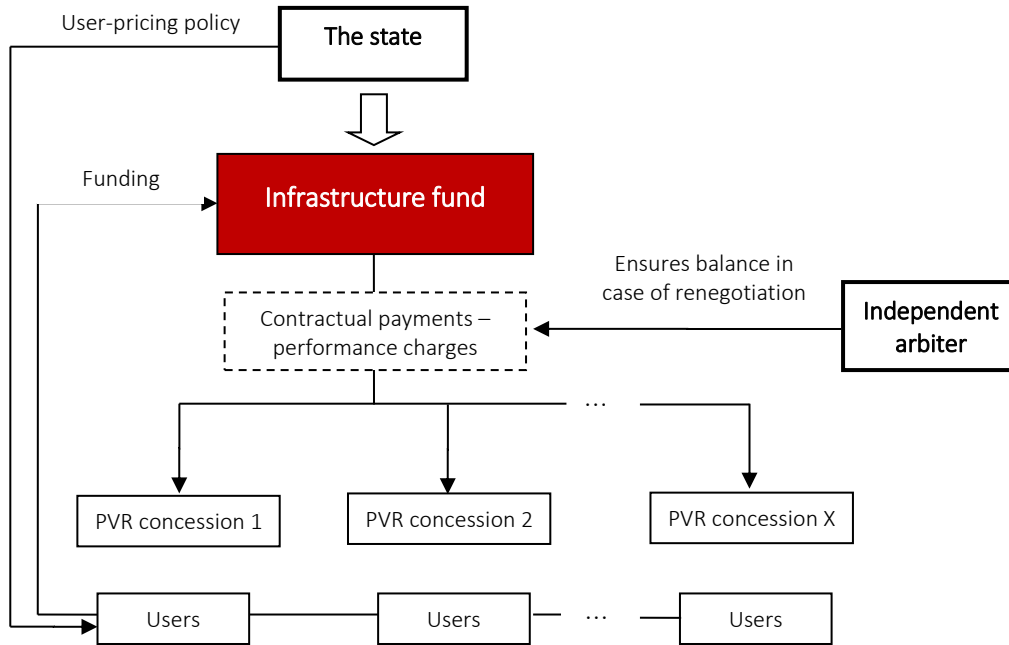
There are a range of measures available to reduce revenue-risk exposure of the PPP by risk sharing, including support from international financial institutions such as the World Bank, EBRD and others. As these are abundantly covered elsewhere, we do not address them.⁹

An approach that closely emulates the possibilities of the public sector when managing infrastructure and minimises the welfare loss on the user side is the PVR concession (Engel et al. 2001). The consequences of the variability are reduced by adjusting the length of the concession (i.e. the repayment period). In theory this approach helps absorb much of the traffic variation, unless it is so far below expectations that not even the running interest can be paid (without the principal). Arguably, in practice the model has not been very popular with the private sector because the return is set in advance – there is no upside if the traffic is above expectations. The concession merely ends sooner. Moreover, the model does not avoid the need to protect from a ramp-up period risk, which still requires mitigation (Bull et al. 2017).

A further option is proposed by Vasallo (2018), who recommends pooling the projects with the funding committed over a road fund to create more transparency. In this particular study, the PPPs are availability based. However, if a government wants to bear as few liabilities as possible, PVR concessions can be set up with revenues pooled in a road fund to offer additional protection by diversifying traffic risk not only across different projects but also over the different stages of the projects. In other words, mature projects could help offset the need for ramp-up guarantees for newer ones.¹⁰

A potential objection against the model proposed by Vasallo (or any availability-based PPP) is that private parties do not have full control over the revenues – they may collect them but then they pass them on to the road fund. As demonstrated in a contribution by Francis and Elliot (2018), which is discussed below, whether it comes directly from user charges or the government itself, the source of funding in advanced economies is irrelevant to the credible commitment to the contract. If a government wants to break the rules, it can do so in either case.

Figure 21. A combination of a road fund, PVR concessions, and an arbiter



The propositions above represent partial solutions to the PPP model with regard to losses due to inefficient risk pricing on the revenue side. To accommodate the rise in cost over time most tariff agreements in PPPs include an adjustment for a growth in inflation. This helps offset the risk somewhat of input prices but does not address uncertainty with regard to long-term cost. Even if the unit price variations were not the source of risk-pricing inefficiency, the exact quantities remain uncertain and need to be determined at the bidding stage. In essence, the cost of risk-pricing inefficiency on the cost side remains and is passed on to the users through the required revenues.

Another mechanism that would partially address inefficient risk pricing on the cost side would be a lifecycle gain-share mechanism. The UK National Audit Office (2018) reported that “a known concern with PFI [i.e. private finance initiatives] is that investors overestimate asset maintenance and equipment replacement needs over the project’s life, allowing surplus funds to build up, generating excessive profits. The PF2 model planned to introduce a lifecycle gain-share mechanism so that any unused funds would be shared equally between the SPV (i.e. special-purpose vehicle) and the public sector”. It should be noted, though, that this would only affect any residual that might have accumulated at the level of the SPV and would not concern any contingencies with the maintenance contractor that had to offer a fixed price for the contract in the beginning. Ultimately this approach did not become part of the PF2 model because HM Treasury recognised this would increase the chance that PF2 contracts would be classified as on-balance sheet.

Long-term contract flexibility

With regard to flexibility in long-term contracts, Engel et al (2018) argue it is possible to devise a PPP contract where the public sector retains the same flexibility it has under a traditional provision. Their exposition is simple. If the private party does not bear significant demand risk (as would be the case in a PVR concession or an availability-based PPP), the cost of providing, maintaining, and operating the

infrastructure is relatively clear from the start. If a hold-up situation occurs, a contract renegotiation will simply express the wishes of the party with the greater bargaining power. This situation might be offset by introducing a buy-out clause in the contract at the beginning, which offers each party an option but not an obligation to end the contract at a predetermined cost. Because the cost of construction and maintenance will be known in advance, the point at which the contract is terminated represents the present value of the total cost to be repaid until the end of the contract. It is essentially an early repayment of a loan. Most contracts today already include a termination clause.

A further characteristic of this approach is that it treats the engagement with the private sector as a one-off operation. We stressed at the beginning of this report (Chapter 1) that the rationale for engaging private sector investment is to pursue efficiency gains. If this is the case, then for long-term involvement a repeated game should be kept in mind. Using a buy-out option indeed resolves a hold-up situation for the current contract.

If countries intend to involve the private sector on a perpetual basis and plan to concession the infrastructure once the existing PPP contract expires or is bought out, it should be clear that this affects the competition for the next one.¹¹ Recent PPP operators will have an information advantage on the characteristics and processes with regard to the infrastructure they were managing vis-à-vis the government and other potential operators. For the same reason, they would need to be excluded from the next competition for the contract because the information makes them potentially the most efficient operators. At the moment, though, the market for major projects is an oligopoly – at least in the EU. Moreover, the re-tendering is again associated with transaction costs, even if these are spread over a long period of time.

A further option, which in its basic form we have dismissed, is contract renegotiation. Apart from the buy-out option above, no rule between the government and a PPP partner can offset a hold-up. A partial solution in this case is a dedicated independent body, a PPP arbiter (also proposed by ITF (2017a), in the model by Vasallo (2018) and introduced in Figure 22). If a hold-up situation occurs, either party can invoke an intervention by an arbiter (e.g. a body of several nominated experts) to attempt to bring a more balanced resolution of a dispute. The challenge in this case is that this is not a fully-fledged economic regulator that accumulates experience over time. Even if informed people are appointed as arbiters, they would be learning, and any consulting advice they want provided in the process will involve learning as well.

A permanent independent regulator with its own staff that accumulates capacity over time and constantly supervises the regulated companies would provide a better solution than a PPP both in terms of inefficient risk pricing and flexibility and is already part of a more comprehensive solution, discussed in the next section.

The regulatory asset base model as a comprehensive solution

Today, the regulatory asset base (RAB) model is mainly applied in network industries, which have natural monopoly characteristics. In some cases it is also applied to node infrastructure (e.g. Heathrow Airport in the UK). The determining factor is not the infrastructure type per se but whether the market structure is competitive or not. The latter is, of course, to a significant extent dependent on the infrastructure characteristics.

The incentive to pursue life-cycle cost efficiency arguably exists within the RAB model as well (a more comprehensive description and a full comparison between RAB and PPP models is provided in Makovšek and Veryard 2016).

While the solutions described above are partial, the RAB model is comprehensive as it allows the diversification of risk across different sections and over time in a network. However, it can also be described by the following:

- It includes a full-time economic regulator, which builds capacity over time and needs to understand the workings and the performance of the regulated company as well as possible. The Office of Road and Rail in the UK, for example, employs about 300 people and on top of that also obtains expert advice from academia and the private sector.
- It provides periodic incentives for efficiency through the economic regulator by setting medium-term efficiency targets that the private company needs to surpass. It breaks down the long-term uncertainty into short-term periods (price-control periods). In so doing it also addresses risk-pricing inefficiency on the cost side, which remains an unresolved issue in PPPs (see Figure 1 in Chapter 1). The utility regulation is credited with achieving significant savings (Table 4), which go beyond the reduction of excess employment.
- The regulator has a duty to fund the functions of the regulated company. The return of the latter is ensured, provided the efficiency targets are met. In conjunction with the regulator's role as a supervisor, the duty to fund in principle implies all exogenous risk factors, which the company cannot manage (e.g. uncertainty due to technology obsolescence), are borne by the users and if that fails, the state.¹² In short, the regulator is obliged to ensure both full-cost recovery for the private investor – provided the efficiency targets are met – and consumer protection.
- Because the company that manages the infrastructure is supervised and not controlled, the assets and related obligations are not on the public balance sheet even under the more transparent accounting standards available.
- This, at least in principle, provides the regulated company with the freedom to pursue contracts with its suppliers where risk allocation is not impacted by a particular accounting treatment.
- Ultimately, the economic regulator represents a solution to inter-temporal adjustment, which is unavoidable in long-term contracts. As an entity which incrementally builds its experience and consistently pursues top-down and bottom-up benchmarking of performance, it is well equipped to deal with periodic renegotiations. This is one of the key shortcomings of the PPP model, which an ad-hoc arbiter could only partially address.

Several characteristics of this model have attracted a substantially lower cost of financing than what the availability-based PPPs have enjoyed (one or more percentage points; see Makovšek and Veryard 2016).

Interestingly, although road networks would seem well suited to a RAB model, no country has so far tried to introduce one. There are countries, however, where substantial portions of the motorway network are managed by PPPs. This is the case in Spain, Portugal, Italy and France (the figure reaches 80% for the latter).

The introduction of such a system requires time to prepare the foundations and is a much more comprehensive exercise than tendering for a PPP on a road section. Australia is currently considering the model, and an investigation for this Working Group has revealed how a transition might look (Alchin

2018). The RAB is also not without challenges. We discuss below three major issues for the RAB model: the capex bias argument, opportunistic financial engineering and dependence on user charging.

Table 5. Real cost savings on operational expenditures in UK regulated industries

Control period	Savings per year
First	2.2%
Second	6.8%
Third	6.3%
Fourth	3.4%
Fifth	2.6%
Sixth	-2.6%

Source: Oxera (2008).

Applying the regulatory asset base model to a motorway network

In principle, the RAB model cannot be applied on stand-alone greenfield projects. It implies existing assets are placed under a RAB. New projects are financed by the regulated company borrowing against its balance sheet.

For Australia to set up a model similar to a RAB, it would need to conclude a series of preparations:

- It would need to agree on what type of roads it would like to apply the system to. Would this be the entire road transport system or only part of it (e.g. motorways)?
- It would need to determine what part of the network would be covered by a single regulated entity (i.e. only within each federal state or across borders, subject to economic considerations/economies of scale).
- The funding framework of the RAB needs to be clear to avoid unnecessary frictions on the government side. Ideally it would come from dedicated sources rather than general taxation. This would provide the necessary stability to the firm managing the infrastructure and allow adequate planning of activities. A reform to initiate user pricing for heavy goods vehicles is currently underway. Light vehicles will be addressed further in the future.
- The data on the asset condition needs to be of an adequate quality and sufficiently complete to allow the establishment of the RAB value at the time it is established. At present, data on asset condition is best for motorways, key freight and other major routes.
- A decision needs to be made on whether user pricing should be left to the regulated company, subject to outcome targets/incentives provided by the regulator and the government. Or should the regulated entity only be responsible for the maintenance and operation, while the user pricing is left to the government? In the regulated-utility model, the former principle is applied.

- How will the structuring decisions of the RAB affect its accounting treatment? Under the accounting principles most governments are relying on now this is not an issue. Hopefully, however, governments will eventually adopt a more transparent stance in this area. Generally, the obligations of regulated utilities are off the public balance sheet and even under more transparent accounting standards. This is because the government exercises supervision through the economic regulator. If the structuring of the regulatory model places too much of control on the side of the government, the accounting treatment would be affected too.

In the more distant future questions could also arise with regard to infrastructure planning, which at present is in the hands of the state. In utilities the planning is done by the regulated company subject to inputs from other stakeholders. In transport we would tend to argue the situation is more complicated. Major transport infrastructure connections affect multiple stakeholders, property rights and invariably involve political decision making, ideally supported by good economic evaluation. One sub-system (e.g. roads and railways) interacts with another, and for the moment the only one which is able to coordinate between them is the government. If we chose to include only a part of the network (e.g. motorways) in a RAB, then coordination is again needed between the motorway and the rest of the network. Whether and how planning could be transferred to the private owner is beyond the scope of this Working Group.

Of the questions above the most challenging one will likely be the funding. A striking fact is that, of the total network length in Australia of 874 000 km, only 241 km are subject to real tolls. A form of cost recovery is also in place for heavy vehicles.

In general, road-related taxes (e.g. fuel tax and vehicle registration) in Australia are not hypothecated. In 2015-16, road-related revenues collected by the national and territorial governments totalled AUD 27 billion, while road outlays by the public sector totalled AUD 26.2 billion. As vehicles become more fuel-efficient, and as electric vehicles form a larger share of the fleet, road-related revenues will continue to decline. Increasingly, it seems road outlays will need to compete with pressures to increase spending in other sectors, such as health. Current road funding arrangements, which are dependent on the general budget and do not involve a binding medium to long-term agreement to fund, could lead to a growing maintenance backlog. These arrangements will need to be reformed if a full RAB model is to be applied. (Alchin 2018).

Australian governments are actively considering economic regulation of heavy vehicle charges. In addition, the Australian Government has announced its intention to conduct a public inquiry, to be chaired by an eminent person, into the potential impacts of road user charging on road users. The inquiry would help to inform governments' decision-making on potential reform options and models.

Table 5 below illustrates how a transition towards a RAB might proceed. We note that a privatisation could only follow after the economic regulator spent five to 10 years building capacity up.

Table 6. Three potential paths of road reform in Australia

(shaded cells reflect major changes)

		Stage of development			
Issue	Current system	Application of FCB and independent heavy vehicle price regulation	Incentive regulation of a corporatised entity with user-pricing outcome targets	Regulatory asset base established on commercial terms but light vehicle charging not applied	Regulatory asset base and price regulator for all vehicles
Possible Timing	Now	2-3 years	3-5 years	3-8 years	10-15 years
Government	General taxation, vehicle registration, fuel and other dedicated road taxes	General taxation, vehicle registration, fuel and other dedicated road taxes	General taxation, vehicle registration, fuel and other dedicated road taxes	General taxation, vehicle registration, fuel and other dedicated road taxes	No obligation towards network under RAB
Heavy vehicle charging	Heavy vehicle charge + fuel tax and registration (cost recovery of expenditure over past several years)	Heavy vehicle charge and registration (cost recovery on forward cost base)	Hypothecated heavy vehicle charge, fuel tax and registration charges	Hypothecated heavy vehicle charge	Hypothecated heavy vehicle charge
Light vehicle charging	No (Fuel tax and registration charges).	No (Fuel tax + registration charges).	No (Hypothecation of fuel tax and registration charges)	No (Hypothecation of fuel tax and registration charges)	Yes (potentially by distance and location)
Who makes charging decisions?	Ministerial Council (extent of cost recovery)	<u>Price regulator for users only</u>	Ministries/regulators provide framework	Ministries/regulators provide framework	Ministries/regulators provide framework
Network subject to regulation					
Key freight routes	No	Yes	Yes	Key freight routes; potentially some others	Yes
Key freight routes and other major roads	No	No	Yes; heavy vehicles only	Yes; heavy vehicles only	Yes

Source: Alchin (2018).

Addressing the main challenges of the regulatory asset base model

Two common concerns with regard to the RAB model are capex bias and financial engineering.

Capex bias

The objective of any economic regulation is to protect the consumer, while ensuring investors (private owners of the regulated company) receive a fair return. To avoid a monopolist overcharging consumers, private operators need to be regulated. Historically in the United States, an approach known as rate-of-return regulation was dominant in the water and electricity sectors.

Rate-of-return regulation sets the allowed rate of return on the basis of assets, where the latter and the operational expenditures are more or less left to be determined by the regulated company. This approach provided little incentive to increase efficiency and introduced a perverse incentive to the regulated company to overinvest in its assets, earning a popular nickname, gold plating. This issue was theoretically explained by Averch and Johnson and has since been dubbed the Averch-Johnson effect (Averch and Johnson, 1962).

In the 1980s, price cap, or RPI-X, regulation was introduced. In this approach the return of the regulated company is still dependent on establishing a fair rate of return and the value of the assets (RAB). In the new approach, however, the prices of the regulated company's services were allowed to rise with general inflation (i.e. the RPI part), provided the efficiency targets (the "X") set by the regulators were met. Initially, the efficiency target approach was used on operational expenditures (opex) only, providing a pass-through for capital expenditures (capex). This was largely conditioned by the fact that while publicly owned utilities had suffered unsatisfactory levels of capital investment and renewals, creating a maintenance backlog that needed to be first resolved. Later, capital investment became subject to benchmarking and efficiency targets as well. However, benchmarking is comparably more difficult, which may have lead regulators to err on the side of caution to not dis-incentivise investment.¹³

The concerns with regard to capital bias in the RPI-X model, however, did not completely subside, and it has been questioned whether the model produced an additional form of perverse incentives. RPI-X sets the efficiency targets for capital and operation expenditures separately. This could motivate the regulated company to prefer capital-intensive solutions rather than those affecting operational expenditures. An example from the water industry would be a choice to invest in a new drinking water plant (increasing capex) rather than spending money on a long-term awareness campaign to conserve drinking water (opex).

For a framework of cost-efficiency benchmarking to work, it therefore needs to be able to overcome the two possible sources of capital biases noted above, namely the traditional Averch-Johnson effect and the further bias that may result from the adoption of separate approaches for operating and capital expenditure. This was the objective of another dedicated report to our Working Group, which analysed the evidence in the cases of rail, road, and water regulation in the UK.

The analysis by Smith et al. (2018) determined that:

- A comprehensive attempt to consider the evidence for the AJ effect is contained in Law (2014). His review of 192 empirical studies since 1962 shows that due to a number of challenges in providing conclusive evidence, the existence of the AJ effect remains to be empirically proven.
- In the UK, case evidence to date on the AJ effect and the further bias from using separate approaches to regulating operational and capex approaches is relatively weak.

- Regulators remain alert with regard to capital bias and have proposed a number of solutions, though their concern for the moment appears based on considering economic incentives and looking at anecdotal evidence.
- So-called totex solutions, whereby operating and capital expenditure are benchmarked together, have been proposed and tried to different degrees in the regulatory approaches applied to rail, water and roads in the UK.
- Totex resolves multiple issues but still faces the inherent challenge of capital expenditure, such as lumpy renewals and the problems of comparing bespoke enhancement levels and projects across companies. These can be reasonably managed.
- In terms of incentive-regulation challenges, in particular in context of capex bias, transport infrastructure could be regulated as successfully as utilities.

While in this section we have dealt with capex bias in the regulated model of infrastructure provision, we should not ignore that purely public provision does not avoid this problem.¹⁴

Financial engineering

Financial engineering has characterised regulatory asset base in the past. In the regulated model, the required rate of return (weighted average cost of capital, WACC) and the ratio between debt and equity in this measure are determined by the regulator's judgement of the level required for company debt to retail investment-grade status. This will tend to be a conservative estimate based on generic conditions and may not represent the actual debt-to-equity ratio of any specific regulated company.

This approach and a long and unprecedented period of generally low-cost financing has allowed the private owners of the regulated company a form of arbitrage, through which they reduce the equity in the firm, replacing it with debt.¹⁵ This process has not been viewed with public or academic sympathy (Helm 2008).

The increased leveraging of the regulated firms has two consequences. The first consequence is the reduction of equity will reduce the absolute corporate profit tax, which benefits consumers as well since the investors return expectations target the post-tax returns. Second, the increased leverage creates an appearance this that could change the actual cost of financing of the regulated firm. Standard financial theory, however (amended Modigliani-Miller theorem; Brealey et al. 2012), contends that the changes in leverage do not, or only to a very limited extent, affect the cost of the financing to the firm. Hence, the financial engineering as discussed above should not really be a problem.

Over the past twenty years, the financial markets have experienced a period of significant and unexpected reductions in the cost of debt. The assumption of regulators has typically been that utilities use long-term fixed-rate debt (this promotes stability in pricing). Regulators typically make separate allowances for the cost of existing embedded debt and new incremental debt required during the forthcoming control period.

This distinction has been important in an environment of falling debt costs. There has been some evolution in regulatory approaches. In some cases embedded debt has been treated as a cost pass-through item. This approach fails to recognise the ability utilities may have to refinance debt in falling markets and has poor incentive properties in general, which has tended to lead regulators to making allowance for embedded debt using comparative benchmarks. Future debt has tended to be priced in at fixed rates, based on market conditions at the time of determination, but this is giving way to indexation

based on general market movements to reduce the need for regulators to include a risk premium for forecast errors in their determinations.¹⁶

The fact that the regulation of financing costs tends to reflect benchmarking figures and companies will in practice take varying positions and make different financing choices (e.g. relating to the proportion of fixed rate debt) can inevitably create winners and losers. Regulators are often criticised for being over generous if retrospectively a company is observed to outperform its regulatory targets on any aspect of cost, including the cost of finance. This ignores the fact that the opportunity to outperform is central to the concept of incentive regulation.

However, in the specific case of financing and company leverage, it does seem regulators' expectations of both the levels of leverage consistent with investment grade and the costs of debt have lagged behind market experience over many years, resulting in there being systematically more winners than losers on the investor side. What's more, this has created an impression that one generation of investors has been drawing dividends out of the regulated companies and the next is expected to inject them back in, which is as of yet an untested proposition. Concerns have been expressed that the high gearing will impair the ability of the regulated companies to pursue capital intensive investment plans (see the example of the Thames Tideway Tunnel in the next section for an instance of this).

A higher leveraging of the regulated firm raises another concern, which is the higher risk of failure if there are adverse market events. The UK system has well established regimes to protect customers in the event of company default, and these have been shown to be effective (Enron/Wessex Water is an example). In addition, it is worth noting that during the global financial crisis there were substantial injections of equity by investors in highly-leveraged utilities, supporting a view that private equity investors are quick to take surplus out but also quick to put it back if needed. We cannot say that this would happen in all cases, which would explain why regulators strengthen their financial resilience regimes.¹⁷

A point often missed is that the RAB and PPP models are very much alike with respect to the above. The PPP experience, however, offers at least one lesson.

At face value a PPP is different in the sense that the model already starts as highly leveraged (projects where equity represents 10% and debt 90% are common). Because of this, the financing structure needs to have an excess cash-flow to keep the lenders confident that the debt repayment will be serviced with high certainty. As the project progresses, is constructed and moves into operation, the risk profile of the project is reduced. A natural strategy in this case has been to refinance, i.e. replace the initial debt, which has more restrictive covenants of the project, with cheaper debt. This allows a greater part of the cash flow to be freed up. The same process can make the projects vulnerable to failure due to unexpected shocks even at the more mature stages of operation. In short, in a RAB model the cash that can be freed rests in the firm's equity. In a PPP, it is the excess cash flow that meets the debt covenants. As opposed to the RAB model, after the year 2000 the UK government introduced a sharing mechanism of the refinancing gains in the private finance initiative projects (the UK availability-based PPP model).

Beyond the project's risk profile, if the market rates of debt also happened to drop significantly after the project achieved financial close, refinancing could also occur due to changed market circumstances, and refinancing gains would be shared as well. Not sharing the gains of financial engineering in the case of regulated utilities is perhaps a lost opportunity for the regulators. What is important, regardless, is that credible commitment of the government and the regulators depends on taking decisions that can be defended to experts and in the court of public opinion.

User funding is not a prerequisite

Although user funding is desirable, it is not an absolute prerequisite for RAB. As shown in Alchin (2018), broad road user funding is still some way off in Australia. This is also the case elsewhere. Even if a decision is made to introduce it, the transition is generally gradual and takes many years. The electorate is also more likely to accept incremental changes rather than instant reforms. This implies that the structure of funding will change slowly through time and move from one in which the general budget plays a significant part to one in which the regulated entity is almost self-reliant.

At the moment, countries that pursue expansion of their infrastructure and do not wish to show the ensuing debt on the balance sheet choose PPP as a main vehicle. Given our arguments above, a RAB may achieve the same objective, however, it has several advantages. The question, though, is, would private investors be comfortable with the general budget as a funding source?

Francis and Elliot (2018) provide a detailed account of whether the funding source matters. We summarise their key points below.

The protection from the apparent independence of government action that a revenue stream based on user charges may provide is something of an illusion in practice.

The investor confidence does not come from the sources of funding per se, and government can intervene in either case. The confidence comes from past experience, where the governments and public institutions have kept their commitments. The element of repeated-game holds the governments in check. Should a public institution fail to keep up its commitments in a single case, there would be a market wide loss of confidence, leading to a rise of required returns by private investors. Short-term gains by a myopic government will be reflected in higher cost over the long run.

In addition to the repeated-game element, the following factors would be far more important than the actual source of funding:

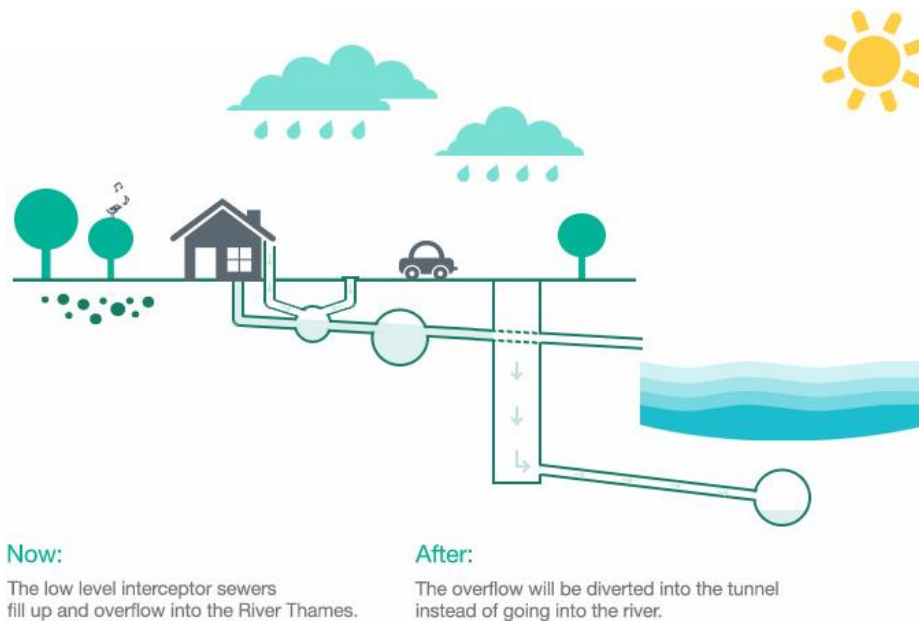
- an established institutional framework
- a track record of agencies operating without political interference
- a credible appeals process
- a commitment to the ongoing use of the model to promote good behaviour.

In summary, the consideration of a RAB model is in principle independent from the funding sources. According to Alchin (2018), what is more likely is that the need to meet the commitments of a government-funded RAB could lead to tensions within the government, given the far-reaching consequences in case of failure.

Potential hybrid solutions

For the moment hybrid solutions do not seem to extend the basic two options, as a case study of the Thames Tideway Tunnel (TTT) in the United Kingdom carried out for this report (Zhivov 2018) suggests. Due for completion in 2027, the TTT will be a 7.2-metre wide, 25-kilometre long sewer under the River Thames' tideway in London, United Kingdom (UK). London's sewers are designed to spill into the tideway when they reach capacity, such as during heavy rain. The TTT is expected to reduce the spill overs drastically (Figure 23). At the expected cost of GBP 4.2 billion (2016 prices), it is the largest water and sewerage infrastructure project in the UK since the industry was privatised in 1989 (NAO, 2017).

Figure 22. How the Thames Tideway Tunnel works



Source: Bazalgette (2016).

The circumstances behind the TTT were rather unique. While incentive regulation could have accommodated Thames Water financing, constructing and operating the TTT, it was unavailable. Thames Water lacked the necessary financial flexibility due to high gearing. In addition, the scale of risks and uncertainties would have a major impact on financing costs of Thames Water even if the gearing was not the problem (the expected size of the project is less than half of the Thames Water RAB).

The project needed to be off the government's balance sheet, i.e. it had to be privately financed. The TTT being a highly complex venture, the risks and uncertainties could have increased finance costs beyond reasonable levels. Accordingly, government support to ensure bankability was essential, but not to an extent which would infringe on the objective above.

The solution involved five components:

- Thames Water had the most knowledge and experience with regard to the technical specifications of the tunnel and, with the Water Services Regulation Authority (Ofwat), oversight, developed detailed planning and cost estimations prior to tendering for construction contracts.
- Construction was let with target-price construction contracts, which involve the contractor sharing a proportion of any underspend/overrun with the special purpose vehicle that finances the TTT (the infrastructure provider). There is also a bonus pool that all construction contractors would share in for delivering the whole project below budget/early.¹⁸
- Ofwat has developed a modified incentive-regulation framework, which regulates the consumer charges the infrastructure operator receives during both the construction and operation phases. It regulates the customer charges that fund the TTT. These are based on actual

construction costs and use a competitively determined rate of return for the whole construction phase. The regulatory framework also includes consumers sharing a proportion of any underspend/overrun with the infrastructure provider.

- The UK government has developed a government support package (GSP), under which UK taxpayers would absorb the impact of specified risks with the infrastructure provider.
- Thames Water also ran a separate competition to select an infrastructure provider to finance the TTT, i.e. there was a financing competition, which given the size of the project raised a lot of interest.

The project resembles a PPP with respect to construction, and as the realised construction cost progress, the asset moves into a RAB regime. Our assessment was that given the required boundary conditions and the current understanding of how incentives might work, the project was probably structured as well as it could be. In part, posterity will show whether the structure has worked as intended.

There are several concerns, but it is difficult to see how these could be resolved without breaking one or more of the boundary conditions of the project. Two basic ones deserve emphasis:

The target-price construction contracts are supposed to be distinct from fixed-price/fixed-date contracts used in a PPP in the sense that they should allow more pain/gain sharing and hopefully lead to more efficient risk pricing. An element that should ensure this is open-book accounting, where the procuring authority can verify the cost that the contractor has actually incurred. There is no research to confirm the target-price arrangement works as intended. Some information asymmetry remains, and the contractor may still be more incentivised to build to cost/time rather than below, meeting his private contingency, which the procuring authority cannot observe. Moreover, to provide greater certainty in this particular case the target was set at P80. A more balanced risk sharing scheme might arguably cost consumers less in the end, but in this particular case the sharing would need to come from the state, likely infringing the off-the balance sheet criterion.

Ideally, the reason why private investment should be involved is to pursue efficiency gains. The expected annual cost of operation for the TTT will likely be dwarfed by the capital value of the project. Despite the very low premium of private finance (the WACC was 2.5% in this particular case, and the ten-year risk-free rate was 2.0% at the time of announcement), it is questionable whether significant operational cost savings can be achieved to offset even such a small premium but on a very large base.¹⁹

In summary, while specific elements of the approach may raise concerns, the broader hybrid model may be capable of delivering the best possible value given its boundary conditions and the current understanding of incentive mechanisms. The replication of the model, however, will depend on achieving comparable circumstances, which in this case appear fairly unique. These include a procuring body, Thames Water, which seems to have had the best understanding of the technical requirements of the project and developed a fairly detailed design, mature regulatory capacity and a mature government agency to provide targeted de-risking support.

Box 10. Further reading on Chapter 5

Detailed analyses of the issues covered in this chapter are available in these Working Group Papers:

Engel, E., Fischer, R. and A. Galetovic (2018), “Dealing with the Obsolescence of Transport Infrastructure in Public-Private Partnerships”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Francis, R. and D. Elliot (2018), “Infrastructure Funding: Does It Matter Where the Money Comes From?”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Hasselgren, B. (2018), “Risk allocation in Public-Private Partnerships and the Regulatory Asset Base Model”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Holm, K. V. and T. H. Nielsen (2018), “The Danish State Guarantee Model for Infrastructure Investment”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Smith, A. et al. (2018), “Capex Bias and Adverse Incentives in Incentive Regulation: Issues and Solutions”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Vasallo, J. M. (2018), “Public-Private Partnerships in Transport: Unbundling Prices from User Charges”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Zhivov, N. (2018), “The Thames Tideway Tunnel”: A Hybrid Approach to Infrastructure Delivery”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Also of interest:

Makovšek, D. and D. Veryard (2016), “The Regulatory Asset Base and Project Finance Models”, International Transport Forum Discussion Papers, No. 2016/01, OECD Publishing, Paris.

Notes

- 1 There are of course many other factors outside of port control that affect its attractiveness.
- 2 We note that having competition in the market is not at odds with the use of PPPs. Some may contend if there is competition, why resort to PPPs, the market can organise itself. This is not always the case. The port and airport infrastructure involves large capital and sunk investment. These are significant entry barriers. The private sector is much more willing to enter (invest) if an airport is already built and has an established demand level. Similarly in the case of seaports, it will be easier to attract private investors if the state builds the piers and break waters, while the private sector invests in the super structure – the operations (cranes, warehouses...).
- 3 Demand endogeneity (the ability to impact it through ones actions) and competition in the market are two related but different concepts. Demand is endogenous when ones actions increase consumers’ willingness to pay; higher quality for example. In the extreme case a new product or service may not compete with anybody, but may still attract more or less demand. Competition, on the other hand, means that somebody else can offer the same good or service cheaper (or a better quality/price package). These two concepts may be distinct in economics, but serve the same function in our discussion (they can provide a continuous incentive).

- 4 Rouboutsos and Pantelias (2015) provide an overview of how manageable demand risk is in different transport modes, including urban transport.
- 5 Hart (2003) asserts we should not rely on an output specification if we cannot define it well enough and, consequently, cannot control the quality well. This provides the private operator with the incentive to shade (i.e. reduce) the quality in those aspects which are not easily observable. Health care might be such an example, which is why PPPs predominantly include building management and auxiliary services (e.g. cleaning, catering) but not clinical services.
- 6 ASfiNAG, Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschaft (A Stockholding Company for the Financing of Motorways and Expressways).
- 7 NDS, Národná diaľničná spoločnosť (National Motorway Company).
- 8 Lenders normally require that the actual cash flows on the project are substantially higher than the exact amount necessary for debt servicing, reflecting the need to insure the projects ability to repay the debt. Depending on the individual project's risk the debt servicing ratios can be set at 1.20 or higher (i.e. the cash flow must be 120% of what is actual debt servicing requirement).
- 9 Yescombe (2011), lossa (2015), Bull et al. 2017 are a few examples.
- 10 We note that the capacity to diversify risk across different sections and over time is internalised to the maximum extent when a corporation manages the entire network.
- 11 It is not uncommon for governments to concession an existing revenue generating asset to the highest bidder, enabling the current government to spend more.
- 12 For the moment this rarely occurs. Some of Australia's regulated electricity transmission companies are facing declining user numbers. Should the investments in the transmission infrastructure become unrecoverable from the users, a decision will need to be made as to who will bear these cost. According to Engel et al. (2018), it should be the state.
- 13 Capital expenditure has a cyclical and potentially lumpy nature, which makes it harder to benchmark against other companies than opex (Smith et al. 2018).
- 14 This discussion is more related to project selection, strategic misrepresentation of data to get projects approved and the construction of projects with negative benefit to cost ratios that are not economically justifiable (such as roads to nowhere).
- 15 A crude example of an operation that would enable such a result is sale and lease back, though we're not contending that it is this form of financial engineering that has been used. In it, an asset has been sold and the lease represents a service to be paid. The proceeds of the sale, however, release cash that can be paid out through dividends.
- 16 For instance, see Ofwat's final methodology for its 2019 review: <https://www.ofwat.gov.uk/wp-content/uploads/2017/12/Final-methodology-1.pdf>.
- 17 Ofwat now requires water companies to produce a Long Term Viability Statement that confirms the financial viability of the company under an appropriate set of stress tests and over an appropriate forward-looking period. See Ofwat "Monitoring Financial Resilience 2016-17", (<https://www.ofwat.gov.uk/wp-content/uploads/2017/11/Monitoring-financial-resilience-2017-Report.pdf>).
- 18 A similar approach was used in the case of the Oresundsbron described in Chapter 3.
- 19 It is notable that the cost would have been even higher had Thames Water been able to finance the project without any government assistance. Ofwat put the WACC for the water utilities at 3.6%. See also <https://data.oecd.org/interest/long-term-interest-rates.htm>

References

- Averch, H. and L. L. Johnson (1962), “Behavior of the firm under regulatory constraint”, *The American Economic Review*, 52(5), 1052-1069.
- Bazalgette (2016), “Our solution”, accessed 13 June 2017 from <https://www.tideway.london/the-tunnel/our-solution/>.
- Brealey, R. et al. (2012), *Principles of corporate finance*, Tata McGraw-Hill Education.
- Bull, M., Mauchan, A. and L. Wilson (2017), “Toll-Road PPPs: identifying, Mitigating and Managing Traffic Risk”, *PPIAF and Global Infrastructure Facility (GIF)*, Washington D.C. (<http://globalinfrastructure.org/sites/gif/files/Traffic%20Risk.pdf>)
- Dresner, M., Lin, J. S. C. and R. Windle (1996), “The impact of low-cost carriers on airport and route competition”, *Journal of Transport Economics and Policy*, 309-328.
- Engel, E., Fischer, R. and A. Galetovic (2001), “Least-present-value-of-revenue auctions and highway franchising,” *Journal of Political Economy*, 109, 993-1020.
- Hart, O. (2003), “Incomplete contracts and public ownership: remarks, and an application to Public-Private Partnerships”, *The Economic Journal*, 113 pp. 69-76.
- Helm, D. R. (2008), “A New Regulatory Model for Water: The Periodic Review”, *Financial Regulation and Competition*, May.
- Iossa, E. (2015), “Contract and procurement design for PPPs in highways: the road ahead”, *Economia e Politica Industriale*, 42(3), 245-276.
- ITF (2015), *A New Hinterland Rail Link for the Port of Koper? Review of Risks and Delivery Options*, Case-Specific Policy Analysis series, International Transport Forum, Paris.
- Law, S. M. (2014), “Assessing the Averch-Johnson-Wellisz Effect for Regulated Utilities”, *International Journal of Economics and Finance*, 6(8), p. 41.
- NAO (2018), “PFI and PF2. Report by the Comptroller and Auditor General”, <https://www.nao.org.uk/wp-content/uploads/2018/01/PFI-and-PF2.pdf>.
- NAO (2017), “Review of the Thames Tideway Tunnel”, London: National Audit Office.
- Oxera (April 2008), “Network Rail’s scope for efficiency savings in CP4: prepared for Office of Rail Regulation”, London, <http://www.rail-reg.gov.uk/upload/pdf/pr08-oxeraeffic-160408.pdf>.
- Rouboutsos, A. and A. Pantelias (2015), “Allocating revenue risk in transport infrastructure public private partnership projects: how it matters”, *Transport Reviews*, 35(2), 183-203.
- Yescombe, E. R. (2011), *Public-private partnerships: principles of policy and finance*, Elsevier.

CHAPTER 6

Uncertainty and mobilising private investment

One of the major initiatives to enable a greater mobilisation of private investment in infrastructure is the establishment of infrastructure as an asset class. It is a measure that provides investors with more information on the financial performance of different infrastructure investments. As a consequence, the cost of financing for many of the existing projects should be reduced. Potentially, some projects which appeared unbankable before may become acceptable. A study investigating what the impact of this change could be is difficult to find.

Beyond providing the investors with more information, governments also have stronger de-risking tools available to leverage private investment. These range from contingent support such as guarantees to capital grants and other measures. Beyond governments themselves this support can also come through supranational funds or development banks and agencies.

One of the challenges policy makers face is an understanding of preconditions for such a de-risking policy to be effective. In this chapter we provide a high-level case study of the EU. It provides a limited albeit interesting insight into how challenging it can be to mobilise private investment even in advanced economies when uncertainty is not the only problem.

In 2008, in the wake of the global financial crisis policy makers at first thought the main issue was financing constraints that came with the reduced capacity of the banks to lend. Despite a political declaration after this was no longer the case, an increased mobilisation of private investment in (transport) infrastructure did not appear.¹ This time the assumption was that an uncertain macroeconomic climate deterred private investors from engaging. Additional supranational support in the form of additional de-risking capacity by the European Investment Bank (EIB) was provided through the European Fund for Strategic Investment (EFSI), with the first projects approved in 2015.

Using the limited data available, we sought to illuminate what broad factors may affect de-risking policies, especially after the economic crisis. Our hypotheses, based on four reasons why private investment in transport infrastructure in Europe continued to stagnate (until 2016 according to our data) are the following:

- Adverse economic conditions increased the sensitivity of private investors to risk, effectively requiring more public de-risking support.
- The fiscal constraints reduced the willingness and/or capacity of governments to provide de-risking support.
- Regardless of the point above, governments also pursue Public-Private Partnerships (PPPs) to avoid recording the related obligations on the public balance sheet. This trend, too, would have been dulled by government fiscal constraints and an attempt to reform the EU public accounting rules around the same time.
- A de-risking policy assumes there is a stock of user-funded projects waiting to be executed. This may not necessarily be true.

This chapter begins by providing a brief overview of de-risking tools and then covers each of the four points above. Lastly, we reflect on de-risking as a tool given our other findings in the synthesis so far.

De-risking is distinct from subsidies

De-risking can take multiple forms and is generally a part of the contract's provisions with the private party. Some of the instruments are available in the private sector, others can be provided by the state or intergovernmental organisations (e.g. development banks). Table 7 below summarises the main elements but is not exhaustive.

Table 7. Forms of risk mitigation

Type of Measure	Instrument
1. Guarantees, realised directly by the government or by its own controlled agency or development bank	1. Minimum payment, paid by contracting authority
	2. Guarantee in case of default
	3. Guarantee in case of refinancing
	4. Exchange-rate guarantees
2. Insurance (private sector)	1. Wrap insurance, technology guarantees, warranties, commercial and political risk insurance
3. Hedging (private sector)	1. Derivatives contracts such as swaps, forwards, options, etc.
4. Contract design, paid by contracting authority	1. Availability payment mechanisms
	2. Offtake contracts
5. Provision of capital, realised directly by the government or by its own controlled agency or development bank	1. Subordinated (junior) debt
	2. Debt: <ul style="list-style-type: none"> 2.1 At market condition 2.2 At lower interest rate
	3. Equity: <ul style="list-style-type: none"> 3.1 At market conditions 3.2 At more advantageous conditions
6. Grants, generally delivered by contracting authority, even if some dedicated fund at national level may exist; tax incentives can be delivered by national or local authorities	1. Lump sum capital grant
	2. Revenue grant: <ul style="list-style-type: none"> 2.1 Periodic fixed amount (mitigating the demand risk) 2.2 Revenue integration (leaves demand risk to the private player)
	3. Grant on debt interests
	4. Favourable taxation schemes for special-purpose vehicles (SPV)
	5. Favourable taxation schemes for equity investors

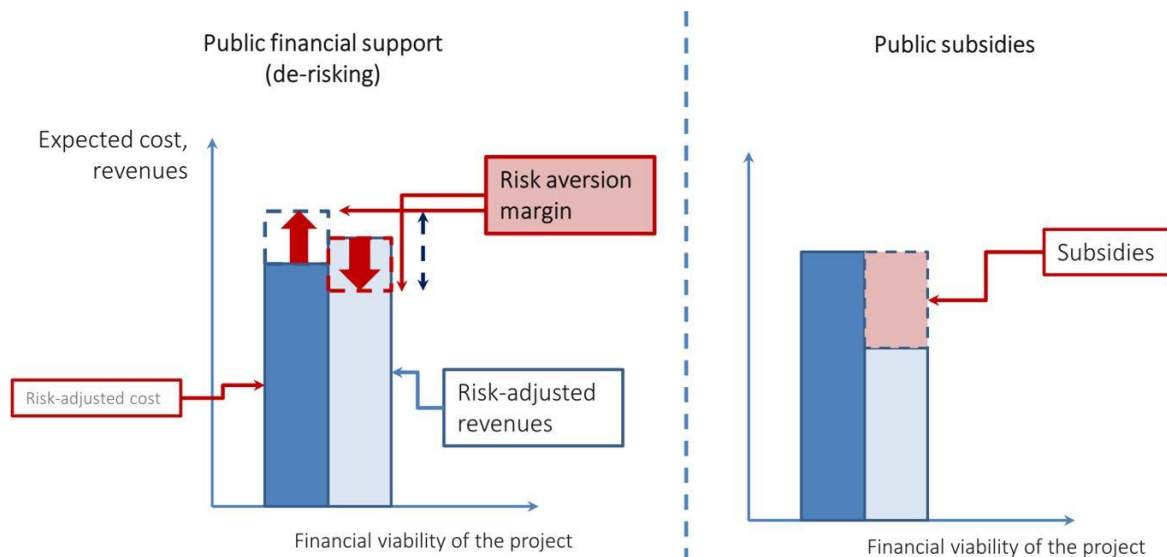
Source: OECD (2015).

As discussed, the inability to fully assess risk incurs an uncertainty premium. A potentially sound project could therefore be perceived as financially unviable because the market is not capable of recognising it as such.

This should be seen as distinct from a project where it is clear in advance that it is unable to generate sufficient revenues to recover its cost (e.g. providing a public transport service to remote areas or for

particular groups of users). Such a project requires subsidies.² At the risk of oversimplifying, Figure 24 illustrates the difference. On the left-hand side the base case cost and revenues of the project are given, but investors perceive those as insufficient (following a risk analysis or a lack of information to inform it). On the right-hand side is a case where it is clear the project cannot recover its cost from the outset.

Figure 23. The concepts of de-risking and subsidies



De-risking investors likely has some impact on project performance. They are responsible for monitoring those delivering the project (i.e. the suppliers). There is no systematic evidence available whatsoever what the impact might be. Even the most basic empirical evidence on how different contract types affect not only on-time and on-budget delivery but also project end-cost is unavailable (e.g. Kennedy et al., 2018; Makovšek and Moszoro, 2018). This is not surprising given the lack of enthusiasm on the side of public authorities to pursue ex post analysis, a point we have frequently voiced throughout this report.

Having outlined the basics of de-risking, we now turn to the factors that might explain a substantial part of the private investment mobilisation in the EU post crisis.

De-risking is important but does not solve every problem

Infrastructure investment is a well-known anti-cyclical policy measure. However, during an economic crisis both the public and the private sector are affected.

Macroeconomic conditions and private investor sensitivity to risk

For the private sector, increased macroeconomic uncertainty increases the sensitivity of private investors and their expected returns.

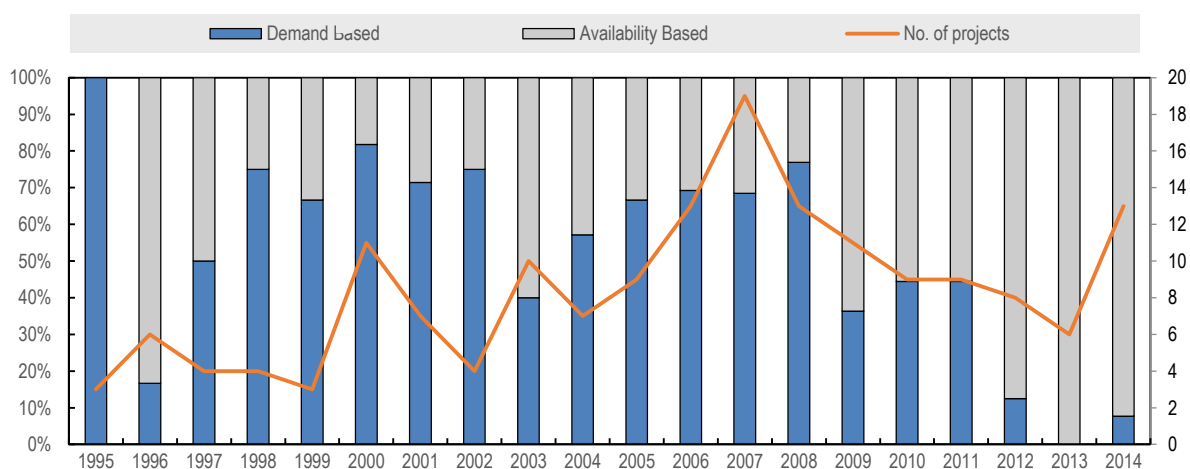
The increased sensitivity can be seen in the development of credit spreads for PPPs, which grew from 80 basis points over Libor/Euribor to almost 350 basis points in 2012. The spreads added to the problems of traditional lending channels, namely banks, which restricted their capacity to lend following the collapse of the monoline insurance companies and new banking regulations.

A more illustrative representation (though not without the same problem vis-à-vis banks) of increased sensitivity to uncertainty comes from contract design trends. Data with regard to the many types of de-risking support available (showcased in Table) is the most accessible. In availability-based PPPs, the state retains demand risk as opposed to demand-based schemes.

The preference for contract design can also be considered a proxy for the investors' risk appetite and may imply increased risk aversion beyond demand risk. In Figure 24, a depression in the interest to take on demand risk is evident immediately after 2008. Though the current example refers to a particular sector and a particular risk, demand risk is linked to macroeconomic conditions and thus may be reflective of broader risk attitudes of private investors.

In short, during adverse economic conditions, more de-risking support is needed for the projects to be acceptable to private investors.

Figure 24. Distribution of demand-based vs. availability-based contracts in private investment in roads in the European Union, 1995-2014

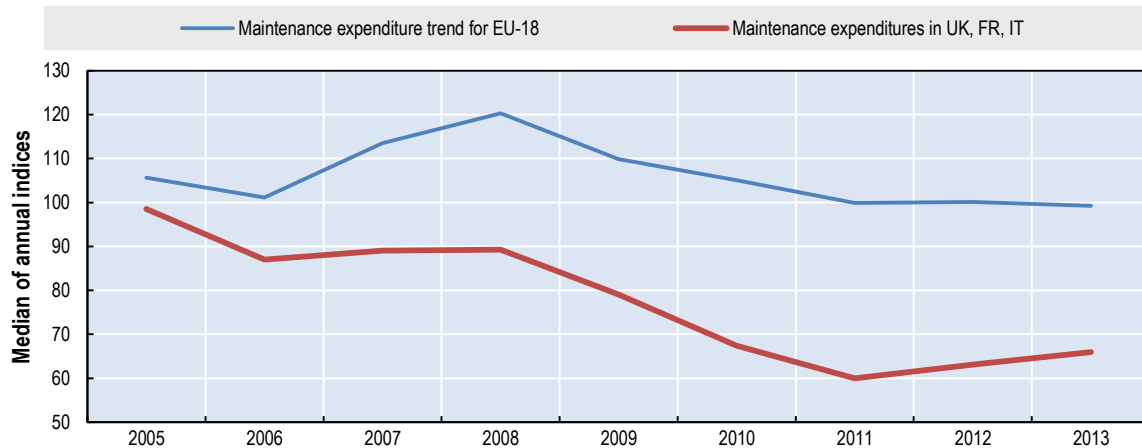


Source: DEALOGIC database; BENEFIT4Transport project data.

Fiscal capacity and de-risking

For the public sector, an economic crisis leads to pressures on current spending and sovereign debt levels. Less public money is available to co-fund and de-risk transport infrastructure investment. As a consequence governments allocated substantially less money to invest in transport infrastructure. In Chapter 2 we showed that more than 80% of private investment flows until 2016 happened in a handful of countries (the UK, Spain, Portugal, France, Turkey, Italy and Germany). There, we focused on road and rail data since port and airport data are particularly lumpy and thinly spread. Figure 4 showed that between 2008 and 2014, public investment dropped by roughly USD 20 billion, or about a quarter. Private investment contracted by a similar proportion in relative terms but far less in absolute terms given that it represented less than 10% of total investment at best. Another indicator confirming the point was a substantial drop in maintenance expenditures (Figure 26).

Figure 25. Road maintenance trends in selected countries, 2005-2014



Notes: Data was only available for three OECD countries. Available data for other countries (Austria, Belgium, Hungary, Czech Republic, Denmark, Spain, Finland, Iceland, Ireland, Lithuania, Lichtenstein, Luxembourg, Norway, Poland, Slovakia, Slovenia and Sweden) was included to illustrate the trend is not particular to the UK, Italy and France.

Source: OECD/ITF.

In short, it seems reasonable to assume the economic crisis put governments in a position where they have less money both to co-fund transport infrastructure projects and to provide de-risking support. If projects could be user-funded (even when government bears the demand risk it can still collect tolls), the existing accounting framework in Europe should still motivate governments to pursue private investment. These two assumptions, though, are less clear-cut.

Uncertainty through reform

A reform in public debt accounting rules may have introduced additional uncertainty. If the private sector were willing, one would expect an increased interest of countries in pursuing private investment because it allows them to invest without recording the required obligations on the public balance sheet. This lack of transparency is also why some have sought to reform the public debt accounting rules in the EU. The reform would effectively bring all PPPs, their assets and respective obligations on the public balance sheets retroactively.

Ultimately, the reform did not take place and the old accounting rules prevailed. It was not until June 2013, when the new ESA 2010 (European System of National and Regional Accounts) rules were introduced, with further clarifications following. The process of reform until governments adopted the new rules created uncertainty with regard to the accounting treatment of PPPs for national decision makers.

The EU provided member states with an additional de-risking tool: the European Fund for Strategic Investments (EFSI). It opens a way out for countries with respect to the accounting treatment of projects. The support provided by the European Investment Bank (EIB) is treated as a non-government entity and does not affect the accounting treatment of a particular project, and the government's contributions to the EFSI are treated off the balance sheet as well. However, the first EFSI-supported projects were only approved in 2015.

No abundance of user-funded projects

The existence of a large stock of potentially user-funded projects waiting to be financed seems unlikely. There is no overview available as to what is the share of user-funded infrastructure being delivered every year. There is some data available on the share of PPPs that are user-funded, but that is a very small subset of the total annual transport infrastructure investment.³

Using the example of the road sector, on average only 55% of the EU's motorway network is tolled. Moreover, the motorway system generally represents only a smaller portion of a national road network (in France, for example, about 10% of the national road network). Some countries also extend user-charging to parts of the remaining network for heavy goods vehicles (HGVs) only, but generally a significant participation of public budgets (state, regional or local) is required.

The obstacles to user-charging are less and less those of technology but of political transition. In the UK, for example, the introduction of user-charging has remained a challenging objective that did not materialise despite announcements by multiple governments. In some cases, governments had to abandon an already agreed policy to introduce HGV charging (e.g. the *ecotaxe* initiative in France). The introduction of user-charging in many cases remains a very challenging political rather than technical challenge. On top of this, projects that could be fully self-reliant in terms of funding represent the cream of the crop in terms of the infrastructure the state is responsible for. The rest can only become viable if there is a cross-funding arrangement in place or the government provides subsidies.

In summary, in this chapter we have attempted to provide a high-level snapshot of the challenges of mobilising private investment following an economic crisis in countries that had a strong private investment track record already before. A crisis affects both the public and the private sector – it reduces the ability of the public sector to co-fund and provide de-risking support and increases the need of the private sector for it. Perverse public accounting incentives carry the moral hazard of sacrificing value for money to achieve particular accounting treatment, but they seem less relevant if there simply is no money. It seems clear a de-risking approach cannot achieve an order of magnitude leap in private investment if the underlying problem is funding.⁴ A de-risking approach may help overcome some of the uncertainty aversion, however, we do not know how such a policy will affect project outcomes. If private investment should be pursued on the merit of improved efficiency, is a crisis or its aftermath the right time to pursue a private investment expansion?

Given the data gaps that preclude a comprehensive analysis, our findings are tentative.

Box 11. Further reading on Chapter 6

Detailed analyses of the issues covered in this chapter are available in these Working Group Papers:

Kennedy et al. (2018), "Risk Pricing in Infrastructure Delivery: Making Procurement Less Costly", Working Group Paper, International Transport Forum, Paris (forthcoming)

Makovšek, D. (2018), "Mobilising Private Investment in Infrastructure: Investment De-Risking and Uncertainty", Working Group Paper, International Transport Forum, Paris (forthcoming)

Also of interest:

Makovšek, D., and M. Moszoro (2018), "Risk Pricing Inefficiency in Public–Private Partnerships", *Transport Reviews*, 38(3), pp. 298-321.

Notes

- 1 Other reasons such as the inadequate capacity of countries to prepare well-structured proposals are cited as a cause as well (Revoltella et al. 2016). Given our focus is on the countries that traditionally dominated in PPP investment in the EU, this element was not included in our analysis.
- 2 If the state organises a tender to operate a public transport service for the lowest subsidy, then it effectively transfers the determination (demand risk) of how much money can be recovered by the private operator.
- 3 For the EPEC’s annual market update, see <http://www.eib.org/epec/>
- 4 Note we already explained in Chapter 1 that private investment cannot close the infrastructure-funding or financing gap. The absence of transparent public-debt accounting principles, however, may give the impression it can.

References

- OECD (2015), “Infrastructure Financing Instruments and Incentives: a Taxonomy”, OECD Publishing, Paris, <http://www.oecd.org/finance/private-pensions/Infrastructure-Financing-Instruments-and-Incentives.pdf>.
- Revoltella, D. et al. (2016), “Infrastructure investment in Europe and international competitiveness”, (No. 2016/01), EIB Working Papers.

CHAPTER 7

Advancing infrastructure procurement: The way forward

Throughout this synthesis we have raised the issue of not understanding the differential performance of alternative delivery models. This includes not only the higher-level question of PPP versus traditional procurement, but more precisely the treatment of risk (risk allocation and/or risk sharing and the associated question of which project activities governments insource or outsource via external contracts); how much externalised project activities are bundled and the associated scope of the project's contracts; the nature of the exchange between government and private sector firms delivering the project's contracts. This includes the approach to remuneration within these contracts (e.g. fixed price, reimbursement or target price), in conjunction with other positive and/or negative incentive mechanisms, such as pain-share/gain-share regimes and performance bonds. In other words, it is about infrastructure procurement in general.

There is little doubt that building the wrong project right rather than building the right project wrong is the greater evil. However, it would not be an exaggeration to consider that building the right project wrongly can lead to significantly higher costs than building, or procuring, the right project in an optimal fashion. Of course, many countries are aware of this and have designed processes or gateways that attempt to lead to better procurement decision-making. These exercises are valuable but remain subjective and susceptible to political interference.

While project selection outcomes can be improved through cost-benefit analysis (CBA), there is no such structured decision support system available for procurement. The approach taken in CBA is grounded in microeconomic theory, and in the decades that it has been used it has gone through a virtuous circle of using the empirical data it relies on for further refining its tools and reduce subjective bias (though expert judgement will always be a key input in the process of deploying CBA).¹ The fact that CBA as a tool for project selection is so well-developed reflects poorly on procurement, which does not have an evidence-supported tool. There is an abundance of advanced microeconomic theory that is directly relevant to procurement (including risk treatment, the bundling and the exchange relationship). There is also an abundance of latent (!) data to test this theory and develop it into a procurement decision support system.

Below we describe two initiatives designed to remedy this unsatisfactory situation. The first, on data collection, aims to improve our understanding of contract performance to develop baseline data by which procurement related microeconomic theory can be tested and turned into a practical and implementable tool. The second initiative represents the inception of this practical and implementable tool, or Procurement Design Assessment System (PDAS). This second initiative is based on what we know about the relative merits of state-of-the-art microeconomic procurement-related theory and how this theory can be configured into the core of PDAS. We then outline directions we can take to extend this core, allowing PDAS to be used across all infrastructure sectors. In total, these two initiatives advance the key themes across the recommendations in this overview, including the specific and fundamental final recommendation on fostering competitive markets to improve value for money.

A database to study the performance of contract design

In 2016, an initiative was launched by the International Transport Forum (ITF) in collaboration with University College London (UCL) to develop a better understanding of differential performance among alternative contract designs. These include the contract designs used in a PPP, but also those used in traditional procurement. The objective is to build a database that would record the end-unit cost of road projects alongside other project performance measures. It also captures their broad contract design and other characteristics that would allow us to filter out the effect of contract design on value for money.

The road infrastructure sector was chosen for several reasons:

- Road design standards in European and other advanced economies are long established. Comparing two roads of the same type will lead to a greater homogeneity in terms of the cost and performance variables affected by procurement in contrast to, say, hospitals.
- Road projects can be relatively large, which makes them relevant in terms of the size of capital and operating expenditure and, therefore, the size of potential savings. This in turn creates traction with policy makers.
- The incidence of new road construction is significant, hence there is a good pool of observations from which to develop this data base. Moreover, the cost and performance of roads are dynamic in terms of the period up to and beyond road rehabilitation, which promotes a database that can be periodically updated.

Once the process and effectiveness of the analytical approach is established for the construction phase, the database would be extended by adding maintenance and eventually service quality to provide a comprehensive data source. Appendix 4 describes the initiative in greater detail.

How far has this initiative progressed? A number of road data owners in several countries in Europe and Australia have expressed interest to participate. There is a strong intuition among potential participants that a suboptimal approach to procurement can have negative consequences in terms of undermining value-for-money. The lack of hard evidence for these impacts makes it challenging to generate wider interest; nevertheless, many have appreciated the relevance of this initiative.

A similar initiative (though much smaller and in a social infrastructure sector) is currently being launched in Australia at the Queensland University of Technology (QUT) with an Australian Research Council grant (2016-2020).² For this project, schools were selected as the focus, for similar reasons to those for the choice of roads in the ITF-UCL initiative: Schools exhibit more homogeneity than most other social infrastructure sectors, are non-trivial in terms of their capital and operational expenditure (typically over AUD 1 billion for a PPP contract of around ten schools) and are dynamic in their operations (typically including one or two major refurbishments over a 30-year term).

The research team (led by QUT and including the University of Melbourne and the University of New South Wales (UNSW)) is collecting data on 60 PPP and traditionally procured schools across Australia. The data includes design characteristics, user satisfaction (principals and teachers), the total finance, design, construction, operations and maintenance cost to date per square metre. The data is then combined to create a “value rating tool”. The expected outcomes of the Australian initiative include:

- Improvements to both PPP and non-PPP models via the dissemination of best practice accounting for superior value ratings.

- Identification of “turning points” i.e. the point at which an increase in expenditure yields a greater increase in performance and the point at which a reduction in expenditure yields a smaller reduction in performance.
- An enduring post-completion review tool.
- Advancing the disciplines of design and cost management. Currently design follows cost or cost follows design, but either way they are not synchronised – when advancing value-for-money demands the synchronisation of adjustments to both performance (via design) and cost.

Where it seeks to connect service level with cost, this research is similar to the objectives of the database of road performance and cost initiated by the ITF. Objective performance indicators already exist (e.g. a road roughness index) and could be complemented with other data sources reflecting user satisfaction.³

Such databases would be extremely valuable. Governments are being asked to do more within constrained budgets and thus face on-going fiscal pressure. These pressures also bear on infrastructure maintenance and procurement. Tools as the ones outlined above could assist governments and their agencies in better understanding the cost and performance of their outlays in the road sector. The ability to empirically assess contract performance on a systematic scale is critical for this.

An evidence-supported tool to inform procurement

Decision makers are aware that the design of procurement influences project outcomes. However, in the absence of sufficient empirical evidence, processes typically revolve around matching the relative advantages of a stereotypical procurement method with the project (see Box 7).⁴ In other words, the broad characteristics of a project tend to automatically define agencies’ decisions on the “best” approach to procurement.

Furthermore, the selection of a procurement model almost exclusively depends on construction-related expert opinion or subjective judgement. This tends to be susceptible to short-term orientation because of short-term in budget allocations (e.g. the time in which the money allocated needs to be spent). Lack of understanding of trade-offs between different procurement modes (how expensive being on-cost can be; the performance of fixed vs target price mechanisms, impact of contract duration on cost and performance etc.) can also play a role. Finally, substantially more is known about the performance of procurement models with regard to the delivery of an asset to the end of construction as opposed to the performance of procurement models in operations of the asset.

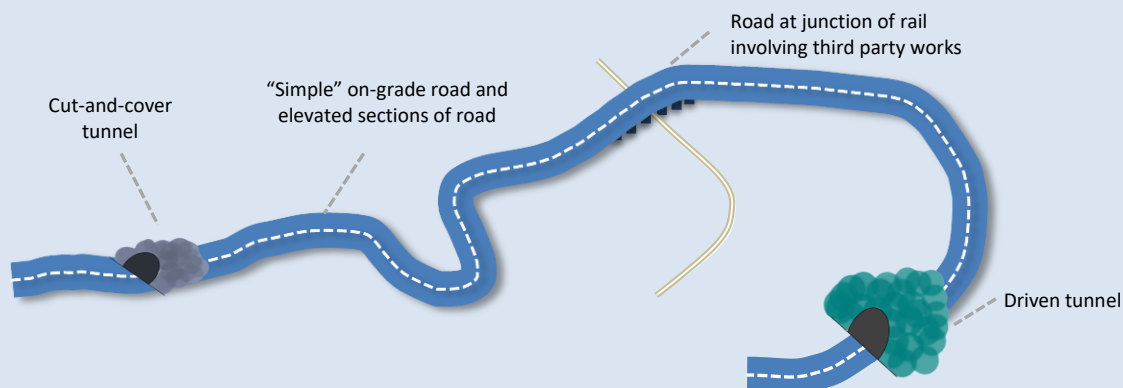
In Box 12 the example shows that the choice of the procurement mode also adversely affected the competition, leading to only two firms expressing an interest in bidding for a large alliance project.

At present, no tool exists that is both evidence-supported (including operational evidence) and comprehensive, which could inform decision makers of the consequences and trade-offs that certain choices, particularly on procurement design, will have on project outcomes.

How can this be improved? One starting point for optimising contracts is the insight that risk should be considered at a more granular level (Makovšek and Moszoro, 2018). In a more targeted approach toward contract scoping and design, what should be the level of “activities” to observe? After all, any tool aiming to improve current procurement approaches needs to remain practical.

Box 12. The challenges of defending a choice without a robust decision support system (I)

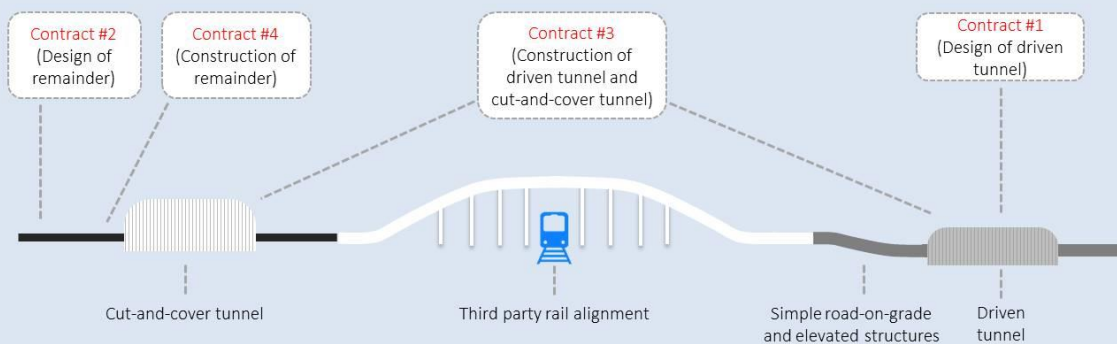
In this single alliance contract from Australia, a single alliance contract was chosen to deliver the project illustrated below. The choice of this procurement approach reduced the number of firms expressing interest to two firms, despite the fact the project did not involve technical difficulties or specialities that may have otherwise explained the very low number of firms expressing an interest. The public client noted that “the overall project is complex and so we’ll use a procurement approach that allows us to adapt as we go and deal with complexity as it emerges - an alliance mode”.



Source: Bridge and Bianchi (2014).

Box 13. The challenges of defending a choice without a robust decision support system (II)

The project that was procured as a single alliancing contract has been broken down in four contracts following an appraisal with the model developed by Queensland University of Technology (QUT). Contracts 1, 2, and 4 should have been primarily based on competition for the contract, while contract 3 should have been collaborative.



A promising first demonstration of a procurement decision support tool has already been made.⁵ Rather than considering risk pricing efficiency, it focuses on how procurement design choices affect both competition and cost variations in construction and operations. It provides an approach to breaking

down a project into a reasonable number of activities and, based on established microeconomic theory, puts forward a set of criteria to inform contract scope and type (Teo and Bridge, 2017). Thus, it offers a window to a comprehensive tool that could bring efficient procurement a huge leap forward.

With the help of this tool, the project illustrated above in Box was broken down into several contracts of different types. This case study is illustrated in Box . Instead of a single large alliancing contract, the tool proposed four contracts. Very likely, this approach would have delivered more competition for the road project and possibly significant cost savings for government.⁶

Compared to current procurement practices, the tool represents a significant step forward. Some limitations will need to be addressed for it to fully mature and enter practical use. These include a limited scope of infrastructure to which it can currently be applied, or the need to integrate latest research findings (not least by the Working Group). The tool would considerably benefit from advances in the database initiative describes above. Together, both could pave the way towards a comprehensive Procurement Design Assessment System (PDAS).

Notes

- 1 We acknowledge there is an abundant literature available on how the CBA can be manipulated or ignored in the decision-making process. This is not a problem of the tool but of decision makers' accountability. The value of the tool remains. Any system that equips experts with a more objective process and evidence to better argue their case is an improvement on a situation where such a system is absent.
- 2 Details about the Activity #1 in the grant, in which this database is being developed, can be found at: <https://research.qut.edu.au/arcvio/>.
- 3 In France for example an app (<https://www.jaimalamaroute.com/>) collects user feedback on road sections.
- 4 Clients can focus on pursuing requirements, predominantly during construction and in doing so automatically select the procurement mode. When the selected procurement model is defined as a subset, or in the same terms, as the desired outcomes of procurement, we arrive at a tautology (Chang and Ive, 2002; Teo, Bridge and Jefferies, 2010).
- 5 The final report of the ARC grant (ID Number: LP0989753) is available at: <https://eprints.qut.edu.au/76520/>.
- 6 This model has since been cited in the Australian Productivity Commission's 2014 final report into Public Infrastructure (Volume 2, page 461).

References

- Bridge, A. and Bianchi, R., (2014), “Major Infrastructure Procurement Research Project 2009-2013. Reforming the Procurement of Construction and Financing of Australian Infrastructure: Advancing Capacity, Competition and Investment”, Final Report, 14 August 2014 (v. 2), Queensland University of Technology and Griffith University, https://eprints.qut.edu.au/76520/1/76520_Verification_Material.pdf.
- Makovšek, D., and Moszoro, M., (2018), “Risk Pricing Inefficiency in Public–Private Partnerships”, *Transport Reviews*, 38(3), pp. 298-321.

Appendix 1. Members of the Working Group

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Mr. Björn Hasselgren	Senior Advisor, National Planning Department, Swedish Transport Administration
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Mr. Phill Wheat	Associate Professor, Institute for Transport Studies, University of Leeds, United Kingdom

Appendix 2. Research Questions and Outputs

Introduction: Getting the basics right

What are the economic characteristics of infrastructure? What is infrastructure and what are operations? What are the models of private participation in infrastructure and through which significant private investment actually takes place?

Makovšek, D. (2018), “What is Private Investment in Transport Infrastructure and Why is it Difficult?”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Can private investment improve productive efficiency? Improve project selection? Close the infrastructure funding gap? Have other positive effects when it is private?

Makovšek, D. (2018), “The Role of Private Investment in Transport Infrastructure”, Working Group Paper, International Transport Forum, Paris (forthcoming).

What have the private investment trends in transport infrastructure been over the last 20 years? How much of that was foreign private investment?

Mistura, F. (2018), “Quantifying Private and Foreign Investment in Transport Infrastructure”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Defining the challenge: How uncertainty in contracts matters

How does uncertainty affect risk pricing? Beyond investors, do suppliers in PPPs also have issues with risk pricing? How does its transfer to the private sector affect competition? What does uncertainty mean for the public vs. private cost of financing?

Makovšek, D. and Moszoro, M. (2018), “Risk pricing inefficiency in public–private partnerships”, *Transport Reviews*, 38(3), 298-321.

Is uncertainty also an issue in long-term services/operations contracts?

Beck et al. (2018), “Uncertainty in Long-term Service Contracts: Franchising Rail Transport Operations”, Working Group Paper, International Transport Forum, Paris (forthcoming).

What is the competition for large transport infrastructure projects in the EU Market? Is there a difference between traditional procurement and PPPs?

Roumboutsos, A. (2018), “Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Addressing uncertainty for suppliers: the construction phase as example

<i>Adversarial vs. collaborative procurement – is collaborative contracting the future?</i>	Eriksson et al. (2018), “Collaborative Infrastructure Procurement in Sweden and the Netherlands”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>What lessons in dealing with risk and uncertainty were learnt in Danish mega projects from Storebaelt to Femernbaelt?</i>	Vincentzen, L. and Andersson, K. S. (2018), “Risk Allocation in Mega-Projects in Denmark”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>What can governments do in the short run to reduce inefficient pricing of risk by construction contractors?</i>	Kennedy et al. (2018), “Risk Pricing in Infrastructure Delivery: Making Procurement Less Costly”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Addressing uncertainty in long-term contracts in the absence of continuous pressure for efficiency

<i>What is the public sector organisational counterfactual on which private investment should seek to improve?</i>	Holm, K.V. and Nielsen, T.H. (2018), “The Danish State Guarantee Model for Infrastructure Investment”, Working Group Paper, International Transport Forum, Paris (forthcoming).
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Partial fixes to the Private-Public Partnership approach

<i>How would an organisational structure consisting of PPPs come close to a network-wide management approach? What benefits would it yield?</i>	Vasallo, J. (2018), “Public-Private Partnerships in Transport: Unbundling Prices from User Charges”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>Should the public or the private side bear the cost of long-term uncertainty? How could we design a PPP contract to avoid hold-up due to incomplete contracts?</i>	Engel et al., (2018), “Dealing with the Obsolescence of Transport Infrastructure in Public-Private Partnerships”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Long-term strategic approach

<i>How do the PPP and regulated utility model (RAB) compare in terms of efficiency incentives?</i>	Makovšek, D. and D. Veryard (2016), “The Regulatory Asset Base and Project Finance Models”, International Transport Forum Discussion Papers, No. 2016/01, Paris.
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<i>What basic considerations underlie the choice between a PPP and RAB approach?</i>	Hasselgren, B. (2018), “Risk allocation in Public-Private Partnerships and the Regulatory Asset Base Model”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>Which are the preconditions a country would need to take to establish a RAB model on a motorway network? Is user-charging a must?</i>	Alchin, S. (2018), “A Corporatised Delivery Model for the Australian Road Network”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>From the investors’ point of view, does a RAB need to be fully reliant on user-charging?</i>	Francis, R. and Elliot, D. (2018), “Infrastructure Funding: Does it Matter Where the Money Comes From?”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>Incentive regulation can also yield perverse incentives. Can the capex bias be managed?</i>	Smith et al. (2018), “Capex Bias and Adverse Incentives in Incentive Regulation: Issues and Solutions”, Working Group Paper, International Transport Forum, Paris (forthcoming).
<i>Does it make sense to pursue hybrid solutions between PPP and RAB?</i>	Zhivov, N. (2018), “The Thames Tideway Tunnel: A Hybrid Approach to Infrastructure Delivery”, Working Group Paper, International Transport Forum, Paris (forthcoming).

Uncertainty and private investment mobilisation in transport infrastructure

<i>What lessons can we draw from recent attempts to mobilise private investment in infrastructure in the aftermath of the global financial crisis?</i>	Makovšek, D. (2018), “Mobilising Private Investment in Infrastructure: Investment De-Risking and Uncertainty”, Working Group Paper, International Transport Forum, Paris (forthcoming).
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Synthesis

ITF (2018), *Private Investment in Transport Infrastructure: Dealing with Uncertainty in Contracts*, Research Report, International Transport Forum, Paris

Appendix 3. Risk Allocation in Spanish Road Projects

Risk Allocation in Spanish Road Projects compared to Global Infrastructure Hub (GIH) recommendations
(red= risk categories where there was a failure)

Category	Description	GIH Allocation			GIH recommendation in Spanish Projects			
		Public	Private	Shared	Nº of projects with public risk allocation	Nº of projects with private risk allocation	Nº of projects with Shared risk allocation	% Projects respecting GIH recommendations
Land purchase and site risk (1)	The risk of acquiring title to the land to be used for a project, the selection of that site and the geophysical conditions of that site. Planning permission. Access rights. Security. Heritage. Archaeological. Pollution, hazardous materials. Latent defects. Easements, encroachments setback, etc.			X	12	29	0	0%
Environmental and social risk	The risk of the existing latent environmental conditions affecting the project and the subsequent risk of damage to the environment or local communities.			X	0	0	41	100%
Design risk	The risk that the project has not been designed adequately for the purpose required. Feasibility study. Approval of designs. Changes to design.		X		0	41	0	100%

Category	Description	GIH Allocation			GIH recommendation in Spanish Projects			
		Public	Private	Shared	Nº of projects with public risk allocation	Nº of projects with private risk allocation	Nº of projects with Shared risk allocation	% Projects respecting GIH recommendations
Construction risk	Labour dispute. Interface/ project management. Commissioning damage. Intellectual property breach / infringement. Quality assurance standards. Defects. Subcontractor disputes/insolvency. Cost overruns where no compensation /relief event applies.		X		0	41	0	100%
Completion risk (including delay and cost overrun)	The risk of commissioning the asset on time and on budget and the consequences of missing either of those two criteria.		X		0	41	0	100%
Performance/ price risk	The risk that the asset is able to achieve the performance specification metrics and the price or cost of doing so. Damage pollution accidents. Meeting handback requirements. Vandalism. Equipment becoming prematurely obsolete. Expansion.		X		0	41	0	100%
Resource or input risk	The risk that the supply of inputs or resources required for the operation of the project is interrupted or the cost increases.		X		0	41	0	100%
Demand risk (2)	The availability by both volume and quality along with transportation of resource or inputs to a project or the demand for the product of service of a project by consumers/users.			X	1	29	11	27%

Category	Description	GIH Allocation			GIH recommendation in Spanish Projects			
		Public	Private	Shared	Nº of projects with public risk allocation	Nº of projects with private risk allocation	Nº of projects with Shared risk allocation	% Projects respecting GIH recommendations
Maintenance risk	The risk of maintaining the asset to the appropriate standards and specifications for the life of the project. Increased maintenance costs due to increased volumes. Incorrect estimates and cost overruns.		X		0	41	0	100%
Force majeure risk (3)	The risk that unexpected events occur that are beyond the control of the parties and delay or prohibit performance.			X	41	0	0	0%
Exchange and interest rate risk	The risk of currency and interest rate fluctuations over the life of a project.		X		0	41	0	100%
Insurance risk	The risk that insurance for particular risks is or becomes unavailable.			X	0	0	41	100%
Political risk (4)	The risk of Government intervention, discrimination, seizure or expropriation of the project. Public sector budgeting.	X			0	0	41	0%
Regulatory/ change in law risk (5)	The risk of law changing and affecting the ability of the project to perform and the price at which compliance with law can be maintained. Change in taxation.	X			0	41	0	0%
Inflation risk	The risk that the costs of the project increase more than expected.			X	0	0	41	100%
Strategic risk	Change in shareholding of Private Partner. Conflicts of interest between shareholders of Private Partner.		X		0	41	0	100%

Category	Description	GIH Allocation			GIH recommendation in Spanish Projects			
		Public	Private	Shared	Nº of projects with public risk allocation	Nº of projects with private risk allocation	Nº of projects with Shared risk allocation	% Projects respecting GIH recommendations
Disruptive technology risk (6)	The risk that a new emerging technology unexpectedly displaces an established technology used in the toll road sector.	X			0	41	0	0%
Early termination risk (including any compensation risk)	The risk of a project being terminated before the expiry of time and the monetary consequences of such termination.			X	0	0	41	100%

Source: Data and analysis provided by Fernando Penalba/SEITT.

Appendix 4: Benefits of an end-unit cost database for road infrastructure

A database of end-unit costs could provide the following three substantial benefits: Benchmarking, cost savings and accountability.

A benchmarking tool

First and foremost, the database would serve as a benchmarking tool for a series of applications. It could help answer questions such as the following:

Is the lowest bid for a proposed project suspicious as being abnormally low, compared to the cost of similar projects in the database?

A bid is deemed abnormally low when the price offered for the project does not allow full cost recovery for the contractor. Consequently, the procuring authority may find itself under considerable pressure through the contractors' cost claims and may face contractor failure during project execution. The potential consequences are increased transaction cost for both parties to the contract, higher project execution cost and delays in project delivery.

How similar or different (e.g. higher or lower) is the normalised cost per kilometre of motorway (e.g. 2x2 lanes) in one country compared to other countries?

If the cost of road infrastructure delivery in one country is substantially lower than in other countries, then potentially infrastructure quality or longevity might be an issue. If it is substantially higher, there might be room for considerable savings.

What is the source of the cost differentials between similar projects?

It is implicitly known that building a 2x2 lane motorway in the Netherlands does not cost the same as in the UK, Italy, Australia or the USA. Through including descriptive project data that allows comparing projects with similar attributes, the database would provide the opportunity to identify or eliminate broad direct causes (e.g. terrain configuration). Depending on the descriptive data captured in the database, it may be possible to explain more reasons that lead to such an observed variation in end costs. For example, in terms of procurement and contract design, such a database would be able to assess how different contracting arrangements perform (e.g. design-bid-build vs. design and build) in terms of end cost not only on-time/on-budget performance. Despite numerous decades of project delivery, a lot of empirical questions about procurement design are still unanswered because such a database does not exist.

Cost saving opportunity

Through the various possibilities for benchmarking, opportunities to save cost may arise for procuring authorities.

By understanding in more detail the drivers of end-unit cost differentials, procuring authorities can gradually modify their procurement processes and engage in contract designs that have demonstrably performed better. They would also be able to identify which are the most critical parameters in a road project that appear to influence end-unit cost variability and aim to control them in a well-informed manner.

Improved accountability

Finally, procuring authorities will be able to defend their decisions with respect to road project delivery based on well-established empirical information. This will increase accountability and protect both the taxpayers from inefficient and excessively expensive project delivery and public officials whose decisions would be subject to public or organisational scrutiny with respect to their outcomes.

A departure from existing data collection

The proposed database would require information the collection of which would constitute a departure from existing practices of gathering information on road projects. For example, many procuring authorities in many countries populate, maintain and manage unit-price databases. A unit-price database is not sufficient to achieve the objectives. In most contract types unit-prices do not fully reflect the contractors' revenue expectations. Depending on the contract type, variation claims may considerably affect the end price of road construction. In addition, there are a multitude of other factors that will drive cost (terrain, complexity/interfaces with third party systems, etc.) beyond the cost of basic inputs.

What kind of information?

The database would contain data on final cost of delivery of road infrastructure projects. Each project would include descriptions of project characteristics (greenfield/brownfield; urban/non-urban; terrain difficulty; share of tunnel; elevated construction, etc.), which would allow comparison of cost per relative unit (e.g. cost per km). The database would also aim to capture the type of procurement underlying the delivery of the project (e.g. public vs PPP, single phase vs. two-phase, ItT, ItN, etc.) as well as the type of contract signed with the relevant contractors (e.g. types of works involved, fixed-price vs. cost-plus, etc.).

The main challenge is striking a balance between being pragmatic and being comprehensive. The pragmatic dimension implies that data requests made to data owners should be reasonable and easy to deliver. The comprehensive dimension implies that sufficient descriptive data must be captured to allow useful comparisons.

Notwithstanding this trade-off, the remaining four general principles of data collection need to be adhered to. These include measurability (well-defined, specific, quantifiable, and available data), reliability (consistent, stable, and up-to-date data), accuracy and robustness, while good care needs to be put in place so that the collected end-cost unit data reflect project characteristics as built and not as designed.

Private Investment in Transport Infrastructure

Dealing with Uncertainty in Contracts

This report examines how decision makers in the public and private sector can better manage the uncertainty inherent in contracts for privately-financed infrastructure. It presents the findings of 33 experts from 13 countries, convened in a working group by the International Transport Forum. Detailed analyses of specific questions are available in 17 working group papers that complement this synthesis.

