International Transport Forum

Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe

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Athena Roumboutsos

University of the Aegean, Chios

Working Group Report

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International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
contact@itf-oecd.org
www.itf-oecd.org

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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 4.

Acknowledgements

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Executive summary

What we did

Competition *for* the market supports price efficiency, improves allocative efficiency, reduces production costs, promotes innovation and protects social welfare. To this end, competition for large projects was investigated based on information contained in contract award notices (CAN) published by EU member states between 2006 and 2016 concerning road and rail works. Key drivers contributing to competition for the project considered were: institutional maturity, tender attributes and national policies coupled with competition *in* the market. The key project attribute considered was size: only projects of over EUR 10 million were analysed. In order to compare competition *in* the market, an adjusted concentration ratio (ACR) was used reflecting the share of awarded contracts per actor in the rail works, road works and transport infrastructure public-private partnership (PPP) market. Competition *for* the market was studied using descriptive statistics and regression analysis. Findings were compared to reported findings on PPP competition *for* the market.

What we found

The overview of contract award notices for rail and road works revealed a change in market trends as of the year 2010, with rail works becoming of greater demand. Rail and road works were then studied in two separate periods: before and after the year 2010. The analysis of competition *in* the market using the ACR revealed a similar market structure for PPPs, road and rail works: a two-tier market with the top tier reaping about 70-75% of all projects, while the vast number of actors belonging to the lower tier shared the rest. Whilst bearing a different ranking, top tier actors were the same for PPPs and road works. In rail, actors predominately active in road works, shifted to rail between 2011 and 2016, taking advantage of the growth in contracted works and occupying top tier positions. Hence, in 2016 the PPP, road and rail works markets had the same structure and were dominated by the same top-ranking actors.

The study of competition *for* the market revealed the varying and, overall, modest influence on competition of the tendering process attributes. The key driver is how national authorities structure the demand side of the market: overall demand for respective works, their share of large contracts and the concentration of top-ranking home actors. Based on these attributes particular country types could be identified reflecting the combination of the share of the overall demand for respective works in Europe versus the share of large contracts tendered in the country and coupled with the concentration of top-ranking home actors. The demand for works might very well reflect country needs or national development policies. However, these combinations had a considerable effect on how competition *for* the market evolved under the various contexts as well as how the tendering process attributes influenced competition. Furthermore, the policies effected in adjacent markets (here rail and road works) had a significant impact suggesting that possibly the national context refers to the structure of

both the demand and supply side of the markets where top-ranking actors are active, such as infrastructure in general and is not necessarily restricted to just transport infrastructure.

In conclusion, research on competition *in* the market and *for* the market with respect to large infrastructure projects, found that while the identified drivers of competition and their respective group of factors are important, their influence varies depending on the country context and the conditions of competition in the national market. In other words, there is no "one solution fits all" and large contracts, under various conditions of market "attractiveness", can drive competition or deter it. This applies both to PPPs and traditionally procured projects.

What we recommend

Large PPPs and traditionally procured projects should be addressed in the same way

Considerable research and debate have focused on PPPs in terms of their financing and reducing the cost of financing through varying forms of guarantees. However, little consideration has been given to driving competition at the bidding stage. The same applies for traditionally procured projects. While some consideration has been given to megaprojects, large infrastructure projects have only been treated as per their complexity in implementation. The present study highlighted a common factor: the top actors in PPPs are the same as for large, traditionally procured projects. Hence, given the same supply market, the demand market should be adapted accordingly.

Keep an eye on how competition in the market evolves

Knowledge of how competition in the market evolves will allow contracting authorities to promote competition for the project by formulating both their demand for works and the respective share of large projects.

Plan procurement centrally

Competition in the market is formulated across adjacent sectors. Actor expertise may extend to other sectors given the opportunity (e.g. increase in market demand in another construction sector, decrease in market demand in the sector of key expertise, changes in overall market demand in country of origin). This will change the dynamics of competition for the market. Contracting authorities should consider this fact and plan procurement of works accordingly.

Complex procurement procedures secure minimum competition

Open call procedures and assessments primarily based on the price offer may attract more competition but if not reasonably designed in the context of other calls for works in relevant sectors, these procedures might lead to single bid awards or no competition at all. Reverting to more complex procurement processes (restricted calls, negotiated procedure following competition, competitive dialogue) will secure minimum competition. However, these procurement procedures require both institutional maturity and experience on the part of the contracting authority.

Think of the future

Strategies followed to protect or favour national actors may take on various approaches and have an impact on the entire European market and its competition potential. While, supporting the national/local

economy may be important in the short or medium term, it may also have serious ramifications on the level of competition for the market in the country and in Europe overall.

Provision of accurate data by contracting authorities

The publication of the contract award notice constitutes the final step when following EU directives on procurement. However, this step, which in essence is the “crowning” of the entire procurement process is not always undertaken with due diligence. While inaccuracies in the CANs constitute limitations to the current study, they also highlight the importance contracting authorities attach to this final announcement of tendering results.

Introduction

While public-private partnerships (PPPs) are an established model of infrastructure delivery, the debate of their advantage over traditional procurement remains focused on two main issues: their cost for the taxpayer and their managerial efficiency. The two issues are related. In PPPs, the efficiency of private management is expected to offset the higher cost of capital related to private financing as opposed to public borrowing, thus achieving value-for-money (Martin, 2013). Notably, value-for-money is also achieved through the appropriate allocation of risks to the party (private or public) that is in a better position to manage it (Loosemore et al., 2006).

While the proposition seems rather straightforward in concept, empirical evidence does not always support it. Performance can only be assessed *ex post* and there is agreement on the absence of such performance data (Chen, Daito and Gifford, 2016). When such data exists, there is no conclusive evidence that PPPs have performed better. For example, a study undertaken in the United Kingdom concluded that there was no convincing evidence that PPPs have been more efficient than traditional procured projects (Winch, 2012). The BENEFIT H2020 project studying some 100 cases of PPPs and traditionally procured transport infrastructure projects did not conclude that PPPs performed better (Roumboutsos, Voordijk and Pantelias, 2018).

There have been considerable efforts regarding appropriate project risk allocation reported in the academic and professional literature, in terms of best practices and guidelines, *ex post* assessments and models, concluding, for the most part, that appropriate risk allocation is not always achieved (see for example Roumboutsos and Pantelias, 2015).

Recently, Makovšek and Moszoro (2018) considered viewing the debate through the hypothesis of market efficiency. According to the authors, "if the relevant capital markets are competitive and complete (i.e. all risks can be traded), the private cost of finance will represent the efficient cost of the risks involved in the project – the financing costs of the public and private approaches would be equivalent. Under this approach, value-for-money assessments would depend solely on the efficiency differential between public and private ownership and management".

Considering the PPP market, there is overwhelming evidence that it does not possess the characteristics of a competitive market. Reports from Public Works Financing (2013; 2016) indicate an established market with leading construction firms representing more than 50% of the number of transport PPP projects under construction or in operation. Furthermore, there are reports concerning the small number of bidders responding to tenders (see for example NAO, 2007; Zitron, 2006 or Hellowell and Vecchi, 2012). This evidence comes as no surprise considering the complexity of PPP projects, their scale in terms of budget and the transaction costs involved in tendering (see for example Sánchez Soliño and Gago de Santos, 2010). Blanc-Brude (2013) suggests that these project characteristics limit new entrants from bidding, while Roumboutsos, Suárez Alemán and Ågren (2017) consider market concentration as a result of firm strategies facilitated by the PPP model of procurement.

Following this line of thinking, the next question is if this observation is a phenomenon of the PPP market or of large projects in general and what the effects on competition are of the various tendering

procedures and their respective award criteria in the traditional procurement market. To this end, the present research exploits the database of contract award notices (CANs) of tenders under the EU procurement law for infrastructure and, more specifically, for transport infrastructure as reported by public contracting authorities between the years 2006 and 2016.

Findings and observations are used to draw conclusions with respect to competition for large infrastructure projects in the rail and road sectors, which represent the large majority of projects procured. The drivers of the level of competition are identified allowing for the formulation of recommendations. The paper starts by laying the groundwork for a discussion on the topic of competition. Measuring competition is an objective of this paper and is adapted to the attributes of the study dataset, leading to the methodology applied. Results from a combined analysis are presented and discussed on this basis.

Discussing competition

Competition has always been considered “a force that leads to an ideal solution of the economic performance problem” (Scherer and Ross, 1990). A competitive market is one where the number of firms producing homogeneous products is so large and each firm’s market share is so small that the commodity’s price cannot be changed or influenced by any individual firm by altering its own output quantity. Under perfect competition, sellers are forced to sell at a price equal to the marginal cost and in this context allocative efficiency is improved, production costs are reduced and social welfare is protected (Chen and Lin, 2007). In addition, competition is expected to foster innovation, as new approaches to efficiency are introduced (Boone, 2001; Flath, 2011). In the context of the present study, increased competition at the bidding stage suggests that bidders will price risk efficiently (Makovšek and Moszoro, 2018) and seek appropriate risk allocation.

Measuring competition

The World Bank (2002) summarises three main ways to measure competition.

The first relates to the assumption of price tending to marginal cost and measures competition based on the price-cost margin. Consequently, markets having firms with low price-cost margins are considered more competitive. This approach requires extensive and detailed information and there are very few studies in the construction sector using this approach. For example, Williams (1981), using data from 1961 to 1977, calculated the actual rate of return of 22 British industrial sectors and found that the rate of return in the construction industry was consistently higher than that of the manufacturing industry concluding that the construction industry is less competitive than manufacturing.

The second approach looks at the consequences of a market structure rather than the market structure itself. It estimates the residual elasticity of demand for the firm’s own product—the extent to which a price rise by the firm would lead customers to find a substitute and buy from rival firms or reject the product altogether. This approach has raised considerable controversy. Here, there is an overwhelming view that observed behaviours are attributed to “management strategy” (or “survival of the best”

[Bennett, 1992; Ball, Farshchi and Grilli, 2000]) rather than exogenous economic forces (Abdul-Aziz, 1994; Hillebrandt, Cannon and Lansley, 1995). "Management strategy" suggests market power. Accepting "exogenous economic forces" suggests that price mark-ups depend on the construction cycle rather than on a firm's attempts to create inelastic demand. The assumptions here are that firstly, short run supply elasticities are less than long run ones and secondly, that there is ease of market entry and exit. The implication of the first assumption is that construction prices will rise and fall, with lags, in relation to changes in demand. The second assumption suggests that construction costs in individual markets are a function of the total construction demand rather than the demand in a particular sector.

The third approach measures the extent to which production is concentrated among a small number of firms. The Concentration Ratio (CR) and the Herfindahl-Hershamann Index (HHI) are both commonly used. The CR usually refers to the top four firms but may be extended to include any number of firms and concerns the sum of their market shares. The HHI sums the squares of the market shares of all firms in the market (Perloff, Karp and Golan, 2007). Their values will define the level of concentration in the market. Both indices are highly correlated (Scherer, F. M., 1980). The HHI gives a higher weighting to the larger firms in the market but requires full knowledge of market shares. Chiang, Tang and Leung (2001) used the HHI to assess the market structures of different sectors within the construction industry in Hong Kong and concluded that the private building sector was more competitive than the public building sector. In addition, the authors considered that the technological and capital requirements for the public housing and civil engineering sectors have significant entry barriers that increase the concentration level of the respective markets. Cheung and Shen (2017) used the CR4 and HHI to evaluate the market of ten megaprojects in Hong Kong. Their starting point was the extensive budget overruns observed. They found that CR4 yield results indicating a moderately concentrated market and HHI gave results suggesting a non-concentrated market. The difference was due to the fact that the market was characterised by the presence of numerous small firms and a few sizable companies. Findings suggested a two-tier market structure with a few leading firms behaving like oligopolistic firms and numerous small firms individually contributing to an extremely tiny fraction of the industry output and acting as price takers. The two-level entry barriers identified contribute to the persistence of an oligopoly among large firms which was responsible for the notable tender price surge.

Notably, concentration ratios can only be applied to specific and localised markets as the identification of all firms active in the infrastructure industry is intangible (Ye, Shen and Lu, 2014).

Features of competition for infrastructure projects

Competition usually refers to firms that provide products in a specific market. In the infrastructure sector, projects are the major "product" and are usually predefined by clients, while contractors provide services. Infrastructure projects are granted through competitive bidding. Competitive bidding is the major mechanism of competition. Construction business competition normally refers to a contractor's bidding activities (Kim and Reinschmidt, 2006). More specifically, the objective of using competitive bidding is to replace competition in the market by competition for the market. The assumption is that an increase in competition (i.e. in the number of bidders) should encourage more aggressive bidding so that, as the number of bidders increases, prices decrease towards efficiency prices (Holt, 1979; McAfee and McMillan, 1987). However, clients are often blamed for inviting too many contractors (Fu, Drew and Lo, 2003; Flanagan and Norman, 1985) leading to "over-competition", which could jeopardise project performance with respect to schedule, cost, quality, and environment (Sturts and Griffis, 2005).

In this context, the study of competition in the sector has often focused on the tendering and bidding process and more specifically on the number of bidders, which is used as a proxy for competition intensity. For example, Amaral, Saussier and Yvrande-Billon (2009), when comparing the French and London models of urban public transport procurement, compared the average number of bidders per tender and the share of tenders with only one bid. However, the measurement of competition intensity at the project level has limitations. First, this indicator mirrors only a part of the competition. Second, it pays little attention to any potentially uneven distribution of market powers between existing competitors, which could be a consequence of business competition over a period of time (Newcombe, 1990). Third, changes in the procurement process and the evaluation criteria may change the level of competition (Aghion, Harris and Vickers, 2001). Finally, it is related to the level of tendering transaction costs, suggesting that in each situation there is an optimum number of bidders for which transaction costs are minimised for both the bidders and the contracting authority (Roumboutsos and Sciancalepore, 2014).

More specifically, the level of competition for a project is linked to the competitiveness of the environment (Hong and Shum, 2002). Competitiveness for a project stems from the competitive advantage possessed by a firm and the competitive strategy a contractor adopted to compete for a given project (Ball, Farshchi and Grilli, 2000). Furthermore, competitiveness for a project may vary according to project attributes such as type, size, and so on. However, reported findings are not conclusive. For example, Drew and Skitmore (1992; 1993; 1997) and Drew, Skitmore and Lo (2001) carried out continuous research on the topic and found merely evidence of the effect of project size and type on competition. Notably, external factors may be the cause of inconclusiveness, such as inefficient capital markets. Larger firms may have an advantage over smaller ones in that they can raise the funding necessary for performance bonds and participate in build-and-operate private finance initiatives in ways that smaller firms cannot. Capital market inefficiency arises because banks, or the insurance market, may not be able to monitor contractor performance well enough, and so rely on firm size as a proxy for competence and solvency (Pantelias and Roumboutsos, 2015). In addition, there seems to be a location advantage taking the form of national protectionism or favouritism (Saussier, 2013). Further to this point, Somaini (2011), using highway auction data from the US state of Michigan, concluded that, while a bidder's distance to a project location is important in explaining participation and bid levels, there is no evidence of more aggressive bidding when competitors are located close to the project.

Competitiveness for a project also varies based on the contractor's attributes. Fu, Drew and Lo (2003) studied this issue and Flanagan et al. (2007) considered it a point of key research. Notably, experience and expertise are related to firm size and their related strategies with respect to extending expertise and capabilities to address complex projects. Roumboutsos, Suárez Alemán and Ågren (2017) advocate that the PPP model of procurement allowed firms to grow in size and expertise, leading to market concentration. Another point of differentiation reflecting on competition for the project is contractors' risk-taking behaviour. Bidding is risky because the actual cost of the job is unknown. Thus, the bid should be high enough to make a profit but low enough to win the tender. Kim and Reinschmidt (2011) using an evolutionary simulation model investigated the effects of risk attitude on a contractor's success and on the market structure. They found that risk attitude is a competitive characteristic of contractors with those being moderately risk-adverse more competitive in the long run. Hence, competitiveness may be related to a smaller number of bids per project.

Finally, Ye, Jiang and Shen (2008) distinguished Market Competition Intensity (MCI) from Project Competition Intensity (PCI). Following a case study approach, they identified that there are two forms of PCI: "overt" and "convert". Convert describes the unison of smaller firms under larger ones. The same notion was the object of a study conducted by Felso, Baarsma and Mulder (2005). The authors studied

the results of tenders between 1999 and 2004 to identify the existence of “combinations” (defined as two or more firms agreeing to tender together). Combination agreements can be seen as agreements that have the effect or object of restriction of competition. They concluded that the construction industry and, especially, the segment of infrastructure projects, has features that induce fierce competition. However, the competition is intense to such a degree that it becomes very attractive for firms to share the market and raise prices (Bijvoet et al., 2002).

In conclusion, reported research does not provide robust methodologies concerning the measurement and assessment of competition in the infrastructure sector. Each assessment is based on data availability.

Competition for transport PPPs

Public procurement processes are structured to secure transparency, public accountability and market competition. However, the complexity of PPP arrangements, also reflected in the rigorous tendering processes, increases transaction costs and may deter potential bidders, raising concerns about the competitiveness of the PPP market.

Therefore, many studies have focused on the effect transaction costs have on a potential bidder’s willingness to participate in the competition process. For example, Dudkin and Välilä (2006), based on the analysis of a sample of PPP projects in different European countries (Ireland, Netherlands and Portugal, the United Kingdom), estimated that the average bidding cost for a PPP project is approximately 13% of project capital value. Yescombe (2007) shows that tendering costs can reach 5-10% of the capital cost of a project, depending on project characteristics and the sector. While these figures, even at lower values, represent significant costs, their adverse result is a lower number of bidders, suggesting less competition.

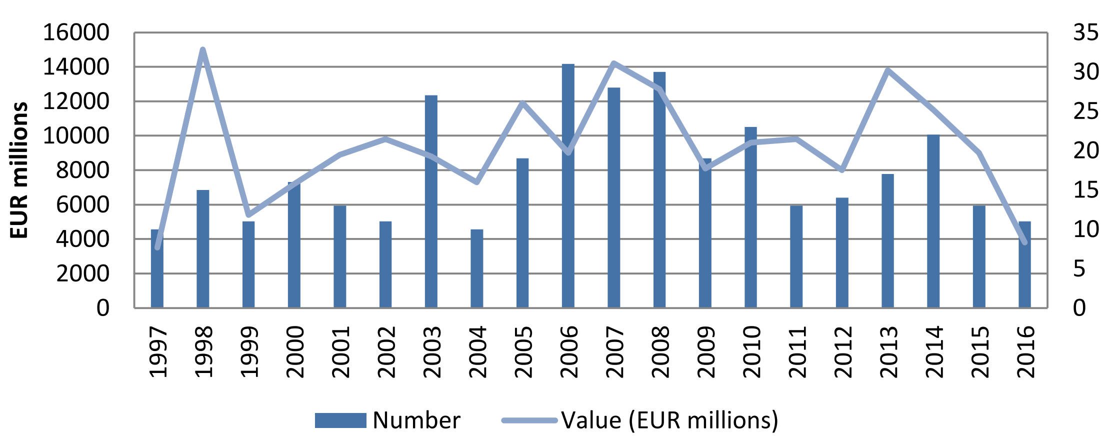
Roumboutsos and Sciancalepore (2014) in their review identified a number of elements influencing transaction costs at the PPP tendering stage. These included a variety of bidder-related endogenous reasons (expertise, backlog, etc.), and project-specific ones (sector, technical complexity, financing structure etc.) that might lead to an undesired result in terms of competition. Such elements include:

- Project Size: Many aspects of the tendering process require work, which is not dependent on the size of the project. Hence, the share of transaction costs on the project capital value tends to decrease with the increase of project size (Farajian and Cui, 2010; Dudkin and Välilä, 2006).
- Sector: This is mostly related to public sector expertise and the potential of using in-house resources. Dudkin and Välilä (2006) found this tendency in the case of UK school PPPs. The 2007 report of the National Audit Office (NAO) identifies differences between sectors expressed in the duration of tendering procedure.
- Project Complexity: PPPs are, in general, highly complex projects and require significant effort during contracting (project financing, risk allocation agreements, different and often contrasting stakeholder objectives, uncertainty and incomplete contracts, etc.) leading to lengthy negotiations at the contracting stage (Farajian and Cui, 2010; Dudkin and Välilä, 2006; Kee and Forrer, 2008).
- Bundling of services: At the heart of the PPP model (Hart, 2003), the bundling of services allows the private party to internalise benefits between the various stages of project development. In addition, even though bidding costs increase with more services bundled, the private sector has

more opportunity to internalise benefits. Estache and Iimi (2011) showed that by reducing the engineering cost of a project by 10%, competition would increase by 5.2% but would reduce the final bid by only 2.3% in the road cases modelled.

- Number of bidders: There is ambiguity with respect to transaction costs and the number of bidders. Sánchez Soliño and Gago de Santos (2010) find no evidence of an influence of the number of competitors on the bidding cost for the preferred bidder. However, lost bids are usually added to the total amount of transaction costs (Farajian and Cui, 2010). Dudkin and Välilä (2006) suggest that the bidding cost can have a parabolic trend with the number of bidders. The reason is the reduced effort in bid preparation in case of low competition and the low probability of being awarded the contract when bidders are too many. Hence, the lesser effort in the extreme cases.
- Project country: In principle, this refers to the maturity of the PPP legislative framework (Farajian and Cui, 2010) as well as the legal framework in general in a given country. For example, in the United Kingdom average bidding costs are considered to be higher than in some other European countries, due to its common-law status which requires a broader effort in defining contracts. The public sector has tried to reduce transaction costs for bidders and improve competition by providing a clear legal framework (Brown et al., 2006). This is not always empirically observed. For example, the 2007 NAO report showed that 85% of PFI projects that closed prior to 2004 attracted three or more developed bids compared to 67% in the study period (2004-2006). Yvrande-Billon (2006) showed that, in France, since the compulsory use of competitive tendering, the average number of bidders for urban public transport has been continuously decreasing while the unit costs of service provision has increased. Similar are the findings of Chong, Staropoli and Yvrande-Billon (2010) for all public work contracts in France for the period 2005-2007. These reports present a paradox due to the implied causality of the "clarified" legal framework. The number of bids received per tender is also related to "market demand and supply" (see above). These reports refer to the period between 2000 and 2007/8, when the PPP market witnessed a significant growth (see Figure 1) in demand allowing contractors to be "selective" in their bidding efforts.

Figure 1. PPP transport projects, 1997-2016



Source: Compilation from EPEC database http://data.eib.org/epec/

In addition, the number of potential bidders should also be considered when reflecting on the number of bids received. As PPPs are large and complex projects, there are relatively few actors that have the resources to address project complexity and raise the financing needed. Roumboutsos, Suárez Alemán and Ågren (2017) suggested that the supply side of the PPP market is concentrated, amongst other reasons, due to lead firm ability to exploit transaction cost savings from standardised tendering and contracting procedures and use them as rents. Siemiatycki (2012) came to the same conclusion following a different approach.

Hence, the number of tenders and the level of market concentration will influence the number of bidders and, in turn, competition for the project.

The data set

Contract award notices

The publication of a contract award notice (CAN) is the final step in the procurement process as set out in the EU directives on public procurement, which apply for public works, supplies and services over a certain budget threshold. CANs are published in standard forms[1] completed by the contracting authorities and sent for publication to the Tenders Electronic Daily (TED). Amongst others, CANs include the following information:

- the contracting authority's name
- the procured works/services/supplies expressed through the respective Common Procurement Vocabulary (CPV) codes
- the tender procedure described as Open, Restricted, Negotiated or Competitive Dialogue[2]
- the award criteria described as Least Price or Multi-criteria along with the weight of the offered price in the overall assessment
- the number of bids received
- the name of the firm(s) awarded the contract
- the contract value as estimated and awarded.

CANs also include the standard form ID number, which corresponds to the respective directive. As per the rest of the information, this is identical in all CAN standard forms (see note 1 in the Notes section). The EU directive on concessions was only published in 2014. Considering the length of the PPP procurement and award process, very few PPPs may be identified based on the standard form ID number. Prior to this date (2014) many contracting authorities would follow a similar administration procedure and PPPs/concessions were also included in the CAN dataset, though difficult to distinguish. However, while not obligatory, contracting authorities may publish contract notices (CN) informing potential bidders of their intent to procure. These notices, apart from including key information on the

tender also include the contract duration period, which ultimately forms the basic criterion of distinction between PPPs/concessions and traditional procurement.

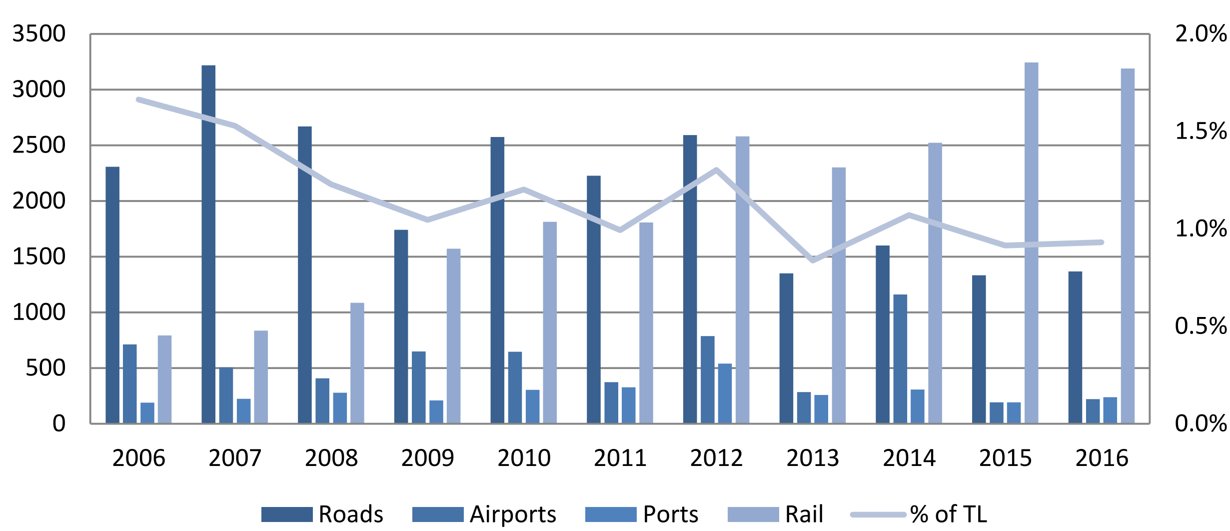
TED recently published both contract notices and contract award notices for the period 2006 to 2016. This data, provided in comma-separated values (csv) format constitute the basis of the analysis that follows. Notably, they include all published notices concerning public tenders in the European Union, not only those concerning transport infrastructure.

Retrieving transport infrastructure tender information

Amongst the data available, a key difficulty addressed has been the retrieval of notices that concerned transport infrastructure. In addition, it has been of equal importance to retrieve notices (data records or simply records henceforth), that might be comparable. For example, a PPP contract may include construction, supplies (eg. rolling stock) and services (e.g. operation/maintenance). In traditional procurement these services are usually "unbundled", while parts of the same project might be procured separately as extremely few contracts would be "turnkey". Parts of the same contract type (e.g. works) can be identified, as they are tendered simultaneously baring the same CAN Identification Number.

The retrieval of transport infrastructure tender information was based on CPV codes. Codes related to transport infrastructure were selected and the entire database was screened based on these codes (see Appendix 1). The selected records were then categorised per mode of transport: roads/bridges/tunnels, airports, ports and rail. With respect to urban transit, CPV codes related to metros were selected and categorised under rail. Figure 2 represents the number of contract award notices published per year by mode and their total share over all notices published.

Figure 2. Number of contract award notices published and their share over total notices published (2006-2016)



Usability of the retrieved CAN information

Figure 2 should be considered as presenting the trend rather than the exact number of notices published concerning transport infrastructure over time. One limitation is related to the fact that the standard forms are not always fully or correctly completed by contracting authorities (see Single Market Scoreboard, 2016 – Key figures[3]). In this context, CPV codes are not always provided. In addition, the internet links to the announcement expire after approximately 12 months making it impossible to crosscheck data. In addition, additional countries published notices over the study period following their introduction to the European Union or the group of associate countries. Regardless, it is interesting to note that very few tenders concern ports. This fact is to be expected given the relatively small number of ports and that most ports in the European Union are under concession and, therefore, corresponding investments are not made by the public sector. Airport activity is also present although it drops after 2012. The 2011/2012 period seems to be a landmark for roads and rail, as the number of projects in these sectors are almost equal, although after 2012 rail becomes the prominent sector for investment in terms of the number of calls issued.

It would be highly interesting to view Figure 2 in terms of value. However, while the standard forms include both estimated and awarded contract budgets, this information is not always available. When it is, it is not always valid, as contracting authorities seem to register in euros, thousands of euros, or local currency. In addition, while the EU procurement directives apply for contracts with values of over a certain threshold, many contracting authorities have followed them even for smaller value contracts. The EU directive thresholds are announced annually. The thresholds of interest for 2018 are presented in Table 1 and show no significant change over the study period (i.e. 2006-2016).

Two issues have been identified: the accuracy of values provided and the completeness of records. However, as the focus of the research is on large projects, it is assumed that the respective contracting authorities would most probably have addressed the procurement process with due diligence and, therefore, the records of interest should be (1) complete and (2) accurate[4]. This assumption, however, requires a definition: what is a large project?

Table 1. Thresholds for utility sectors and concessions

Type	Threshold (EUR)	Directives
Works contracts	5 225 000	2004/17/EC 2014/25/EU
Services and supplies	418 000	2004/17/EC 2014/25/EU
Concessions	5 225 000	2014/23/EU

Source: https://ec.europa.eu/growth/single-market/public-procurement/rules-implementation/thresholds_en.

Large infrastructure projects

The threshold set by the directives speculates on the scale of "large" with respect to the EU procurement policy. The European Investment Bank (EIB) through the European PPP Expertise Centre (EPEC) monitors PPP projects funded by the EIB of over EUR 10 million, even though the lowest average value of a transport infrastructure project included in the EPEC database is approximately EUR 200 million (see

Table 2). This project value suggests projects in the near-range of megaprojects[5]. In addition, PPPs also include operation/maintenance values over the lifetime of the project and, therefore, their value is not directly comparable. In addition, the EPEC database includes information on only 195 PPP projects supported by the EIB. The BENEFIT project studied 55 PPP project cases in the European Union including all modes. Their construction value expressed in 2013 euros ranged from EUR 20 million to EUR 2.3 billion.

Considering the above, and for the purpose of the present research, large projects are defined as those with a contract value over EUR 10 million. The dataset is split into six segments: 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. Furthermore, seeking a level of homogeneity, the research is concentrated on rail and road works, which represent the largest part of the data retrieved. In this context, Table 3 presents the number of contract awards per contract size range over the study period. Only records including contractor names are considered.

Table 4 presents contract size per year. Notably, while only approximately 10% of all investments are above the EUR 100 million threshold, ports, airports, rail and road investments have a similar distribution with the former geared towards smaller contract sizes. Table 4 highlights two other interesting points: a gradual shift towards larger size contracts and abnormal information regarding the year 2010. When comparing to Figure 1, the drop observed in 2010 is not evident. A probable explanation might be a conservative approach to large project calls issued in 2009 by contracting authorities in response to the global economic crisis of 2007/8.

Also, of interest is the distribution per contract type (works, services and supplies) per infrastructure mode and contract size range. Tables 5 and 6 present this information. Works constitute the largest part of contracts awarded followed by services. The share of supply contracts for rail is notable, signifying the procurement of rolling stock and other equipment. Contracts for services, supplies and works seem to have a similar distribution across contract size groups with approximately 75% of contracts concentrated in the range of EUR 10-50 million. When considering the procurement of PPP contracts, according to the EU Directive 2014/23/EU, these are registered as services or works and are difficult to distinguish prior to the implementation of the respective Directive. Hence, the dataset had to be treated uniformly without distinguishing PPPs from traditional contracts.

Table 2. Transport PPPs per EU country, 2006-2016

Country	Total number	Total value (EUR billion)	Average value per PPP (EUR billion)
Austria	4	1.2	0.30
Belgium	12	3.4	0.28
Bulgaria	1	0.2	0.20
Croatia	3	1.0	0.33
Cyprus	1	0.6	0.60
Denmark	1	0,2	0.20
Finland	2	0.6	0.30
France	35	16.6	0.47
Germany	14	4.3	0.31
Greece	9	7.8	0.87
Hungary	1	1.6	1.60
Ireland	11	3.4	0.31
Italy	8	3.4	0.43
Lithuania	1	N/A	
Luxemburg	0		
Netherlands	15	5.5	0.37
Poland	5	2.8	0.56
Portugal	13	9.3	0.72
Romania	1	N/A	
Slovakia	2	2.2	1.10
Slovenia	0		
Spain	56	12.7	0.23
Sweden	0		
United Kingdom	0		
Total	**195**	**76.8**	**0.39**
Least average value	0.2		

Source: Compilation from EPEC database http://data.eib.org/epec/.

Table 3. Distribution of contract size per infrastructure mode

Mode	[10-20) EUR million	[20-50) EUR million	[50-100) EUR million	[100-200) EUR million	[200-500) EUR million	≥500 EUR million	Total
Airports	216	150	21	5	8	1	401
%	53.9	37.4	5.2	1.2	2.0	0.2	
Ports	191	96	27	6	4	0	324
%	59.0	29.6	8.3	1.9	1.2	0	
Rail	1 012	797	394	220	100	65	2 588
%	45.8	31.8	12.1	5.6	3.4	1.2	
Roads	1 372	952	362	169	103	35	2 993
%	44.3	31.6	12.7	6.3	3.4	1.6	
Total	2 791	1 995	804	400	215	101	6 306
%	44.26	31.64	12.75	6.34	3.4	1.60	

Table 4. Distribution of contract size over time

Year	[10-20) EUR million %	[20-50) EUR million %	[50-100) EUR million %	[100-200) EUR million %	[200-500) EUR million %	≥500 EUR million %	Total
2006	45.6	38.8	8.6	3.3	2.5	1.2	570
2007	45.8	35.7	12.2	2.9	2.5	0.8	747
2008	42.4	37.9	10.8	6.7	1.6	0.6	805
2009	44.2	29.6	9.3	7.4	7.9	1.7	582
2010	37.3	33.9	13.6	9.3	5.1	0.8	118
2011	44.7	28.5	14.3	3.7	6.9	2.0	407
2012	44.1	33.2	12.8	7.4	1.6	0.9	698
2013	35.7	24.5	23.8	10.5	3.6	1.9	526
2014	49.8	24.7	12.7	6.1	2.9	3.8	659
2015	53.3	27.4	10.0	5.1	3.3	1.0	610
2016	37.0	31.3	15.4	9.9	3.4	2.9	584
Total	2791	1995	804	400	215	101	6 306
%	44.26	31.64	12.75	6.34	3.40	1.60	

Table 5. Contract type per infrastructure mode

Mode	Services	Supplies	Works	Total
Airports	86	55	260	401
%	21.4	13.7	64.8	
Ports	57	3	264	324
%	17.6	0.9	81.5	
Rail	691	460	1 437	2 588
%	26.7	17.8	55.5	
Roads	252	2	2 739	2 993
%	8.4	0.1	91.5	
Total	**1 086**	**520**	**4 700**	**6 306**
%	17.2%	8.2%	74.5%	100.0%

Table 6. Contract type and size

Year	[10-20) EUR million %	[20-50) EUR million %	[50-100) EUR million %	[100-200) EUR million %	[200-500) EUR million %	≥500 EUR million %	Total
Services	507	335	101	80	35	28	1 086
%	46.7	30.8	9.3	7.4	3.2	2.6	
Supplies	239	121	91	30	19	20	520
%	46.0	23.3	17.5	5.8	3.7	3.8	
Works	2 045	1 539	612	290	161	53	4 700
%	43.5	32.7	13.0	6.2	3.4	1.1	
Total	**2 791**	**1 995**	**804**	**400**	**215**	**101**	**6 306**
%	44.3	31.6	12.7	6.3	3.4	1.6	

Methodology

The analysis dataset

Research had to be tailored to the available data and its limitations. The CANs dataset is treated without distinguishing PPPs contract awards from traditionally procured contracts. The emphasis is placed on the selected road and rail contracts for works. This concerns information on 1 437 CANs for rail works and 2 677 CANs for road works over EUR 10 million (see Table 5).

Figure 3. CANs for road and rail works over the study period

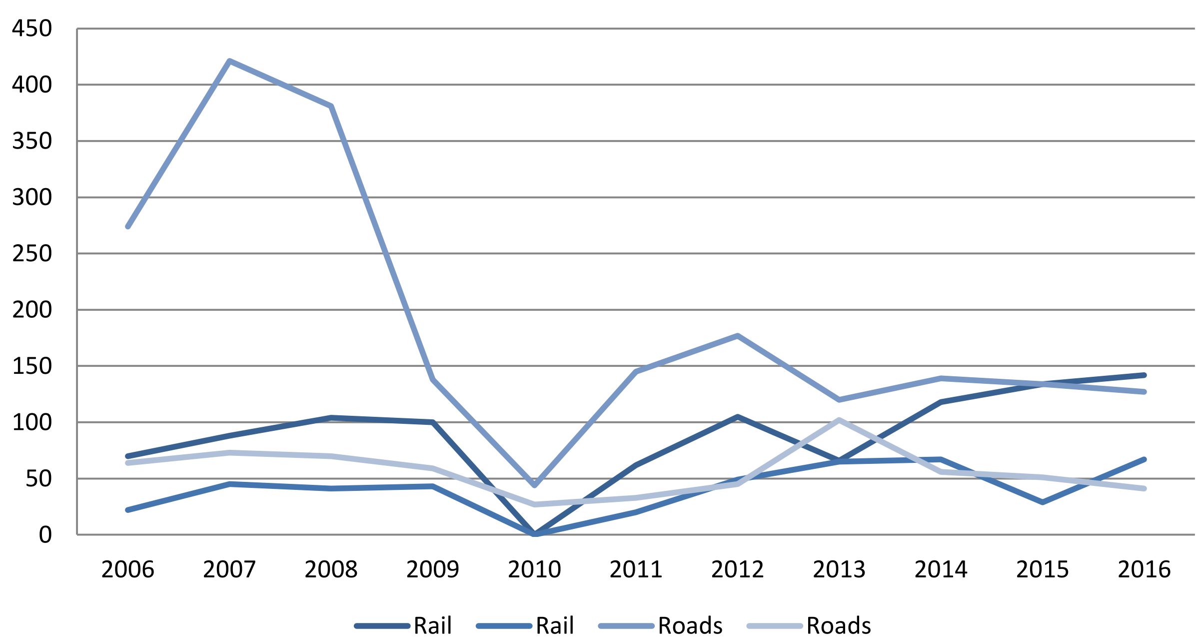


Figure 3 shows the respective CANs over time. The year 2010 presents an abnormality as observed previously. To this end, the dataset is studied in four subsets: rail works CANs 2006-2009; rail works CANs 2011-2016; road works CANs 2006-2009 and road works CANs 2011-2016. Table 7 shows the number of records (CANs) analysed per subset.

Table 7. CANs per segment analysed

Segment	[10-20) Million EUR	[20-50) Million EUR	[50-100) Million EUR	[100-200) Million EUR	[200-500) Million EUR	≥500 Million EUR	Total
Road 2006-2009	656	558	128	57	67	14	1 480
Road 2011-2016	556	313	185	100	31	12	1 197
Rail 2006-2009	181	181	102	28	18	3	513
Rail 2011-2016	339	288	154	87	34	22	924

The dataset is a large convenience sample deducted from the entire TED CANs dataset. The CANs published between 2006 and 2016 include approximately 4.9 million records. All CANs do not include all information entries (see Single Market Scoreboard EC report[6]). Of these, almost 47 500 records included relevant CPVs as well as contract value, awardee names and contracting authorities related to transport infrastructure. The number of selected CANs was reduced further when processing awardee names. There were 6 306 CANs with values over EUR 10 million concerning all contract types (works, services and supplies). Concentrating only on works contracts, the number was reduced to 4 158. When excluding records for the year 2010, the final number of records analysed was 4 087.

Additional information was collected to support the analysis including:

1. The identification of contractor groups of firms. This involved an internet search, screening of published company annual accounts, screening of firm websites and history background offered. Considering the dynamic nature of contractor groups, the information collected has limitations, as all firms belonging to the same group cannot be accurately identified. Therefore, results may show less market concentration than is actually the case.
2. Retrieval of available information on transport PPPs from the European PPP Expertise Centre (EPEC) database.
3. Collection of “Public Works Financing” public domain announcements concerning the top-ranking developers for transport infrastructure.
4. Information and research results from the Horizon 2020 funded project BENEFIT, whose research also included the analysis of 55 PPP projects in Europe[7].

Analysis

The analysis addresses both competition in the market and competition for the market. The study dataset is analysed in this respect and conclusions are drawn for the entire set. Then based on existing knowledge with respect to PPPs, conclusions are formulated separately.

Competition in the market

An adjusted concentration ratio (ACR) is introduced to illustrate market structure and concentration. It is based on the share of awarded contracts in number as opposed to value, given the fact that value figures are not always accurately reported, and information exists for awarded consortia and not concerning each firm’s share in the contract. As in the case of the concentration ratio, the adjusted one is calculated for the top four (ACR4) firms and then extended to the next four (ACR[8-4]) and then the next until ACR(N-4) represents a share smaller than 2% of the awarded contracts.

Competition for the market

As in other studies, the number of bids received per tender is considered a proxy for competition. An optimum number of bids per tender is not identified or used. The emphasis is on identifying factors and conditions leading to greater competition, i.e. greater number of bids.

Factors influencing the number of bids per tender, as identified and considered in the literature review conducted earlier are:

- Project size in terms of value: The study dataset includes all CANs for projects of over EUR 10 million for which information is available. Project size is studied in the range 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.
- Institutional maturity of the contracting authority: Institutional indicators constructed for transport infrastructure procured projects, originally developed for the BENEFIT project, are employed (Soepcipto, Willems and Verhoest, 2018). The indicators include three dimensions. The first, the political dimension, is composed of the three main governance indicators of the World Bank (WGI), i.e. political stability and absence of violence, control of corruption, and voice and accountability. The second, the regulatory dimension, is composed by two governance indicators of the World Bank, i.e. rule of law and regulatory quality, combined with the inverse of the aggregated OECD indicators of regulation in energy, transport and communications (ETCR) on the regulatory restrictiveness of markets (i.e. measuring the level of liberalisation). The third, the administrative dimension, includes the government effectiveness developed by WGI. The necessary data from the two sources (WGI and OECD-ECTR) is operationalised as a single indicator with values in the range [0,1].
- Procurement process: The CANs include the type of procurement process followed. These include:
    - open calls
    - negotiated process following an open call
    - competitive dialogue
    - negotiated process without an open call
    - award without a previous announcement
    - restricted calls
    - Contracting authorities have a role in setting competition by adopting a particular procedure. In negotiated, competitive dialogue or restricted calls, while all actors are entitled to express interest, a selected number is invited to do so while a minimum number of bidders must be secured simultaneously by the contracting authority (see note 2 in the Notes section). The procurement process is modelled based on an estimation of the incurred transaction costs. Sánchez Soliño and Gago de Santos (2010) found that the negotiated process is estimated to incur transaction costs three times higher than those of the open procedure. Competitive dialogue, based on the length of the procurement process (Hoezen, Voordijk and Dewulf, 2012) is assigned a level of transaction cost equal to six times those of the open procedure. This assignment is arbitrary but has little effect on the results given the extremely small number of tenders conducted through competitive dialogue.
- Selection criteria: Two variables are considered. The first is binary as to whether the award criterion is based on the least price method or whether a multi-criteria assessment is conducted. The second concerns the weight of the price criterion in the assessment. When a least price assessment is made, the variable value is 100 (%), otherwise the weight (as a percentage of all

criteria) of the bid price is considered. Therefore, selection criteria are included either as a binary indicator (least price = 0; multi-criteria selection = 1) or as a continuous variable in the range [0, 100] representing the weight of the price criterion.

- Contractor power or weight: This value represents the "power" of each actor and has been calculated based on the number of projects awarded in the study period. As there is evidence of differences in competition between sectors, this value has been calculated for all identified actors for:
    - infrastructure awards (all sectors – airports, ports, rail and roads – and all contract types)
    - rail works contracts for the periods 2006 to 2009 and 2010 to 2016
    - road works contracts for the periods 2006 to 2009 and 2010 to 2016.
- Market demand size is also an influencing factor. This factor has also been included in the analysis on varying levels (the entire market, works market per sector, works per project range size, etc.).

Initial expectations

The factors/variables described previously are expected to influence the number of bids per tender in varying ways depending on the combination of other factor values. These expectations are summarised in Table 8 and are based on the discussion on competition conducted earlier.

Table 8. Initial expectations

Variable	Expectation
Project size	Given the fact that both expertise and financial strength are required to undertake large projects, the number of potential bidders is expected to decrease as project size increases.
Institutional maturity	Institutional maturity is expected to foster competition. However, contracting authorities with high institutional maturity might consider more complex procurement processes (e.g. negotiated instead of open calls) and bid assessment criteria (multi-criteria instead of least price). This might lead to a smaller number of potential bidders. Simultaneously, as a minimum number of bidders is required in this type of procurement process, there is a smaller probability of single bid awards.
Procurement process	Procurement processes are expressed as an indicator and assigned a value (from 1 to 6) based on the estimation of transaction costs potentially incurred. As the indicator value increases, the number of offers is expected to decrease. However, as in the case of institutional maturity, there is a smaller probability of single bid awards. Hence, under conditions, an increase in the procurement process indicator may lead to an increase in competition (increase in the number of bids).
Price criterion	As the weight of the price criterion tends to 100 (least price assessment) more bidders are expected to express interest. However, this can only be expected in cases where the price criterion overweighs all other criteria.
Contractor power	The initial expectation is that the interest of powerful contractors for a tender will deter other actors from bidding.
Market size	As noted in the discussion on competition, demand will influence the number of bidders. As market size grows, fewer bidders are expected.

Methods

The analysis includes a combination of descriptive statistics and linear regression analysis. Both methods have their limitations as will be indicated. Reports in literature suggest that linear regression analysis does not provide a good fit and that, possibly, evolution models would be more suitable. Notably, the best linear regression fit was reported by Drew and Skitmore (1997) with an adjusted R square static 0.254. Nonetheless, given the multiplicity of drivers influencing competition, linear regression has been adopted as a useful tool in identifying trends, especially as opposing influences are expected as described above. The Statistical Package for the Social Sciences (SPSS) was used for the analysis.

Analysis

Competition in the market: PPPs versus traditional procurement

Public Works Financing provides the list of the top-ranking developers undertaking projects in the transport sector internationally. The ranking is based on the number of projects underway or in operation across all transport infrastructure sectors since 1985. Projects sold or contractually expired are listed separately. The published ranking includes the number of projects operated or under construction in the United States and Canada.

Figure 4 provides the adjusted concentration ratio (ACR) representation of the ranking published for 2016 (ACR PPPs 2016) excluding infrastructure financing actors and the projects operated/under construction in the United States and Canada. As the total number of PPP projects/concessions is not provided, ACR is normalised on the total number of projects operated or under construction by the top firms. More specifically, the ranking is based on firm participation, therefore the same project is counted twice (or multiple times). In this graph, the ACR of works contracts for rail and road infrastructure for the periods 2006 to 2009 and 2011 to 2016 are added. With the exception of the ACR curve for rail works in the period 2011-2016, ACR curves almost coincide, indicating a very similar market structure with the top eight firms competing in an apparent oligopoly and firms ranked after ACR20 facing strong competition.

The comparison of the ACR 2016 curves (reflecting the period 2011-2016) for rail and road works is also interesting. In the period 2011 to 2016, the number of tenders decreased for road works and increased for rail (see Figure 3). In this period, firms more active in the road sector shifted emphasis to rail works – and, in many cases, became dominant – resulting in a more competitive market for rail in the period 2011-2016 and an increased concentration of road works in the same period.

Figure 4. ACR4 of top-ranking PPP/concession contractors and dataset

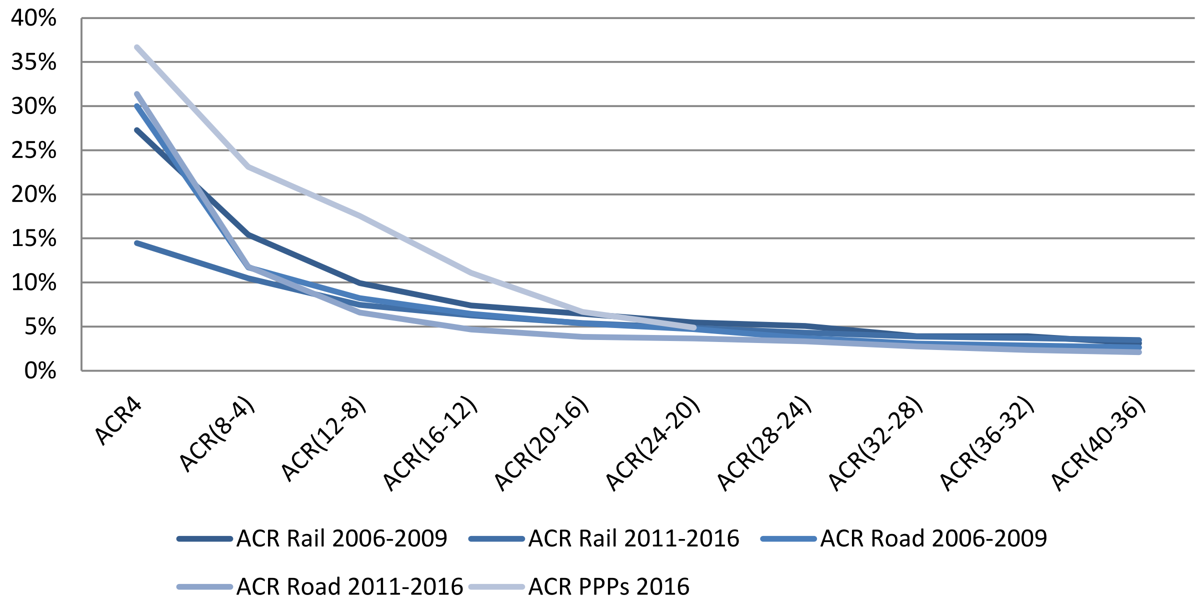
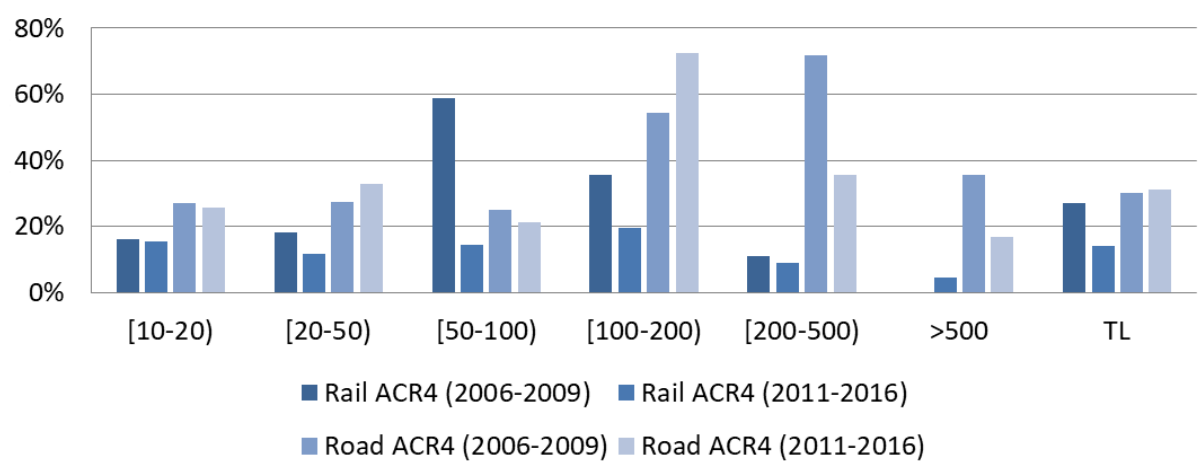


Figure 5 addresses the assumption that larger firms concentrate on larger value projects. Compared to the overall value for the respective period (noted as TL in Figure 5), ACR4 for road and rail works is shown in the various project value ranges. The top four contractors appear to be active across all project value ranges and no tendency for a preferred value range(s) is identified.

Figure 5. ACR4 for rail and road works per project value range

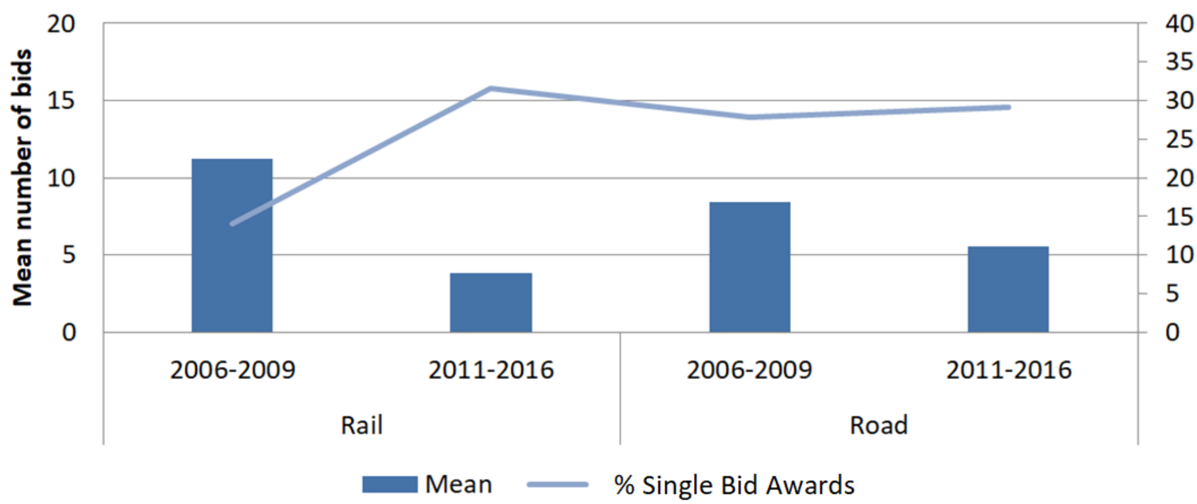


Competition for the market: An overview

The overview concerns both the mean number of bids/offers received per data subset as well as the share of single bid awards. More specifically, while the mean number of bids might be acceptable (e.g. over three or four bids), there might be a significant share of contracts awarded to the single bidder.

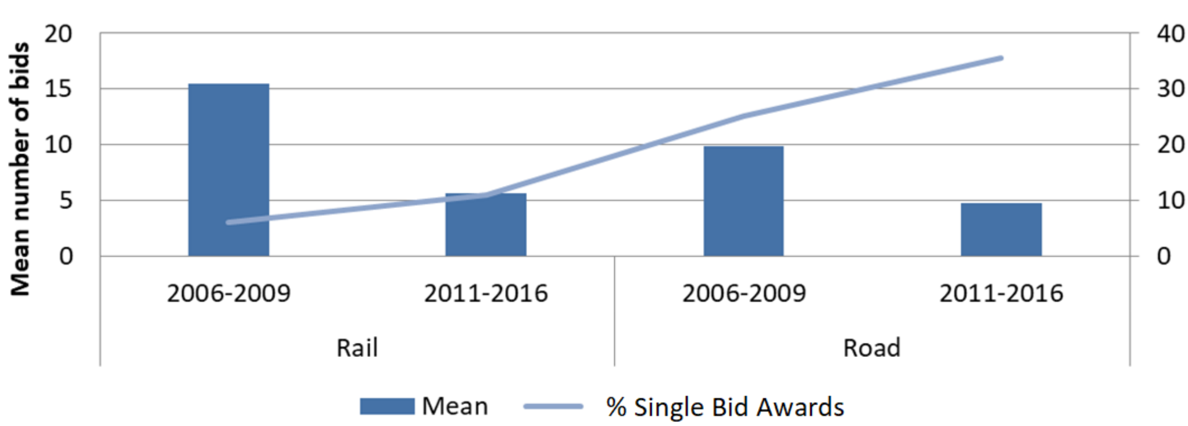
Figure 6 provides an overview of competition for contracts for the four data subsets under consideration, i.e. road and rail contracts for the periods 2006-2009 and 2011-2016, respectively.

Figure 6. Mean number of bids per tender and share of single bid awards



Of the four datasets illustrated in Figure 6, rail in the period 2006-2009 seems to present better competition conditions with the greater mean number of bids per tender and a relatively small share of single bid awards (14%). The other three datasets show a considerable share of single bid awards (approximately 30%), where no competition took place. This value is higher than the European average for public procurement (approximately 20%, see Single Market Scoreboard EC report). For rail works in the period 2011-2016, the increase in the share of single bid awards is combined with a significant drop in the mean number of bids by almost 50%. This is most likely the result of the increase in demand for rail works.

Figure 7. Open calls: Mean number of bids per tender and share of single bid awards



The situation described in Figure 6 is amplified when viewing open call procedures (see Figure 7). A very high share of bid awards is observed for road works between 2011-2016. This share is below 10% for rail works in both periods. The mean number of bids received for rail works in the period 2006-2009 could suggest competition or even "over-bidding". The picture is reversed for restricted calls (see Figure 8),

with the least competition identified for rail works in the period 2011-2016. The most competitive conditions exist for road works in the same period.

Finally, when considering the negotiated process, the mean number of bids is approximately the same across datasets, suggesting a pattern promoted by the contracting authorities or the EU Directives. However, the share of single bid awards varies significantly with the most competitive conditions witnessed for rail works between 2006-2009.

Figure 8. Restricted calls: Mean number of bids per tender and share of single bid awards

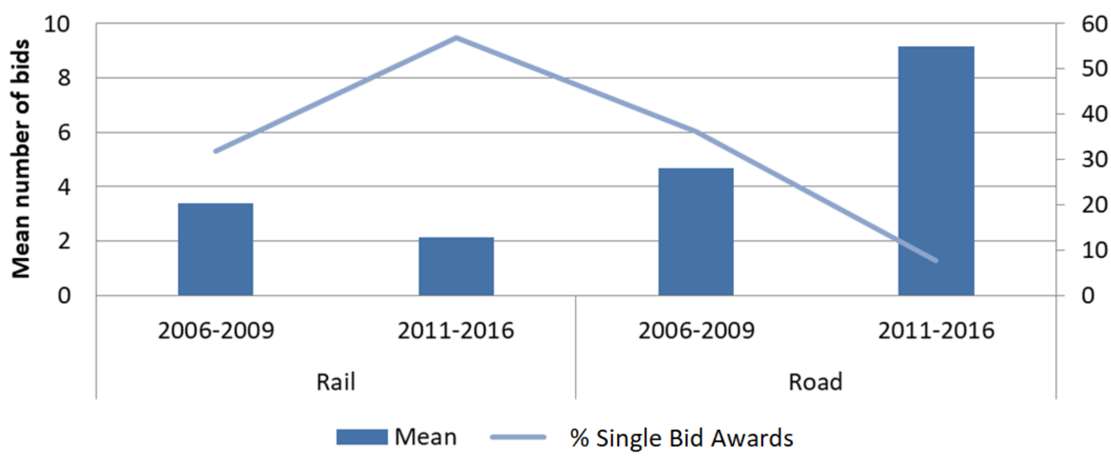
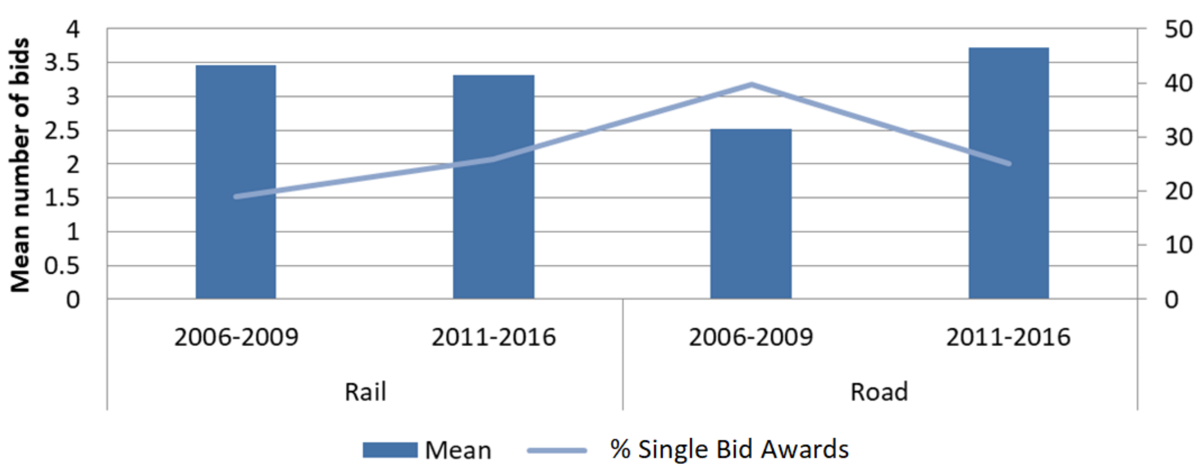


Figure 9. Negotiated calls: Mean number of bids per tender and share of single bid awards



Putting Figures 6-9 in context, Figure 10 shows the share of selected procurement procedures for the four datasets. For road works, contracting authorities prefer open calls. Contracting authorities choose negotiated processes far more for rail works, with "all others" representing negotiated calls without a call for competition. A balance in procurement procedures is observed for rail works in the period 2011-2016. For this dataset, the mean number of bids is almost identical across procurement procedures with the smallest share of single bid awards observed for open calls. It might be inferred from this that for the

period 2011-2016, competition for rail works was best under open calls. However, the complexity of rail work projects might require more complex award processes, where potential expertise might limit contracting authorities' contractor selection range.

Finally, as shown in Figure 11 and when compared to all the other figures in this section, no significant change in competition is observed based on contract value size.

In conclusion, the description of competition in the various segments does not offer conclusive evidence of the conditions that would lead to improved competition for the market. It does, however, illustrate that the selected segments for analysis are distinctly different.

Figure 10. Selected procurement processes

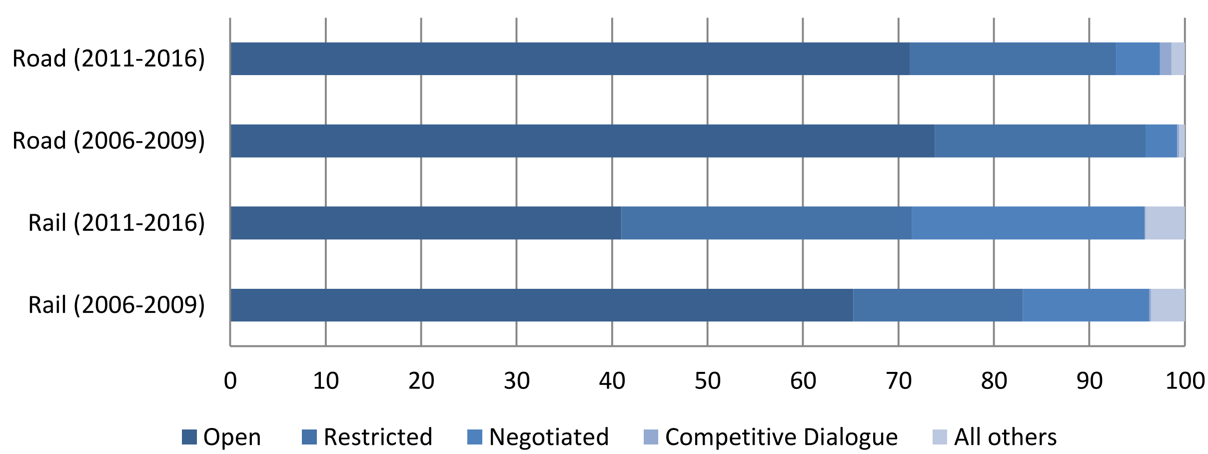
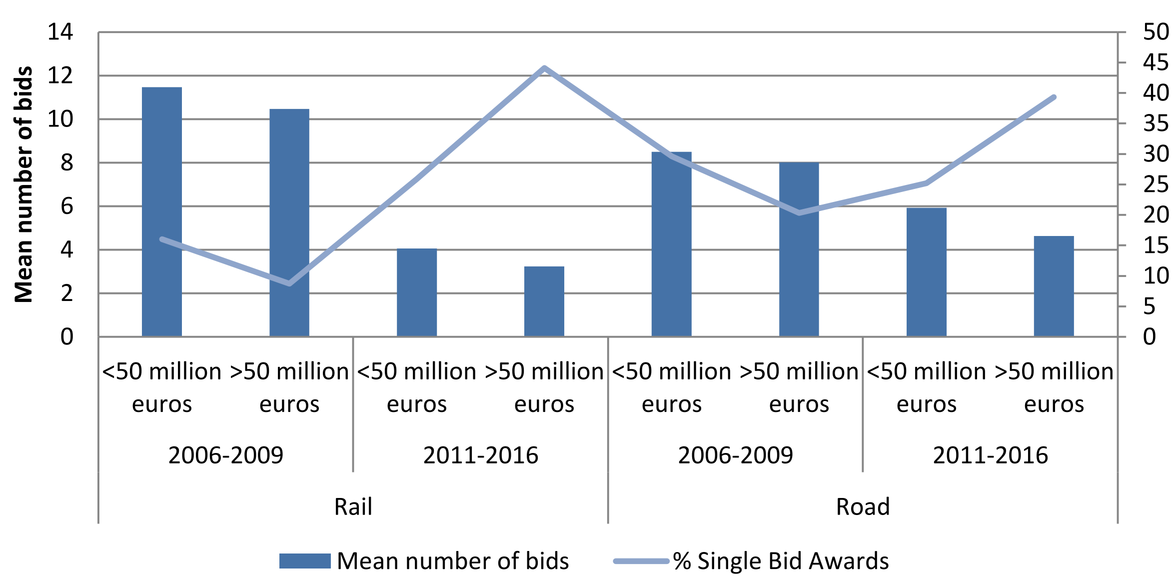


Figure 11. Contract value size: Mean number of bids per tender and share of single bid awards



Competition for the market: Modelling bids per tender

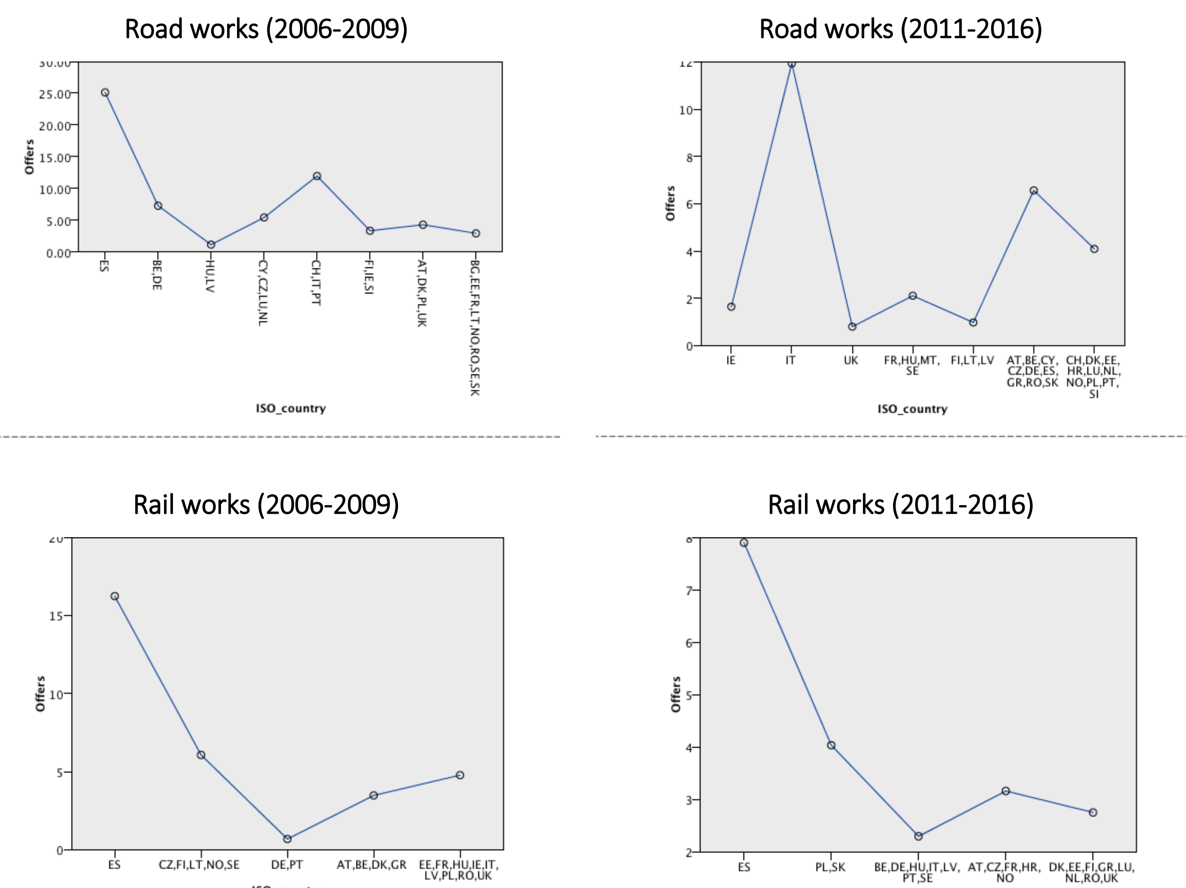
Figures 6 to 11 show similarities but also differences in trends depending on the sector (road or rail), time period (before or after 2010), value range and procurement process (open, negotiated following competition, restricted, etc.). Figures 4 and 5 (competition in the market) illustrate the existence of a two-tier market in both sectors and in all project value ranges.

Linear regression models run by sector, time periods and various combinations of project value ranges gave equally diverging results and demonstrated low goodness of model fit. However, strong linearity was identified in the residuals, i.e. cases that did not fit the model showed linear patterns indicating the existence of a variable(s) that "would explain" cases. The SPSS facility "Automatic linear modelling" was employed to identify influencing factors that were possibly overlooked. This resulted in the emphasis placed on the contracting country, independent of its institutional maturity.

The importance of the contracting country

Figure 12 presents the mean number of offers per country for road and rail in the corresponding periods.

Figure 12. Mean number of offers by country



Despite differences in institutional maturity, the least mean number of offers was received by:

- Hungary and Latvia (2006-2009) and Finland, Lithuania and Latvia (2011-2016) for the road work contracts
- Germany and Portugal (2006-2009) as well as Belgium, Hungary, Italy, Latvia and Sweden (2011-2016) for the rail work contracts.

The finding suggests national policies and their effect is extremely strong with the analysis revealing that the effect of country contributes to approximately:

- 95% and 75% of the observed results in the road sector for the periods 2006-2009 and 2011-2016, respectively (model accuracy 71% and 45% respectively, as predicted by "automatic linear modelling" where variables are transformed, and outliers excluded from the analysis)
- 45% and 62% of the observed results in the road sector for the periods 2006-2009 and 2011-2016, respectively (model accuracy 36% and 57% respectively, as predicted by "automatic linear modelling" where variables are transformed, and outliers excluded from the analysis).

To assess the impact of the mean number of offers on a country level, linear regression was run for this single independent variable. Results are presented in Table 9. This is extremely interesting taking into account the fact that the best fit reported in literature for the procurement of construction projects has been for adjusted R2 of 0.254. The finding also suggests that key influencing factors are related to country specific factors. It is also interesting to note that competition *for* the rail works market in the period 2011-2016 is less influenced by country factors, while competition *in* the market is stronger for the same data subset (see Figure 4).

Table 9. Explanatory power of the variable country on the mean number of bids

Segment	Adjusted R^2	Standardised coefficient	Sig.
Road (2006-2009)	0.699	0.836	0.000
Road (2011-2016)	0.534	0.731	0.000
Rail (2006-2009)	0.460	0.678	0.000
Rail (2011-2016)	0.399	0.632	0.000

Potentially, this effect might be related to the share of contracts awarded to home bidders. However, compared to studies conducted on the issue of home awards, the share identified for the infrastructure sector (see Table A2.1 in Appendix 2) is less or considerably less (see Table 10). More specifically, road works present a near average share of cross-border awards, while the market is far more open for rail works contracts.

Table 10. Share of home bidder awards – study comparison

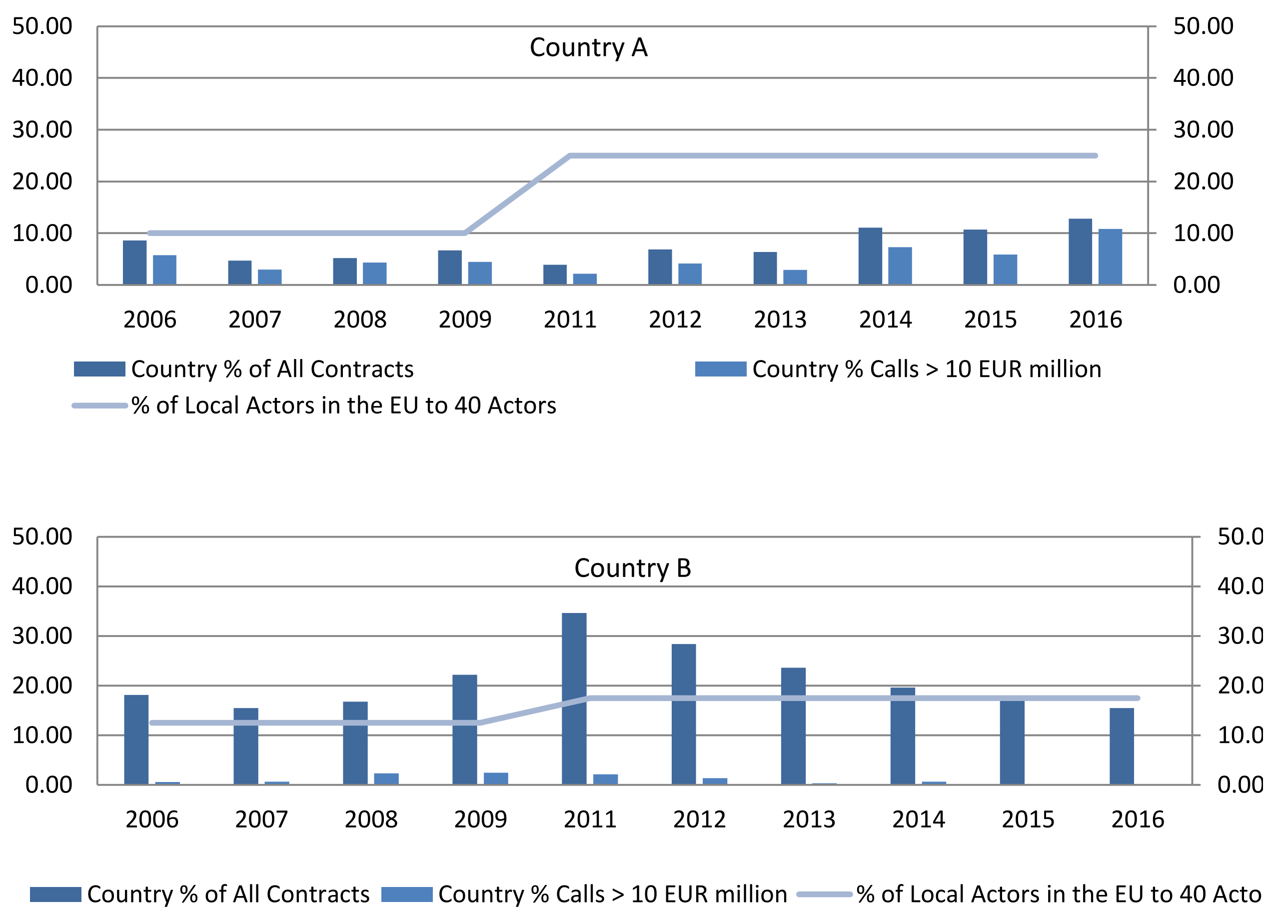
Study	Period	Number of awards	Cross-border awards (%)
Ramboll (2011) – Construction works	2009	40 347	1.0
EC (2017) – Construction works	2009-2015	315 360	1.0
Road current study	2006-2009	1 469	2.0
Road current study	2011-2016	1 199	3.0
Rail current study	2006-2009	513	18.4
Rail current study	2011-2016	924	19.5

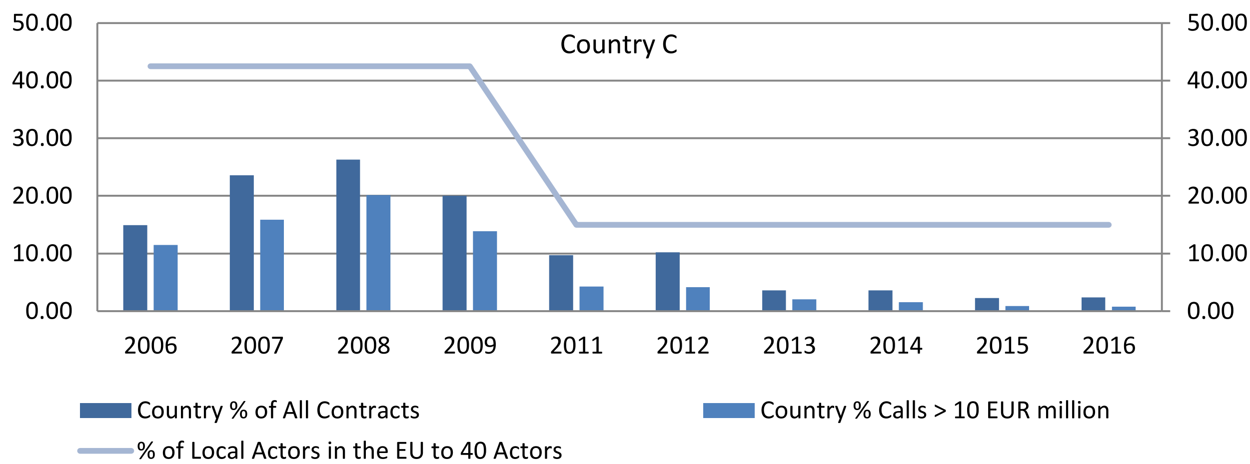
Following the above, three more variables were introduced to represent procurement characteristics on a country level:

- The country share of EU calls for works in the sector (including for contracts below EUR 10 million).
- The share of large contracts tendered (over EUR 10 million) over all contracts tendered for respective works in the country.
- The concentration of top contractors/actors in the country. The assigned values are based on the 40 top-ranking actors per sector (road or rail) and period. The variable value is equal to zero if none of the 40 top actors originate from the specific country.

The first two variables are set in many ways by the contracting country based on country size or GDP (ability to finance transport infrastructure), needs and/or strategies. For example, a country will devote a budget for rail infrastructure (especially given the EU strategy Shift2Rail) and size projects (contracts) according to needs or strategies. More specifically, a country may decide to represent a large share of the EU calls for rail work contracts or a small share; and it can size projects as small (below EUR 10 million) or large (above EUR 10 million).

Figure 13. Example of strategies concerning project size (rail works)





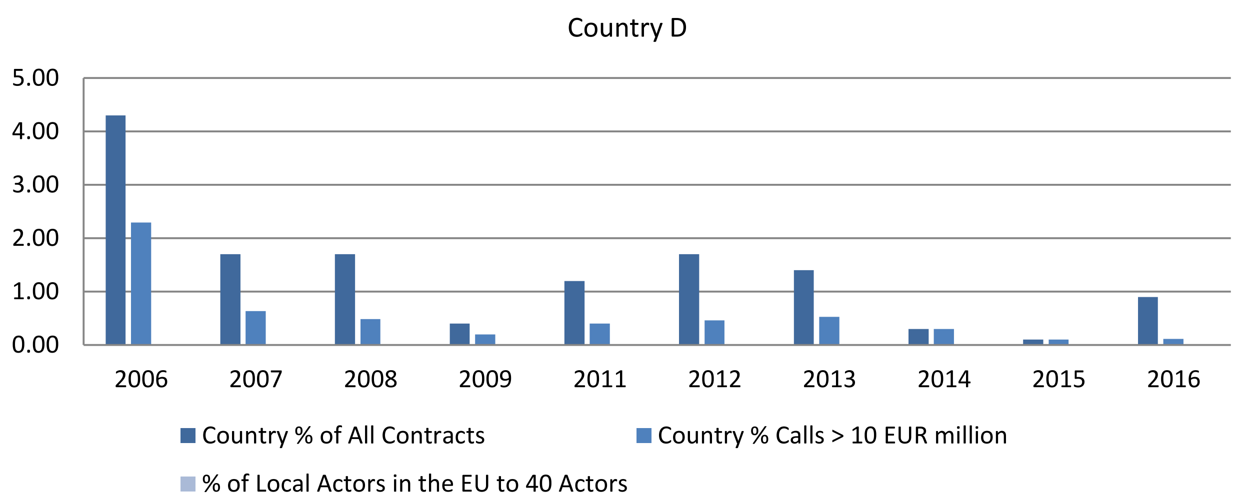


Figure 13 presents four large EU member states (A, B, C and D). Of the top 40 actors in the period 2006-2009, 65% originate from countries A, B and C. This share is 57.5% for the period 2011-2016 as per the current study. No top-ranking actors originate from country D. With respect to the issues discussed:

- Country A issues about 10% of all EU calls for rail works and the majority of these calls are contracts over EUR 10 million.
- Country B leads in the number of calls for rail work contracts in the European Union in the period 2006-2016 (with an increase during the years of the global financial crisis), but only a small fraction of these calls corresponds to contracts over EUR 10 million.
- Country C leads in the number of calls for rail work contracts in the European Union in the period 2006-2009, falling back to very few investments for the period 2011-2016. The majority of these calls are over EUR 10 million.
- Country D publishes approximately 5% of all calls for rail works for 2006-2009, dropping to less than 5% for the period 2011-2016. However, practically all calls concern contracts over EUR 10 million.

Interestingly, countries B and D put out approximately the same number of large rail works contracts. Also, countries A and C, which follow a similar approach to sizing projects, have a high concentration of top actors originating from them. The concentration of actors originating from country B is higher in the second period. Various interpretations are possible:

- Calls and project size are tailored to country needs in rail infrastructure.
- Countries A and C promote and support top home actors by supplying their local markets with large projects. Country A follows this approach in both periods, while Country C only in the first period.
- Country B supplies the local market with many contracts, while the number of large projects tendered does not attract cross-border competition, especially when there are countries like D where strong competitors do not exist in the local market.

Any of the above (or their combination) could be a reasonable interpretation. Nonetheless, whether based on specific strategies or responding to national infrastructure needs, the number of calls issued based on the size of the respective projects and the strength of the local actors formulate national/country characteristics for competition for the market.

Finally, considering the impact the growth of the rail works market might have had on competition for road works contracts for 2011-2016, two additional variables were included in the analysis of the road dataset for 2011-2016:

1. the country share of EU calls for rail works in the sector (including for contracts below EUR 10 million)
2. the share of large rail contracts tendered (over EUR 10 million) over all rail works contracts tendered in the country for 2011-2016.

Drivers of competition for the market

The drivers of competition for the market, considered in the analysis as independent variables, may be categorised under three broad groups:

- Institutional maturity: While many factors constitute institutional maturity, here these have been included in one compound indicator as described in the methodology.
- Procurement characteristics: These include the procurement process, the assessment criteria, the weight of the price criterion and the value of the contract to be awarded.
- The market: This concerns:
    - demand expressed through:
        - total demand for works in the country with respect to the market segment (rail or road works for the periods 2006-2009 and 2011-2016)
        - share of large contracts (> EUR 10 million) over total demand in the market segment in the country
        - total (European) market trend

        - total demand for works in the country where bidder expertise might apply (rail sector in this analysis)
        - share of large contracts (> EUR 10 million) over total demand for works where bidder expertise might apply (rail sector in this analysis).
    - Supply expressed by the actors (bidders): In the present analysis they are described by:
        - awarded contractor weight/power (expressed as the total number of projects the actor was involved in for the period 2006-2016)
        - awarded contractor weight in the segment (expressed as the total number of projects the actor was involved in in the specific segment)
        - concentration of top-ranking actors in the segment (country of origin).

The described drivers and their factors are the independent variables in the linear multivariate regression models run for the dependent variable "Number of Offers" (or Bids), with the objective to identify which factors matter in improving competition for the market (project). In this case, road and rail contracts were addressed separately, also for the periods 2006-2009 and 2011-2016, as discussed earlier in the current study. In addition, based on the influence country characteristics or strategies may have on competition, analysis was conducted on both entire data subsets and clusters of cases for the same subset. Classification was based on country characteristics as described previously. In addition, the analysis of road work CANs for 2011-2016 includes both total country demand and the share of large projects concerning rail works contracts. Full results are presented in Appendix 3 of the study.

Results mirror the transition in the rail and road works market as expected. They also mirror the multiple influences on achieving competition (greater number of bids/offers) through the relatively small value of the predictor coefficients, as most were in the range [-1, 1].

Table 11 summarises findings for the entire data subsets. The better model fit achieved for the period 2006-2009 is also characteristic of the relative stability of the markets and their competition in that period. The independent variables considered are able to explain most of the variation in datasets. The effect of institutional maturity, as well as the drivers of the procurement process, need to be interpreted for Figure 7 and Figure 8. Typically, the mean number of bidders drops from open calls to restricted to negotiated (procurement process variable value increases). Simultaneously, the weight of the price criterion is typically larger in open calls but might also be related to single bid awards. The value of the contract has a small negative effect on competition in the road sector. The increase in country demand seems to be outstretching resources (bidders' willingness to participate in tenders). The larger weight of contractors in the segment seems to deter competition.

However, findings become more meaningful when considering country characteristics. Prevailing clusters per dataset had specific characteristics in accordance to the characteristics of countries A, B, C and D described in Figure 13:

- country type A: average country demand for works; high share of large contracts tendered; considerable concentration of top-ranking actors
- country type B: High country demand for works; low share of large contracts tendered; considerable concentration of top-ranking actors
- country type C: High country demand for works; high share of large contracts tendered; high concentration of top-ranking actors

- country type D: Low country demand for works; high share of large contracts tendered; low or no concentration of top-ranking actors.

Table 11. Multivariate linear regression analysis results,
Sample: entire segment

	2006-2009		2011-2016	
	Rail	Road	Rail	Road
aR2 / Predictors	0.428	0.540	0.241	0.348
Institutional maturity		↘		↘
Procurement process		↘	↘	
Weight of price criterion	↘↘	↗	↘	↘
Assessment criteria	↘	↗		
Value		↘		↘
Country demand	↗	↘↘	↘	↘↘
Share of large contracts			↘	
TL market trend			↗	
Country demand for rail works				
Share of large rail works contracts				↗↗↗
Contractor weight			↗	
Contractor weight in segment		↘	↘	↘
Number of actors in consortium				↗
Concentration of top actors		↗↗↗		↘

Legend: ↗: positive influence ranging from ↗ (low) to ↗↗↗ (high); ↘ negative influence ranging from ↘ (low) to ↘↘↘ (high).

In tables 12 and 13, which present the results when using clusters, the above-described country types (A, B, C or D) are used to denote the clustered cases. When classifying cases, institutional maturity and the procurement process were also included. Institutional maturity is rather high in most EU countries and, hence, significant differentiation was not observed. The preferred procurement process in the dataset prevails (see Figure 10) in the classification of cases.

Table 12 presents findings for the period 2006-2009. Some clusters do not present improved goodness of fit, but in all cases, taking country characteristics into account allows for more insightful interpretations. For the rail dataset, competition improves:

- When the criterion is least price and market demand increases in A-type countries
- Large value contracts are important in C-type countries that have a high concentration of top actors. Spain is a characteristic example of a C-type country. Figure 12 shows the exceptional high mean number of offers in the country.
- In D-type countries, the increase in total market demand and contract value outstretches resources leading to a drop in competition for tenders.

For the road sector:

- A shift to more complex procurement processes (restricted or negotiated calls instead of open calls) secures greater competition in B-type countries. A characteristic example of a B-type country is France. Researchers have noted the decrease in the number of bidders for contracts (Yvrande-Billon, 2006; Chong, Staropoli and Yvrande-Billon, 2010), which is emphasised by the preference for open call procedures in the road sector (see Table 10).
- Results are intuitively comprehensible for D-type countries. Factors influence competition in the same way as for D-type countries in the rail sector.

In Table 13, which refers to the period 2011-2016, only cluster models with a considerably better fit than the entire segment samples are presented (see Appendix 3 for the full results). Regardless, even lower goodness of fit is supportive of the resulting interpretation process. Additional clusters considering the impact of the rail works market in the country were formulated for the road segment for this period. A second letter characterises these clusters. It denotes the country type for the rail market.

Table 12. Multivariate linear regression analysis results, Sample: clusters (2006-2009)

	Rail			Road	
Cluster types	A	C	D	B	D
aR2 / Predictors	0.617	0.472	0.284	0.302	0.578
Institutional maturity					↘
Procurement process	↘↘		↘↘	↗	↘
Weight of price criterion	↗				↗
Assessment criteria					
Value		↗	↘↘	↘↘	↘
Country demand	↗		↘↘	↗↗	
Share of large contracts		↗↗		↘↘	↘
TL market trend					
Country demand for rail works					
Share of large rail works contracts					
Contractor weight		↘		↗	
Contractor weight in segment					↘
Number of actors in consortium				↗	
Concentration of top actors			↗↗↗		↗↗

Looking at the rail sector:

- Institutional maturity is important in increasing competition. Central European countries are mostly classified under country type D. Here, the existence of top actors, should they exist, will deter competition.

- In A-type countries, the increase in market demand and contract value improves competition. These are countries using the increase in market to increase the dynamics of local actors (see Figure 10). A typical example for the rail sector is Italy.

In the road sector for the period 2011-2016:

- B-type countries behave as in the period 2006-2009. B-type countries with respect to roads demonstrating a similar behaviour for the rail sector show increased competition when the share of large contracts increases, possibly in an effort to maintain the status quo in the market.
- D-type countries behave as intuitively expected. The same applies for DD countries.
- The growth in the rail market improves competition in D and DD countries. Possibly because this attracts cross-border interest. See for example Romania, Slovakia or Poland (Appendix 2) with respect to the share of home awards.

Table 13. Multivariate linear regression analysis results
Sample: clusters (2011-2016)

	Rail			Road		
Cluster types	D	A	B	D	BB	DD
aR2 / Predictors	0.322	0.507	0.455	0.500	0.518	0.433
Institutional maturity	↗↗			↘	↗	↘
Procurement process			↗↗		↗↗	
Weight of price criterion		↘↘	↗	↘↘	↗	↘
Assessment criteria						
Value		↗↗↗	↘	↘↘		↘
Country demand		↗↗				
Share of large contracts			↘		↗	
TL market trend						
Country demand for rail works				↗		↗↗
Share of large rail works contracts						
Contractor weight					↘	
Contractor weight in segment						↘
Number of actors in consortium						
Concentration of top actors	↘↘↘	↘				

Concluding the analysis, it seems that the original expectations described in Table 8 are confirmed, especially regarding the variety of effects these factors have on competition under different market conditions.

Discussion and future research

The analysis conducted in the study of competition in and for the market for large infrastructure road and rail projects came across a diversity of findings on the topic already reported (see the above section "Discussion on competition"). A key contribution of this research has been the identification of the importance of the country context and its potential to be classified by type facilitating both the study and the policy and decision-making process of national and international authorities.

As suggested by other researchers (Newcombe, 1990; Aghion, Harris and Vickers, 2001), competition for the market cannot be examined independently from competition in the market. This applies at both a national and international level. To this end, the introduction of an adjusted concentration ratio (ACR) was both useful and enlightening in modelling competition for the market and interpreting findings. Notably, the use of the ACR helped overcome the acknowledged limitations of the CR and HHI (Ye, Shen and Lu, 2014).

Competition in the market: PPPs versus traditional procurement

The ACR applied to the ranking of international PPP transport infrastructure developers as published by Public Works Financing for 2016 was compared to the respective ACRs for large road and rail contracts awarded in the periods 2006-2009 and 2011-2016. Their patterns coincided indicating a two-tier market represented by a few firms/actors participating in most contracts and the vast majority of firms participating in very few or just one in the entire period. Furthermore, top-ranking firms in the road sector were able to achieve top-ranking positions in the rail sector when this market became of interest (2011-2016), suggesting the relative ease of market entry for the top firms. Finally, most of the top-ranking firms in the PPP ACR were also present in the road and rail ACRs suggesting competition in the market for PPPs and large road and rail infrastructure projects does not differ, as the same top-ranking firms are present in all markets.

A final observation concerns the fact that other researchers investigating local markets (e.g. Chiang,Tang and Leung, 2001; Chueng and Shen, 2017) conclude on the same market structure. However, the prevailing question is if this structure supports infrastructure development.

Competition for the market: PPPs versus traditional procurement

Competition for the market used information from the contract award notices (CANs) published by member states in the TED. This dataset, whilst providing a wealth of information (see Notes), also proved limiting considering the process of retrieving relevant CANs, identifying awarded firms and predominately distinguishing CANs linked to PPPs. These difficulties add to the fact that there is a large share of CANs with missing information, contract awards for which CANs have not been published and uncertainty with respect to the accuracy of reported contract values. The latter was addressed by introducing contract value ranges in place of actually values[8]. However, the study dataset was treated uniformly and, considering the number of PPP contracts as opposed to public financed ones, this dataset mostly represents the latter.

A key finding, as noted earlier, has been the recognition of the importance for competition for the market of the country context. Under certain conditions of the national market (some could be identified as A, B, C or D type countries), different factors of the key drivers contribute to competition for the market. The key conditions for characterising a country are based on how it organises the demand side of the market; high or low demand for works as a share of overall demand for respective works in the European Union; project size (small or large value projects); and how competition in the market is expressed as a percentage of the top-ranking home firms. This could be seen as the convolution of competition in and for the market, as contracting authorities will also set the type of procurement procedure to be followed as well as the selection criteria. The role of other markets that the same firms might consider (are active in) was also found to be important, suggesting that competition crosses relevant sectors. For example, in the study, the same firms responded to road and rail tenders.

With this background, the drivers for competition for the market are discussed.

Institutional maturity

Institutional maturity seems to have a counter-intuitive effect. In most cases, it appears to be negative albeit low in significance. The interpretation has been that open processes also account for a large share of single bid awards. Choosing more complex procurement types requires institutional maturity to gain the potential benefits. Here, while fewer bids are anticipated, less single bid awards are expected.

When considering PPPs, institutional maturity has been advocated by many scholars and practitioners as a prerequisite in achieving value-for-money in PPPs. With respect to tendering, more complex tendering procedures are usually adopted for PPP contracts.

Procurement characteristics

Few cases showed that an increase in the complexity of the procurement method promotes competition (exception for Country B types). This is to be expected as entry barriers are reduced especially when associated with the least price criterion. However, looking at the exception, Country B type gives some useful insights. The key characteristic of B-type countries is the small share of large value projects tendered. Turning to more complex procurement procedures in this case improves competition.

Moreover, the larger the project tendered the greater the need to identify and discuss alternative approaches or solutions in order to achieve optimum quality. By default, alternatives may only be negotiated in more complex procurement procedures. In this context, competition in terms of the mean number of bids is similar for PPPs and traditionally procured projects.

Finally, contract value appeared in a number of instances as a predictor having a somewhat negative influence on competition, i.e. as the value of a contract increases there are fewer bidders. However, in two country types it appeared to have a positive effect. In the first instance, that of a C-type country (high share of large projects and high concentration of top-ranking firms), an increase in the value of contracts seems to promote competition, probably due to top-ranking firms finding interest in the calls when the European demand market is stable. In the second instance, this effect appears in an A-type country at a time when the European market for rail works is increasing. A-type countries seem to promote the development of firms and, therefore, competition is a short-term result.

Market

All factors considered under the market driver for both demand and supply were found significant under various contexts. Most importantly, they significantly increased the goodness of model fit in the second period (2011-2016) for both rail and road contracts. While their effect, as in other cases, varied depending on the context, one can infer that these factors define competition when markets are in transition. Findings also suggest favouritism or protectionism as discussed by Saussier (2013), by adopting national strategies which favour or protect the national market.

However, most importantly, findings confirm both market power and the ease of market entry and exit for, at least, the top-ranking firms. This complicates competition for the market as the market takes on a wider definition and is not only related to road and rail works contracts, as in this case, but all other sectors for which expertise exists or might be acquired. Notably, many firms develop expertise for just one sector whereas the top-ranking firms typically provide services across not only all transport infrastructure sectors (see the ACR curves) but infrastructure in general, for example in the energy and water sectors. The influence of these markets may explain the residuals of the regression analysis.

Overall, a concept of national/local market "attractiveness" for bidders may be introduced, albeit for top-ranking firms.

Limitations and future research

The limitations of this research relate to those of the study sample. Nonetheless, the dataset was able to provide significant insights as well as highlighting the need for future research. Suggesting a typology for country demonstrated strategies or infrastructure development needs assists interpretations, which need to be further confirmed through in-depth case studies and/or surveys. Sample size did not allow for the provision of all possible combinations of contexts and, therefore, not all country types could be clustered. The identification of at least one type with significant representation across Europe would also confirm assumptions. Despite shortcomings, the introduction of country types provides an initial tool to assist national policy and decision makers in defining the national terms of competition.

The study sample in its present form could also provide further insights by modelling as one market road and rail works for the 2011-2016 period. This is expected to provide a better model fit. Also, the extension of the current dataset to the energy and water works sector would be of interest and fully confirm the estimation that model residuals are related to influences and competition in other related sectors.

Finally, addressing the issue of whether a two-tier market structure is positive for the overall "health" of the construction industry is important.

Conclusions and recommendations

Researching competition *in* the market and *for* the market with respect to large infrastructure projects, the analysis concluded that while the identified drivers of competition and their respective group of factors are important, their influence varies depending on the country context and the conditions of competition in the national market. In other words, there is no "one solution fits all". This overall conclusion has significant ramifications when considering the impact national decisions concerning development works and procurement processes may have on competition both at a national and EU (if not international) level. This also highlights the responsibility of policy and decision-making authorities nationally and in the European Union.

Knowledge of how competition evolves in the market is illustrated by the adjusted concentration ratio (ACR) curves along with shifts (i.e. the prevailing dynamics) in actor racking and their concentration in the local market. A high concentration of top-ranking actors in the country is positive for competition for the market; a low concentration might deter interest, while an increase in the number of calls issued may invite cross-border interest in cases with a lack of top-ranking actors in the country. Most importantly, actors are not exclusively active in one sector. Their expertise may extend to other sectors given the opportunity (e.g. increase in market demand in another construction sector, decrease in market demand in the sector of key expertise, changes in overall market demand in country of origin).

Reverting to more complex procurement processes (restricted calls, negotiated procedure following competition, competitive dialogue) will secure minimum competition. However, these procurement procedures require both institutional maturity and experience on the part of the contracting authority.

Open call procedures and assessments primarily based on the price offer may attract more competition but if not reasonably designed in the context of other calls, also in relevant sectors, these procedures might lead to single bid awards or no competition at all.

Strategies followed by member states to protect or favour national actors may take on various approaches and have an impact on the entire European market and its competition potential. While, supporting the national and local economy may be important in the short or medium term, it may also have serious ramifications on the overall level of competition for the market in Europe.

Competition for large projects remains ambiguous per se, as many other factors will influence competition for these projects starting from the procurement process selected and the competition in the market. This applies for both PPPs and traditionally procured infrastructure projects.

However, despite the prevailing complexity, there is a common factor through which competition for the market may be achieved: Most of the factors may be influenced by the knowledgeable contracting authority creating conditions of market "attractiveness".

Notes

1 Information on public tenders is published by contracting authorities using standard forms. These forms accompany the respective EU Directives. The dataset is related to the 2004 and 2014 EU procurement directives with the 2014 version also including concession contract notice (CN) and concession award notice (CAN) forms. The forms may be found at https://data.europa.eu/euodp/en/data/dataset/ted-csv.

2 The procurement procedures are described identically under Articles 45 to 50 of Directives 2014/24/EU and 2014/25/EU on the procurement by entities operating in the water, energy, transport and postal services. These procedures are described briefly on the European Commission site: https://europa.eu/youreurope/business/public-tenders/rules-procedures/index_en.htm.

3 Single Market Scoreboard EC report for the period 1/201612/2016 concerning public procurement (see EC, 2017).

4 The TED team states that they have double checked large value contracts (see https://data.europa.eu/euodp/en/data/dataset/ted-csv.).

5 Megaprojects are defined as projects with a project budget over 500 million euros by COST Action TU1003, http://www.cost.eu/COST_Actions/tud/TU1003.

6 https://ec.europa.eu/internal_market/scoreboard/performance_per_policy_area/public_procurement/index_en.htm.

7 As part of the research activities of COST Action TU1001 "PPPs in Transport: Theory and Trends" and the Horizon 2020 funded Project BENEFIT, case studies of PPP projects were collected. This information is available in Roumboutsos (2016), Roumboutsos, Farrell and Verhoest et al. (2014) and Roumboutsos et al. (2013) as well as on the BENEFIT wiki (www.benefit4transport.eu). In all cases, the tendering procedure was described as either a negotiated procedure followed by negotiations or a variety of competitive dialogue.

8 Also the TED team has investigated and crossed checked very large contract values adding a level of confidence to the analysis.

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Appendix 1. Selected Common Procurement Vocabulary codes

The following table includes selected Common Procurement Vocabulary (CPV) codes. Some codes may be considered as “general” in that they may apply across all modes. Furthermore, some contracts may include works, services or supplies for more than one mode. As contract descriptions were not always available, a contract award notice (CAN) was categorised depending on the prevailing codes. For example, if a CAN included more rail codes, the CAN was assigned under the Rail Mode category.

Table A1.1. Selected CPV codes

Code	Description	Mode
45212180-1	Ticket offices construction work	All
45213000-3	Construction work for commercial buildings, warehouses and industrial buildings, buildings relating to transport	All
45213300-6	Buildings associated with transport	All
45213313-0	Service-area building construction work	All
45213350-1	Construction work for buildings relating to various means of transport	All
45213352-5	Service depot construction work	All
45221000-2	Construction work for bridges and tunnels, shafts and subways	All
45230000-8	Construction work for pipelines, communication and power lines, for highways, roads, airfields and railways; flatwork	All
45234160-5	Catenary's construction works	All
45234200-8	Cable-supported transport systems	All
45234210-1	Cable-supported transport systems with cabins	All
50200000-7	Repair, maintenance and associated services related to aircraft, railways, roads and marine equipment	All
50316000-3	Maintenance and repair of ticket-issuing machinery	All
50317000-0	Maintenance and repair of ticket-validation machinery	All
63700000-6	Support services for land, water and air transport	All
63710000-9	Support services for land transport	All
63721500-4	Passenger terminal operation services	All
66000000-0	Financing and insurance services	All
71242000-6	Project and design preparation, estimation of costs	All
71311200-3	Transport systems consultancy services	All
71520000-9	Construction supervision services	All
71521000-6	Construction-site supervision services	All
71530000-2	Construction consultancy services	All
71540000-5	Construction management services	All

71541000-2	Construction project management services	All
79420000-4	Management-related services	All
79421000-1	Project-management services other than for construction work	All
79421100-2	Project-supervision services other than for construction work	All
79421200-3	Project-design services other than for construction work	All
34622500-8	Luggage vans and special-purpose vans	Airports
34960000-4	Airport equipment	Airports
34961000-1	Baggage-handling system	Airports
34961100-2	Baggage-handling equipment	Airports
34962000-8	Air-traffic control equipment	Airports
34962100-9	Control tower equipment	Airports
34962200-0	Air-traffic control	Airports
34962220-6	Air-traffic control systems	Airports
34964000-2	Doppler VHF Omni direction Range (DVOR)	Airports
34965000-9	Distance Measuring Equipment (DME)	Airports
34966000-6	Radio Direction Finder and Non-Directional Beacon	Airports
34966100-7	Radio Direction Finder (RDF)	Airports
34966200-8	Non-Directional Beacon (NDB)	Airports
34967000-3	Airport Communication System (COM)	Airports
34968000-0	Airport Surveillance System and Lighting System	Airports
34968100-1	Airport Surveillance System (SUR)	Airports
34968200-2	Airport Lighting System (PAPI)	Airports
34969000-7	Passenger boarding bridges and stairs for aircraft	Airports
34969100-8	Passenger boarding bridges for aircraft	Airports
34969200-9	Passenger boarding stairs for aircraft	Airports
34997200-4	Airport lighting	Airports
34997210-7	Runway lights	Airports
45112740-4	Landscaping work for airports	Airports
45213330-5	Construction work for buildings relating to air transport	Airports
45213331-2	Airport buildings construction work	Airports
45213332-9	Airport control tower construction work	Airports
45213333-6	Installation works of airport check-in counters	Airports
45213351-8	Maintenance hangar construction work	Airports
45213353-2	Installation works of passenger boarding bridges	Airports
45235000-3	Construction work for airfields, runways and manoeuvring surfaces	Airports
45235100-4	Construction work for airports	Airports
45235110-7	Construction work for airfields	Airports

45235111-4	Airfield pavement construction work	Airports
45235200-5	Runway construction works	Airports
45235210-8	Runway resurfacing	Airports
45235300-6	Construction work for aircraft-manoeuvring surfaces	Airports
45235310-9	Taxiway construction work	Airports
45235311-6	Taxiway pavement construction work	Airports
45235320-2	Construction work for aircraft aprons	Airports
50210000-0	Repair, maintenance and associated services related to aircraft and other equipment	Airports
60400000-2	Air transport services	Airports
63112000-7	Baggage handling services	Airports
63112100-8	Passenger baggage handling services	Airports
63112110-1	Baggage collection services	Airports
63730000-5	Support services for air transport	Airports
63731000-2	Airport operation services	Airports
63731100-3	Airport slot coordination services	Airports
63732000-9	Air-traffic control services	Airports
63733000-6	Aircraft refuelling services	Airports
63734000-3	Hangar services	Airports
71311240-5	Airport engineering services	Ports
34931000-2	Harbour equipment	Ports
34950000-1	Loadbearing equipment	Ports
34951000-8	Access platforms	Ports
34952000-5	Hydraulic-platforms hoists	Ports
34953100-3	Ferry ramps	Ports
34955000-6	Floating dock	Ports
34955100-7	Floating storage unit	Ports
34998000-9	Control, safety or signalling equipment for port installations	Ports
42414110-5	Harbour cranes	Ports
45213340-8	Construction work for buildings relating to water transport	Ports
45213341-5	Ferry terminal building construction work	Ports
45213342-2	Ro-ro terminal construction work	Ports
45221117-5	Weighbridge construction work	Ports
45240000-1	Construction work for water projects	Ports
45241000-8	Harbour construction works	Ports
45241100-9	Quay construction work	Ports
45241200-0	Offshore terminal in situ construction work	Ports
45241300-1	Pier construction work	Ports

45241400-2	Dock construction work	Ports
45241500-3	Wharf construction work	Ports
45241600-4	Installation of port lighting equipment	Ports
45243200-4	Breakwater construction work	Ports
45243300-5	Sea wall construction work	Ports
45243500-7	Sea defences construction work	Ports
45243510-0	Embankment works	Ports
45243600-8	Quay wall construction work	Ports
45245000-6	Dredging and pumping works for water treatment plant installations	Ports
45247100-1	Construction work for waterways	Ports
45247120-7	Waterways except canals	Ports
45248100-8	Canal locks construction work	Ports
45248200-9	Dry docks construction work	Ports
45248300-0	Construction work for floating docks	Ports
45248400-1	Landing stages construction work	Ports
45248500-2	Movable barrages construction work	Ports
50246000-1	Harbour equipment maintenance services	Ports
50246200-3	Buoy maintenance services	Ports
50246300-4	Repair and maintenance services of floating structures	Ports
50246400-5	Repair and maintenance services of floating platforms	Ports
51511110-1	Installation services of cranes	Ports
51511200-9	Installation services of handling equipment	Ports
51511300-0	Installation services of suspended access equipment	Ports
51511400-1	Installation services of special conveying systems	Ports
63100000-0	Cargo handling and storage services	Ports
63110000-3	Cargo handling services	Ports
63111000-0	Container handling services	Ports
63120000-6	Storage and warehousing services	Ports
63121000-3	Storage and retrieval services	Ports
63121100-4	Storage services	Ports
63712500-8	Weighbridge services	Ports
63720000-2	Support services for water transport	Ports
63721000-9	Port and waterway operation services and associated services	Ports
63721100-0	Bunkering services	Ports
63721200-1	Port operation services	Ports
63721300-2	Waterway operation services	Ports
63721400-3	Ship refuelling services	Ports

63722000-6	Ship-piloting services	Ports
63723000-3	Berthing services	Ports
63724000-0	Navigation services	Ports
63724300-3	Buoy positioning services	Ports
63724310-6	Buoy marking services	Ports
63726000-4	Miscellaneous water transport support services	Ports
63726200-6	Ice-breaking services	Ports
63726300-7	Vessel storage services	Ports
63726900-3	Anchor handling services	Ports
63727000-1	Towing and pushing services of ships	Ports
63727100-2	Towing services	Ports
63727200-3	Pushing services	Ports
76500000-8	Onshore and offshore services	Ports
76510000-1	Onshore services	Ports
76520000-4	Offshore services	Ports
76521000-1	Offshore installation services	Ports
76522000-8	Offshore supply-vessel services	Ports
98362000-8	Port management services	Ports
34600000-3	Railway and tramway locomotives and rolling stock and associated parts	Rail
34610000-6	Rail locomotives and tenders	Rail
34611000-3	Locomotives	Rail
34612000-0	Locomotive tenders and cable cars	Rail
34612100-1	Locomotive tenders	Rail
34620000-9	Rolling stock	Rail
34621000-6	Railway maintenance or service vehicles, and railway freight wagons	Rail
34621100-7	Railway freight wagons	Rail
34621200-8	Railway maintenance or service vehicles	Rail
34622000-3	Railway and tramway passenger coaches, and trolleybuses	Rail
34622200-5	Railway passenger coaches	Rail
34622400-7	Railway carriages	Rail
34630000-2	Parts of railway or tramway locomotives or rolling stock; railways traffic-control equipment	Rail
34631000-9	Parts of locomotives or rolling stock	Rail
34632000-6	Railways traffic-control equipment	Rail
34632200-8	Electrical signalling equipment for railways	Rail
34632300-9	Electrical installations for railways	Rail
34940000-8	Railway equipment	Rail
34941000-5	Rails and accessories	Rail

34941200-7	Track rails	Rail
34941500-0	Crossheads	Rail
34941600-1	Crossovers	Rail
34941800-3	Railway points	Rail
34943000-9	Train-monitoring system	Rail
34945000-3	Track-alignment machinery	Rail
34946000-0	Railway-track construction materials and supplies	Rail
34946100-1	Railway-track construction materials	Rail
34946110-4	Rails	Rail
34946120-7	Railway materials	Rail
34946122-1	Check rails	Rail
34946200-2	Railway-track construction supplies	Rail
34946210-5	Current-conducting rails	Rail
34946220-8	Switch blades, crossing frogs, point rods and crossing pieces	Rail
34946221-5	Switch blades	Rail
34946222-2	Crossing frogs	Rail
34946223-9	Point rods	Rail
34946224-6	Crossing pieces	Rail
34946230-1	Rail clips, bedplates and ties	Rail
34946231-8	Rail clips	Rail
34947000-7	Sleepers and parts of sleepers	Rail
34947100-8	Sleepers	Rail
34947200-9	Parts of sleepers	Rail
42415000-8	Forklift trucks, works trucks, railway-station platforms tractors	Rail
42415300-1	Railway-station platforms tractors	Rail
45213320-2	Construction work for buildings relating to railway transport	Rail
45213321-9	Railway station construction work	Rail
45213322-6	Rail terminal building construction work	Rail
45221112-0	Railway bridge construction work	Rail
45221122-3	Railway viaduct construction work	Rail
45221213-8	Covered or partially-covered railway excavations	Rail
45221242-0	Railway tunnel construction work	Rail
45234000-6	Construction work for railways and cable transport systems	Rail
45234100-7	Railway construction works	Rail
45234110-0	Intercity railway works	Rail
45234111-7	City railway construction work	Rail
45234112-4	Railway depot construction work	Rail

45234114-8	Railway embankment construction work	Rail
45234115-5	Railway signalling works	Rail
45234116-2	Track construction works	Rail
45234120-3	Urban railway works	Rail
45234122-7	Underground railway works	Rail
45234123-4	Partially underground railway works	Rail
45234124-1	Underground passenger railway transport	Rail
45234125-8	Underground railway station	Rail
45234129-6	Urban railway track construction works	Rail
45234170-8	Locomotive-substations construction works	Rail
45234180-1	Construction work for railways workshop	Rail
45234181-8	Construction work for rail track sectioning cabins	Rail
45234240-0	Funicular railway system	Rail
48140000-1	Railway traffic control software package	Rail
50220000-3	Repair, maintenance and associated services related to railways and other equipment	Rail
50221000-0	Repair and maintenance services of locomotives	Rail
50221100-1	Repair and maintenance services of locomotive gearboxes	Rail
50221200-2	Repair and maintenance services of locomotive transmissions	Rail
50221300-3	Repair and maintenance services of locomotive wheelsets	Rail
50221400-4	Repair and maintenance services of locomotive brakes and brake parts	Rail
50222000-7	Repair and maintenance services of rolling stock	Rail
50222100-8	Repair and maintenance services of dampers	Rail
50223000-4	Reconditioning services of locomotives	Rail
50224000-1	Reconditioning services of rolling stock	Rail
50224100-2	Reconditioning services of rolling stock seats	Rail
50224200-3	Reconditioning services of passenger coaches	Rail
50225000-8	Railway-track maintenance services	Rail
50229000-6	Demolition of rolling stock	Rail
51143000-6	Installation services of railway engines	Rail
51611120-5	Installation services of railway real-time departures and arrival display screens or boards	Rail
60200000-0	Railway transport services	Rail
60210000-3	Public transport services by railways	Rail
60600000-4	Water transport services	Rail
60610000-7	Ferry transport services	Rail
60640000-6	Shipping operations	Rail
63711000-6	Support services for railway transport	Rail
63711100-7	Train monitoring services	Rail

66514130-6	Railway insurance services	Rail
71311230-2	Railway engineering services	Rail
71631470-5	Railway-track inspection services	Rail
72212140-2	Railway traffic control software development services	Rail
44212100-0	Bridge	Roads
44212110-3	Bridge sections	Roads
44212120-6	Structures of bridges	Roads
45112730-1	Landscaping work for roads and motorways	Roads
45213310-9	Construction work for buildings relating to road transport	Roads
45221100-3	Construction work for bridges	Roads
45221110-6	Bridge construction work	Roads
45221111-3	Road bridge construction work	Roads
45221114-4	Construction work for iron bridges	Roads
45221115-1	Construction work for steel bridges	Roads
45221119-9	Bridge renewal construction work	Roads
45221120-9	Viaduct construction work	Roads
45221121-6	Road viaduct construction work	Roads
45221200-4	Construction work for tunnels, shafts and subways	Roads
45221210-7	Covered or partially-covered excavations	Roads
45221211-4	Underpass	Roads
45221214-5	Covered or partially-covered road excavations	Roads
45221241-3	Road tunnel construction work	Roads
45221245-1	Under-river tunnel construction work	Roads
45221246-8	Undersea tunnel construction work	Roads
45221247-5	Tunnelling works	Roads
45221248-2	Tunnel linings construction work	Roads
45221250-9	Underground work other than tunnels, shafts and subways	Roads
45222000-9	Construction work for engineering works except bridges, tunnels, shafts and subways	Roads
45223710-6	Motorway service area construction work	Roads
45233000-9	Construction, foundation and surface works for highways, roads	Roads
45233100-0	Construction work for highways, roads	Roads
45233110-3	Motorway construction works	Roads
45233120-6	Road construction works	Roads
45233121-3	Main road construction works	Roads
45233122-0	Ring road construction work	Roads
45233123-7	Secondary road construction work	Roads
45233124-4	Trunk road construction work	Roads

45233125-1	Road junction construction work	Roads
45233126-8	Grade-separated junction construction work	Roads
45233127-5	T-junction construction work	Roads
45233128-2	Roundabout construction work	Roads
45233129-9	Crossroad construction work	Roads
45233130-9	Construction work for highways	Roads
45233131-6	Construction work for elevated highways	Roads
45233139-3	Highway maintenance work	Roads
45233140-2	Roadworks	Roads
45233141-9	Road-maintenance works	Roads
45233142-6	Road-repair works	Roads
45233210-4	Surface work for highways	Roads
45233220-7	Surface work for roads	Roads
45233221-4	Road-surface painting work	Roads
45233222-1	Paving and asphalting works	Roads
45233223-8	Carriageway resurfacing works	Roads
45233224-5	Dual carriageway construction work	Roads
45233225-2	Single carriageway construction work	Roads
45233226-9	Access road construction work	Roads
45233227-6	Slip road construction work	Roads
45233228-3	Surface coating construction work	Roads
45233300-2	Foundation work for highways, roads, streets and footpaths	Roads
45233310-5	Foundation work for highways	Roads
45233320-8	Foundation work for roads	Roads
45233330-1	Foundation work for streets	Roads
50230000-6	Repair, maintenance and associated services related to roads and other equipment	Roads
63712000-3	Support services for road transport	Roads
63712200-5	Highway operation services	Roads
63712210-8	Highway toll services	Roads
63712300-6	Bridge and tunnel operation services	Roads
63712310-9	Bridge operating services	Roads
63712311-6	Bridge toll services	Roads
63712320-2	Tunnel operation services	Roads
63712321-9	Tunnel toll services	Roads
71311210-6	Highways consultancy services	Roads
71311220-9	Highways engineering services	Roads
71311300-4	Infrastructure works consultancy services	Roads

71322300-4	Bridge-design services	Roads
34612200-2	Cable cars	Urban Transit
34622100-4	Tramway passenger coaches	Urban Transit
34622300-6	Trolleybuses	Urban Transit
34941300-8	Tramline	Urban Transit
45213311-6	Bus station construction work	Urban Transit
45213314-7	Bus garage construction work	Urban Transit
45213315-4	Bus-stop shelter construction work	Urban Transit
45234121-0	Tramway works	Urban Transit
45234126-5	Tramline construction works	Urban Transit
45234127-2	Tramway depot construction work	Urban Transit
45234128-9	Tramway platforms construction work	Urban Transit
50111000-6	Fleet management, repair and maintenance services	Urban Transit
50111100-7	Vehicle-fleet management services	Urban Transit
50111110-0	Vehicle-fleet-support services	Urban Transit
50113100-1	Bus repair services	Urban Transit
50113200-2	Bus maintenance services	Urban Transit
50118300-8	Breakdown and recovery services for buses	Urban Transit
60112000-6	Public road transport services	Urban Transit
63712100-4	Bus station services	Urban Transit

Appendix 2. Share of home contract awards

Table 2.1. Share of awards within contracting country

Country	Rail works				Road works			
	2006-2009		2011-2016		2006-2009		2011-2016	
	% of tenders	% home awarded	% of tenders	% home awarded	% of tenders	% home awarded	% of tenders	% home awarded
AT	1.9%	90.9%	2.2%	100.0%	0.9%	92.9%	2.1%	96.3%
BE	1.4%	75.0%	1.7%	90.0%	0.3%	75.0%	0.6%	100.0%
BG	0.7%	75.0%	1.8%	90.9%	1.7%	100.0%	3.4%	95.6%
CH					0.1%	100.0%	0.6%	100.0%
CY					0.1%	100.0%	0.2%	100.0%
CZ	2.8%	100.0%	7.1%	96.5%	3.2%	98.0%	2.9%	100.0%
DE	2.9%	81.3%	15.9%	82.7%	6.0%	98.9%	11.3%	98.6%
DK	0.7%	75.0%	0.7%	75.0%	0.6%	88.9%	1.7%	100.0%
EE	0.5%	100.0%	0.2%	50.0%	1.0%	100.0%	0.6%	100.0%
ES	46.9%	70.5%	7.6%	76.9%	15.5%	97.5%	1.8%	95.7%
FI	1.2%	100.0%	2.3%	88.9%	0.3%	100.0%	0.5%	100.0%
FR	6.0%	87.9%	14.9%	19.0%	20.1%	99.4%	15.8%	100.0%
GR	4.0%	91.3%	1.3%	100.0%	1.9%	96.7%	0.4%	100.0%
HR			0.3%	66.7%			0.6%	100.0%
HU	3.6%	76.2%	2.0%	83.3%	8.5%	99.2%	8.1%	100.0%
IE	0.2%	100.0%			1.1%	100.0%	5.4%	100.0%
IT	13.4%	97.4%	24.6%	95.1%	6.5%	100.0%	7.8%	100.0%
LT	0.7%	100.0%			1.5%	100.0%	1.5%	95.0%
LU			0.3%	66.7%	0.1%	100.0%	0.2%	100.0%
LV	0.2%	0.0%	0.1%	100.0%	2.8%	95.5%	1.5%	100.0%
MT							1.1%	100.0%
NL	0.2%	100.0%	1.9%	91.3%	1.6%	100.0%	0.2%	100.0%
NO	1.0%	100.0%	1.0%	81.8%	2.7%	100.0%	0.8%	100.0%
PL	1.7%	90.0%	2.3%	96.4%	8.4%	92.3%	16.4%	90.7%
PT	1.6%	100.0%	0.2%	100.0%	0.6%	100.0%	2.7%	94.3%
RO	0.2%	0.0%	2.3%	74.1%	1.0%	100.0%	0.8%	90.9%
SE	4.3%	100.0%	2.5%	100.0%	6.0%	98.9%	3.8%	100.0%
SI	0.2%	100.0%	0.2%	100.0%	1.7%	96.2%	0.4%	20.0%
SK	0.9%	60.0%	0.4%	40.0%	1.4%	95.2%	2.4%	90.3%
UK	2.9%	100.0%	6.5%	96.0%	4.3%	98.5%	4.4%	96.5%
Total	**100.0%**	**81.6%**	**100.0%**	**80.5%**	**100.0%**	**98.0%**	**100.0%**	**97.0%**

Appendix 3. Linear regression results

Rail 2006-2009 segment

Multivariate linear regression: entire dataset

A stepwise approach is adopted using all potential variables. Results are presented below. The best fit is achieved for Model 3 with the explanatory variables: country demand for rail works; weight of price criterion; assessment criterion. Residuals follow a normal distribution suggesting random influencing factors. However, in all cases explanatory variables carry signs contradicting initial assumptions.

Table A3.1. Model summary for rail, 2006-2009

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	.572	0.327	0.323	6.72691
2	.648	0.420	0.412	6.26971
3	.662	0.439	0.428	6.18546

Table A3.2. Coefficients for rail, 2006-2009

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
3	(Constant)	21.889	5.105		4.288	0.000
	Country demand for rail works	0.303	0.062	0.354	4.894	0.000
	Weight of price criterion	-0.200	0.048	-0.693	-4.168	0.000
	Assessment criterion	-6.427	2.805	-0.353	-2.292	0.023

Multivariate linear regression: clustering cases based on country characteristics

Various runs were conducted after various clustering approaches. The best fit was achieved by runs conducted on the dataset classified in three clusters. K-means cluster analysis was employed based on country specific variables:

1. The country share of calls for works per sector (including for contracts below EUR 10 million).
2. The country share of large contracts tendered (over EUR 10 million) over all contracts tendered for the segment.
3. The concentration of top contractors/actors in the country. The assigned values are based on the 40 top actors per segment and period. The variable value was equal to zero if none of the 40 top actors originated from the specific country.
4. The indicator describing institutional maturity.
5. The procurement process.

Table A6.3 provides the description of the clusters. Runs by cluster provided the following best fit results after various combinations and runs. Goodness of fit is better than for the entire dataset and variables have trends that coincide with predictions.

Table A3.3. Cluster description for rail, 2006-2009

	Cluster centres			Number of cases in each cluster		
	1	2	3			
Country demand	10.72	22.22	4.34	Cluster	1	88
Country % of large contracts	18.55	72.22	66.84		2	266
Country concentration of top actors	5.85	42.50	6.16		3	158
Institutional maturity	0.77	0.69	0.68	Valid		512
Procurement process	2.64	1.21	2.37	Missing		1

Table A3.4. Model summary for rail, 2006-2009: Cluster 1

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.463	0.215	0.185	2.68195
2	0.635	0.403	0.358	2.38173
3	0.811	0.658	0.617	1.83935

Table A3.5. Coefficients for rail, 2006-2009: Cluster 1

Model		Unstandardised coefficients		Standardised coefficients		
		B	Std. error	Beta	T	Sig.
3	(Constant)	-6.013	2.311		-2.602	0.015
	Procurement process	-0.955	0.254	-0.441	-3.758	0.001
	Weight of price criterion	0.116	0.022	0.673	5.200	0.000
	Country demand for rail works	0.296	0.69	0.559	4.312	0.000

Table A3.6. Model summary for rail, 2006-2009: Cluster 2

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.612	0.375	0.362	9.04596
2	0.668	0.446	0.422	8.60686
3	0.710	0.504	0.472	8.22613

Table A3.7. Coefficients for rail, 2006-2009: Cluster 2

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
3	(Constant)	-104.752	19.029		-5.505	0.000
	Country share of large contracts	-1.278	0.270	0.514	4.738	0.000
	Value range	4.910	1.586	0.348	3.096	0.003
	Contractor weight	-0.027	0.11	-0.251	-2.335	0.024

Table A3.8. Model summary for rail, 2006-2009: Cluster 3

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.229	0.052	0.40	2.92118
2	0.372	0.138	0.115	2.80424
3	0.457	0.208	0.177	2.70508
4	0.566	0.320	0.284	2.52367

Table A3.9. Coefficients for rail, 2006-2009: Cluster 3

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
4	(Constant)	11.765	1.880		6.227	0.000
	Value range	-1.072	0.265	-0.414	-4.299	0.000
	Procurement process	-1.209	0.281	-0.463	-4.299	0.000
	Country concentration of top actors	0.477	0.107	0.710	4.452	0.000
	Country demand	-0.608	0.174	-0.528	-3.489	0.001

Rail 2011-2016 segment

As for rail works contracts in the period 2006-2009, the same procedure is followed. The best fit results for multivariate analysis on the entire dataset and in clusters are presented below.

Multivariate linear regression: Entire dataset

Table A3.10. Model summary for rail, 2011-16

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.491	0.241	0.231	3.26763
2	0.502	0.252	0.241	3.24734

Table A3.11. Coefficients for rail, 2011-16

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	10.615	1.531		6.932	0.000
	Procurement process	-0.615	0.111	-0.236	-5.897	0.000
	Weight of price criterion	-0.059	0.013	-0.176	-4.449	0.000
	Country share of large contracts	-0.029	0.006	-0.208	-4.994	0.000
	Country market	-0.090	0.022	-0.165	-4.116	0.000
	TL market trend	1.841	0.474	0.157	3.881	0.000
	Contractor weight	0.010	0.002	0.210	3.958	0.000
	Contractor weight in segment	-0.033	0.012	-0.138	-2.679	0.008

Multivariate linear regression: Clustering cases based on country characteristics

Table A3.12. Cluster description for rail, 2011-16

	Cluster centres				Number of cases in each cluster		
	1	2	3	4			
Country demand	3.25	10.54	9.18	17.42	Cluster	1	115
Country % of large contracts	78.65	68.21	39.08	14.54		2	269
Country concentration of top actors	4.43	24.55	10.44	9.26		3	262
Institutional maturity	0.73	0.60	0.75	0.77		4	277
Procurement process	3.51	1.95	2.21	2.55	Valid		923
					Missing		1

Table A3.13. Model summary for rail, 2011-16: Cluster 1

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.433	0.196	0.170	1.49791
2	0.604	0.365	0.322	1.35365

Table A3.14. Coefficients for rail, 2011-16: Cluster 1

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	-0.218	1.231		-0.177	0.028
	Concentration of top actors	-0.996	0.246	-0.685	-4.055	0.000
	Institutional maturity	4.982	1.766	0.476	2.821	0.008

Table A3.15. Model summary for rail, 2011-16: Cluster 2

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.491	0.241	0.227	2.66791
2	0.523	0.274	0.256	2.61722

Table A3.16. Coefficients for rail, 2011-16: Cluster 2

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	14.260	1.785		7.989	0.000
	Procurement process	-2.733	0.395	-0.526	-6.916	0.000
	Country demand	0.860	0.151	-0.594	-5.679	0.000
	Value	-1.247E-8	0.00	-0.220	-3.124	0.002
	Country share of large contracts	0.054	0.020	0.261	2.694	0.008

Table A3.17. Model summary for rail, 2011-16: Cluster 3

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.715	0.511	0.476	2.53716
2	0.740	0.548	0.507	2.46189

Table A3.18. Coefficients for rail, 2011-16: Cluster 3

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	22.290	4.572		4.875	0.000
	Price weight criterion	-0.092	0.016	-0.543	-5.590	0.000
	Country demand	0.262	0.067	0.419	3.931	0.000
	Value	7.467E-8	0.000	0.808	3.458	0.001
	Country concentration of top actors	0.076	0.036	-0.228	-2.116	0.039

Table A3.19. Model summary for rail, 2011-16: Cluster 4

Model	R	R^2	R^2	Std. error of the estimate
1	0.561	0.315	0.289	2.56615
2	0.581	0.337	0.307	2.53353

Table A3.20. Coefficients for rail, 2011-16: Cluster 4

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	9.186	4.204		2.185	0.031
	Institutional maturity	11.327	3.933	-0.273	-2.880	0.005
	Country demand	-0.119	0.027	-0.331	-4.367	0.000
	Value	-1.518E-8	0.000	-0.178	-2.367	0.022
	Procurement process	-0.398	0.155	-0.231	-2.577	0.011
	Assessment indicator	3.230	1.102	0.366	2.931	0.004
	Price weight criterion	0.061	0.029	0.262	2.109	0.037

Road 2006-2009 segment

The top results for multivariate analysis on the entire dataset and by cluster are presented below.

Multivariate linear regression: Entire dataset

Table A3.21. Model summary for road, 2006-09

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.729	0.532	0.529	6.85263
2	0.733	0.538	0.535	6.81310
3	0.736	0.542	0.538	6.78790
4	0.737	0.544	0.540	6.77386

Table A3.22. Coefficients for road, 2006-09

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
4	(Constant)	21.527	2.723		7.906	0.000
	Concentration of top actors	0.723	0.026	0.846	28.119	0.000
	Country demand	-0.306	0.017	-0.570	-18.375	0.000
	Institutional maturity	-27.979	2.896	-0.231	-9.966	0.000
	Procurement process	-1.143	0.299	-0.086	-3.821	0.000
	Price criterion weight	0.078	0.016	0.202	4.866	0.000
	Assessment type	3.079	0.819	0.153	3.760	0.000
	Contractor weight in segment	-0.007	0.003	-0.066	-2.584	0.010
	Value range	-0.445	0.200	-0.051	-2.231	0.026

Multivariate linear regression: Clustering cases based on country characteristics

Table A3.23. Cluster description for road, 2006-09

	Cluster centres		Number of cases in each cluster		
	1	2			
Country demand	50.23	6.01	Cluster	1	328
Country % of large contracts	7.44	32.06		2	1141
Country concentration of top actors	22.50	9.14			
Institutional maturity	0.77	0.71	Valid		1469
Procurement process	1.29	1.41	Missing		0

Table A3.24. Model summary for road, 2006-09: Cluster 1

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.521	0.272	0.257	1.66365
2	0.555	0.308	0.290	1.62588
3	0.568	0.323	0.302	1.612238

Table A3.25. Coefficients for road, 2006-09: Cluster 1

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
3	(Constant)	3.704	0.776		4.775	0.000
	Value range	-0.686	0.100	-0.491	-6.830	0.000
	Contractor weight	0.001	0.000	0.203	2.727	0.007
	Procurement process	0.851	0.246	0.210	3.453	0.000
	Country demand	0.088	0.020	0.543	4.419	0.000
	Country share of large contracts	-0.469	0.146	-0.367	-3.225	0.001
	Number of consortium members	0.226	0.110	0.157	2.060	0.041

Table A3.26. Model summary for road, 2006-09: Cluster 2

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.746	0.556	0.556	7.18316
2	0.752	0.565	0.563	7.11449
3	0.756	0.571	0.568	7.07340
4	0.759	0.576	0.573	7.03271
5	0.762	0.582	0.578	6.99310

Table A3.27. Coefficients for road, 2006-09: Cluster 2

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
5	(Constant)	26.493	2.928		9.050	0.000
	Concentration of top actors	0.760	0.028	0.781	27.147	0.000
	Institutional maturity	-25.970	3.036	-0.209	-8.533	0.000
	Value range	-0.744	0.252	-0.073	-2.955	0.003
	Procurement process	-1.058	0.328	-0.079	-3.228	0.001
	Contractor weight in the segment	-0.018	0.005	-0.083	-3.401	0.001
	Price weight criterion	0.042	0.012	0.098	3.540	0.000
	Country share of large projects	-0.055	0.018	-0.77	-3.104	0.002

Road 2011-2016 segment

The best results for multivariate analysis on the entire dataset and in clusters are presented below. This dataset includes additional variables in order to examine the influence of market demand in adjacent sectors, i.e. the demand for rail works. Hence, the country market demand and the respective share of large contracts for rail are included as variables. These variables were not added to the other segments as: (1) the markets seemed stable before 2010, and (2) actors from the road sector shifted to the rail works sector and not the opposite. Therefore, it is of interest to examine how this information influences competition for the market (project).

Multivariate linear regression – Entire dataset

Table A3.28. Model summary for road, 2011-16

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.598	0.357	0.348	5.22196
2	0.595	0.354	0.347	5.22876

Table A3.29. Coefficients for road, 2011-16

Model		Unstandardised coefficients		Standardised coefficients		
		B	Std. error	Beta	T	Sig.
1	(Constant)	29.335	1.920		15.281	0.000
	Institutional maturity	-25.785	2.635	-0.340	-9.784	0.000
	Country demand for rail works	0.491	0.038	0.695	12.866	0.000
	Country demand	-0.324	0.030	-0.632	-10.651	0.000
	Contractor weight in segment	-0.011	0.003	-0.134	-3.879	0.000
	Value	-8.248E-9	0.000	-0.136	-4.407	0.000
	Consortium member number	0.626	0.205	0.108	3.055	0.002
	Concentration of top actors	-0.133	0.039	-0.180	-3.406	0.001
	Price criterion weight	-0.049	0.011	-0.173	-4.541	0.000

Multivariate linear regression: Clustering cases based on country characteristics

Apart from clusters created based on the country characteristics used for all segments, clusters also including information on the rail market were included. The latter have missing cases, as not all countries were active in both road and rail works.

Table A3.30. Description of Clusters 1.1-1.3 for road, 2011-16

	Cluster centres			Number of cases in each cluster		
	1.1	1.2	1.3			
Country demand	9.18	35.53	3.96	Cluster	1.1	702
Country % of large contracts	16.97	9.65	56.46		1.2	239
Country concentration of top actors	4.75	27.50	3.60		1.3	256
Institutional maturity	0.72	0.75	0.73	Valid		1197
Procurement process	1.45	1.73	1.42	Missing		0

Table A3.31. Description of Clusters 2.1-2.3 for road, 2011-16

	Cluster centres			Number of cases in each cluster		
	2.1	2.2	2.3			
Country demand	31.92	3.97	10.21	Cluster	2.1	317
Country % of large contracts	9.62	26.06	20.56		2.2	345
Country concentration of top actors	20.75	5.26	3.47		2.3	290
Institutional maturity	0.77	0.68	0.71			
Procurement process	1.57	1.67	1.50			
Country demand for rail works	24.18	3.94	6.65	Valid		952
Country % of large rail contracts	8.93	52.94	12.57	Missing		245

Table A3.32. Model summary for road, 2011-16: Cluster 1.1

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.521	0.272	0.266	5.66379
2	0.554	0.307	0.300	5.53025

Table A3.33. Coefficients for road, 2011-16: Cluster 1.1

Model		Unstandardised coefficients		Standardised coefficients		
		B	Std. error	Beta	T	Sig.
2	(Constant)	31.407	2.216		14.172	0.000
	Price weight criterion	-0.036	0.013	-0.107	-2.740	0.006
	Institutional maturity	-29.585	3.139	-0.399	-9.424	0.000
	Country demand for rail works	0.514	0.044	0.634	11.654	0.000
	Country demand	-0.349	0.043	-0.418	-8.140	0.000
	Contractor weight in segment	-0.025	0.005	-0.189	-5.116	0.000

Table A3.34. Model summary for road, 2011-16: Cluster 1.2

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.671	0.450	0.435	2.09864
2	0.688	0.474	0.455	2.06239

Table A3.35. Coefficients for road, 2011-16: Cluster 1.2

Model		Unstandardised coefficients		Standardised coefficients		
		B	Std. error	Beta	T	Sig.
2	(Constant)	-0.934	0.954		-0.979	0.033
	Procurement process	2.011	0.245	0.577	8.224	0.000
	Value	-1.060E-8	0.000	-0.263	-3.600	0.000
	Price weight criterion	0.044	0.016	0.196	2.765	0.007
	Country share of large contracts	-0.069	0.031	-0.160	-2.222	0.028

Table A3.36. Model summary for road, 2011-16: Cluster 1.3

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.690	0.476	0.460	5.31335
2	0.721	0.519	0.500	5.11174

Table A3.37. Coefficients for road, 2011-16: Cluster 1.3

Model		Unstandardised coefficients		Standardised coefficients		
		B	Std. error	Beta	T	Sig.
2	(Constant)	31.092	5.176		6.007	0.000
	Price weight criterion	-0.156	0.029	-0.410	-5.454	0.000
	Country demand for rail works	0.673	0.197	0.280	3.420	0.001
	Value	-1.610E-8	0.000	-0.329	-4.623	0.000
	Institutional maturity	-17.581	5.872	-0.237	-2.994	0.003

Table A6.38. Model summary for road, 2011-16: Cluster 2.1

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.718	0.515	0.505	2.35710
2	0.728	0.531	0.518	2.32545

Table A3.39. Coefficients for road, 2011-16: Cluster 2.1

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	-21.686	7.829		-2.770	0.006
	Price weight criterion	0.038	0.015	0.267	2.454	0.015
	Procurement process	2.005	0.270	0.383	7.430	0.000
	Institutional maturity	26.562	11.134	0.266	2.386	0.018
	Contractor weight	-0.002	0.001	-0.145	-2.683	0.008
	Country share of large contracts	0.053	0.021	0.182	2.502	0.013

Table A3.40. Model summary for road, 2011-16: Cluster 2.2

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.655	0.430	0.421	6.59401
2	0.666	0.443	0.433	6.52682

Table A3.41. Coefficients for road, 2011-16: Cluster 2.2

Model		Unstandardised coefficients		Standardised coefficients	T	Sig.
		B	Std. error	Beta		
2	(Constant)	24.101	3.288		7.331	0.000
	Country demand for rail works	1.089	0.126	0.438	8.665	0.000
	Institutional maturity	-23.190	4.124	-0.264	-5.623	0.000
	Contract weight in segment	-0.021	0.010	-0.106	-2.169	0.031
	Price weight criterion	-0.042	0.016	-0.129	-2.694	0.007
	Value	-7.480E-9	0.000	-0.123	-2.599	0.010

Appendix 4. 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. (2020), “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. (2020), "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, (2020), "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.

Competition for Infrastructure Projects: Traditional Procurement and PPPs in Europe

This paper investigates the level of competition for large road and rail infrastructure projects that were tendered by EU member states between 2006 and 2016. It finds competition is likely inadequate for both traditionally procured projects and public-private partnerships and should be addressed. 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.

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
+33 (0)1 73 31 25 00
contact@itf-oecd.org
www.itf-oecd.org

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