Default Probability Assessment for Project Finance Bank Loans and Basel Regulations: *Searching for a New Paradigm*

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KEY FINDINGS

- Probability of default estimation and subsequent impact on credit risk capital is important for project finance lenders in India especially after emerging Basel III reforms and subsequent discussion papers on credit risk capital. (Informally called as Basel IV)
- The authors suggest a cash flow simulation model developed using risk parameters "specific" to each project. The application of the model is shown on a road project and it calculates cumulative default risk probability of the project.
- The article argues that this model will result in better assessment and monitoring of credit risk. Authors also suggest new rules for engagement for the project finance lenders in the emerging regulatory scenario.

ABSTRACT: *Syndicated loan data from India suggest that despite the pressure on margins and volumes, available "bankable" deals in infrastructure are still strongly contested by commercial lenders. With the implementation of Ind AS accounting norms (IFRS) for commercial banks, the expected credit loss–based provisions have to be set by the bank based on internally estimated probability of default (PD) for different loan portfolios. This change may lead to heavier risk-weighted capital requirements for banks, thus impacting the project finance business. Basel III norms and subsequent discussion papers propose a revised standardized approach doing away with internal modeling approaches and introduction of standardized output floors for specialized lending, including project finance. In this light, the authors present a cash flow simulation model to address the issue of PD estimation by simulating key risk factors. This method may be useful as each project and each sector is unique and so are the risks associated with it. Thus, the authors argue that the use of a simulation model will result in better assessment and monitoring of credit risk than conventional assessment methods, leading to lower default rates and therefore lower capital charge. The authors then suggest some new rules of engagement for project finance lenders to stay relevant in the changing regulatory scenario.*

TOPICS: ***Simulations, project finance, credit risk management****

Syndicated project finance loans in India grew by 24% during the first quarter of 2019 over the previous year, largely riding on two major project finance bank loan deals to Hindustan Petroleum and Mumbai Metro. Two Indian banks, the State Bank of India and Yes Bank, feature in the global league tables with volumes of USD 4,726 million and USD 1,459 million, respectively. In general, however, apart from the mega deals, a slowdown is apparent. Syndicated lending in Asia Pacific totaled USD 84.7 billion during the first quarter of 2019, a 35% decline over a year ago and the slowest period of lending in the region since 2012. China and Singapore loans each registered a 78% year-on-year decline (Refinitiv 2019).

It is clear from the decreasing volumes and pressure on margins for large-scale projects that available "bankable" deals in infrastructure are still strongly contested by commercial lenders. An acute funding gap exists at the smaller end of the market, especially where the projects are being developed by sponsors who don't have particularly strong institutional relationships with commercial lenders.

What has led to massive decline in the volumes of project finance bank loans is also the fact that the majority of project finance deals involve infrastructure assets that are long term and are therefore subject to various risks, including those due to policy changes, delays in clearances, macroeconomic conditions, and political factors. Every event that delays the implementation of a project leads to cost and time overruns that in turn have a bearing on the techno-economic viability of the project or would necessitate revision in the price of the end-product. Very often the infrastructure products are meant to serve the public good, which imposes a limitation on the ability to determine its price. This limitation compounds the project-specific credit risk in this sector. Given the significant rankings of a few Indian banks in project finance "league tables," the project-specific credit risk may in turn lead to higher capital charges for the lending banks, particularly when some of the mitigants traditionally used to alleviate regulatory capital concerns may no longer be available to banks.

Within the Basel II framework for assessing the risk-based capital requirements, banks using the internal ratings–based (IRB) approach, treat project finance and similar structured financing for infrastructure and physical assets as "specialized lending." In the Basel III reforms (BCBS 2010), the heavier risk-weighted capital requirements and new leverage ratio constrain banks' lending overall, while the net stable funding ratio (NSFR) particularly affects longer-term assets, including project finance loans (BCBS 2014). Following Basel III, the Basel Committee has continued to revise the capital framework, publishing a series of proposals that market participants are already calling Basel IV. Basel IV proposes restrictions on application of the IRB approach (that use bank estimates of model parameters) for project finance and other specialized lending, leaving only the revised standardized approach and the IRB supervisory slotting approach (BCBS 2016).

We argue that project finance bank loans are an important tool for supporting economic growth through the financing of investment in infrastructure. Indian banks have high exposure to assets in the infrastructure sector. Infrastructure assets are stressed and the higher capital requirements in the emerging Basel III/IV reforms are predicted to have a particularly restrictive impact on established lenders in India.

Furthermore, with the implementation of Ind AS accounting norms for commercial banks, the expected credit loss (ECL) based provisions have to be set by the bank based on internally estimated probabilities of default for different loan portfolios. One of the key limitations of PD estimation for infrastructure loan exposures is the low historical default incidence. This may, in turn, make it difficult for banks to estimate PD for the purpose of using the revised standardized approaches as suggested by Basel IV.

This article is organized in three sections. The first discusses the present framework of Basel regulations and project finance. The second addresses the issue of PD estimation by simulating key risk factors (taking an example of a road project) and examines the impact of these factors on projects asset value and debt service coverage ratio (DSCR). The advantage of simulation-based PD estimation is that the banks will not have to rely on historical default performances of such loans and the PD of each individual transaction can be modeled using this approach. Additionally, the simulation-based approach provides a powerful early warning signal for monitoring default.

The third section addresses the larger issue of new rules of engagement that project finance bankers in India should adopt, typically in the light of changing regulatory scenario. The authors suggest a paradigm shift for Indian banks involved in project lending by using such approaches as selling syndicated loans in the secondary market. Last but not least, the third section suggests that banks can leverage, for a fee, their asset management and monitoring capacities for the benefit of other long-term institutional investors in project vehicles.

BASEL ACCORDS AND PROJECT FINANCE

The Basel Committee on Banking Supervision (BCBS) sets global standards that are adopted by the Reserve Bank of India (RBI). Since 2008, the RBI has prescribed the methodology specified as the New Capital

Exhibit 1
IRB Approaches for Different Asset Categories

Asset Class		IRB Approach		
	Traditional Corporates		Foundation	Advanced
Corporates Loans	Specialized Lending	Foundation	Supervisory Slotting Criteria	Advanced
Retail Loans			Advanced	
Equity			Market Based PD/LGD	

Increasing Complexity and Data Requirement →

Decreasing Regulatory Capital Requirement

Adequacy Framework, under which Indian banks have to use a *standardized approach* to measure credit risk capital. In 2012, the RBI allowed banks to migrate to IRB approaches for credit risk capital estimation under Basel II guidelines. Depending on their internal credit risk measurement capabilities, a bank could apply either the *foundation IRB approach* or the *advanced IRB approach*.

The IRB approaches, described in Exhibit 1, allow banks, subject to the approval of the RBI, to use their own internal estimates for some or all of the credit risk components—probability of default, loss given default (LGD), exposure at default (EAD), and effective maturity (M)—in determining the capital requirement for a given credit exposure.

Within the Basel II framework, the IRB approaches would treat project finance and similar structured financing for infrastructure and physical assets as '"specialized lending" (SL). According to this methodology (specified since 2008), the corporate asset class includes, but is not limited to, four separate subclasses of SL. These subclasses include: project finance (PF), object finance (funding the acquisition of such physical assets as ships, aircraft, and satellites), commodities finance (structured short-term lending to financial reserves, inventories, or receivables of exchange-traded commodities), and income-producing real estate (IPRE).

The regulatory capital requirement for project finance loans is determined under one of the following three approaches:

1. The foundation approach,
2. The supervisory slotting criteria (SSC) approach or the simplified rating method, or
3. The advanced approach.

The application of these approaches depends on a bank's ability to meet the requirements for estimation of PD, LGD, and EAD. Banks that can meet the requirements for estimation of all three risk parameters (PD, LGD and EAD) can use the advanced IRB approach.

Banks that meet the requirements partially and can estimate only the PD will be able to use the foundation approach to derive risk weights for SL subclasses, subject to RBI approval.

Banks that cannot meet the requirements for the estimation of PD under the IRB approach (and many banks could not, as historical default data were scarce), will be required to follow the SSC approach: they will be required to map their internal grades to five supervisory categories (including a default category), each of which is associated with a specific risk weight. Supervisory rating grades for project finance exposures are Strong, Good, Satisfactory, and Weak.

The IRB approach to capital calculation for credit risk is based upon measures of unexpected losses (UL) and expected losses (EL). Exhibit 3 shows EL and UL risk weights for SL exposures using these supervisory categories (Exhibit 2).

RBI allows banks (on a case-by-case basis) to assign a "preferential risk weight" to SL exposures falling into the Strong and Good supervisory categories. In such a case, the corresponding EL risk weight is 0% for Strong exposures and 5% for Good exposures (instead of 5% and 10%, respectively, as mentioned in Exhibit 3).

For SL exposures subject to the supervisory slotting criteria approach, the capital charge amount is 9% of the risk-weighted assets (RWA) produced. So, combining the UL and EL risk weights, we can calculate risk

Exhibit 2
UL and EL Risk Weights (specialized lending)

Supervisory Category	Strong	Good	Satisfactory	Weak	Default
External Rating Equivalent	BBB– or above	BB+ or BB	BB– or B+	B to C–	Not applicable
UL Risk Weight	70.00%	90.00%	115.00%	250.00%	0.00%
EL Risk Weight	5.00%	10.00%	35.00%	100.00%	625.00%

Source: BCBS 2019.

Exhibit 3
Capital Charge

Supervisory Category	Preferred	Strong	Good	Satisfactory	Weak	Default
Risk Weight (UL + EL)	50.00%	75.00%	100.00%	150.00%	350.00%	625.00%
Capital Charge (at 9% of total risk weight)	4.50%	6.75%	9.00%	13.50%	31.50%	56.25%

Source: BCBS 2019.

weights and capital charge according to rating grade, as seen in Exhibit 3.

As is clear by these calculations, and also as argued by Scannela (2013, p. 223), in most cases banks using IRB approaches would have equal or lower capital requirements than banks using the standardized approach.

The Basel III guidelines formulated after the Global Financial Crisis of 2007/2008 aimed to strengthen the regulatory capital as well as the liquidity coverage that banks maintain (BCBS 2013). The guidelines are in the process of implementation in India and are scheduled to be implemented by March 2020. Basel III advises banks to improve both the amount and quality of capital to be maintained against risk-weighted assets. According to the guidelines, a higher proportion of required capital must be in the form of common equity; capital "buffers" effectively increase the capital requirement and still higher capital requirements apply to globally systemically important banks (G-SIBs). Furthermore, banks will be required to maintain at least 3% common equity tier 1 capital against gross assets and off-balance-sheet items (without any risk weighting), effectively limiting their leverage to 33.33x. The liquidity coverage ratio (LCR) requires commercial lenders to hold "high-quality liquid assets" at least equal to 30 days' projected net cash outflows in a highly stressed scenario, while the net stable funding ratio (NSFR) will require banks to have "available stable funding" at least equal to "required stable funding," meaning they will need to fund more of their longer-term assets (such as project finance loans) with more costly equity or longer-term obligations. Of these changes, the heavier risk-weighted capital requirements and new leverage ratio constrain banks' lending overall, while the NSFR particularly affects longer-term assets, including project finance loans.

Following Basel III, the BCBS has continued to revise the capital framework, publishing a series of proposals that market participants are already calling "Basel IV." These include proposed revisions to the standardized approach for calculating risk-weighted assets, including methods to determine risk weights using measures in addition to or instead of external credit ratings. Under these proposals, a project finance loan that does not have an issue-specific external credit rating (or where the use of such ratings is not allowed) would have a risk weight of 150% during the construction phase and 100% during the operation phase.

As we have seen in this section, under the Basel II standardized approach, an unrated claim on a corporate borrower would have a risk weight of 100%, and under the Basel II IRB provisions on specialized lending, the risk weights range from 70% to 250% (Exhibit 3). Basel IV standards also propose "capital floors" that would require commercial lenders using the IRB approach to maintain a minimum level of aggregate capital by reference to the aggregate capital that would be required under the standardized approach. Thus, even commercial lenders using the IRB approach would be affected by higher risk weights applicable under the revised standardized approach. Basel IV also proposes restrictions on application of the IRB approach to project finance and other specialized lending, leaving only the standardized approach and the IRB supervisory slotting approach (BCBS 2016).

All of these methods continue to rely on ratings that include both qualitative and quantitative factors. In project finance, however, each sector is unique and so is each project. So, we suggest a methodology to measure individual project-specific credit risk on the basis of an objective PD estimation. Even if we assume that the advanced approaches may not be adopted very soon in India, the imminent implementation of IFRS accounting standards suggests that banks will have to internally estimate the expected credit losses under Ind AS-109. However, individual bank's project finance loan portfolios are concentrated with large exposures to a few projects. *Default data thus has very few data points and statistically significant PD and LGD estimates are difficult to derive.* This article suggests a cash flow simulation–based approach to estimate project-specific probability of default. The authors argue that the use of simulation model will result in better assessment and monitoring of credit risk than conventional assessment methods, leading to lower default rates and therefore lower capital charge.

A SIMULATION-BASED APPROACH TO ESTIMATING PROBABILITY OF DEFAULT FOR PROJECT FINANCE LOANS

The simulation approach for calculating PD for project finance loans is based on cash flow estimations. Thus, the starting point is the preparation of a cash flow model of a project.

The parameters of project finance include the following:

- *Financial strength*—financial ratios and stress analysis;
- Market and economic conditions;
- Enforceability of contracts, collateral, and security;
- *Transaction characteristics*—design and technology risk, construction risk, completion guarantees, track record and financial strength of contractor, and supply risk;
- *Strength of sponsor*—track record and support.

Development of the project's cash flow projections incorporating debt-servicing capacity is the main tool for just about every aspect of analyzing and negotiating the project finance structure.

For long-tenure, heavily leveraged transactions, such as project finance, a free cash flow/weighted average cost of capital approach to valuation may not lead to ideal results, as capital structure changes over time and tax rates may not be constant over the transaction period. Ruback (2002) came up with a capital cash flow (CCF) approach to value heavily leveraged and risky project finance assets. The CCF approach includes all cash flows available to capital providers, including interest tax shields. Therefore, it equals profit after tax plus depreciation less capital expenditure and increase in working capital plus the interest paid to debt providers. The interest tax shield decreases taxable income and therefore increases after-tax cash flows. In other words, CCF becomes equal to free cash flows plus interest tax shields. Thus,

$$\begin{aligned} \text{CCF} &= \text{Profit after tax} + \text{Depreciation} \\ &\quad + \text{Interest} - \Delta\ \text{NWC} - \text{Capex} \end{aligned}$$

The capital cash flows are discounted at the cost of assets, which in turn depends on the riskiness of assets and need not be re-estimated every time when capital structure changes.

Finally, based on the projected CCF and the amount of debt (principal plus interest) that has to be serviced in each period, the periodic debt service coverage ratio (DSCR) and the average debt service coverage ratio for the project can be estimated over the project life cycle (Equation 1).

$$\text{DSCR} = \text{CCF}/\text{DS} \tag{1}$$

where CCF = Capital cash flow and DS = Debt service.

In our model, we have replaced cash flow available for debt service (CFADS) or the net operating income with capital cash flows. Although not identical, in our opinion the formula for CCF mathematically will be almost equal to CFADS or the net operating income.

$$\text{DS} = \text{Principal} + \text{Interest}$$

It is assumed that the project lender would have done sensitivity checks on the key risk assumptions of the CCF, particularly those related to consulting reports, engineering studies, and traffic projections (for a road project). While preparing the cash flow model, it is also assumed that all requirements regarding creation of reserves and liquidated damages (wherein the contractual counterparty pays for time overruns and quality shortfalls/equipment underperformance, etc.) to cover time and overrun costs have been taken care of.

Monte Carlo simulations of key risk factors can provide better insights into the probability distribution of the financial viability measures like loan life coverage ratio, net present value (NPV), and debt service coverage ratio. The DSCR is defined as net operating income divided by total debt service. As mentioned earlier, the formula for CCF mathematically will be almost equal to the net operating income. Furthermore, given that a DSCR greater than 1 is a necessary condition for the project to be able to service its debt during the tenor of loan facility, the equation for the probability of default can be expressed as follows:

$$\text{Probability of default (PD)} \Rightarrow DSCR_t < 1 \quad (2)$$

where $t = 1, 2, 3, \ldots, n$ and $DSCR_t$ represents the DSCR of the project at time t and equals CCF_t/DS_t, as per Equation (1).

Now if we use Monte Carlo simulation, the results can identify the proportion of scenarios out of the total simulated scenarios in which DSCR can fall below 1 for any time period. Thus, a cash flow–based measure of PD for the project at time t becomes:

$$PD_t = \frac{\text{No. of scenarios CCF} < (P + I)}{\text{Total no. of scenarios CCF}} \quad (3)$$

where

P = principal payment

I = interest payment

$P + I$ represent debt repayments at time t

The cumulative probability of default (CPD) at any time n represents the probability that there will be a default on the project debt any time up to period n and can be estimated by measuring the number of scenarios in which default has occurred up to time n as a proportion of the total number of simulated scenarios.

$$CPD_n = \frac{\text{No. of scenarios of default (for } t - 1, 2, 3, \ldots, \text{n)}}{\text{Total no. of scenarios of CCF}} \quad (4)$$

We now present the application of this simulated cash flow model on an illustrative case.

ILLUSTRATIVE CASE STUDY: COIMBATORE BYPASS ROAD PROJECT

The Coimbatore Bypass was the first road project to be implemented in South India on a build, operate, and transfer (BOT) basis. The road ran between Neelambur and Madukkarai in southern India. The project involved construction of a 28-kilometer-long two-lane bypass road, the 32.2-meter new Athupalam bridge across the river Noyal, and the railway overbridge at Chettipalayam. Larsen & Toubro (L&T) was authorized to collect and retain the fee from users of the new and old Athupalam bridges. The bypass was expected to ease the traffic congestion in Coimbatore city, Tamil Nadu, and the Salem-Cochin national highway running between Tamil Nadu and Kerala (states in southern India). Anticipated users of the new road included shippers sending goods through the port of Cochin. The project cost was about USD 15 million. The project concession period was for 12 years.

L&T set up a special purpose vehicle (SPV) called L&T Transportation Infrastructure Ltd. (LTTIL) to implement the project. L&T held 100% of the equity in LTTIL. LTTIL implemented the project on a BOT basis, with the revenue accruing directly to it. The project was constructed by L&T Construction, one of the largest construction organizations in India.

The project was financed by share capital of USD 6 million and term loan of USD 9 million, with a debt–equity ratio of 1.5:1. The debt financing was done jointly by State Bank of India (SBI), L&T Finance Ltd., Housing and Urban Development Corporation, Housing Development Finance Corporation, and Industrial Development Bank of India (IDBI). IDBI had sanctioned USD 4 million for the project in the form of infrastructure bonds. The loan was given in two tranches of USD 2 million each at 15% interest rate. Principal repayment was to begin from the eighth year onwards. SBI loaned USD 4 million to the project.

Construction was started in January 1998 and completed in 22 months. The Athupalam Bridge opened for traffic in December 1998, and the bypass became operative on January 19, 2000. L&T faced problems with the tolling of the old Athupalam Bridge, which was not within the route of the bypass. This bridge was an already existing facility being used by the incoming

Exhibit 4
Toll Charges for Using the Coimbatore Bypass Road

Type of Vehicle	Toll Charges per Unit (USD)
Car, Jeep, and Van	0.47
Light Commercial Vehicles	0.70
Heavy Commercial Vehicles	1.40
Multi-Axle Vehicles	2.10

Exhibit 5
Toll Charges for Using the Old Athupalam Bridge

Type of Vehicle	Toll Charges per Unit (USD)
Car, Jeep, and Van	0.13
Light Commercial Vehicles	0.38
Heavy Commercial Vehicles	0.38
Multi-Axle Vehicles	0.05

Source: Public documents, ICMR India (2002).

traffic from Kerala to Tamil Nadu. Transport operators had initially refused to pay the tolls. The Coimbatore District Bus Owners Association and the Lorry Owners Association refused to pay even the subsidized tariff reached after some negotiations. The project went into distress and litigation and was subsequently resolved.

We present below a base-case cash flow model on the revenue and expenses assumptions mentioned in Exhibit 4 and Exhibit 5.

The authors, based on project estimates, use the revenue assumptions given in Exhibit 6. The revenue assumptions are based on traffic growth data in 1998 (Indiastat 1998).

The Coimbatore bypass cash flow model is presented in Exhibit 7, which is a representation of 30 years' cash flows.

Based on the cash flow model, the financial viability measures are calculated and presented in Exhibit 8.

The asset value and NPV are calculated using a discount rate of 14%. If we take unlevered asset beta of road projects in India to be 0.7 (Equitymaster 2010), the unlevered cost of equity, using a risk-free rate of 8.50% and risk premium of 8.00% (RBI 2012), is approximately 14.00%.

Using the cash flow projections and the base case financial model, the financial viability of the project in

Exhibit 6
Revenue Assumptions

	Model Assumption
Revenue Assumptions	
Increase in Toll Rate per Annum	5%
Traffic Growth Rate per Annum	5%
Cost Assumptions	
Increase in O&M Costs per Annum	5%
Interest Rate per Annum on Debt	15%

terms of NPV, internal rate of return (IRR), and DSCR is sound. Project asset value is higher than book value of debt and there is no economic reason for default. In any case, equity NPV is positive and equity IRR is significantly greater than the cost of equity.

We now present a sensitivity analysis on key input parameters (revenue, traffic growth rate, and O&M expense). The results are presented in Exhibit 9.

The sensitivity analysis results show that project financial viability is highly sensitive to traffic revenues and growth rate of traffic.

SIMULATION RESULTS

Forecasting of travel demand represents the fundamental step of planning and management of transportation facilities (de Dios Ortuzar and Willumsen 2011). These forecasts are subjected to various sources of errors including error in the measurement of input data, error in the estimated value of model parameters, and error in the specification of the underlying models themselves; also, the model itself may be stochastic, and the scenarios adopted for model forecasting may not necessarily be compatible with the real evolution of the transport system (Wong and Ottomanelli 2011). In a similar study in the road transportation sector, Seger and Kisgyörgy (2018) used Monte Carlo simulation with a general understanding of correlations. To model the probability of default consequence of the identified risks, the simulation approach is used. For this, a time measure was used to model risk consequence and probability. Particularly, the variation in the distribution of possible outcomes, their likelihood, and their subjective values has been examined. The benefit of using simulation is that it assists in recognizing an extreme risk scenario because it can assign a choice of ratings to a particular factor or variable (e.g., min, average, and max). To feed the inputs

EXHIBIT 7

Coimbatore Bypass Base Cash Flow Model: Indicative and Compressed 30-Year Forecast (USD millions)

At the End of Year… #	–2	–1	0	1	2	3	4	12	15	30
Equity Capital (A)	–0.23	–0.45	–0.22	–0.91						
Loan Funds (B)	–1.01	–0.50	–0.25	–1.76						
Total Capital Employed (A + B)	**–1.24**	**–0.95**	**–0.47**	**–2.67**						
Revenue from Operations										
Revenue from Bridge				0.11	0.12	0.13	0.14	0.35	0.47	–
Revenue from Bypass				0.21	0.23	0.26	0.29	0.67	0.92	3.52
Total Revenue				**0.32**	**0.35**	**0.39**	**0.43**	**1.02**	**1.39**	**3.52**
Expenses										
O&M Cost				0.05	0.06	0.07	0.08	0.08	0.10	0.20
Depreciation				0.26	0.24	0.21	0.19	0.07	0.05	0.02
Interest				0.26	0.26	0.26	0.25	0.02	0.01	–
Total Expenses				**0.57**	**0.56**	**0.54**	**0.52**	**0.17**	**0.16**	**0.22**
Profit before Tax (PBT)				**–0.25**	**–0.21**	**–0.15**	**–0.09**	**0.85**	**1.23**	**3.3**
Tax @ 35%				–	–	–	–	0.30	0.43	0.08
Profit after Tax (PAT)				**–0.26**	**–0.21**	**–0.15**	**–0.09**	**0.55**	**0.80**	**3.22**
Cash Flow (PAT + Depreciation)					0.03	0.06	0.12	0.62	0.85	3.24
Less: Debt Servicing				–	–	0.10	0.10	0.33		
Cash Flow for Owners (PAT + Depreciation – Repayment)				–	0.03	–0.04	0.02	0.29	0.85	3.24
Cash Flow for Long-Term Providers (PAT + Depreciation + Interest)				0.26	0.29	0.32	0.37	0.64	0.86	3.2

Note: This exhibit represents cash flows for the project since inception (before and after the commencement of the project) and at the end of specific years (years 12, 15, and 30) of the project.

EXHIBIT 8

Base Case Project Financial Viability Measures

Project NPV (USD millions)	0.83
Project IRR	17.57%
Project Asset Value (USD millions)	4.545
Project Debt (USD millions)	3.525
Average DSCR	2.44
Minimum DSCR	1.26
Equity NPV(USD millions)	0.88
Equity IRR	19.67%

needed for Monte Carlo Simulation, expert opinion was used. Further, graphical version @Risk 6.0 is used to perform the required computations and compute the risks and uncertainties. Prior to this, we computed the probability measure for each risk, corresponding to its risk-likelihood measure (see Exhibit 10). It was based on the opinion of the experts. Then, we assign the sensitivity consequence of each risk driver on performance through expert's opinion. These consequences were modeled as probability distributions. Single simulation and 10,000 iterations were used to analyze the uncertain conditions for the global simulation calculator (GSC) under study, and the outcome is shown in Exhibit 11. The delay/disturbance profiles of the risk consequences were analyzed at a 95% confidence interval.

There was a definite lack of data, particularly because the project dates back to 1998, when the sector was opening up. However, there is academic literature now about risk factors, sensitivity, and assumed correlations. Seger and Kisgyörgy (2018) used Monte Carlo simulation and showed results assuming triangular distributions with a general understanding of correlations. The triangular probability density function (usually the symmetrical triangular distribution) also contains 100% of the possible values. With this distribution however, the probabilities increase linearly from zero to the peak or central value and then decrease linearly at the same rate back to zero. As can be seen

EXHIBIT 9
Sensitivity Analysis

Revenue	Assumption	Average DSCR	Minimum DSCR	Project NPV (USD millions)
Base Case		2.44	1.26	0.83
Sensitivity Parameters:				
Revenues	100% (Base case)			
Revenue short fall of	–10%	2.17	1.13	0.52
Revenue short fall of	–20%	1.89	1.00	2.5
Revenue short fall of	–30%	1.61	0.87	(0.10)
Growth Rate in Traffic	5% (Base case)			
Traffic growth rate of	4%	2.32	1.17	0.69
Traffic growth rate of	3%	2.20	1.08	0.56
Traffic growth rate of	2%	2.09	0.99	0.35
O&M Expenses	5% (Base case)			
Exps growth rate of	6%	2.43	1.25	0.81
Exps growth rate of	7%	2.41	1.24	0.78
Exps growth rate of	8%	2.39	1.23	0.75

EXHIBIT 10
Assumed Probability Distribution for Input Variables

Category	Distribution	Min	Mean	Max
Growth Rate in Traffic Volume	Triangular	12.60	88.09	187
Growth Rate of Traffic Revenue/ Net Flows for Long-Term Fund Providers	Triangular	0	5%	10.00%
Growth Rate in O&M Cost/ Net Flows for Long-Term Funds Providers	Triangular	0	3.35	10

EXHIBIT 11
Simulated Probability Distribution

Particulars	Min	Mean	Max
NPV (USD millions)	(0.61)	3.04	6.23
Asset Value	2.76	6.62	9.73

in Exhibit 10, however, each input variable will have a minimum and maximum value and also a most likely value. The most likely number of values fall between the minimum and maximum values, forming a triangular-shaped distribution, which shows that values near the minimum and maximum are less likely to occur than those near the most likely value. The triangular probability distribution for three key inputs (revenue, traffic growth rate, and O&M expense) is explained in Exhibit 10. The input variables may demonstrate correlated changes in value. The assumed correlations are based on understanding of comovements of risk factors of road projects. For example, for a higher growth in traffic, the operating expenses on road maintenance may also increase and are thus positively correlated. Similarly, growth rate in traffic is correlated to forecasted initial per day traffic. We have used the results of the sensitivity analysis and 10 sets of rigorous deviations (sensitivity) as explained in Exhibit 10 to set up the simulation with the @Risk package.

Ten thousand simulated scenarios are generated on defined input variables for the estimation of project cash flows and generation of probability distributions of multiple outputs namely project NPV, DSCR, and asset value. The summary statistics of the results (Exhibit 12) show that project NPV has a positively skewed distribution. However, this does not suggest that there is no probability of default. We used the approach explained earlier in this article (simulation-based approach) and used Equation (4) to calculate cumulative probability of default. There is a 19.87% cumulative probability that NPV is negative. The minimum DSCR is positive (but less than one) but probability distribution of minimum DSCR (sensitivity shows the same results) shows that there is a cumulative probability of 14.62% that DSCR will be less than 1. Thus, the cumulative

EXHIBIT 12

CRISIL Average One-Year Transition Rate for Structured Finance Obligations, 1992–2018

Rating Category	Issue Years	CRISIL AAA (SO)	CRISIL AA (SO)	CRISIL A (SO)	CRISIL BBB (SO)	CRISIL BB (SO) & Below	CRISIL D (SO)
CRISIL AAA (SO)	3576	98.43%	1.37%	0.14%	0.00%	0.03%	0.03%
CRISIL AA (SO)	943	5.41%	91.62%	2.76%	0.11%	0.00%	0.11%
CRISIL A (SO)	864	1.16%	5.32%	87.73%	1.74%	3.13%	0.93%
CRISIL BBB (SO)	541	2.22%	1.66%	12.20%	80.59%	2.22%	1.11%
CRISIL BB (SO) & Below	115	1.74%	1.74%	4.35%	9.57%	62.61%	**24.35%**
	6039						

Source: CRISIL (2018).

probability of default of the project can be taken as 14.62%. Also, there is a 16.80% cumulative probability that asset value will fall below the book value of debt and thus structural EDF is 16.80%.

To project lenders in this case, who later on faced crisis as bridge operation were disturbed, this simulated scenario would have been a powerful monitoring tool to begin with.

If we map the probability of default of 14.62%, calculated earlier, to CRISIL'S cumulative transition matrix for structured obligations (the nearest equivalent to project finance loans), we find that this probability of default corresponds to a CRISIL rating of BB or lower (Exhibit 12). This analysis would have indicated higher risk weights for the project based on the implied rating. This shows that the project was not as safe as it was presumed to have been on the basis of the static NPV, IRR, and DSCR values. And, it would have definitely incurred heavy capital charges under the IRB approach.

In the final section of this article, we assume that proposed changes in regulation to estimate credit risk capital (popularly called Basel IV) are indeed accepted globally and then subsequently by the RBI. This would mean the elimination of internal modeling under consideration and the introduction of standardized output floors. This would automatically increase risk weights and yield a major increase in capital requirements for long-term project financings and other specialized lending products. This means that project lenders will not just need to find and adopt better credit assessment and monitoring methods but also will also need to find new ways to stay relevant and profitable.

REGULATORY CHALLENGES AND PROJECT FINANCE: SEARCH FOR A NEW PARADIGM

Institutional investors are rapidly increasing their appetite to invest in Indian infrastructure assets. Foreign institutional investor flows into Indian equities are USD 11 billion year to date, surpassing the total annual tally in each of the four previous years and setting 2019 on course for the highest annual inflows since 2012. Pension plans, insurance companies, and sovereign wealth funds are piling into India, buying stakes in everything from airports to renewable energy. Private equity deal activity in India surged to USD 19 billion in 2018, the highest level in at least a decade, according to PitchBook data. We believe that because of their superior appraisal and monitoring skills, however, project finance bank lenders will remain an important source of funds, particularly for initial risk capital. We suggest additional measures that project finance lenders may take in order to mitigate risk due to changed regulations.

Secondary Market Sell-Down

One way commercial lenders have sought to mitigate the requirement to maintain more capital under Basel III is to employ "originate-to-distribute" strategies. At the most basic level, these models allow commercial lenders to originate and underwrite transactions and to subsequently sell them in the secondary market, thus reducing their original requirement to maintain capital. This allows commercial lenders to use their transaction skills to take loans on their books and then to migrate them (often following construction) to a more capital efficient platform.

Rather than approach mitigation on a transaction-by-transaction basis in order to free up capital for future lending, commercial lenders are also increasingly looking to sell portions of their project finance books, either to other commercial lenders or to other types of institutional investors.

Securitization

Alternatively, collateralized debt obligations (CDOs) can be used by banks to facilitate the transfer of risk associated with long-term project financing to capital market investors. CDOs enable commercial lenders to repackage multiple project risks associated with an underlying portfolio of bonds or loans into a single marketable security. The term CDO covers both collateralized bond obligations and collateralized loan obligations (CLOs).

Advisory for Other Long-Term Lenders

Global sovereign wealth funds, pension funds, private equity, and other non-bank institutional investors are increasingly seeking exposure to infrastructure assets in India as investment and regulatory environment has improved. Also, with the introduction of insolvency and bankruptcy code, legal issues regarding asset distress and restructuring have been addressed. However, such investors often do not have the transactional specializations or the agency and asset management capabilities to originate and/or deal with large-scale portfolios of project finance loans. The recent transaction between a commercial lender and one of the United Kingdom's largest pension funds perhaps flagged a new direction for sales of portfolios of loans to institutional investors in the UK, with the relevant bank retaining an interest in a USD 3.1 billion portfolio of loans sold (presumably for administrative and/or credit retention reasons) and undertaking to monitor credit and manage the portfolio for the relevant fund in return for a fee. This can be also be a new rule of engagement for banks in India (Mayer 2017).

CONCLUSION

Given the quantum of funds required and the reluctance of banks to fund large-scale project assets, Indian infrastructure investments increasingly look at other long-term sources of finance. However, syndicated loan markets and project finance bank loans still play a large part in providing initial risk capital to projects. Bank loans have an advantage over market-driven long-term funds as they are easy to negotiate in times of distress and provide excellent monitoring of projects. However, the emerging Basel III reforms and subsequent discussion papers on credit risk capital are predicted to have a particularly restrictive impact on established lenders in India. In this regard, authors conclude that it is important now to explore and find ways to address the challenges of managing credit risk and to navigate the new rules of engagement in this changing paradigm for project finance lenders. One of the key limitations of credit risk capital estimation for infrastructure loan exposures is the low historical default incidence. This may make it difficult for banks to estimate probabilities of default using historical transition matrices once the revised standardized approaches, as suggested by the revised regulations, are implemented. The authors present a cash flow simulation model to address this issue by simulating the underlying drivers of default risk (as explained using the example of a road project). The authors argue that the use of a simulation model will result in better assessment and monitoring of credit risk than conventional assessment methods, leading to lower default rates and therefore lower capital charge. The authors also suggest some new rules of engagement for project finance lenders to stay relevant. These include selling syndicated loans in the secondary market, securitization, and leveraging bank's asset management and monitoring capabilities for the benefit of other long-term investors. There is no doubt that in the coming years commercial bank lenders will have to grapple with and find solutions to regulatory restrictions to participate in this market. But large institutional investors are eyeing these assets, which have fairly robust risk profiles and offer returns that match their liabilities. It is time for commercial lenders to work in tandem with these institutional investors and create a win–win business model.

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ADDITIONAL READING

Turning Around Distressed Project Finance Assets in India: *What More Needs to Be Done?*
Vikas Srivastava and Surya Dashottar
The Journal of Structured Finance
https://jsf.pm-research.com/content/24/3/52

ABSTRACT: *With the Insolvency and Bankruptcy Code firmly in place, India's distressed project finance assets are turning out to be attractive to institutional investors. Project finance assets need asset- and deal-specific financing solutions in order to achieve successful turnarounds. The turnaround solution must ensure optimum risk allocation and mitigation leading to the buildup of future cash flows. This will, in turn, lead to deleveraging of stressed balance sheets. The authors present a conceptual model and argue that even now the political and regulatory risks for infrastructure project loans in India have not been completely mitigated. This has resulted in a situation of a debt overhang, wherein even economically viable projects may not attract fresh funding. To address this, the article suggests the possible use of priority funding structures, where existing lenders cede charge of the assets in favor of a new lender as a way to reduce the cost of debt and unlock shareholder value. This solution will also ensure that the restructuring package is properly priced (from the project finance lender's perspective), resulting in the efficiency and viability of the restructured asset.*

Restructuring Project Finance Bank Debt in India: *Information Asymmetry and Agency Costs*
Vikas Srivastava
The Journal of Structured Finance
https://jsf.pm-research.com/content/21/3/106

ABSTRACT: *Mounting non-performing assets (NPAs), particularly for project finance bank loans to public–private partnership (PPP) projects in the infrastructure sector, is a cause of concern for the*

Indian banking industry. In order to tackle the problem of NPAs, the Reserve Bank of India (RBI) advises banks on joint and corrective actions that include early detection of declines in asset quality, infusions of equity, conversion of debt into equity, fresh management commitments, and distressed sales of assets. This article presents a conceptual framework and suggests that in economies such as India's, there is information asymmetry among the key stakeholders of PPP projects. This makes it difficult for banks to structure perfect deals or monitor loans after they have been made. Information asymmetry leads to agency costs for the project as sponsors' actions are sometimes directed at shedding the risk to the banks and exiting the project. The data show that debt has increased and that the interest coverage ratio has declined for infrastructure companies in the last five years. The author calculates the new risk premiums that equity investors will demand as debt piles up in the balance sheets of infrastructure companies. Data from Moody's Investors Service are analyzed to consider the feasibility of distressed asset sales. The author argues for a simple solution: Policies for project finance debt restructuring should aim at, in addition to financial solutions, addressing the structural problems of information asymmetry and agency costs among the key stakeholders. This should lead to a solution for NPAs that is sustainable in the long run.

Project Finance Default in India: ***Implications for Bank Loans to the Infrastructure Sector***

Vikas Srivastava

The Journal of Structured Finance
https://jsf.pm-research.com/content/20/2/81

ABSTRACT: *For large, capital-intensive infrastructure projects, project finance is an attractive financing alternative. The project finance structure attracts high leverage and allows for optimal sharing, allocation, and mitigation of risk among the project parties, equity providers, and financiers. In an ideal situation, the contractual bundle quarantines the developers and financiers. In India, because of a lack of other long-term sources of debt, it is bank credit that funds infrastructure projects. These projects have a higher marginal default rate in the construction period. In India, it is difficult to mitigate regulatory and political risks, particularly risks related to land acquisition and environmental clearances for a project to start. These risks compound the problems of early default and lead to deterioration of asset quality on the books of the banks. Thus, banks have to bear higher capital charges to comply with Basel II norms. This article argues that in uncertain regulatory/political/legal macro-environments, where optimally priced risk mitigants are not available, the use of project finance bank loans to fund highly leveraged infrastructure assets must be reconsidered.*