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Trends in Global Infrastructure Investment and Financial Consequences

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Abstract
Governments all around the world are faced with economic and social problems borne from the need for modern and reliable infrastructure. Rapid urbanization, increasing population size and economic growth are the main causes of increasing infrastructure investment needs in the world. While the need is growing, government budgets are increasingly squeezed by demands for healthcare improvements, defence, education and many others. The problems in the provision of finance for these investments are aggravated with the new Covid crisis, as the funds reserved for infrastructure investments are now likely to be allocated to urgent needs such as healthcare and unemployment benefits. In such a volatile environment, identifying future investment needs and discussing how these needs will be met is important and timely more than ever. This paper, introduces the global infrastructure investment trends in the future and discusses the use of public and private finance for infrastructure spending. In this concept, the following questions are explored, (1) What is the volume and trend of global infrastructure investment needs? (2) How do infrastructure investment needs differ among regions? (3) How will this infrastructure investment needs be financed?, and (4) What may be some of the future issues to be solved? To find out future infrastructure investment needs and trends, reports outlining the future prospects of the infrastructure sector are examined and trends are revealed. Then, a review of financing mechanisms is introduced in the light of the main procurement systems used by governments for realizing infrastructure projects. In this concept, design-bid-build, design-build and project finance models are explored in terms of their organizational and financial structure. Future issues to be solved are mainly derived from a cross examination of concerns raised in published infrastructure investment case studies and of future trends. Results reveal that the need for investment in infrastructure is growing steadily. As a response to this growth, the use of private finance is increasingly being encouraged by governments all over the world and a variety of international organizations. However, it appears that long-standing private finance issues predominantly observed in demand-based projects will continue to be discussed over the coming years by policymakers, scholars and communities. Indeed, many governments and organizations are already speeding up research efforts into ensuring the resilience of public private partnerships (PPP) in infrastructure projects. The insights from this research are expected to revive interest and research efforts into the potential future challenges for infrastructure financing and options available for governments.

Keywords: Infrastructure investments; public projects; private projects; public private partnerships (PPP); Covid-19; megaprojects

1. Introduction

Governments all around the world are faced with economic and social problems borne from the need for modern and reliable infrastructure. Main factors contributing to the growing need for modern infrastructure facilities include rapid urbanization, increase in population size and economic growth. World population which has been around 7,8

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billion in 2020 is expected to rise to 9,7 billion people by 2050 (UN Population Division, 2019). The tremendous growth in urban population undoubtedly will create new demands for infrastructure. The inadequacy of infrastructure is likely to be more critical for some emerging economies, as more than a third of world's urban population increases are expected to be observed in only three developing countries, namely India, China and Nigeria (PWC, 2020).

Infrastructure also plays a crucial role in the development of national economies. Industries need power, water and digital communication infrastructure for their operations. They need transportation infrastructure for connecting workers to production facilities and for logistics / supply chain purposes. To make sure that the industrial waste is managed safely, waste disposal facilities and networks are needed. Without the necessary infrastructure, economies will fall short of their full growth potential and thus national goals will not be achieved.

In the face of social and economic challenges resulting from inadequate or poorly performing infrastructure facilities, governments and various organizations are gathering efforts to set forth current trends and to estimate future infrastructure investment needs. A better understanding of the required volume of infrastructure investment and the varying sectoral requirements in different geographical locations is important for sustainable development objectives such as economic growth and social development.

Based on this observation, the present paper explores the following questions, (1) What is the volume of and trend of global infrastructure investment needs? (2) How do infrastructure investment needs differ among regions? (3) How will this infrastructure investment needs be financed? (4) What may be some of the future issues to be solved?

2. Global Infrastructure Investment

According to the report by McKinsey Global Institute (2013), USD 57 trillion in infrastructure spending is needed worldwide between 2013 and 2030 in order to keep up with economic growth prospects. This corresponds to USD 3,2 trillion investment per annum. The forecasts for future investment needs in infrastructure by Global Infrastructure Hub and Oxford Economics (2017) are similar. It has been stated that the average infrastructure spending needed in the World between 2016 and 2040 is approximately USD 3,2 trillion per year. Note that these are the baseline estimates subject to the assumption that investments will at least be in line with expected growth trends. The spending requirements will certainly be higher than these estimates in case the growth rates are higher or upper level developmental objectives are targeted by governments. Global Infrastructure Hub and Oxford Economics (2017) estimate that in the latter case, average investment requirement per year will be USD 3,7 trillion.

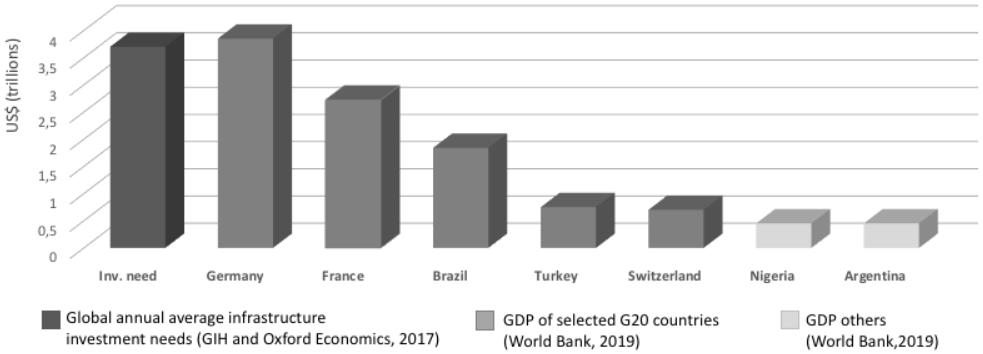

Figure 1. Global annual infrastructure needs and GDP of selected countries

In Figure 1, the annual global infrastructure investment needs are compared to the GDPs of selected countries. The medium grey boxes indicate selected G20 countries, which are some of the largest economies in the World. As it can be observed, the investment need is almost as high as the GDP of the German economy, and much higher than some other G20 countries. Yearly future investment needs are almost eight times larger than the Nigerian economy, which is the largest economy in Africa.

The question that follows is: in recent years, how much was the World spending on infrastructure? Studies show that over the last decades, global infrastructure spending has been around USD 2 trillion per annum. For example, according to the study by Global Infrastructure Hub and Oxford Economics (2017), the global infrastructure spending ranged from USD 1.8 trillion in 2007 to USD 2.3 trillion in 2015. Similarly, McKinsey report (McKinsey Global Institute, 2013) remarks that USD 36 trillion was spent on infrastructure during the 18 years between 1995 and 2013. These yearly infrastructure spending rates correspond to around 3% to 3.8 % of World GDP.

From previous discussions on the future spending needs and the historical trends, it is clear that the World will have to increase the volume of spending dedicated to infrastructure. In this concept, Mc Kinsey (2013) report remarks, "*Simply to support projected economic growth between now and 2030, we estimate that global infrastructure investment would need to increase by nearly 60 percent from the $36 trillion spent on infrastructure over the past 18 years to $57 trillion over the next 18 years.*" Although the share of infrastructure spending in World GDP may not change significantly, increasing spending volumes will certainly require effective financial response plans.

2.1 Geographical and sectoral breakdown of investment needs

Infrastructure for meeting basic human needs such as clean water and electricity for lighting is still an important issue in some regions of the developing world. In advanced economies on the other hand, concerns over maintaining and upgrading the ageing building stock and infrastructure are dominant (Gundes, 2011). Thus, it can be expected that the demand for new infrastructure in developed countries would be lower compared to their developing counterparts. According to Mc Kinsey Global Institute (2013), between 1995 and 2013, advanced economies accounted for 70% of global infrastructure investment volume. Infrastructure investment volumes may still be quite high in some

advanced economies. However when infrastructure investment rates are calculated as a share of GDP, it can be observed that these are significantly lower in advanced economies. Figure 2 (a) shows the geographical distribution of global investment needs in infrastructure between 2013 and 2030. The data is obtained from the "Global Infrastructure Outlook" report by Global Infrastructure Hub and Oxford Economics (2017). As it can be seen from the figure, Asia accounts for more than half of the investment needs in the coming decades. Americas and Europe follow Asia in infrastructure needs.

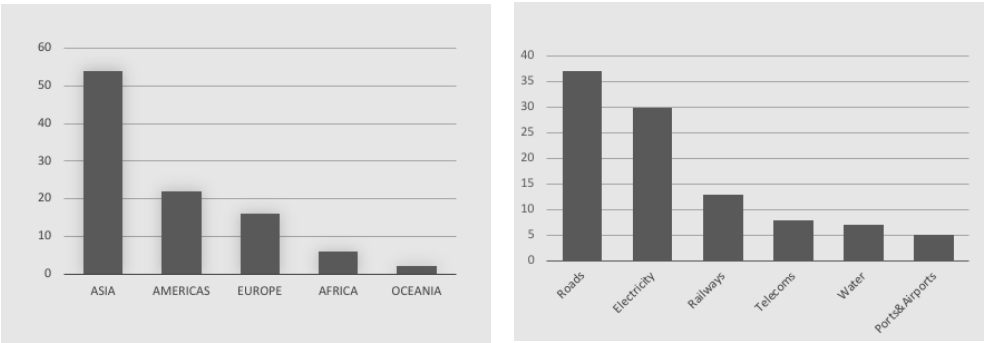

Figure 2. (a) Investment needs by region (%), (b) Investment needs by sector (%)
Source: Adapted from the data provided by Global Infrastructure Hub and Oxford Economics (2017).

Looking at Figure 2 (b), which shows the sectoral distribution of global infrastructure requirements, it can be observed that roads followed by electricity make up the majority of future investment needs. Similarly, the report by McKinsey Global Institute (2013) also show that road and power projects account for the majority of investment needs.
However, the course of current investment trends does not always seem to match future investment needs. The terms 'investment gap' or 'infrastructure gap' are used to define such difference between investment requirements in the future and the infrastructure provision scenario under current trends. Investment gap appears to be more significant in the roads and ports sectors, where future investment needs are 30 % larger than the scenario under current trends (Global Infrastructure Hub and Oxford Economics, 2017).

3. Financing Infrastructure Investments

Raising the required finance for these investments is a highly problematic issue for governments due to budgetary constraints. From previous discussions on the size of the infrastructure gap, it can easily be deduced that the urgent need for investing in infrastructure for governments was already a significant burden due to high indebtedness levels and the problems associated with allocating scarce resources among competing ends such as education, healthcare, defence, pensions and others. In addition, the recent Covid crisis has brought a totally new dimension to this problem. For example, it may now be necessary to channel funds reserved for infrastructure spending to unemployment benefits or healthcare. All of these actions will certainly necessitate a deeper look at the financing problem.

What is the solution to the financing problem? There have been extensive discussions about the ways of finding the required finance for these investments. In many reports and newsletters, it can be observed that the agenda revolves around encouraging greater private capital into infrastructure investment. This problem is also being discussed in the World Economic forum's global future council on infrastructure. In this concept, it has been stated that :

"….Private investment is a well-trodden path for financing infrastructure development. With government funds increasingly squeezed to pay for things like healthcare, education and pension obligations, turning to the private sector to fund some infrastructure projects will be essential, now more than ever. This has been a near consensus opinion among development institutions since at least 2015…." (World Economic Forum, 2019).

However, there has always been extensive debates as to whether public finance or private finance provides better value in infrastructure investments. For example in the UK, where private finance has been a priority since 1990's, reforms have been introduced about the Private Finance Initiative PFI model as it has been severely scrutinized by opponents.

Therefore, above all it has become extremely important and timely to discuss about the options available for governments. This discussion is important for obtaining better value from public infrastructure investments. Moreover, Covid 19 has changed the budgets of governments and also the significant consequences for way we live and work in our lives. Therefore, a work on the issue is timely.

3.1 Options for governments

In the present paper, financing options available for governments are limited to the basics of conventional public and private finance instruments. There are also alternative options for tackling the infrastructure finance problem, apart from public and private finance. However, the review on financing options here is not meant to be exhaustive. Rather, the aim is to stimulate thought and foster research interest in the feasible pathways for governments to achieve their infrastructure targets. The inclusion of this discussion is timely and relevant in a time when new challenges introduced by Covid-19 are posing a threat to the infrastructure industry. Keeping this in mind, it is particularly important to address the potential challenges, apart from the long-term issues that have always been at the centre of debates.

In order to set forth the options available for governments for realizing new infrastructure projects, first of all the difference between public financed and privately financed projects should be clarified. In very broad terms, publicly financed projects are owned and operated by the government. Normally, the majority of infrastructure projects in the world are public projects. For example, according to the World Bank and PPIAF (2017) in 2017, 83% of investments in infrastructure worldwide were public projects.

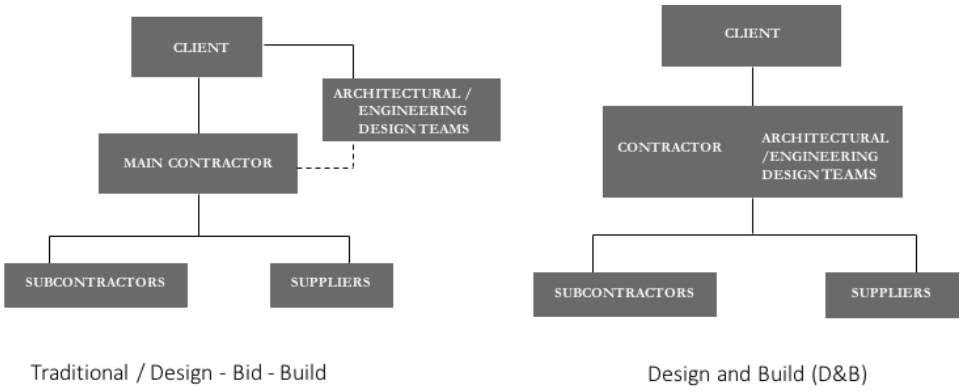

Figure 3. The most common procurement models used in publicly financed projects

The main procurement systems used by governments for realizing public projects are the traditional or design-bid-build (DBB), design and build (D&B) and their close variants (Figure 3). In the traditional system, the government as the client firstly engages design teams to design the projects and once the design is complete, selects a contractor by competitive tender. The contractor carries the cost and schedule risks of the project. Alternatively, in the design-build model, one design build company selected by competitive tender assumes all responsibilities for both the design and construction of the facility. Similar to DBB, cost and schedule risks remain with the contractor in the DB model. In both cases the public sector raises the money for upfront costs from taxes or borrowing and pays the contractor for these costs as they arise. Once the construction is finished, the government starts to operate the project.

In this article, private projects referred to those investments for which the private sector is responsible for raising finance, constructing and operating the facility. The use of private finance for infrastructure is more common in advanced economies (Mc Kinsey Global Institute, 2013). Policies of some countries actively promote private sector participation in infrastructure investments (e.g. see Fernandes et al., 2016; Fernandes et al., 2019). They prefer private finance not only because public resources are scarce, but also because private finance may be treated as off-balance sheet spending. That is; private infrastructure finance does not raise public sector debt (Atkins et al., 2017). However, there are some exceptions; particularly in cases for which the public sector provides some sort of financial support to the project. For example, any guarantees provided by the government for project risks are recorded in the public sector balance sheet as spending.

Although numerous types of PPPs are available (e.g. see PPIAF, 2009; Bull et al., 2017), private finance for infrastructure is commonly provided through project finance models. Figure 4 demonstrates the typical organizational structure in a BOT type project finance transaction. The government or the governmental body that is willing to build a major infrastructure project is the client. The project company or the Special Purpose Vehicle (SPV) that appears in the center is usually a joint venture composed of either solely private companies such as contractors, suppliers etc. or alternatively it may also include public corporations. The project company is awarded the contract for obtaining finance, constructing and operating the facility for a certain period of time, say 15 or 20 years. Once

the operating period is complete, the infrastructure is transferred to the government in the BOT model.

The shareholders in the project company are also equity investors. The amount is between 10% to 30% of project costs. The remaining part of project costs (typically 70%-90%) are covered by loans obtained from financial institutions. As such, it can be stated that in the project finance model, the majority of money influx comes from lenders. However, in recent years the leverage ratios are declining (Mc Kinsey, 2013). That is mainly because the long-term nature of project finance loans which does not match the short-term liabilities of lenders.

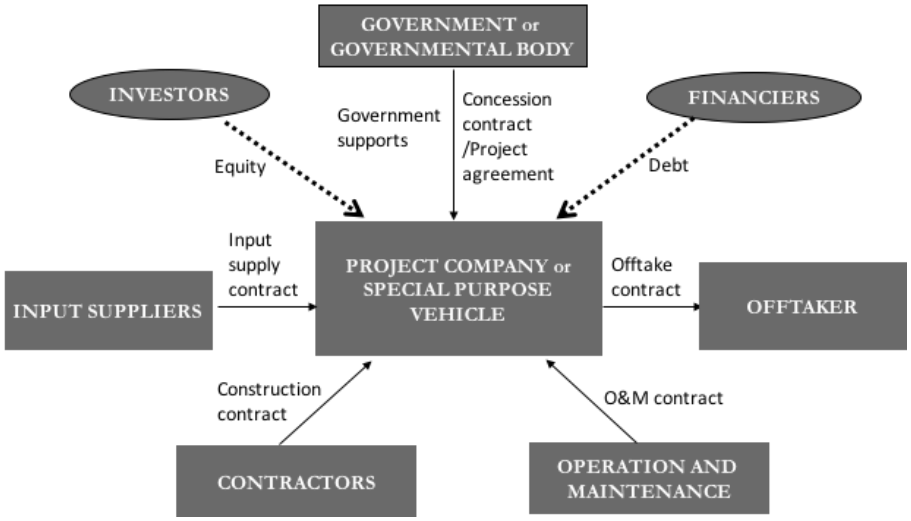

Figure 4. Typical organizational structure in project finance

In the project finance model, the repayment of these loans come from cash flows generated by the operation of the project. For example, if the project is a toll road or bridge project, then there should be sufficient number of vehicles passing through the bridge in the operational phase so that the revenues generated will cover repayment of those loans to lenders. If the project is a power plant, then private investors will want to make sure that the electricity generated will be sold during the whole operational phase, so that the repayment of loans will be guaranteed (e.g. see Propersi and Gundes). This is achieved through offtake contracts in power projects. Other contracts signed by the project company may include the input supply contract for operational inputs such as fuel or raw materials, construction contracts and operation and maintenance (O&M) contracts.

4. Discussion

Covid-19 pandemic had enormous impacts on many aspects of our lives. Closure of schools and workplaces, transition to remote working and online education, rising unemployment and immediate healthcare requirements were some of the important consequences of the pandemic. This period has undoubtedly taught us major lessons on

our social, economic and political systems. Infrastructure sector had also its share of the pandemic in various aspects. The 'infrastructure and Covid-19' issue may be examined from two different perspectives: sectoral infrastructure investment requirements and financing.

As stated above, a number of infrastructure reports prepared in the pre-Covid era had shown that roads followed by electricity/energy were the primal sectors that required major investment in the coming decades. However, this pattern is likely to undergo some changes after the social and economic transformations introduced by Covid-19. According to Rathbone (2020) energy transmission, digital and telecommunications sectors will increasingly receive the interests of investors in infrastructure in the post-Covid world. On the other hand, while the demand for transport, utilities and network investments is expected to remain constant, investor appetite in airports is predicted to decline (Rathbone, 2020). Healthcare, social care and charging infrastructure projects for electric vehicles are likely to be other important areas that will continue to be attractive for investors.

As far as the financial dimension is concerned, there appears to be a need for discussing several major issues. Until the Covid-19 crisis, the use of private finance for the realization of infrastructure requirements has been considerably advocated by many political and financial circles. It still continues to be so for some, however recently opposing views have also been expressed. For governments infrastructure spending has always been a stimulus to boost economies (International Transport Forum OECD, 2021). Thus, the recent strong pressure on government budgets, rising deficits and high indebtedness levels may still suggest that PPPs will continue to be a preferred option for infrastructure delivery. No matter how the debates end, there is no doubt that Covid-19 has taught us important lessons about private finance. Consequently, the search for a solution to the problems faced by current and planned PPP projects has already been the target of recent research efforts (e.g. see Baxter and Casady, 2020; Casady and Baxter, 2020).

In the context of PPPs, special attention should be paid to demand-based projects. Recent data show that demand-based PPPs are undergoing major problems and thus their resilience to shocks should be scrutinized closely. This issue may further be explained on an example from the transportation sector. In transportation PPPs, the sources of revenue for the private partner may either be directly the users of the infrastructure, or the contracting authority. In the purest form of the 'user-pay' model, remuneration of the private partner is based directly on the payments by the users of the facility. This payment mechanism is usually referred to as the 'real tolls' model in PPP toll road projects. This type of risk could explicitly be observed in private toll road projects. As the travel demand has dropped during the pandemic due to lockdowns and transition to remote working, projects structured through the pure 'real tolls' model have come against a great challenge. Consequently, the revenues of the private parties in the pure 'user pays' contracts have significantly declined.

A different version of the same problem has occurred in projects for which traffic/revenue guarantees are provided in addition to the 'user pays' model. As stated before, in the 'real tolls' model the project company generates revenues from private roads in the form of direct toll payments from road users. If the demand of users is low, then there will not be enough cash flows to pay for debt service and the project will fail. Thus, lenders will not

be willing to provide loans to a project with low demand prospects. To overcome this problem, public sector usually retains demand risks through minimum traffic or revenue guarantees. In this way, the private investors are assured that there will be enough cash flows to repay the debt service and thus the bankability of the project increases. However, in many cases guarantees place an increased burden on public budgets and thus they had already become the target of criticisms and social oppositions. The Covid-19 crisis has shown how far the consequences of this untreated problem may reach. The public sector had and still has to pay considerable amounts guarantees for unused or under-used infrastructure. In other words, public sector had to assume the most critical risk component -the demand risk-, leaving taxpayers on the hook.

In summary, demand-based projects have become highly problematic regardless of whether guarantees are provided or not. How about 'authority pays' contracts for which the private partner receives regular payments from the public sector authority? To better understand the issue, 'authority pay' model is explained once again on transportation projects.

In the 'authority pays' type models, the contracting authority is responsible for making regular 'service payments' to the private partner. The most common types of the 'authority pays' models are the 'shadow toll' and the 'availability payment' mechanisms. In the shadow toll mechanism, the public authority makes regular payments to the private partner based on actual traffic levels and distance travelled. The banding of traffic volumes limits the traffic risk exposure of both public and private parties in the 'shadow toll' mechanism. That is; the toll rates are not flat. Instead the rates vary according to differing traffic levels in accordance with a multi-level banding structure: when the traffic volume is low (e.g. first band), the rates are high and when the traffic volume is high, the rates per vehicle kilometers is lower (e.g. third band). The rates are usually zero in the highest traffic volume band to limit the traffic risk exposure of the public authority.

On the other hand, in 'availability based' projects the public partner makes regular payments to the private party as long as the facility is available. There may be some deductions on the payments depending on low performance or troubles about availability, but the private partner assumes no demand risk in the availability payment mechanism. Thus, in the 'authority pays' contracts main concerns raised could be about the ability of public sector to continue its payments. However, this is not likely as in the Covid crisis many governments chose not to terminate contracts even though they had the right to do so.

Given the tendency for a more careful consideration of risks, it may be stated that in the post-Covid world private investors' appetite is likely to shift from pure demand-based to availability-based projects. Demand-based projects may still be preferable in cases where additional public guarantees are provided. However as explained above, guarantees have always been met with skepticism on the public side and thus models that provide an optimal rebalancing of risks should be taken into consideration.

Above all, there is a clear need for a reassessment of procurement options with a special focus on their advantages and disadvantages from a lessons learned perspective. Procurement and contracting methods have significantly evolved through time, but the comprehensive historical review provided by De Valence (2021) concludes that "the more things change, the more they appear to stay the same" (De Valence, 2021, p.16), pointing

out the continuity of several critical issues. In fact, the same observation also appears to apply to the delivery of infrastructure investments, regardless of whether they are financed by the public or the private sectors.

5. Conclusions

Governments are planning to invest trillions of dollars in megaprojects in infrastructure. In the face of budgetary constraints, it is extremely important to consider the financial options wisely. The aim of the present research is not to provide a critical review of all options in order to arrive at conclusions about whether public finance or private finance provides better value. Rather, the objective is to stimulate thought and debate on problematic areas in infrastructure financing for future improvement. Such discussion is relevant in a time when Covid is posing a huge challenge to national economies.

Private finance is encouraged by governments all around the world mainly because construction spending may largely be kept off balance. In other words for governments private finance means new infrastructure that is not reflected in public sector debt. Proponents further argue that private finance projects generally outperform public finance projects in terms of time and cost performance. Experience to date shows that this is actually true to a certain extent. However at the same time, private finance could also mean deferment of spending into the future, depending on the terms of agreement and risk sharing mechanisms between the public and private sectors. Due to such 'affordability illusion', governments may even end up paying more than they would under conventional schemes. Indeed, many projects are unattractive for private investors until significant amount of guarantees are provided by public sector. Without government guarantees, securing finance at reasonable terms may become troublesome, if not impossible and consequently, private investors will not be willing to take over such investment opportunities.

Public sector guarantees are usually provided in the form of demand risk assumptions. This is particularly important for projects with uncertain future demands and most commonly in private toll road projects. Although in theory, shifting construction and operational risks to private parties lies at the heart of project finance, in practice governments are left with the choice of bearing some of these risks to make PPP transactions attractive to lenders, or giving up the PPP model.

Demand risk is the most salient element in demand-based private projects. In demand-based projects such as private toll roads, demand or traffic risk has always been a tender issue. However with Covid, the world has seen that these are also critically vulnerable to severe market shocks. There have been shutdowns, travel bans and a sudden move to remote working conditions. As a result, revenues from toll roads operated by private parties have dropped and thus many governments will have to pay even more as guarantees. The long-term impacts of Covid are yet to be seen but the crisis is likely to trigger the development of new financing and contractual structures for infrastructure in the future.

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