Public Sector Deficit Risk and Infrastructure P3s: *A Value for Funding Analytical Approach to Evaluation*

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It is axiomatic that public-sector interest in public–private partnerships (P3) for financing major infrastructure projects increases when fiscal resources are constrained. This connection might seem easy to understand intuitively. But it is hard to justify in theory with respect to the most important factor in the evaluation of a P3 compared with traditional procurement methods—overall cost. Ideally, public-sector decisions should always seek to minimize the cost and maximize the value of public investment, regardless of the fiscal situation.

Certain characteristics of P3s may be directly connected to mitigating fiscal constraints. The form of contractual obligation in many P3s can be off-budget or outside of statutory debt limits, which might allow a project to proceed with fewer steps. But these are fundamentally short-term fixes that, although useful in terms of process, are not substantive with respect to long-term value.

However, there are also substantive features of P3s that can—both in practice and theory—become more valuable when public-sector resources are constrained. These features can lessen negative impacts on the funding sources that the public sector must arrange to pay for a major project. Under a P3 contract, long-term public-sector funding requirements can be more flexible or lower with respect to timing, degree of recourse, and unexpected costs than those which typically result from traditional procurement and financing arrangements.

In effect, the absorption of timing and cost risks by a P3 is a form of insurance, and it derives its long-term substantive value in the same way—by diversification. In the absence of other arrangements, a public-sector sponsor will have a concentrated and undiversified risk position with respect not only to the infrastructure project itself but also to the localized funding sources it relies on to pay for it. These risks are frequently correlated. For example, user fee revenue from a project is likely to fall when the overall local economy is suffering a downturn while project costs remain the same, leading to a negative impact on funding at a time when the public sector has fewer resources to pay them. Or persistent fiscal constraints can lead to the deferral of project maintenance, increasing the chance of much more expensive repairs later on that cannot be further delayed, regardless of available funding at the time.

In contrast, P3 investors can hold their investment as part of a portfolio that is diversified across non-localized projects and funding sources. Portfolio revenues will reflect the (ideally) uncorrelated results of many projects. If a single project suffers a downturn but retains long-term value, costs can be covered from other sources in the portfolio and an overall shortfall can be avoided. Maintenance can be kept to a schedule with a view to preservation of long-term project value, not momentary liquidity.

Of course, just because P3 investors are well positioned to offer a form of insurance does not mean that such insurance is worth paying for. Risk transfer is not free. It will be primarily reflected in the P3's overall cost of capitalization, which is a one major reason that P3s are often only marginally competitive (if at all) with traditional arrangements.

How can the public-sector sponsor determine whether the extra cost is justified? The standard P3 evaluation framework, Value for Money (VfM), can assess to some extent the value of risk transfer with respect to project cost on a comparative basis between the P3 alternative and a comparable conventional procurement scenario—the "public sector comparator" (PSC). A VfM analysis can be highly detailed and quite fine-tuned, but it is generally limited to a focus on cost and does not include an explicit assessment of the project's fiscal context.[1]

But the value of transferring risk related to project payment obligations is not only related to its cost. Another important factor is the public sector's overall long-term fiscal situation. A simple analogy to individual health insurance can illustrate this point. For two similar individuals of the same age and level of health, the cost of health insurance should be about the same. One of the individuals is well-off and an expensive illness would be easily affordable even without insurance. For the other individual, with fewer savings, the same illness without insurance would lead to bankruptcy. The two should evaluate insurance in a different way, because one has to consider expected losses from possible bankruptcy and the other does not.

The same holds true for different public-sector sponsors. The same risks of inflexible or unexpected funding requirements arising from a major project can have more severe downside consequences to one sponsor compared with another. The value of a P3 that might mitigate the risks will therefore differ for reasons that are not related to project cost but rather to the sponsor's overall fiscal situation.

As noted at the outset of this article, the connection between fiscal condition and P3 value is recognized intuitively, and there is a valid theoretical basis for it. But a more rigorous and quantitative methodology to evaluate this aspect of P3s is still required for comparison to PSC alternatives in actual situations.

This is *not* to suggest that a cost-focused VfM analysis is optional when fiscal resources are constrained. A standard VfM analysis must *always* be completed. To continue with our analogy, insurance buyers should always perform price comparisons and seek maximum value among alternative products, regardless of their financial situation. When fiscal resources are constrained, however, an *additional* dimension of analysis focused on funding risk needs to be added to the evaluation.

In general, we are calling methodologies to explore the fiscal dimension of P3s a 'Value for Funding' (VfF) framework to be used when applicable in conjunction with the standard Value for Money analysis. Our current article is the first in a series of four about defining and developing this framework. In this article, we introduce one approach, focused on U.S. state and local public-sector sponsors, that aims to elucidate the value of P3s in terms of reducing the chance of incurring deficits.

DEFICIT RISK PROFILES

U.S. state and local governments are generally prohibited from incurring a deficit in their annual budgets. Although the strict interpretation of the prohibition can usually be evaded with various workarounds (including, as noted, P3s), the need to resort to such fixes is seen as a negative indicator of fiscal stability and political discipline. On the whole, there appears to be widespread agreement among state and local public-sector policymakers and stakeholders that running deficits is dangerous and costly and that avoiding them has value.

Yet because most government budgets include many uncertain and uncorrelated elements of revenue and cost, there is always a possibility that annual shortfalls will occur, regardless of the efforts of public-sector officials to avoid them.[2] This is why budget stabilization and other reserve funds are an important part of state and local finances. But the level of reserves necessary to completely eliminate any chance of a shortfall would in most cases be a highly inefficient use of resources, even in theory. In practice, most "rainy day" funds are nowhere near that level, and many are barely adequate.[3] So the risk of deficits remains a consideration in public-sector planning, especially for long-term capital projects.

A public-sector sponsor contemplating a major infrastructure project will inevitably be planning within this context of deficit risk. A project whose base planning case is expected to cause persistent shortfalls is unlikely to proceed. In most situations, surpluses are not sought in the base case. As a result, the base planning case should basically show zero future budget deficits. But that in itself does not address whether the *overall risk* of a deficit has changed due to the project.

For example, a large project may be funded with a variable source of revenue (e.g., an increase in the local sales tax) but incur mainly fixed payment obligations (e.g., bond debt service and operating costs). When project revenues and costs are added to the overall budget, the net effect in the expected case is zero, but the proportion of fixed costs in the annual budget is significantly increased. Without the project, the public-sector sponsor might face a relatively small chance of a deficit if overall revenues fell slightly (e.g., 2% or 3%) in a particular year because some variable costs could also be trimmed. With the project in place, however, the same decrease in public revenues could increase the chance of a shortfall to a near certainty due to the higher floor of fixed costs.

When a major infrastructure project might cause a significant increase in the probability of an annual deficit due to a combination of long-term fiscal constraints and revenue volatility, the public-sector sponsor may see value in alternative ways to procure and finance the project that (while not directly related to a lower cost) can reduce that probability. With sufficient data, the degree of the reduction should be relatively precise and quantifiable.

This concept provides the basis of a metric to assess the value of the insurance-type features of a P3 in the sponsor's specific fiscal situation with respect to deficit avoidance. Our approach begins by defining the set of overall probabilities that the public-sector sponsor will incur annual deficits in the timeframe of the infrastructure project as the sponsor's long-term deficit risk profile (DRP). This can be modeled stochastically. The different PSC and P3 alternatives will each have a unique DRP scenario based on the inclusion of their specific characteristics (e.g., procurement process, financing arrangements, concession contractual terms, and so on) in the sponsor's overall budget projections. The various DRPs can then be compared. If there is not a significant difference in the PSC and P3 DRPs, then the insurance-type features of the P3 are probably not very valuable (at least with respect to deficit avoidance), and the results of the VfM cost analysis alone are likely to be dispositive. But if the P3 DRPs show a significantly different and lower probability of deficits, then the DRP analysis can be an additional factor for public-sector policymakers and stakeholders to consider in P3 evaluation. (See Sidebar 1 for a list of abbreviations.)

Sidebar 1: List of Abbreviations

AP	Availability Payment
DC	Demand Charge
DBFOM	Design-Build-Finance-Operate-Maintain
DRP	Deficit Risk Profile
FI-AP	Fiscal Index Availability Payment
P3	Public–Private Partnership
PSC	Public Sector Comparator
P*X*	Probability (*Cumulative at X %*)
VfF	Value for Funding
VfM	Value for Money

In theory, if the specific cost of incurring a deficit of a certain magnitude or frequency could be estimated by the sponsor, then the PSC and P3 DRPs could be used to calculate an "expected loss due to deficits" for each scenario and results could be compared in terms of monetary value. As a practical matter, the consequences of a deficit are unlikely to be specific or predictable enough to confidently assign a monetary value to each, except in unusual cases (e.g., a rating agency has warned the sponsor that a downgrade will occur if the project causes deficits exceeding a certain level, with a predictable rise in the cost of a planned bond issue).

Our approach aims for a more limited, but still potentially useful, quantitative type of result from the DRP analysis, expressed as the difference between the PSC and P3 scenarios in the cumulative probability that annual deficits of a certain size or frequency will occur during the project timeframe.

The Baseline DRP

The first step in our analytical approach is to create a long-term model of the public-sector sponsor's "baseline" DRP against which the PSC and P3 alternatives will be compared. By definition, this will be a stochastic model using Monte Carlo simulation and related techniques.[4] In essence, the model will project a simplified version of the sponsor's annual budget (excluding the project) projected through the same time period in which the infrastructure project is being analyzed under the VfM framework.

Inputs would include relative proportions and expected growth trends of the budget's most important dynamic factors of revenue, cost, and financial position. Most importantly, the model would also include measures of variability (e.g., standard deviation) for the factors and assumptions about probabilistic distribution. These assumptions can be based on an analysis of long-term historic data adjusted for known and predictable long-term trends (e.g., demographics).[5]

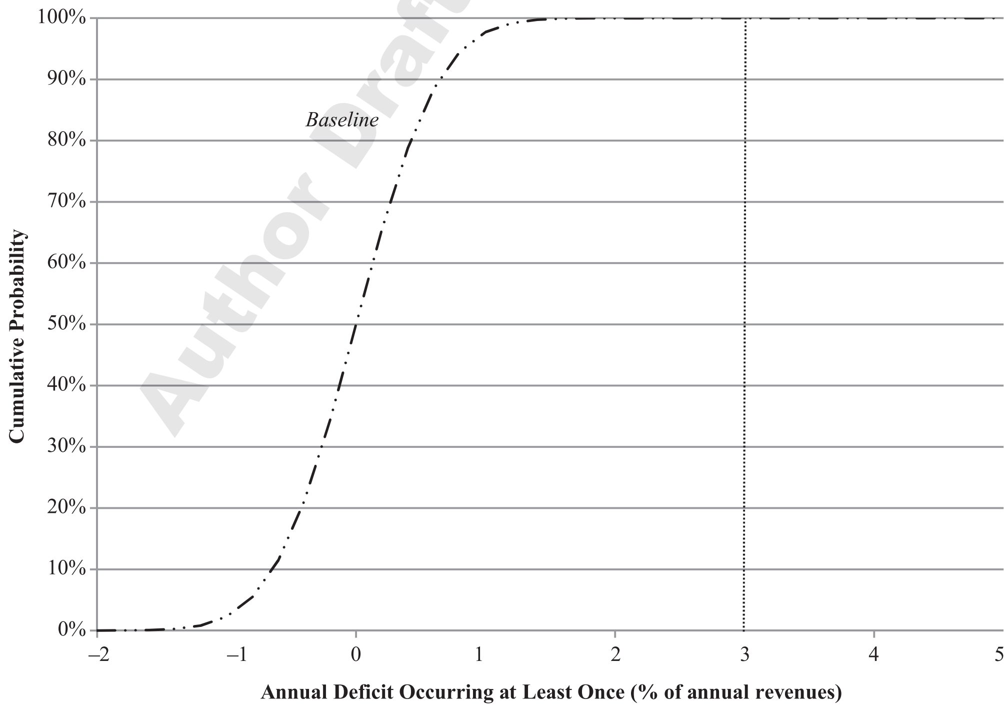
The baseline model output can be graphically summarized in a standard presentation of cumulative probability, as illustrated in Exhibit 1.

The *x*-axis is generally a measure of the frequency or severity of annual deficits incurred by the public-sector sponsor (expressed as a percentage of annual revenue for that year) over the planning or concession timeframe of the infrastructure project. In Exhibit 1, specifically, values along the *x*-axis represent the occurrence of a deficit of *x*% at least once during the timeframe, which for simplicity will be used throughout this article. Alternative specific measures in the same type of cumulative probability model summary could include the frequency of exceeding a specific deficit level, occurrence of deficits in sequential years, present value of cumulative deficits over the timeframe, and so on.

Stochastic model output would of course show annual surpluses as well (expressed on the *x*-axis as a negative number) but these are generally excluded for our purpose here.

The *y*-axis is the cumulative probability that the *x*-axis value is not exceeded. Exhibit 1 reflects model results with a normal distribution, so the 50% probability level (P50) shows the basic "balanced budget" planning expectation of zero deficits occurring over the timeframe. For illustrative clarity, we are assuming that the public-sector sponsor is fiscally quite stable prior to proceeding with the infrastructure project in order to highlight the impact of the project. At the P90 level, for example, the illustration shows only very small deficits ever occurring during the timeframe. Actual cases are not likely to reflect such optimism.

EXHIBIT 1
Baseline Deficit Risk Profile



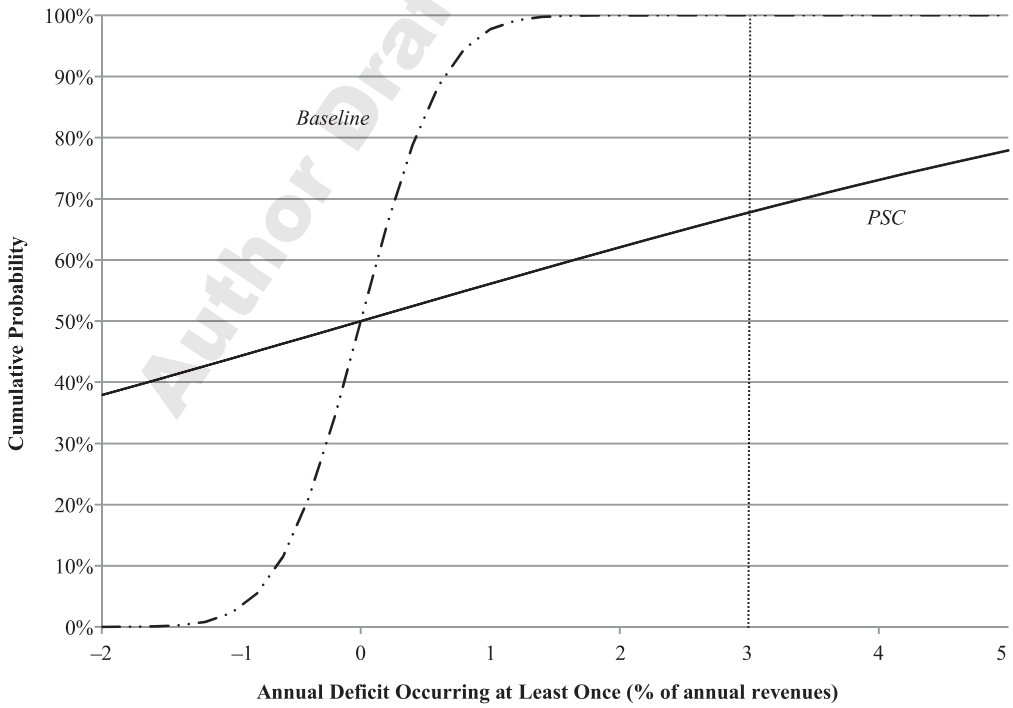
There are two important points to note about the methodology for the Baseline DRP. The first is that the baseline DRP is *not intended to be a precise portrayal* of the public sector's annual budget over the decades-long timeframe of the infrastructure project analysis. Even if such a projection were possible, it is far outside the scope of this analysis. Instead, the limited purpose of the baseline model and resultant DRP is to serve as a common starting point to assess the relative impact of the various PSC and P3 alternatives (which can be relatively accurately and precisely modeled using the type of detailed long-term project finance models that are widely employed by project debt and equity investors). For this purpose, the most important aspects of the baseline model are the relative proportions of fixed and variable revenues and costs and their variation, which may be historically somewhat stable. The primary aim is provide a roughly accurate picture of the public-sector sponsor's long-term operating leverage and cash flow volatility into which the effects of the project PSC and P3 alternatives can be included and compared.

The second important point is that because it is not practical to assign a monetary value to the cost of incurring a deficit (as discussed in the previous section), a heuristic approach is required to assign significance to the results of the stochastic model. In actual cases, this should reflect the public-sector sponsor's specific fiscal priorities. As an example, we assume that while the sponsor is willing to tolerate small annual deficits, any single deficit that exceeds the level of the rainy-day fund is a matter of serious concern. In Exhibit 1, this is shown as the dotted vertical line at 3% of annual revenues, a value based on the approximate current average of U.S. state reserves.[6]

The Public Sector Comparator DRP

The next step of the analysis is to include the impact of proceeding with a major infrastructure project under the public sector comparator scenario. This involves including the new revenues arranged for the project (e.g., a sales tax or tolls) and the new costs (e.g., bond debt service and project operating costs) to the baseline DRP model. This type of project data should be readily available from a concurrent VfM analysis. Exhibit 2 shows the sponsor's new PSC DRP.

EXHIBIT 2
PSC Deficit Risk Profile



Partly for illustrative clarity—but mainly because it generally reflects reality—the PSC example shown in Exhibit 2 assumes a significant increase in the public-sector sponsor's operating leverage due to the project. Although revenue volatility and the balanced-budget base case (i.e., zero deficits at P50) are the same as under the baseline DRP, there is a higher chance of deficits under the PSC DRP. In effect, this reflects the undiversified risk position of the public-sector sponsor in a large project without a long-term private sector partner.

Note also that in this example, the PSC DRP shows only about a 67% chance that an annual deficit will not exceed the 3% annual deficit threshold. To put this another way, there is a 33% chance—one in three—that an unacceptably bad outcome will occur. Although we are intentionally assuming a high level of deficit risk to illustrate the point, our example does reflect the reality that a concern about future deficits is a major reason that much-needed infrastructure projects in the U.S. are not proceeding, despite many otherwise favorable conditions. Most U.S. state and local governments have excellent credit ratings and can access tax-exempt debt capital markets at historically low long-term rates. Resources for construction are readily available on very competitive terms, and new technologies can make building and operating a major project more efficient than ever. Importantly, the opportunity to increase near-term local employment and improve the long-term competitiveness of local infrastructure has rarely been more important. Yet U.S. state and local investment in infrastructure remains at historically low levels.[7] Concern about long-term fiscal stability, including a fear of deficits, is a large part of the reason in many cases.

P3 Alternative DRPs

The final step in our analytical approach is to estimate the DRPs of P3 alternatives for the procurement and financing of the infrastructure project. As with the PSC DRP, this is accomplished by adding projections of revenue and cost of a P3 alternative to the pre-project baseline. The data should be sourced from (or at least consistent with) the P3 projections used in the concurrent VfM analysis in order to ensure the analytical integrity of an overall cost and funding evaluation.

For illustration, we consider three P3 alternatives using the standard design-build-finance-operate-maintain (DBFOM) transaction structure.[8] The alternatives differ by revenue source, specifically as to the public-sector sponsor's payment obligations with respect to that revenue. The first alternative, the availability payment (AP) P3, relies on generally fixed and scheduled payments that are the direct obligation of the sponsor as long as the project is in compliance with availability standards. The second alternative, the demand charge (DC) P3, relies solely on fees and other demand-related charges (e.g., tolls) for the project paid by its users, without recourse to the sponsor. These two alternatives broadly encompass actual DBFOM P3 transactions done to date for major infrastructure projects.

The third alternative, which we call a "fiscal index availability payment" (FI-AP) P3, is a hypothetical transaction form included here as an example of how a VfF analysis might encourage innovation in the context of a specific fiscal priority, such as deficit avoidance. The FI-AP P3 is similar to the AP P3, but with payment obligations that are indexed to the sponsor's actual annual budget results during the timeframe, with various contractual adjustments and options (see Sidebar 2).

Sidebar 2: Fiscal Index Availability Payment P3

The Fiscal Index Availability Payment (FI-AP) P3 is a hypothetical transaction structure based on a standard DBFOM availability payment P3. There are two primary modifications. First, the amount of a scheduled availability payment will be adjusted in accordance with a customized index that is based on the public sector sponsor's observable fiscal metrics (e.g., level of general revenue and core operating costs) and designed to be positively correlated as closely as possible with overall annual fiscal results. Second, the FI-AP P3's investors will earn a targeted return that (in view of the uncertainty of payment levels) will be achieved by varying the length of the P3 concession term. If the fiscal index generally exceeds long-term projections, the concession will end earlier. If the index is generally lower, then the concession will be extended. The sponsor will have various termination payment options during the term.

For the public-sector sponsor, the indexed payment amount will mitigate fiscal stress during a downturn and automatically provide fiscal discipline during better times. The private-sector P3 investors rely on the credit strength of the sponsor for payment (which will keep the cost of capitalization somewhat competitive with PSC alternatives) and on the long-term value of the project (which mitigates downside scenarios). This reliance will align long-term incentives with respect to the sponsor's fiscal health and maintenance of the project's value.

Components of the FI-AP P3 concept have precedents in actual infrastructure P3 transactions, notably inflation-indexed P3 contracts and capitalization, public–private risk-sharing arrangements, and variable term P3 concessions.

Variable-term P3 concessions, though not widespread, have been successfully done for toll roads in Chile and the United Kingdom, including the use of one specific approach, the "least present value of revenues" (LPVR). In effect, a LPVR auction requires P3 investors to propose a fixed target return (the concession length then varies to allow them to achieve it). A FI-AP P3 could presumably use many of the same mechanics and procedures. See Vassallo [2005] and Engel et al. [2002]. More generally, the fundamental rationale for the LPVR and the FI-AP P3 forms is the same; both use the long-term value of an infrastructure asset as the basis for the private sector to provide a "fiscal shock absorber" for the public sector in a cost-effective and transparent way.

Exhibit 3 shows example DRPs for the three P3 alternatives. As with the PSC DRP, the expected planning case for all the P3 DRPs shows a zero deficit at P50 but their respective effects on the baseline are otherwise different.

The AP DRP illustration is quite close to the PSC DRP. This reflects an assumption for the AP P3 illustration that public-sector payment obligations, although contingent to some degree, would need to be assumed to be basically fixed for budget purposes. This would be the case in an actual project where unavailability was rare and unexpected costs were few (e.g., a bridge or a highway). As a result, the inflexible nature of annual funding requirements for the AP P3 would, in fact, be almost the same as for the PSC, and the resultant DRPs would be similar. In this illustration, the AP P3 might have value with respect to public-sector funding in another way (e.g., subordination of P3 contract payment obligations to the sponsor's general obligation bonds),[9] but it is not related to deficit avoidance.

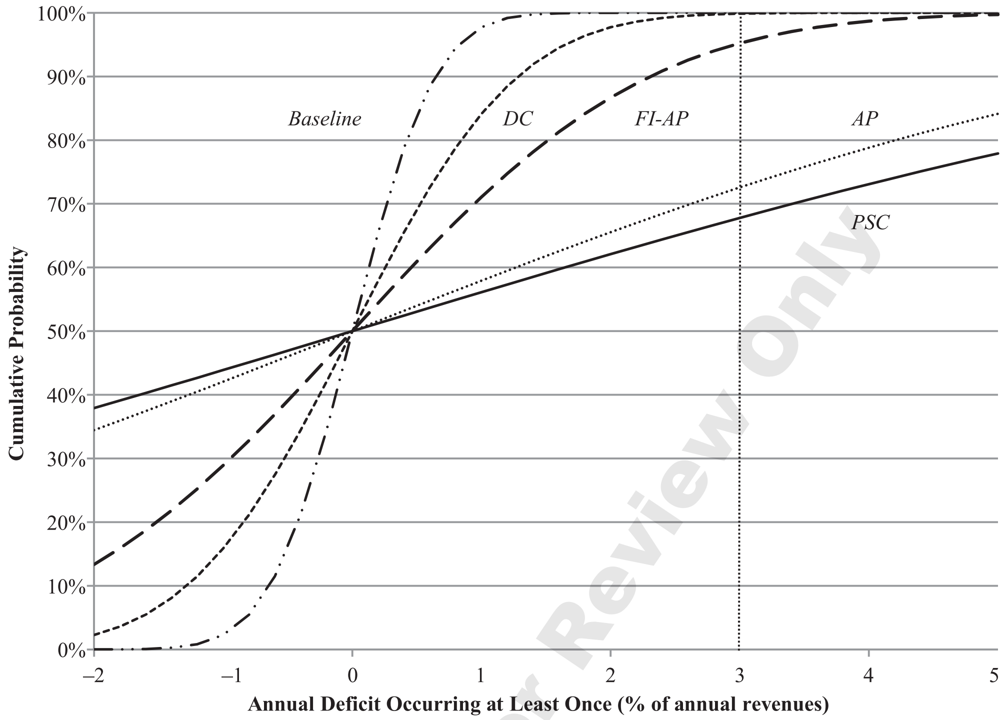
In contrast, the DC DRP is only slightly different from the pre-project baseline DRP, reflecting the assumptions that this P3 type does not rely on fixed payments from the sponsor and that the sponsor has few other funding obligations to the project. As such, the DC P3 has only a negligible effect on the sponsor's annual budget over the long term and easily complies with the 3% deficit avoidance threshold.

But this degree of deficit mitigation is likely to come at a steep price. In most cases, and especially for pure greenfield projects, debt and equity capital for a P3 that relies solely on demand charges (if available at all) will be far more expensive than the sponsor's direct recourse financing alternatives, even excluding tax-exempt options. This higher cost of capital will naturally be a part of the VfM cost comparison to the PSC, and in the absence of other cost-reducing factors, the value of deficit avoidance under this analysis would need to overcome a significantly negative VfM result. Such factors could include the ability for the DC P3 to significantly reduce construction or operating costs in ways that are not available to the PSC, or some sharing of demand risk with the public-sector sponsors,[10] both of which have real world precedents. Importantly, the DRP analysis can add a fiscal context to evaluating these factors when difficult or controversial trade-offs are required.

The DRP illustration for the hypothetical FI-AP P3 alternative assumes that payment obligation indexing is an effective (although not perfect) way to mitigate deficit risk by positively correlating the amount of annual payments with annual budget metrics. But the public-sector sponsor is still obliged to make scheduled payments, and the indexed amount may not be sufficiently lowered (due to imperfections in the index, cost floor levels, and so on) to eliminate deficits in a bad year. The FI-AP DRP is therefore better than the straight AP P3 case but worse than the DC P3. The illustrated FI-AP DRP crosses the 3% threshold at about P95, which might be a realistic planning level for avoiding a severe (but not catastrophic) consequences.

In actual situations where sponsor deficit risk is driven more by the volatility of revenues than by occurrences with a permanent effect, a FI-AP P3

EXHIBIT 3
P3 Deficit Risk Profiles



approach might represent an efficient compromise. The FI-AP P3 cost of capital will reflect some uncertainty as to the timing of payment, but in general, the contract is with recourse to the sponsor, which should permit a more credit-based project financing structure. As a result, the VfM analysis between the FI-AP P3 and the PSC is likely to be more favorable, even where other cost-reducing factors (e.g., a significant reduction in project operating costs) are not physically possible or politically feasible.

CONCLUSION AND NEXT STEPS

Our limited objective in this article has been to outline the rationale and basic methodology for a stochastic analysis of P3 alternatives for infrastructure projects with respect to the public-sector sponsor's deficit risk. We think that the outline in itself is useful as a way to clarify and organize concepts to consider this aspect of P3 value on a qualitative basis. In addition, the outline serves as an example of the type of stochastic analytical tool focused on fiscal issues that might be developed within a broader VfF framework.

To determine whether the DRP analysis methodology presented here is a practical tool for quantitative analysis of specific transaction proposals is a different objective and requires further research. We believe that this might be efficiently achieved by analyzing the historical results of a particular infrastructure project that was financed with a P3 where there are also sufficient fiscal data available about the public-sector sponsor to create a realistic counterfactual PSC case. Historical P3 and counterfactual PSC DRPs could be modeled retrospectively and compared. Because P3s are relatively new in the United States, this approach may be limited with respect to historic timeframe. However, if the timeframe includes the 2008 financial crisis and the subsequent Great Recession (which is true for a number of P3s completed in the mid-2000s), the analysis will incorporate an actual situation of severe downside stress. Comparison of P3 and PSC DRPs in this situation alone could be quite illuminating.[11]

Finally, we would like to stress in general the importance of developing precise analytical tools for evaluating P3s as the foundation for successful innovation with respect to public-sector funding and fiscal issues.

This will be a common theme in our series of articles on the Value for Funding framework. P3s are often discussed as a general "solution" for the infrastructure challenges faced by the public sector in a time of fiscal constraints. But a solution requires a clear understanding of the problem, and often the devil—and specific, measurable value—is in the details. Adding an explicit funding and fiscal dimension to the evaluation of infrastructure project delivery and financing alternatives will help expand the solid bases for innovative P3 solutions.

ENDNOTES

[1]The Value for Money or VfM assessment methodology has been developed and refined for the past several decades in places where P3 infrastructure programs and transaction are prevalent, especially Australia and Europe. Its adoption as a standard methodology in the United States is expanding as interest increases in P3 alternatives to traditional procurement and operation of infrastructure assets. Importantly, there are a number of VfM educational efforts underway. See, for example, IPD [2012] and NCPPP [2012].

Cost comparison is the primary focus of a VfM analysis, but it is well recognized that the ultimate objective is to determine value. In Sabol and Puentes [2014], for example, the VFM discussion includes the following: "PPPs are rarely the lowest-cost way to procure infrastructure for several reasons…. Despite these limitations a well-structured PPP can deliver better value for the public dollar. This value can be derived in a number of ways." The discussion goes on to note several efficiency-enhancing features of P3s, but the point could equally well include fiscal context.

[2]It is important to note that revenue volatility itself can be a challenge for a state or local government that otherwise enjoys positive long-term secular trends and sound current finances. See Pew [2015]. Even when budget surpluses are as frequent as shortfalls, unpredictability narrows the scope for confident long-term infrastructure planning. This would be true even if surpluses did not cause their own set of practical investment and political issues, which they frequently do.

[3]White [2014] suggested that 8.5% of annual spending is the minimum budget reserve that U.S. states should maintain to ensure against revenue volatility. The actual current level, after adjusting for wealth funds at two oil-producing states, is approximately 3.4%, or less than half the recommended minimum.

[4]Sophisticated stochastic modeling methodologies, including a variety of Monte Carlo simulation techniques, are widely used in financial analysis, where uncertainty is intrinsically a primary focus. As the public sector increasingly recognizes uncertainty and revenue volatility as serious long-term challenges, stochastic techniques are being applied to fiscal analysis as well. This is already evident at the national level in many places, especially emerging markets but also for developed countries that face exogenous budget restrictions (e.g., fiscal rules imposed within a monetary union like the Eurozone). See Porter [2007] and Medeiros [2012] for two examples (among others) of highly developed national-level stochastic fiscal analyses.

Such national-level stochastic methodologies may be useful by analogy to U.S. state and local governments. Like smaller countries in the Eurozone, U.S. states and larger cities are within a macroeconomic and monetary policy environment over which they have no control, have severe restrictions on running budget deficits, face long-term growth and demographic challenges, and cannot rely on outside sources if a fiscal crisis erupts. In effect, both groups are on their own in an increasingly uncertain world.

Groundwork for expanding the use of stochastic methodologies for fiscal management by U.S. state and local governments is already being laid in the United States. The Government Finance Officers Association (GFOA) has published several papers on the basics of the approach. See, for example, Savage and Kavanagh [2014].

[5]The practical usefulness of the approach outlined in this article will depend in specific situations on the availability of data about the public-sector sponsor. Most public-sector entities that are large enough to contemplate a large infrastructure project will have a long and accessible history of budgetary data, especially if they issue publicly traded and rated bonds. In many cases, these data will have already been analyzed and key fiscal metrics will have been summarized, which is an important practical consideration for efficient modeling. For example, White [2014] bases reserve stress-test models on data from the National Association of State Budget Officers (NASBO) in addition to their own databases at Moody's Analytics. Summary reports that focus on specific metrics and rankings are done by policy-oriented institutions and organizations on an annual basis. See Arnett [2014], NASBO [2014a, b, c], and NLC [2014].

Accurate estimates of long-term volatility are perhaps the most important metrics to determine for a stochastic projection model. Variation metrics can be directly derived from historical data and may also be already estimated for specific fiscal policy analyses. See, for example, Appendix C of Pew [2014].

[6]See Note 3.

[7]See CBO [2015]. In terms of percentage of GDP, current infrastructure investment by the U.S. public sector is at some of the lowest levels ever recorded. This is due in part to the fiscal constraints at the federal level, but it is indicative that state and local governments—which are at the front lines

of infrastructure issues with respect to local economic competitiveness and quality of life—are unable or unwilling to make up the difference despite otherwise favorable conditions for capital investment.

[8]There are forms of infrastructure P3 transactions that do not include long-term financing. For example, a design-build (DB) P3 can capture potential efficiencies and cost-savings during construction by a private-sector firm combining project phases that are often separate in traditional procurement. This can lead to a positive VfM result for the DB P3. But the long-term DRP of a DB P3 will be similar to the PSC or AP P3 DRPs due to similar levels of long-term fixed obligation in these cases.

[9]In many cases, public-sector capital budgeting rules require that obligations associated with a P3 availability contract be treated as debt, as do the rating agencies in general. This will limit the form's usefulness with respect to off-budget or off-balance-sheet accounting. But other types of substantive value are recognized. From Parker [2013]: "While the availability payments are backed by a high quality commitment, the payments are normally subordinate to the agency's existing debt obligations and, in the case of most public agencies, subject to appropriation."

[10]See Buckberg [2015] for a detailed summary of issues and recent innovation in P3 demand risk sharing.

[11]The history of the Indiana Toll Road (ITR) might be a particularly appropriate research subject for this purpose because its bankruptcy was caused by the Great Recession (which reduced demand and toll revenues to unexpected levels), not by a failure of the function or basic utility of the infrastructure asset itself. Although ITR's bankruptcy was obviously a negative outcome for the private-sector investors, the public sector in effect realized the value of the P3's "insurance" features at a time of economic stress. This perspective is sometimes lost in the generally negative press. From Goldsmith [2015]: "These losses and bankruptcies [as in the ITR case] confuse the public, although an area for further research would be to explore whether such investor losses were in a sense public gains, given that governments collected upfront payments and reinvested the proceeds."

In addition, the counterfactual case in an ITR DRP analysis may be relatively straightforward. Indiana used the proceeds of the concession sale to fund an extensive infrastructure program. The counterfactual case could assume that this same program was instead funded by issuing general obligation bonds with fixed debt service. The impact of the hypothetical additional debt service through the Great Recession would be added to historical results to develop counterfactual budgets during the period. The counterfactual budgets could then be compared with actual budget results with the P3 in place.

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