International Transport Forum

Risk Allocation in Public-Private Partnerships and the Regulatory Asset Base Model

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Working Group Report

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The International Transport Forum

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Foreword

Transport infrastructure is a major enabler of economic development. In the drive to refurbish or build, governments worldwide have turned to the private capital market for financing. The primary narrative behind this push is the huge stocks of private capital that are available, while public financing capabilities are said to be limited and insufficient.

The almost exclusive vehicle of private investment in transport infrastructure, including social infrastructure, is Public-Private Partnerships (PPPs). In the context of PPPs, two important aspects have received little attention.

First, sufficient attention has not been given to the role of suppliers. The focus of governments and Intergovernmental Organisations has been on resolving the challenges to private investment from the viewpoint of investors: reducing the uncertainty they face and enabling them to price risk more efficiently by establishing infrastructure as an asset class.

However, looking only at investors gives an incomplete view of the total cost of the risk transferred from the public to the private sphere. In PPPs, investors transfer some of the major risks they are not comfortable bearing to design, construction, maintenance, and operations contractors.

Suppliers, too, face uncertainties and are unable to efficiently evaluate price risk. In such cases, the base cost of the initial investment – and of subsequent services – may be much higher than they might have been, and not just the cost of their financing.

Uncertainty arises from the difficulties to accurately estimate the cost of construction, maintenance, operations, and financing. But it also stems from "unknown unknowns" (the so-called Knightian uncertainty). For instance, changes in weather patterns or paradigmatic technological shifts, the timing and impact of which are unclear, will influence what infrastructure is needed and where.

So what can policy makers do to reduce the cost of inefficient risk pricing of suppliers? Where does this put PPPs? 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?

These were some of the guiding questions for a Working Group of 33 international experts convened by the International Transport Forum (ITF) in September 2016. The group, which assembled renowned practitioners and academics from areas including private infrastructure finance, incentive regulation, civil engineering, project management and transport policy, examined how to address the problem of uncertainty in contracts with a view to mobilise more private investment in transport infrastructure. As uncertainty matters for all contracts, not only those in the context of private investment in transport infrastructure, the Working Group's findings are relevant for public procurement in general.

The synthesis report of the Working Group was published in June 2018. The report is complemented by a series of 19 topical papers that provide a more in-depth analysis of the issues. A full list of the Working Group's research questions and outputs is available in Appendix 1.

Acknowledgements

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Executive summary

What we did

This paper compares public-private partnerships (PPP) with the regulatory asset base (RAB) model from a risk and risk-allocation perspective. Other factors such as the competitive environment of a single infrastructure project, while also important when deciding on the appropriateness of different organisational structures, are not the focus of this paper. This also is true for technological risks and complexity in general. While these indeed do affect the overall risk of a project the focus of the discussion is on the where (space) and when (time) aspects of the investment environment.

There are many ways of transferring risk and responsibility from the public sector to the private sector. This paper focuses on two methods: PPPs, where a single competition yields a long-term contract, and an RAB, a utility-type regulation with periodic price reviews.

PPPs have been in use for a long time. Hence, a wide body of experience and empirical data exist on their functionality and, to a more limited extent, their efficiency. RAB-like structures have been used in different settings and with different specifications. In general, a regulated operation is based on a specified asset in the balance sheet of a company or public utility, which has the right to recover the net costs of that asset plus the defined rate of return on the assets through the collection of user fees, under the precondition that specified quality criteria are met.

While in the case of PPPs the main contractual relationship is generally between the procuring public sector partner and the private sector contractor, in the case of RABs there is often a regulatory body set up by the government to oversee the operations of the corporation or utility owning the specified asset.

Here it is argued that what defines risk in relation to transport infrastructure assets is *time* (which can be seen as the difference in risk assessment at the time of contract specification or negotiation, and later on as a prediction or as a materialised positive or negative outcome) and *space* (which refers to the definition of the project's influence area and the surroundings, both in terms of actors and impacts).

What we found

The time and space-related analysis sheds new light on the risk situation in transport infrastructure projects. An important starting point when designing the organisational and regulatory framework is the specifics in each individual case with regard to factors like space and time propensities of the project or infrastructure asset. Well-defined and less complex structures in terms of time and space can often be organised into PPP-like structures where risks can be defined, predicted and allocated between the contracting partners without too high complexity or cost.

More complex structures with a longer life span and involving many actors and constituencies (space) might lead to a contractual situation that is too demanding and therefore less efficient for a PPP. Here, an RAB structure might be a preferable design. RAB structures are also preferable in situations where

continuous efficiency pressures from other market players or the users are not at play, and monitoring, benchmarking, and price reviews by a regulatory authority might offer similar efficiency incentives.

Even if structures that combine aspects of both PPPs and RABs are possible, from a practical and a risk-allocative standpoint, the main impression that PPPs and RABs should be seen more as complementary rather than as alternative structures dominates.

What we recommend

Use PPPs for well-defined, shorter projects

The analysis suggests that PPPs should primarily be used for well-defined projects that run for a comparatively short period and where competition exists throughout the project duration. RABs provide stronger incentives for efficiency in cases where competitive pressure is modest, the contracts are more complex and projects (usually) run over a longer period.

Why compare regulatory asset base models and public-private partnerships from a risk allocation perspective?

There is a need for finding the most efficient structures for delivering (transport) infrastructure assets and the operation of these. Resources are generally scarce in relation to demand for transport infrastructure assets. This is especially true in an environment where the natural monopolistic characteristics of transport infrastructure assets are accentuated and government ownership and financing has become the default organisational model. In a government setting, resource allocation is generally obscure and resources normally scarce, partly since relevant cost estimates are lacking and costs are spread over large constituencies. Part of the natural monopoly view is that the management and owning of transport infrastructure assets is affected by monopoly restraints (and possibly political restraints) on efficient delivery. In these cases, marginal cost-based pricing and fee structures are often integral to government ownership. Excessive demand, the need to ration the supply, and challenges to cost recovery are some of the consequences of such pricing policies. Government ownership is a contributing factor to these challenges. Transfer of management duties and responsibility, including risk, to partners or owners in the private sector, might in these circumstances create an environment where infrastructure (including the design, building and operating phases) might become more efficient.

It is crucial to separate risk from uncertainty. Risk is something that is calculable or predictable at a stage in time before the actual (primarily negative) effect occurs. Uncertainty is a situation where there are genuinely unknown factors that will affect the outcome of the project or operations in a way that is difficult to predict or calculate. It could be the case that, from a transport infrastructure point of view, endogenous factors are more easily predicted than exogenous facts. Endogenous factors might thus be described as “risk”, while exogenous factors are more close to “uncertainty”. This is not a perfectly clear-cut definition in all cases, though. Risk allocation is the focus, but defining the concept is not easy.

While there are many possible ways of transferring risk and responsibility from the public sector to the private sector, this paper focuses on two methods; PPPs (a single competition for a long-term contract) and a regulated asset base (RAB; utility type regulation with periodic price reviews).

PPPs have been in use for a long time and have contributed to a wide body of experience and empirical data on their functionality and to a limited extent their efficiency. RAB-like structures have been used in different settings and with different specifications. In general, a regulated operation is based on a specified asset in the balance sheet of a company or public utility, which has the right to recover the net costs of that asset plus the defined rate of return on the assets through the collection of user fees, under the precondition that specified quality criteria are met. While in the case of PPPs the main contractual relation is generally between the procuring public sector partner and the private sector contractor, in the case of RABs there is often a regulatory body set up by the government to oversee the operations of the corporation or utility owning the specified asset.

Preliminary investigations for the Working Group presented background material on the characteristics of both PPPs and RABs (Makovšek and Veryard, 2016). The paper illustrates challenges connected to: a) RABs where an excess or a lack of capital expenditure might prevail; and b) PPPs with the risk of ending up with overly complex and expensive contractual structures, too few bidders or a tendency for "lock in" with the bidder awarded the contract and subsequent renegotiation risks. This paper can also be read in conjunction with the related OECD/ITF paper on renegotiation of PPP contracts, where different aspects and causes of renegotiations were discussed (Makovšek, Perkins and Hasselgren, 2014). Makovšek, Perkins and Hasselgren (2014) present an analytical framework for the further understanding and discussion of the business and political environment where PPP structures in transport infrastructure operate. This analysis also enables distinction of risk in endogenous and exogenous categories.

While the Makovšek and Veryard (2016) paper focused on empirical data, this paper focuses more on the conceptual issues related to different structures for the provision of and operation of transport infrastructure assets. In combination the two papers might be useful for discussing the further development of appropriate structures for infrastructure provision.

One can, of course, question whether a comparison of two relatively different organisational structures like PPPs and RABs might be performed in a meaningful way. Because of this difference in structure they should be viewed as different but complementary options rather than as clear-cut alternatives. In specific situations though, a PPP may be the obvious alternative when an RAB is not the natural choice. A separate infrastructure asset needing to be transferred to a more efficient operational environment is probably not the case for setting up an RAB. However, the opposite is also true and there may be cases where an RAB structure would work better for a set of assets rather than a PPP.

On the one hand, PPPs have been deployed as a "one off" in the context of a single major project. On the other hand, PPPs (sometimes in the form of concessions) have also been used to manage or to deliver entire portfolios of assets, be it motorways, hospitals, or schools. In each case, the focus of the PPP is a single contract and the operation of an asset over time. Depending on where and how the PPP is employed, the degree of "asset specificity" will be different.

In some instances standardised contracts can be deployed for similar types of PPPs (as is the case for the UK PFI School programme), in others a more bespoke approach will be required (i.e. asset specificity will be high).

RABs are more general in their scope. They are more commonly deployed for a set of assets (i.e. a network). However nothing precludes this approach from being used also on single infrastructure assets (as is the case with Heathrow Airport). In the case of the RAB more than a specific contract is in focus, and the operation of that asset over time. A number of investments and the operation over time of these is the focus of the regulation and its efficacy. Perhaps, in order to make the two structures more similar, an RAB should be compared to a portfolio of PPPs where different risk profiles can be allocated to form one structure, to be managed with a portfolio strategy as a base.

A major distinction with the RAB model generally (e.g. in utilities) compared to PPPs is that the private operator is also responsible for allocative efficiency. It selects and procures the investments in line with agreed objectives and under the supervision of the regulator. The different nature of incentivising efficiency in an RAB, as well as the fact that normally a pool of assets or a network is concerned, allows for internal risk diversification and provides more freedom in terms of the approach taken to procurement. Other work within the Working Group has confirmed that regulated companies use different contractual arrangements across a range of their projects, suggesting they aim to align the contractual and risk allocation approach with the individual project (Smith et al., 2018).

In contrast, a PPP is primarily a procurement model. Efficiency gains are either recorded as a financial cost reduction in the bidding for the contract or spread over the lifetime of the contract with some kind of gain-sharing formula. Project finance seeks to maximise the risk transfer to suppliers to keep a high-risk proposition bankable. The project company therefore relies on fixed-price arrangements with suppliers in the construction and in the maintenance phase, which virtually insure the investors from construction (Kennedy et al., 2018) and maintenance risk. In short, the financing model drives the contract arrangements with suppliers and not the nature of the project. The risk allocation in a PPP arrangement is also subject to potential public debt accounting treatment principles.

This paper does not expand on the potential to replicate the utility regulation completely in the transport sector, as for the moment it is generally the government that plans (and selects) infrastructure development.

Makovšek and Moszoro (2018) provided a further dimension to the above discussion. Their evidence review suggested that the observed risk premia prevailing for PPP structures also includes a component that cannot be explained purely from a risk transfer perspective. An "inefficient risk pricing premium" was said to exist. The premium primarily results from two factors. Firstly, the project finance/PPP structures inherently require that the full project risk is expressed (and priced) in advance and therefore overpriced. Secondly, the construction of major infrastructure involves inherent uncertainties and the same is true for long-term maintenance contracts, which also affects pricing. In terms of the evidence, the authors specifically targeted availability-based PPP schemes, i.e. those where the competition for the contract was the single trigger for ensuring an efficient price of service (i.e. value for money) over the life of the contract.

Here PPPs and RABs are compared from a risk and risk-allocation perspective. Other factors like the competitive environment of a single infrastructure project are also important when deciding on the appropriateness of different organisational structures. This also is true for technological risks and complexity in general. While these indeed affect the overall risk of a project the main focus here is on the where (space) and when (time) aspects of the investment environment.

Which risks need to be allocated?

Risks to be allocated

Risks are generally defined or described in broad terms whereby sets of situations are amalgamated into more coherent subsets of situations that can be more easily dealt with than the rich variety of risks that occur in real life. We often define risks as related to financial aspects, project realisation/construction, political circumstances or external effects such as the environment or general economic situation. Other categorisations are also used. These subsets are, of course, examples or simplifications that make predictions and discussions about them easier but less precise. This is the case with generalised discussions on risk allocation, wherein concepts are approximate.

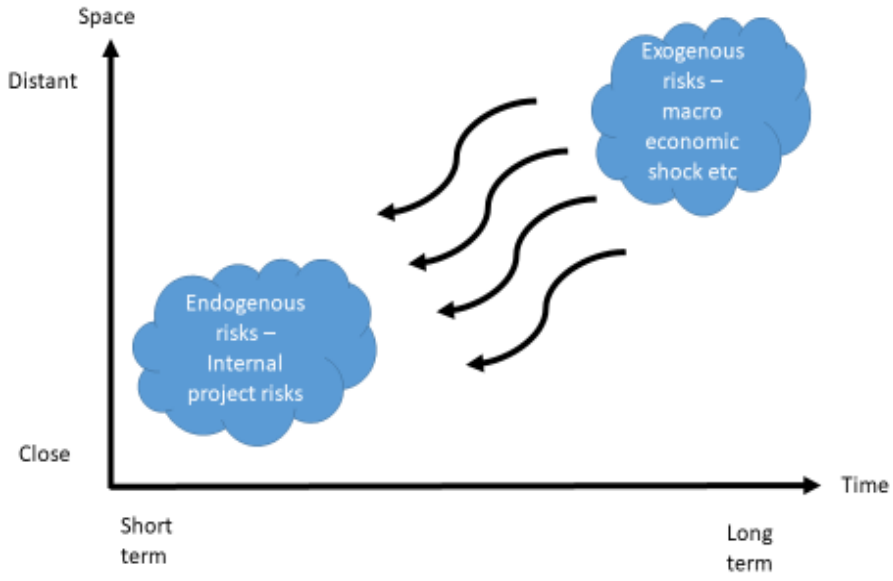
What defines risk in relation to transport infrastructure assets is time (the difference in risk assessment at the time of contract specification or negotiation and later on as a prediction or as a materialised

positive or negative outcome) and space (the definition of the project's influence area and the surroundings, both in terms of actors and impacts).

Time risks can occur either in the immediate or near future or in the more distant future. The general timeframe for infrastructure is from the immediate future up to 30-40 years, but can be up to 100 years. It is understood that risk is something rather different if it occurs in the very near future or only in the very distant future. Forecasting an event based on past observations may be simpler and more accurate for the immediate future but less so for the more distant future. Technological risk is generally difficult to handle in the short run, for example, in situations where new solutions need to be introduced, but in the long term, technologies that survive become part of the everyday system of knowledge. Whether this is also true for complexity as a phenomenon is open to discussion. A hypothesis could be that novel situations are generally perceived as complex, while well-known situations, as they evolve over time become less complex and thus less risk generating.

With regard to space-related risks (and effects), these might be present for only a few actors, and locally, or with many actors covering a wider geographical area. Risks concerning just a few actors might be treated using game theory and incentive-related theory. Risks related to many actors (i.e. stakeholders) more generally involve theory on social welfare, governance of complex systems and more statistically calculated risk measurements. It could also be argued that less dispersed projects are less characterised by complexity compared to projects or systems that are spread over large geographical areas. A shunt yard, for example, in one location might be difficult to manage and filled with risks. A national system of shunt yards, though, is probably connected to higher risks in comparison.

Figure 1. Exogenous and endogenous risks in a space and time framework



In general, risks (and effects) related to few actors and those that will probably materialise in the short term are more easily predicted and can be managed reasonably well. Risks in the more distant future and that have relevance for many actors covering a wider geographical area are more difficult to handle,

if a limitation of negative outcomes is at the core of the interest. The technical asset complexity can further exacerbate the underlying challenges of time and space. This is close to what is generally defined as uncertainty. Neither the frequency of the negative outcome nor the exact effect it would bring is calculable.

From this (very) theoretical perspective, many of the risk-allocation situations that are generally discussed in transport infrastructure might be structured in a way that allows for a general pattern rather than specificities. The often-used concepts of "design", "build" and "operate" for example, are three distinct phases from a time perspective, starting from the time when an asset is only a vision. The degrees of freedom when it comes to the specification of the asset and the operations it allows for are inversely diminishing as we move over the time aspect of these situations. Design phases allow for many different ways of constructing assets, while the build and operate phases deal with a more well-defined asset with given possible outcomes when it comes to risk. A qualification to the space and time perspectives is, whether a particular risk can, at least in theory, be affected by our actions (endogenous) or not (exogenous). This is illustrated in Figure 1.

From a time/space perspective endogenous risk are close to origin. Exogenous risks are closer to the upper right. Over time a part of the upper right section can become lower right, and thus easier to manage or reduce by the project managers. Additionally, the (spatially) distant risks will probably come closer as an effect of improving transport systems. We could thus expect some exogenous risks over time to become more endogenous. The exact pattern of transformation of risks from exogenous to endogenous would of course differ for different kinds of risk. Some will probably not change over time as regards space and manageability; other risks will evolve in different patterns than those described above. The transformation from exogenous to endogenous risk would also represent a learning process whereby the capability of the project manager to handle risk would evolve over time.

Exogenous risks in infrastructure projects from a single project perspective are typically of macroeconomic or political origin and are difficult to insure against. In this case, the only remaining risk management strategy is "transfer" or "absorb". The risk probability or impact cannot be influenced by any intervention, at least not in the short term. A way of handling these risks is by using modern portfolio strategies, whereby an amalgamation of assets with different expected risk profiles will even out the net risks over time and space.

Economic risk implies for example a deterioration of the general macroeconomic situation, which can turn an otherwise successful project into a loss-making activity. This is generally expressed in terms of market risk as a proxy for transport volume actually carried out as compared to projected. Economic factors can of course have different space connotations materialising on different levels of geographical arenas (local, regional, national, international).

Political (and regulatory) risk is the risk that the policies change to include for example less transportation friendly measures, or enabling competing infrastructure construction. These might also have both time and space-related specificities with more or less impact on a specific situation or infrastructure asset.

Endogenous risks are those mentioned above, which, at least in theory, can be managed or reduced by certain interventions. For infrastructure, endogeneity is particularly important with regard to demand risk. From the market structure perspective, the ideal situation is when the user operator can attract demand with service quality and is a price taker. This may be the case for seaport terminal operations, where multiple ports in the same catchment areas compete between others as alternatives, thus competition *in the market* exists.

In other cases such as inter-city motorways, demand risk is generally considered exogenous (Vasallo, 2019), the price being more or less the only factor to manage demand. For this reason, PPP operators generally require exclusivity by non-compete clauses in their contracts, preventing the public sector from building or providing alternatives.

From a contractual and management perspective, the challenges related to the prediction of risk will increase as the time perspective is extended and the space-related aspects grow. In a short-term narrowly space-defined situation, there would be a focus on the relationship between a bidder and a procurer with information asymmetries as the defining aspect for risk assessment and allocation. As we move to long-term contracts (as in a PPPs or RABs), governance aspects of the relationship between principal and agent will more likely be the defining aspect for risk allocation. Post-negotiation opportunism from either contractual party, in trying to reduce costs and risk-taking, e.g. through renegotiations, will also be a key factor.

Grouping risks into "types"

The many possible combinations make a discussion on the risk allocation aspects of different approaches to infrastructure provision multifaceted. A number of different situations might arise over the lifetime of an infrastructure asset. Any discussion on the possible function of a specific model for the provision and management of an infrastructure asset therefore has to be qualified with a description of the situation at hand. Is it a short-term situation or negotiation in the near future, or a long-term relationship or contract? Does it include just a single local physical asset or a national system of assets? Is the set of actors in the specific situation clearly defined? Have a procurer and a provider been clearly defined or is it a more open-ended situation? Does it involve just one contract or negotiation or is it a situation where repetition and learning define it over time? Is the asset in question complex? Is demand risk endogeneity high or low?

Only after defining these aspects is it possible to discuss the pros and cons of different models such as PPPs and RABs in relation to efficiency and risk allocation.

To make the analytical challenge more operable different representative type cases could be constructed from the analytical framework above, starting with the space and time aspects. These could range from a fairly clean-cut and simple case in a local setting with few actors over a shorter time to a challenging situation with a national or international setting, many actors and a time perspective that runs over different phases of an infrastructure asset's life. It could be illustrated as in the figure below. Of course, these different types of situations represent different risk-related challenges making it more or less accurate when it comes to assigning them to either a PPP or RAB structure.

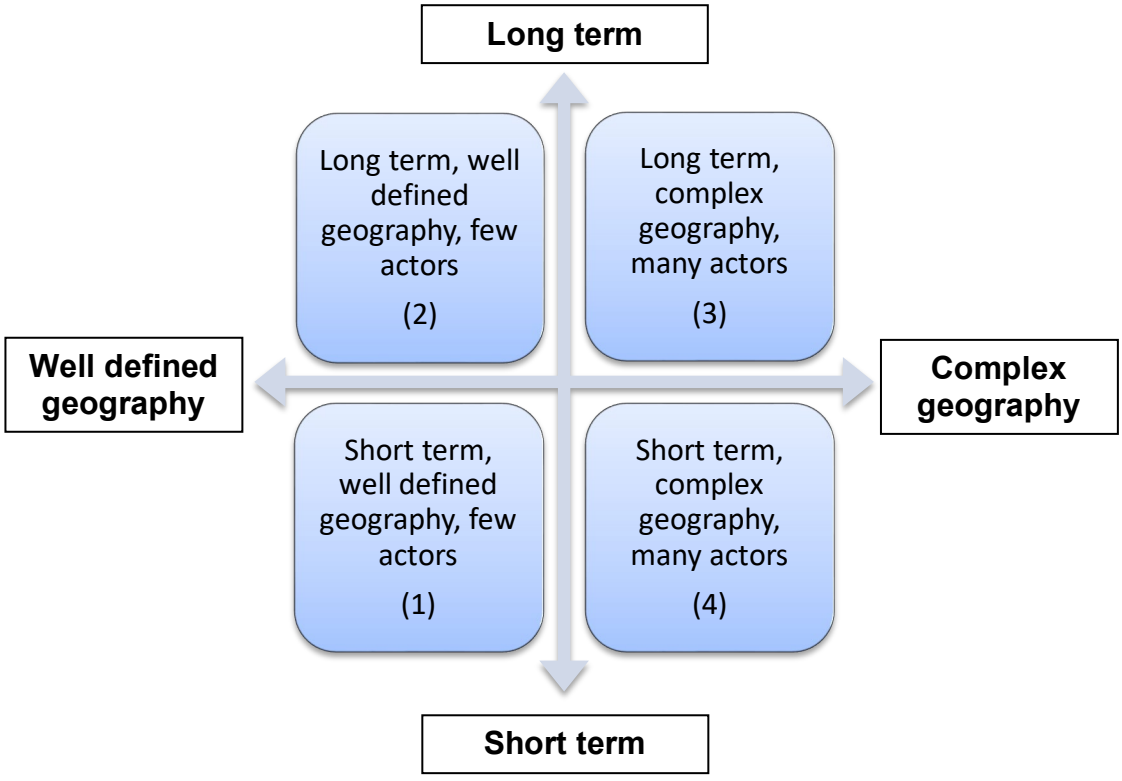
It seems more or less self-evident that it might be difficult to find one organisational model that would fit all the different possible challenges that might be at hand in the different situations exemplified in Figure 2. In the cases where the overall project situation is fairly clear cut and takes place in a shorter time perspective (1) it could be relatively easy to set up a contract or PPP structure to handle the project, even if the prospective gains from using these structures might be limited. PPP structures can also be used for projects with a longer time frame, but generally for those where the overall complexity is reasonably limited (2).

A long-term contract with a very complex project environment, (3) and perhaps (4) above, would probably lead to a more or less unsolvable contract specification and/or prices that are too high to be

attractive to the market/financing institutions due to uncertainty. Type 3 projects, as exemplified above, would come close to situations with high uncertainty.

Alternatively, this can be framed in the language of transaction cost theory, where specificity, frequency and uncertainty (as a factor of opportunistic behaviour) are central themes in deciding on the preferred organisational or contractual design in specific cases.

Figure 2. Different types of infrastructure projects and situations according to space and time



Adding the aspects of (high/low, from a temporal point of view) technical asset complexity and (high/low) demand endogeneity would increase the number of combinations to four in each quadrant. This would complicate the graphical exposition so they are not included in the figure above. Where they are relevant however is in the long term. In a design-build-finance-maintain-operate PPP, the life-cycle cost of an asset needs to be priced *ex ante* in a single competition for the contract. Following Makovšek and Moszoro (2018), when demand is exogenous to the PPP operator, the lack of information about risk due to complexity or other reasons may lead to an inefficient risk-pricing premium. It may well offset the efficiency gains for which the PPP was chosen as a procurement mode in the first place. When demand is endogenous to the PPP operator, asset complexity becomes less relevant, because a continuous pressure for efficiency from the market or users will exist.

Change over time

It can be argued that over time what has been a well-specified single contract structured in a PPP format might develop into a set of similar contracts that cover a wider geographical area, thus transforming

from a single space-related specification to a wider context. Such a development would justify the reorganisation of the management and overall structure of these contracts from a PPP structure to an RAB structure. In fact, this development pattern has often been identified over time in different infrastructure sectors, going from local decoupled projects and systems to interconnected systems of infrastructure assets. In Figure 2, that could be illustrated by a move from the lower left corner (1) to the upper right (3). Complexities will obviously increase as additional geographies are added as well as additional types of projects.

This can also be expressed in terms of uncertainty. In a situation where a number of parameters are unknown or undefined, probably due to an undefined time horizon or project universe, uncertainty will be high. As time passes in any project, the scope of the project is more clearly defined and uncertainty is reduced. Low specification of the project scope and a long time horizon from this perspective seems to be unfavourable for an efficiency enhancing risk allocation.

Arguments for and against the use of public-private partnerships and regulatory asset based models in different transport modes

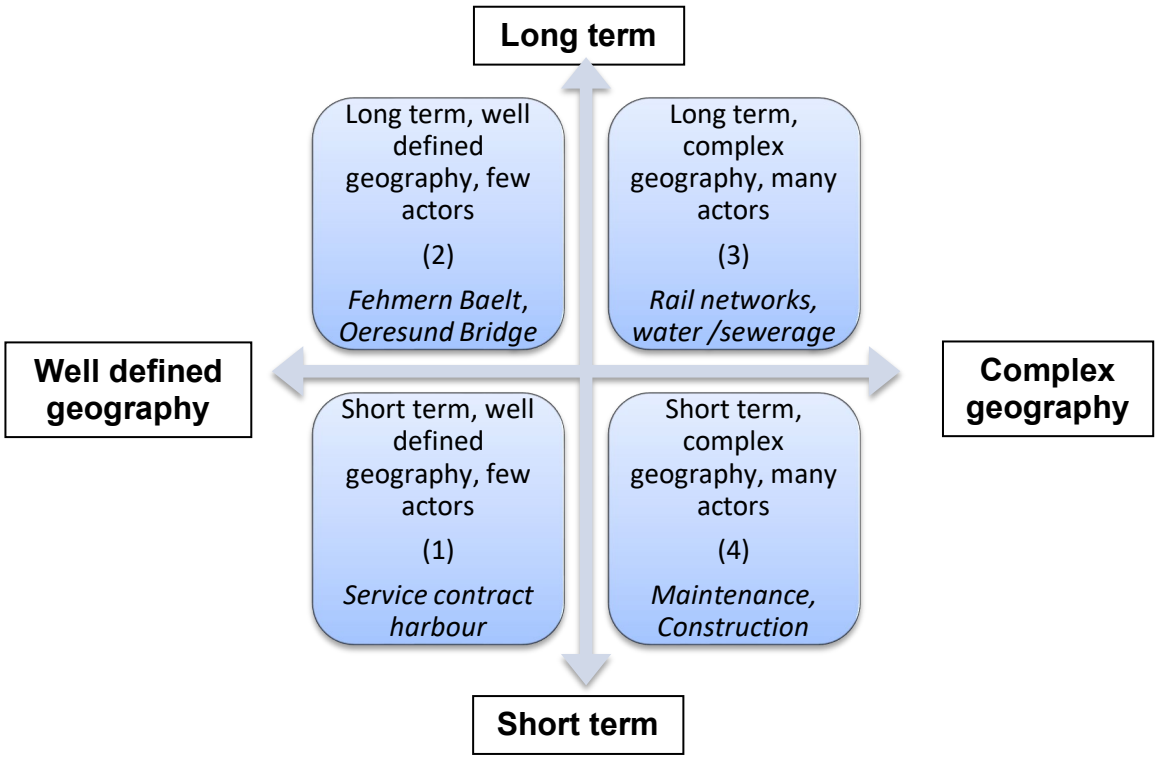
Transport infrastructure is often divided into four modes: rail, road, air and maritime assets (and services). Whether these four modes should be seen as inherently being apt for any of the two structures, a PPP or an RAB, is something to consider. While railroads and roads have a physical land connection and as such involve a number of geographical constituencies, the contrary can be said when it comes to defining maritime and aviation infrastructure. Thus, space and complexity factors would be present for roads and railroads making these less appropriate for narrow PPP structures. In addition, many countries have organised these sectors with a network infrastructure manager in place (e.g. national or regional motorway/railway companies).

In aviation, airports (the major asset) have used either PPPs or RABs, depending on the situation of each specific time or market context when decisions were taken. Maritime services (ports and piloting/light houses) have over time been provided in either government agency form, with RAB-like (public utility) structures, or privately. PPPs, though, have not, or have only very rarely been used, for the overall organisation of these assets, while contracting out of the handling of the goods and logistics management in ports is quite common.

On a lower functional level in the infrastructure sector, or for large projects which are well defined from a time and space perspective, more project-specific structures have been chosen, many times with a state-owned entity (e.g. the Sund and Baelt experience [Holm and Nielsen, 2018]) or a PPP as a basic choice, as an alternative to traditional government agency management and financing.

Figure 3 show some examples of choosing between structures for a number of assets and service or management agreements in transport infrastructure based on current and past experiences. Figure 3 is based on the time and space structure from Figure 2.

Figure 3. Examples of different types of infrastructure projects and situations according to space and time



It could be argued, based on this very schematic analysis, that it would be more likely to see an RAB-like structure in the situations shown at the top of the figure. The upper-right square (3) might be the exclusive domain for an RAB and the upper-left quadrant (2) is where an RAB and a PPP would be applied based on demand endogeneity (the existence of continuous pressure). In the short-term cases (1 and 4) it may make no sense to apply a PPP. Firstly, in a single phase or short-term contract there is no life-cycle cost optimisation incentive. Strong incentives for efficiency can be achieved through payment mechanisms and retainers in performance contracts that do not require a full up-front private financing and put the contractor directly at considerable risk in case of under-performance. In cases when the object of the contract remains more or less the same (e.g. a maintenance contract for a section), the repeated game aspect also comes into play, where meeting the performance objectives in the first round could be considered in bidder selection in the future rounds.

Conclusions

The main conclusion from this discussion is that the specific situation in each single case as regards factors like space and time propensities of the project/infrastructure asset is one important starting point when designing the organisational and regulatory framework.

Well-defined and less complex structures can probably be organised with PPP-like structures where risks can be defined, predicted and allocated between the contracting partners without complexity or high cost.

More complex structures with a longer life span involving many actors and constituencies might lead to a contractual situation that is too demanding, and therefore less efficient, for a PPP. In that case, an RAB model might be a preferable design. RABs are also preferable in situations where a continuous efficiency pressure from other market players or users is not at hand, and monitoring, benchmarking, and price reviews by a regulatory authority might offer similar efficiency incentives.

Even if models that combine aspects of the two structures are possible (e.g. Zhivov 2018), from a practical and a risk-allocative standpoint, the main impression that PPPs and RABs should be seen more as complementary rather than as alternative structures dominates. The analysis suggests that PPPs should primarily be used for well-defined projects where competition prevails throughout the project, while RABs seem to offer stronger incentives for efficiency in cases where competitive pressures are modest and the contractual complexity (and longer-term perspective) is stronger.

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Appendix 1. Research questions and outputs of the Working Group on Private Investment in Infrastructure

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. (2019), "What is Private Investment in Transport Infrastructure and Why is it Difficult?", Working Group Paper, International Transport Forum, Paris.
Can private investment improve productive efficiency? Improve project selection? Close the infrastructure funding gap? Have other positive effects when it is private?	Makovšek, D. (2019), "The Role of Private Investment in Transport Infrastructure", Working Group Paper, International Transport Forum, Paris.
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. (2019), "Quantifying Private and Foreign Investment in Transport Infrastructure", Working Group Paper, International Transport Forum, Paris.

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, A. et al. (2019), "Uncertainty in Long-term Service Contracts: Franchising Rail Transport Operations", Working Group Paper, International Transport Forum, Paris.
What is the competition for large transport infrastructure projects in the EU Market? Is there a difference between traditional procurement and PPPs?	Roumboutsos, A. (forthcoming), "Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe", Working Group Paper, International Transport Forum, Paris.

Addressing uncertainty for suppliers: the construction phase as example

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

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

What is the public sector organisational counterfactual on which private investment should seek to improve?	Holm, K.V. and T.H. Nielsen (2018), "The Danish State Guarantee Model for Infrastructure Investment", Working Group Paper, International Transport Forum, Paris.

Partial fixes to the Private-Public Partnership approach

How would an organisational structure consisting of PPPs come close to a network-wide management approach? What benefits would it yield?	Vassallo, J. (2019), "Public-Private Partnerships in Transport: Unbundling Prices from User Charges", Working Group Paper, International Transport Forum, Paris.
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?	Engel, E., R. Fischer and A. Galetovic, (forthcoming), "Dealing with the Obsolescence of Transport Infrastructure in Public-Private Partnerships", Working Group Paper, International Transport Forum, Paris.

Long-term strategic approach

How do the PPP and regulated utility model (RAB) compare in terms of efficiency incentives?	Makovšek, D. and D. Veryard (2016), "The Regulatory Asset Base and Project Finance Models", International Transport Forum Discussion Papers, No. 2016/01, Paris.

What basic considerations underlie the choice between a PPP and RAB approach?	Hasselgren, B. (2020), "Risk Allocation in Public-Private Partnerships and the Regulatory Asset Base Model", Working Group Paper, International Transport Forum, Paris.
Which are the preconditions a country would need to take to establish a RAB model on a motorway network? Is user-charging a must?	Alchin, S. (2019), "A Corporatised Delivery Model for the Australian Road Network", Working Group Paper, International Transport Forum, Paris.
From the investors' point of view, does a RAB need to be fully reliant on user-charging?	Francis, R. and D. Elliot (2019), "Infrastructure Funding: Does it Matter Where the Money Comes From?", Working Group Paper, International Transport Forum, Paris.
Incentive regulation can also yield perverse incentives. Can the capex bias be managed?	Smith, A. et al. (2019), "Capex Bias and Adverse Incentives in Incentive Regulation: Issues and Solutions", Working Group Paper, International Transport Forum, Paris.
Does it make sense to pursue hybrid solutions between PPP and RAB?	Zhivov, N. (2018), "The Thames Tideway Tunnel: A Hybrid Approach to Infrastructure Delivery", Working Group Paper, International Transport Forum, Paris.
Uncertainty and private investment mobilisation in transport infrastructure	
What lessons can we draw from recent attempts to mobilise private investment in infrastructure in the aftermath of the global financial crisis?	Makovšek, D. (2018), "Mobilising Private Investment in Infrastructure: Investment De-Risking and Uncertainty", Working Group Paper, International Transport Forum, Paris.
Synthesis	ITF (2018), *Private Investment in Transport Infrastructure: Dealing with Uncertainty in Contracts*, Research Report, International Transport Forum, Paris

Risk Allocation in Public-Private Partnerships and the Regulatory Asset Base Model

The two existing models for delivering and managing privately financed infrastructure are the public-private partnership (PPP) and the regulatory asset base (RAB). The PPP model is currently dominant, while the RAB model is rarely considered. This paper investigates under which conditions one approach is better suited than the other. The paper is part of a series of 19 papers and a synthesis report produced by the International Transport Forum's Working Group on Private Investment in Transport Infrastructure.

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