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Editorial: Understanding funding and financing of transportation infrastructure

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Investment in transport infrastructure is under pressure. On the one hand, the need for maintaining and/or replacing existing assets as well as building new ones is higher than ever. On the other hand, funding either for maintaining existing assets or building new ones, is severely constrained. Earlier literature proposed to combine all the above factors in the form of indicators that can describe the elements of the transport infrastructure delivery system. At the heart of this system lies the business model, which generates funding and attracts financing. System elements are drawn and kept together by the efficiency and flexibility of their contractual governance. An important element that determines the overall functionality of the system is the contextual setting: the implementation and transport mode contexts. This special issue brings together multiple research contributions that showcase the importance of understanding the funding and financing characteristics of transport infrastructure. A key common conclusion is that success or failure is not dependent on a single factor but rather a group of factors, which are not the same for all targeted outcomes. All papers, in their analysis of respective factors, identify "turning points" in their positive or negative effect on project performance.

Keywords: *transport infrastructure investment, implementation context, business model, governance, funding scheme, financing scheme, transport mode.*

1. Introduction

Investment in transport infrastructure is under pressure. On the one hand, the need for maintaining and/or replacing existing assets as well as building new ones is higher than ever. Existing infrastructure assets, most of them built from the middle of the 20th century onwards, are reaching the end of their useful life. Many of them are visibly crumbling under the wear and tear of intense usage, adverse climate effects, and the compounded impact of years of underinvestment in maintenance. At the same time the need for developing new infrastructure assets has never been more pronounced as connectivity has become one of the critical factors of competitiveness in both logistics and passenger transportation. On the other hand, funding and financing either for maintaining existing assets or building new ones, is severely constrained. The backlog in infrastructure maintenance has increased during the past decade, mainly as a

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consequence of the global financial crisis (2008-2011), which imposed fiscal constraints on many governments in the world with respect to such expenditure. The same constraints apply to new capital investment which is needed for the development of new assets. It is clear that this imbalance between demand and supply is getting bigger, widening the so-called "infrastructure gap".

Furthermore, following the global financial crisis, an increasing number of publications has focused on negative lessons learned, but little attention has been devoted on how to improve the resilience of transport infrastructure delivery. The result is that private investors, who have long been perceived as the solution to the public sector's financing shortcomings, have become more risk averse than ever. The combination of constrained public budgets, restrictions on new public debt, and private investors being reluctant to pursue investments in infrastructure due to its uncertain outcomes describe succinctly the "perfect storm" that most infrastructure programmes are facing. The key questions then become: "what works?", "when?" and "what can be done?".

The basic assumption related to the benefit of private financing concerns the anticipated management efficiency of the private sector, as when it comes to financing terms the government's cost of capital is usually lower. As private sector efficiency cannot be taken for granted (Winch, 2012), significant research has already been devoted to the topic of funding and financing of infrastructure and its performance. Three general streams of research may be identified (Zang et al, 2016): a stream focusing on in-depth analysis of case studies; a stream focusing on particular factors (e.g. risk allocation) related to efficiency; and a stream focusing on the cost of capital related to PPPs. In the first case, context is a limiting factor in the transfer of lessons learnt. In the second, the influence of other factors is under-represented limiting the exploitability of findings. The last one assumes efficiency and looks at the barriers set by the need to secure both acceptable returns to the private sector as well as social welfare.

2. The framework

Roumboutsos (2015) proposed to combine all the above factors in the form of indicators that can describe the elements of the transport infrastructure delivery system. At the heart of this system lies the business model, which on the one hand attracts financing and on the other generates funding. System elements are drawn and kept together by the efficiency and flexibility of their contractual governance. An important element that determines the overall functionality of the system is the contextual setting: the implementation and transport mode contexts (see Figure 1).

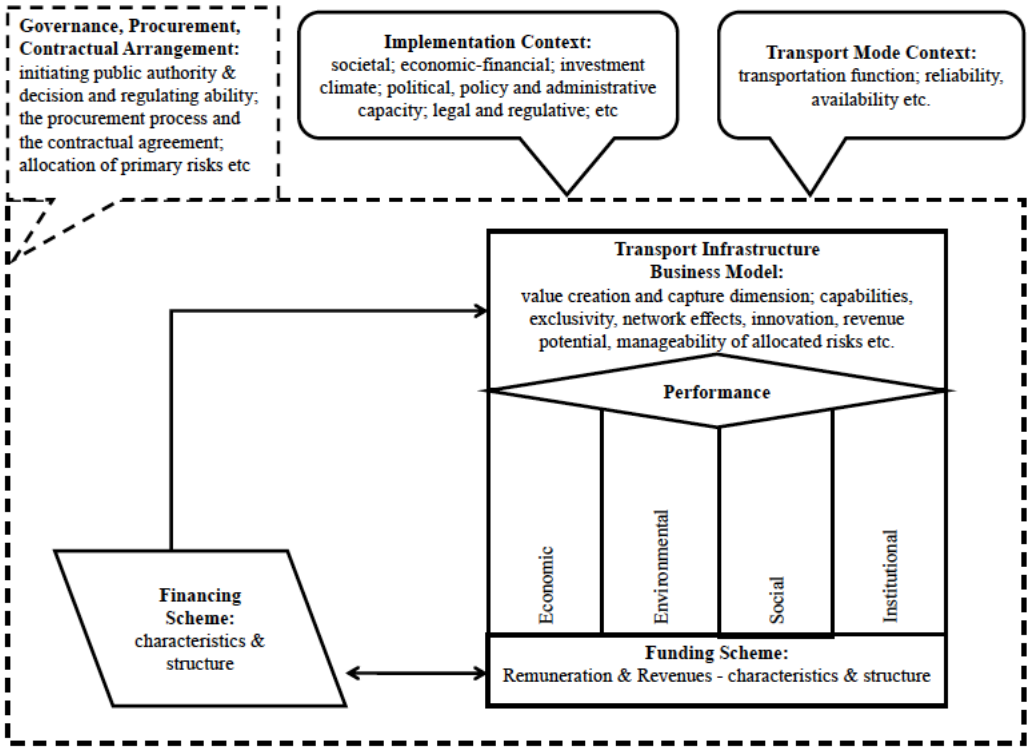

Figure 1. Infrastructure Delivery System and Elements

Effectively, this conceptual representation and its corresponding indicators were developed and operationalised in the context of the BENEFIT project[4] in the form of numerical expressions of the factors influencing project delivery (see Vanelslander and Roumboutsos, 2018). More specifically, the BENEFIT project introduced the following indicators that capture the inherent characteristics of the transport infrastructure delivery system:

The "Implementation context" element is described by two indicators: the Financial-Economic (FEI) and the Institutional (InI) indicator. Both indicators are calculated using input from the World Bank Governance Indicators (WGI) and the OECD indicators of regulation in energy, transport and communications (ETCR), which are published annually for all countries.

The "Business Model" element is described by two composite indicators representing the two major parts of a business model, i.e. costs and revenues. The corresponding indicators also aim to capture conditions improving efficiency and effectiveness which essentially lead to Cost Savings and Revenue Support. Hence, the Cost Saving Indicator (CSI) illustrates the measure of a project's efficiency during construction and operation; and the Revenue Support Indicator (RSI) may be considered as a measure of the project's ability to generate revenues, as well as a measure of the project's efficiency in exploiting potential sources of revenue. Of particular interest is the emphasis placed on the project's exclusivity based on its position in the transport network (Roumboutsos and Pantelias, 2015). This effect is captured by a sub-factor which is termed "Level of Coopetition" (LoC; the term "coopetition" was introduced in academic literature by Brandenburger and Nalebuff (1995) to describe the strategy of cooperation and competition in business).

[4] BENEFIT is the abbreviation of "Business Models for enhancing Funding and enabling Financing for Infrastructure in Transport", a project funded by the European Union Horizon 2020 research and innovation programme under grant agreement No 635973. For more information please look at: www.benefit4transport.eu

The "Governance" element is described by the composite Governance Indicator (GI), which is a measure of the efficiency and flexibility of the project's contractual governance (see Cardenas et al, 2017) and is originally assessed at the award stage.

The "Funding Scheme" element is described by two indicators: The Remuneration Attractiveness Indicator (RAI) and the Revenue Robustness Indicator (RRI). These indicators consider the project's income and revenue streams weighted against the associated risks and are also cumulatively expressed in relation to the percentage (%) of cost coverage they represent.

The "Financing Scheme" element is expressed through one indicator, the Financing Scheme Indicator (FSI), which is based on an expanded version of the weighted average cost of capital (WACC) of the project that is able to consider financing contributions from both public and private sources. An FSI=1 denotes a project financed purely by public funds while an FSI=0 denotes a project fully funded by private capital. As FSI →1 more low-cost finance is committed to the project.

Finally, the "Transport Mode context" element is described with one indicator which is internal to the system, the Reliability-Availability Indicator (IRA). This indicator is calculated based on the observed or foreseen project reliability and availability.

Through the development and use of these indicators the infrastructure delivery system could be modelled and subsequently analysed, providing decision-makers with a more comprehensible decision-support tool and enhancing the understanding of underlying trends and impacts. Notably, the dynamic nature of infrastructure project delivery is represented in the system through the consideration of different sets of values of these indicators at various points of a project's lifetime.

Using a wealth of project cases including both PPP and traditionally delivered infrastructure projects across all transport modes, multiple streams of quantitative analysis were conducted on various subsets of the original sample investigating the impact indicators/factors have on the potential of reaching target outcomes. From the multiplicity of outcomes transport infrastructure is designed to achieve four were selected and modelled, as these constitute the basis for the assessment of attainment of all other outcomes. Two pertain to the Project Management's "iron triangle": cost and time to (construction) completion. The other two correspond to project operational goals which are also considered in order to justify the investment: actual vs forecast traffic and revenues. "Quality", the third element of the "iron triangle" which is usually considered with respect to prescriptive input specifications during construction or operational performance specifications after construction, is difficult to assess objectively, and as a result was not included in the study. In addition, "quality" also influences "user choice" and, in this context, is reflected in the attained traffic levels.

3. Findings

Under this methodological context, in this special issue, Moschouli et al., apply fuzzy set Qualitative Comparative analysis (fs QCA) to identify combinations of factors that affect the cost to construction completion; Cardenas et al., use Importance Analysis, complemented with Bayesian Networks and Sensitivity Analysis, to identify factors influencing cost and time to construction completion and the potential of achieving forecast traffic; and Trujillo et al., test a bivariate model to identify the relevance of the various explanatory factors on the probability of attaining all four investigated outcomes.

Qualitative, in-depth analysis of project cases was also conducted under the BENEFIT project research. Its scope was threefold: first to compare its findings with reported research and through the comparison assess the representation capability (or bias) of the sample of project cases used; second, to test the framework with respect to its logic and functionality; and third, to function as

a guide in the interpretation of the quantitative analysis findings. Part of this qualitative analysis is presented in this special issue by Cirilovic et al..

The added value of carrying out multiple analysis streams (both quantitative and qualitative) is that conclusions can be drawn across a broad spectrum of findings, while taking into account the strengths and weaknesses of each analysis method. For example, Moschouli et al. find that mature institutions, flexible and efficient governance, market efficiency and acceptability, cost saving ability and a high potential for revenues are factors securing "on budget" completion of a project. An unfavourable financial-economic context has a negative impact, especially for private financing schemes. Cardenas et al., also find mature institutions, flexible and efficient governance, and cost saving ability to be important positive factors in achieving construction cost and time targets, as well as forecast traffic. They also identified that the level of project exclusivity (Roumboutsos and Pantelias, 2015) and less risky project remuneration schemes, such as availability-based ones, have a positive impact. Interestingly, such schemes have also been the preferred ones in the European transport PPP market following the global financial crisis (Bernadino and Roumboutsos, 2018).

The objective of identifying influencing factors is to provide decision makers and project managers with decision support tools, as well as with the knowledge of which factors are actionable and which are not. Effectively, Trujillo et al., categorise the explanatory factors as either internal or external. Their work aims to verify whether the likelihood of project success can be increased by measures under the control of the project consortium, or whether it depends on factors exogenous to the project. It turns out that a number of influencing factors, grouped as 'governance' factors, are important for reducing construction time and cost overruns. In the same vein, Cirilovic et al. considering projects under implementation, try to see to what extent project performance can still be influenced by taking suitable measures in response to changing circumstances or strategies that have turned out to be suboptimal. Factors that are subject to such intervention appear to be both project-specific and country-specific while in certain cases can be a combination of both, as identified by the quantitative analyses undertaken by Moscouli et al., Cardenas et al. and Trujillo et al..

Notably, all analyses described above, indicate that PPPs are vulnerable in terms of not achieving their target outcomes under less favourable macroeconomic conditions, especially when associated with riskier remuneration schemes and significant levels of private financing.

Still related to project financing but taking a different approach to the one used under BENEFIT, Sarmento et al., apply the Capital Asset Pricing Model (CAPM) to assess the risk and return of shareholder equity in Portugal. They first calculate the CAPM of each project by measuring the effects of investment and leverage and through several regression analyses try to understand how project variables affect the CAPM and the Weighted Average Cost of Capital (WACC). They conclude that extreme leverage (debt-to-equity ratios of over 90%) leads to unrealistic equity returns, which shows that applying the CAPM blindly in large transport infrastructure investments can be highly misleading. Looking at projects following the global financial crisis, they also show how typical the reduction in the risk-free rate is after 2008, as well as the increase of the CAPM values due to the higher costs of public debt.

The Weighted Average Cost of Capital (WACC) of PPP projects in France is also the focus of the contribution by Bonnafous and Faivre d'Arcier to this special issue. Their research highlights the need for considerable gains in efficiency by the private operator, at least with the current WACCs analysed, and for relatively profitable projects. They also identify swing points at which private involvement becomes more or less interesting. It is notable that their results present similarities to the ones produced by the analyses conducted within the BENEFIT project.

A limiting factor of the research contribution by Bonnafous and Faivre d'Arcier is the lack of availability of data, which is often deemed confidential particularly when originating from private sector entities (such as road operators) (Chen et al, 2015). This presents a sharp contrast

with the data used in the BENEFIT project, which was sourced entirely from the public domain. However, the issue of data availability and the corresponding sensitivity and/or value that this information may have, is only a single manifestation of the multiple and potentially conflicting interests of the various stakeholders involved in the delivery of transport infrastructure. In this context, project success or failure can only be subjectively assessed depending on the particular perspectives and objectives of each stakeholder and how these are met through project performance over time (Pantelias and Roumboutsos, 2018). Similar conflicts exist even when the scope of investigation of project outcomes widens to include all aspects of sustainability, i.e. profit (economic), people (social) and planet (environmental).

4. Conclusion

Overall, this special issue brings together multiple research contributions that showcase the importance of understanding the funding and financing characteristics of transport infrastructure. A key common conclusion is that success or failure is not dependent on a single factor but rather a group of factors, which are not the same for all outcomes. All papers, in their analysis of respective factors, identify "turning points" in their positive or negative effect on project performance. Whilst research in this academic field is ever expanding, this special issue adds to the collective body of work that can further enhance the understanding of project stakeholders and support relevant decisions with a view to increasing future investment in infrastructure and mitigating the widening "infrastructure gap".

References

Bernadino, J. and Roumboutsos, A. (2018). Funding Scheme Indicator: project revenues and returns. In Roumboutsos, A., Voordijk, H. and Pantelias, A. (eds) *Funding and Financing Transport Infrastructure: Business Models to Enhance and Enable Financing of Infrastructure in Transport*, Routledge, United Kingdom.

Bradenburger, A.M. and Nalebuff, B.J. (1995). The right game: use game theory to shape strategy. *Harvard Business Review*, 73(4), 57-71.

Chen, Z., Daito, N. & Gifford J. (2015). Data Review of Transportation Infrastructure Public–Private Partnership: A Meta-Analysis. *Transport Reviews*, 36(2), 228-250.

Pantelias, A. and Roumboutsos, A. (2018). Investing in Transport Infrastructure: A stakeholder's view. In Roumboutsos, A., Voordijk, H. and Pantelias, A. (eds) *Funding and Financing Transport Infrastructure: Business Models to Enhance and Enable Financing of Infrastructure in Transport*, Routledge, United Kingdom.

Roumboutsos, A. (2015). Case Studies in Transport Public–Private Partnerships: Transferring Lessons Learned. *Transportation Research Record: Journal of the Transportation Research Board*, 2530, 26-35.

Roumboutsos, A, and Pantelias, A. (2015). Allocating revenue risk in transport infrastructure PPP projects: how it matters. *Transport Reviews*, 35(2), 183-203.

Zhang, S., Chan, A. P.C., Feng, Y., Duan, H., Ke, Y. (2015). Critical review on PPP Research – A search from the Chinese and International Journals. *International Journal of Project Management*, 34(4), 597-612.

Vanelslander, T. and Roumboutsos, A. (2018). Transport Infrastructure Delivery in Context. In Roumboutsos, A., Voordijk, H. and Pantelias, A. (eds) *Funding and Financing Transport Infrastructure: Business Models to Enhance and Enable Financing of Infrastructure in Transport*, Routledge, United Kingdom.

Winch G. M. (2012). Years of private finance in the United Kingdom. In Winch G. M., Onishi M. and Schmidt, S. (eds) *Taking Stock of PPP and PFI Around the World, Summary of Research report 126*, Association of Chartered Certified Accountants, United Kingdom.