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Addressing Off-Taker Risk in Renewable Projects in India: A Framework for Designing a Payment Security Mechanism as a Credit Enhancement Device

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May 2018

Technical Paper

Acknowledgements

We would like to acknowledge the contributions of Noam Rosenthal (Stanford University) and Arsalan Farooquee; and thank Elysha Davila, Caroline Dreyer and Angel Jacob for editing and review, and Tim Varga for graphics. We would also like to acknowledge the financial support provided by the Steyer-Taylor Center for Energy Policy and Finance to Noam Rosenthal.

Descriptors

Sector	Electricity/Power
Region	India
Keywords	Payment Security Mechanism; PSM; DISCOM; UDAY scheme; Credit enhancement; Renewable energy; Offtaker risk; Counterparty risk
Related CPI Reports	Driving Foreign Investment to Renewable Energy in India: A Payment Security Mechanism to Address Off-Taker Risk
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Executive Summary

One of the most important risks to the Indian renewable energy sector is the counterparty credit risk, associated with the risk of state-owned utilities delaying or defaulting on their contractual payments to power producers, adding as much as 1.07% of additional risk premium to the cost of debt for renewable energy projects (CPI, 2018), and also limiting the availability of capital.

This risk mainly arises from systematic inefficiencies in the public sector electricity utility sector in India. State-owned electricity distribution companies, or DISCOMs, form the largest set of power offtakers for the Indian renewable energy sector, under long-term power purchase agreements (PPAs) at pre-decided tariffs with independent renewable energy power producers. As a result of these inefficiencies, these companies are plagued by poor financial health.

Mitigating this risk requires long-term structural fixes aimed at solving the systematic failures of the utilities sector through coordinated efforts by the central and state governments and DISCOMs. The Ujwal DISCOM Assurance Yojana (UDAY) program; which envisages financial turnaround, operational improvements, and reduction in power generation costs, is a step in this direction (PIB, 2015).

A Payment Security Mechanism (PSM), as defined in this paper, is a funded capital reserve that provides interest-free working capital to its beneficiary projects in the case of a default event by the DISCOM purchasing its power. While such a PSM may achieve various intended benefits and unintended externalities, the aim of this paper is to provide the framework for designing a PSM to explicitly achieve the intended credit enhancement in its beneficiary projects.

This paper, besides providing a methodology for answering these questions also provides illustrative calculations for a range of sample DISCOMs and prescribes methods using data available in the public domain, and under certain assumptions.

Methodology overview

The payment security mechanism as designed in this study builds on existing work by CPI (CPI, 2016). The approach builds on the existing frameworks for credit guarantees for the purpose of enhancing the credit quality by means of providing protection against defaults/ delays in payment obligations due towards a project.

The study uses a probabilistic methodology, calibrated on empirically derived proxies for past payment history, for calculating the optimum PSM size and the credit enhancement achieved using it for a project selling electricity to a given DISCOM. We consider two piecemeal component risk scenarios: Default by the project owing to all risks outside of the counterparty (DISCOM) risk ; and default by the project owing to the default/ delay on payments by the counterparty (DISCOM).

Next, we study the probability of default by the project in the two cases: without the presence of payment support (the base case), and in the presence of a given payment support mechanism (post-intervention). The base case corresponds to the probability of default associated with the base credit rating of the project, whereas the second probability of default corresponds to the probability of default associated with the target credit rating intended to be achieved by the intervention. The underlying assumption is that, for project finance, credit ratings are completely specified by the probability of default.

The study outlines a five-step process to arrive at the optimal size of the PSM that can achieve the intended goal of the intervention, and also illustrates the results by applying this framework to a representative sample set of 8 diverse DISCOMs.

Key findings

The key insights derived from these results are:

We find that the maximum possible credit enhancement that a PSM can achieve is up to BB rating. Against a target of BBB, this is the theoretical maximum credit enhancement that can be achieved through the use of a payment security mechanism under the assumptions made in the study. Further credit enhancement would require the mitigation of other risk factors beyond the counterparty credit risk.

Projects associated with certain DISCOMs do not require payment security support. For instance, the Gujarat DISCOM requires minimal payment support (1 month or less) to enhance the credit quality of its projects. Similarly, the West Bengal DISCOM, in fact, does not require a PSM to achieve the BB rating limit.

We also find the projects associated with some DISCOMs require impractically high payment support. The unusually high payment support (> 45 months) requirement for Uttarakhand DISCOM, as seen in the results, seems anomalous. On one hand, it may point towards an unusually bad DISCOM. On the other hand, this may be due to the lack of granularity of liability data in the published financial reports, which results in unusually high payments month outstanding (PMO) proxies computed for the Uttarakhand DISCOM.

In general, we find that most DISCOMs require moderately high payment support of 12 months' payment. Barring the above outliers, the rest of the DISCOMs require 8-17 months payment support for associated projects to achieve BB rating, and on average, 12 months of payment support. This translates to a fund size equivalent to approximately 10%-20% of the total capital expenditure of the project being supported. The size requirement for this fund may be further reduced to 6%-18% of the capital expenditure by requiring the DISCOM to furnish a revolving letter of credit of 3 months' payment, thus off-loading part of the cost of payment support to the DISCOMs.

We recommend the adoption of the five-step methodology outlined in this paper by central and state level government agencies looking to provide financial risk mitigation interventions targeting the counterparty risk due to DISCOM default, with an implicit goal of raising the credit profile of affected projects. We recognize the possibility of refining these methods and the resultant outputs in the presence of data currently not available in public domain, but likely available to policy-makers. This requires a coordinated effort between various stakeholders such as central and state governments, DISCOMs, regulators and power aggregators. To make PSMs more efficient over multi-year horizons as well as to assess the cost of implementing such a funded PSM, further research is required.

CONTENTS

1. Introduction

One of the most important risks to the Indian renewable energy sector is the counterparty credit risk, associated with the risk of state-owned utilities delaying or defaulting on their contractual payments to power producers, adding as much as 1.07% of additional risk premium to the cost of debt for renewable energy projects (CPI, 2018), and also limiting the availability of capital.

This risk mainly arises from systematic inefficiencies in the public sector electricity utility sector in India. State-owned electricity distribution companies, or DISCOMs, form the largest set of power offtakers for the Indian renewable energy sector, under long-term power purchase agreements (PPAs) at pre-decided tariffs with independent renewable energy power producers.

However, these companies are plagued by poor financial health owing to leakages in transmission and distribution, poor collection efficiency, government-capped electricity tariffs (Energetica India, 2012). This has resulted in crippling debt and frequent defaults and/or delays in power offtake payments. Renewable energy projects, which are typically financed on a project finance basis, rely on cash flows from the power offtakers for payment of their obligations, primarily for furnishing their debt obligations. Delays or defaults by the offtaker places liquidity strain on the project sponsors, and often limits their ability to make timely debt payments, resulting in debt default.

Mitigating this risk requires long-term structural fixes aimed at solving the systematic failures of the utilities sector through coordinated efforts by involved stakeholders such as the central and state governments and DISCOMs. The Ujay DISCOM Assurance Yojana (UDAY) program by the Ministry of Power, approved by the Union Cabinet in November, 2015, which envisages financial turnaround, operational improvements, reduction in power generation costs and development of renewable energy and energy efficiency markets is a step in this direction (PIB, 2015).

However, short-term solutions are needed to immediately mitigate the counterparty risk faced by project sponsors, and indirectly, by banks, in order to reduce the cost of debt by enhancing the credit profile of projects and/or increase the availability of debt by helping the projects reach investment grade status. Lack of debt capital with the appropriate cost, tenor and terms of lending is an important factor limiting the growth of the renewable energy sector towards achieving the ambitious target of 175 GW of generation capacity by 2022. Mitigating the counterparty risk can help towards achieving this target.

Such short-term interventions would involve assuring debt and equity investors in renewable energy projects of timely payments towards the power sold. There is a precedent of government sponsoring such guarantee mechanisms, called Payment Security Mechanisms (PSMs). However, these interventions have met with limited success (this is discussed further in Section 2). Further, the DISCOMs themselves are government-owned entities. This makes a case for a well-structured government-sponsored intervention to alleviate counterparty risk concerns of investors.

A Payment Security Mechanism, as defined in this paper, is a funded capital reserve that provides interest-free working capital to its beneficiary projects in the case of a default event by the DISCOM purchasing its power. While such a PSM may achieve various intended benefits and unintended externalities, the aim of this paper is to provide the framework for designing a PSM to explicitly achieve the intended credit enhancement in its beneficiary projects. This paper builds upon existing work by the Climate Policy Initiative (CPI, April 2016) as well as the existing PSMs sponsored by the Government of India.

In this process, we seek to answer questions such as:

- How to size an efficient PSM for given project(s) exposed to a given DISCOM as offtaker that can help achieve the intended credit enhancement?
- How does one create a probability distribution for the amount of payables defaulted/delayed on by a given DISCOM?
- How does the probabilistic cash flow distribution, and consequently, the probability of default of a given renewable energy project differ with and without a PSM of a given size?

This study, besides providing a methodology for answering these questions (discussed in Section 3), also provides illustrative calculations for a range of sample DISCOMs and prescribes methods using data available in the public domain, and under certain assumptions. These outputs and their implications are discussed in Section 4.

The authors recognize the possibility of refining these methods and the resultant outputs in the presence of data currently not available to the authors, and likely available to policy-makers and the government. The scope of future work in this regards is discussed in Section 5.

2. Prior Constructs

In this section, we discuss the structures of these three constructs, as well as the reasons for their limited success and/or uptake.

2.1 Scheme A: Jawaharlal Nehru National Solar Mission (JNNSM) Phase 1 NTPC Vidyut Vyapar Nigam Limited (NVVN) PSM

This PSM was implemented in 2011-12 under Phase I of the JNNSM (MNRE No.29/5/2010-11/JNNSM(ST)). Under this scheme, DISCOMs were asked to furnish a revolving letter of credit[1] (LC) for 6 months of payment, which is linked to an escrow account[2] held by the MNRE. NVVN would raise a provisional invoice at the end of the month as per the terms of the PPA, and if the DISCOM did not make the payment within 30 days, then NVVN could encash the LC. In addition to this, NVVN also had the right to sell the bundled power in the short-term power market, and reimburse the difference in the market price and the PPA price, if any, from the escrow account. Alternatively, NVVN could also continue supplying power to the DISCOM. The size of the escrow account for this arrangement was calculated to be INR 486 crore, arrived at by assuming a 35% default rate by DISCOMs.

2.2 Scheme B: JNNSM Phase 2, Batch 1 SECI (Solar Energy Corporation of India) PSM

This PSM was implemented in 2013 under Phase 2, Batch 1 of the JNNSM (MNRE vide No. 29/5(1)/2012-13/JNNSM). In this scheme, 750 MW of projects were supported through a PSM scheme, under which DISCOMs were asked to furnish a revolving letter of credit for 1 month, linked to an escrow account of INR 170 crore. SECI would raise a provisional invoice as per the terms of the PPA and in case the DISCOM did not make this payment within 30 days, the LC would be encashed. Beyond encashing the LC, if the payment was not made within a month, the escrow account could be encashed for up to 3 months of the payment defaulted upon by the DISCOM. It is worth noting that this scheme differs from Scheme A, where the size of the escrow account was arrived at by assuming a 35% default rate, and where the escrow account was to be used to cover for the difference in the market price and the PPA price.

2.3 Scheme C: Draft scheme for INR 1500 crore Payment Security Fund for VGF scheme under JNNSM

In August, 2016 SECI proposed an INR 1500 crore Payment Security Fund for ensuring timely payments to solar developers under the VGF scheme announced by the MNRE (MNRE vide letter no.32/2/2014-15/GSP, 4th August 2015; MNRE vide letter dated 23rd Feb. 2016). This scheme follows a similar structure as Case B, mainly offering developers up to 3 months of payments towards delayed payments, as well as several other security measures.

2.4 Effectiveness of existing constructs

All these three payment security schemes pertain to renewable energy auctions by central aggregators – NVVN and SECI. These central aggregators perform the job of procuring power from power producers and selling it to state DISCOMs, bringing mediation power to the aggregators. However, the default risk of DISCOMs has a pass-through effect on to the power producers.

The lack of clear stated objectives of the PSMs, lack of transparency behind the design of the PSMs and the underlying assumptions (35% default rate in Scheme A, and 3 months of payments coverage in Schemes B and C) have done little to alleviate investors' concerns about the counterparty risk. The structure of the

[1] A letter of credit is a standard document offered by banks (typically against the payment of a fee) guaranteeing the beneficiary of payments up to the total amount of the letter, as far as certain conditions are met (for instance, payment default by the entity guaranteed)

[2] Escrow is a legal concept in which a financial instrument or an asset is held by a third party on behalf of two other parties that are in the process of completing a transaction. The funds or assets are held by the escrow agent until it receives the appropriate instructions or until predetermined contractual obligations have been fulfilled. Source: https://www.investopedia.com/

PSM did not take into account differing credit qualities of the DISCOM procuring power from the central aggregator, bringing in inefficiencies in the use of allocated capital.

Another alternative to Payment Security Mechanisms is the use of a tripartite agreement. In Feb 2017, SECI was made a beneficiary of a tripartite agreement between the Government of India, state governments and the Reserve Bank of India (Bridge to India, Feb 2017). NTPC has been beneficiary to such a tripartite agreement since 2002. Under this agreement, in the case of default by state-owned DISCOMs, the central government can withhold financial assistance payments to the state governments. Past experience with NTPC shows that such an agreement plays a strong deterrent role against defaults/ delays by DISCOMs. Accordingly, ICRA (a credit rating agency) enhanced the credit rating of SECI from AA- to AA+.

This tripartite agreement was drafted in response to the limited success of the 3 PSMs (described above) geared towards auctions by central aggregators. However, neither such funded PSMs nor tripartite agreements available to the central aggregators, have been made available to producers who directly sell power to DISCOMs.

This paper seeks to solve these issues by prescribing a theoretical framework to guide the design of a PSM geared towards direct power procurement by state DISCOMs, which ensures the most judicious use of public capital employed and that the counterparty risk perception of debt investors is adequately alleviated. Through this, we ensure that the intended enhancement of the credit risk ratings of the projects benefiting from the scheme is achieved. Section 3 below gives a step-by-step description of a methodology that may be followed to design/size such a PSM for a given DISCOM, along with certain prescribed assumptions and quantitative methods to arrive at the required figures. This work builds upon existing work on Payment Security Mechanisms undertaken by the Climate Policy Initiative (CPI, April 2016).

3. Prescribed methodology

The payment security mechanism as designed in this study builds on existing work by CPI (2016). The approach builds on the existing frameworks for credit guarantees. The guarantees used in project finance, in general, are for the purpose of enhancing the credit quality by the means of providing protection against the defaults/ delays in payment obligations due towards a project.

The study has used a stochastic methodology, calibrated on empirically derived proxies for past payment history, for the optimum PSM (liquidity support) size and the credit enhancement achieved using the same for a project selling electricity to a given DISCOM. As part of the methodology, we look at two piecemeal component risk scenarios:

- The default by the project owing to all risks outside of the counterparty (DISCOM) risk.
- The default by the project owing to the default/ delay on payment by the counterparty (DISCOM) risk.

We study the probability of default by the project in the two cases: without the presence of payment support (the base case), and in the presence of a given payment support mechanism (post-intervention). The probability of default of a project has a one-one mapping with its credit ratings (India Ratings, 2017; Care Ratings, 2017).

The base case corresponds to the probability of default associated with the base credit rating of the project, whereas the second probability of default corresponds to the probability of default associated with the target credit rating intended to be achieved by the intervention. The underlying assumption is that, for project finance, credit ratings are completely specified by the probability of default (S&P Project Finance Ratings Criteria, 2016).

The five-step process prescribed by this study to arrive at the optimal size of the PSM that can achieve the intended goal of the intervention are:

1. Calculating the probability of payment default by a given DISCOM
2. Determining the probability distribution for the number of months of payment outstanding by the DISCOM in the event of default
3. Calculating probability of credit default for a sample renewable energy project without PSM support
4. Calculating probability of credit default for a sample renewable energy project with a PSM support for "i" months of payment
5. Calculating the optimal size of payment support to achieve the target reduction in probability of default

These steps are enumerated in detail below. For the sample calculations at each step we have used "Eastern Power Distribution Company of Andhra Pradesh Limited" as the sample DISCOM.

Step one: Calculating the probability of payment default by a given DISCOM

The probability of payment default is the probability that the DISCOM will default on its payment to power producers in line with the conditions set under the power purchase agreement (PPA). It is difficult to quantify the payment default owing to the nature of available financials and the reporting practices used by the DISCOM.

Thus for the purpose of this paper the probability of payment default and the probability of credit default have been assumed to be equal (hereby called the "probability of default"). This assumption is based on the similarities between the payment risk and credit risk like both are legal obligations, credit risk is related to the default on debt payments, and the payment risk is related to the accounts payable.

An important distinction to be made is between the two probabilities of default (PD) spoken about in this paper – the probability of default by the DISCOM ("p") and the probability of the default by the project ("pd"). Further, let the probability of default by the project given no default by the DISCOM i.e. owing to factors other than default by the DISCOM be represented by "y".

For calculating of the probability of default by the DISCOM ("p") we have used the widely accepted modified Z-score approach for unlisted firms (Altman, 2000). More details about the Altman modified Z-score approach and the subsequent calculation of the probability of default can be found in Box 1.The data for calculating the Z-score of a particular DISCOM is sourced from the annual financial reports available in the public domain. The Z-score is then mapped to the probability of the payment default by the entity.

Box 1: Estimating the probability of default by a DISCOM

The default risk of a firm can be estimated using different methods as mentioned below.

- **Accounting based credit risk models:**
  These use accounting data or financial statements to estimate the credit risk. They are still extensively used in the market, although several other models have been developed. Examples of accounting based credit models include Z-score (Altman, 1968); modified Z-score (Altman, 2000) etc. The latter can be used for private firms.
- **Structural models:**
  These are in general based around a stochastic model of variation in asset liability ratio and require market equity data. It is used for listed firms. The examples include the Merton model (Merton, 1974), KMV-Merton model (Dwyer et al, 2004) etc. Moody's default models are based on structural models.
- **Reduced form models:**
  Reduced-form credit risk models focus on modelling the probability of default rather than trying to explain default in terms of the firm's asset value. Hence in reduced-form models, default is exogenous. An advantage of reduced-form models is that specifying defaults exogenously greatly simplifies the problem because it ignores the constraint of defining what causes default and simply looks at the default event itself. Examples include Hull-White model (Hull and White, 2000), etc. The Credit Risk+ (Linda et al, 2004) developed by Credit Suisse uses the reduced-form model.

The Z-score model:

The Z-score developed by Altman is perhaps the most widely recognized and applied model for predicting financial distress (Bemmann, 2005). Survey work (Falkenstein et al, 2000) has consistently given the edge to Altman's Z-score, or at least declared a tie when other models have challenged it. Therefore, Altman's Z-score has developed bench mark status in the academic literature and among accounting and financial analysis textbooks.

These Z-scores can be used to predict a firm's default over the next two years but are more accurate for one year. In its initial test, the Altman Z-score was found to be 72% accurate in predicting bankruptcy two years prior to the event. In subsequent tests over 31 years up until 1999, the model was found to be 80-90% accurate in predicting bankruptcy one year prior to the event.

The original Z-score model was meant only for publicly listed firms (Altman, 1968).

Altman re-estimated his famous Z-score model to assess private firms (Altman, 2000). He gave the following Z-score or revised model:

$Z = 0.717X1 + 0.847X2 + 3.107X3 + 0.420X4 + 0.998X5$

X1 = working capital / total assets

X2= retained earnings/total assets

X3= earnings before interest and taxes/total assets

X4= book value of equity/book value of total liabilities

X5= sales/total assets

The Z-scores have the following interpretations:

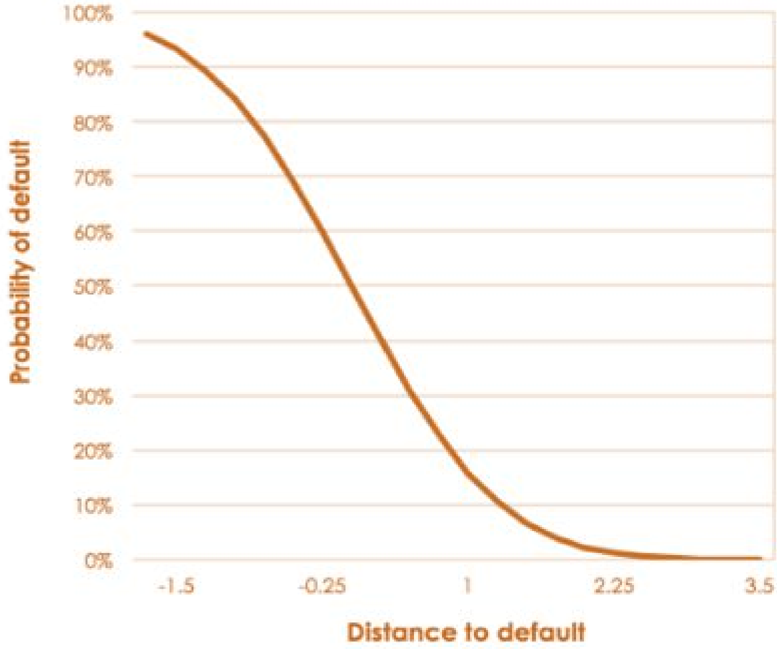
Z > 2.9: "Safe" zone or low probability of bankruptcy

1.23 < Z < 2.9: "Grey" zone

Z < 1.23: "Distress" zone or high probability of bankruptcy

The Z-scores can be converted into the probability of default using the normal density function (Wahlen, Baginski and Bradshaw, 2010). This provides an approximation of probability of default in quantitative terms. Under such an approach, the firm asset value is assumed to have a normal distribution and Z-score - 1 is taken as the distance to default.

Figure 1: Converting distance to default (Z-score – 1) to probability of default



*Source (CPI, 2016)

For instance, the calculation for the probability of default on payment by the sample DISCOM Eastern Power Distribution Company of Andhra Pradesh Limited, based on the financials for the year 2016, is 0.46 for the upcoming year.

Step two: Determining the probability distribution for the number of months of payment outstanding by the DISCOM in the event of default

As discussed earlier the payment pattern by an entity is visible in the form of the accounts payable outstanding at any point of time. To arrive at the stochastic distribution of the months of payment defaulted upon by the DISCOM, we first create a sample of data points using financial data about accounts payable outstanding at the end of the financial year, disclosed by DISCOMs as part of their financial accounting. This helps create a pattern of payment liabilities by the DISCOM.

For calculating this we have used the Months of Payment Outstanding (MPO), which represents company's average payable period measuring how long it takes a company to pay its invoices from trade creditors, such as suppliers.

Box 2: Months Payable Outstanding (MPO)

MPO= [(Accounts payable outstanding) / (Cost of sales)]*12

Accounts payable outstanding = The DISCOMs short term obligation towards the creditors. We have simply used the total current liabilities outstanding at the time of reporting. Although the ideal figure for the calculation purpose would be the dues outstanding towards the power producers but due to differences in the reporting along the years and also for the different reporting style used by the DISCOMs total current liabilities outstanding has been used as the proxy.

Cost of sales = total costs pertaining to cost of the goods sold during the year. For a DISCOM, which is in the business of distribution of electricity consumed instantaneously (as usually no storage is available), the figure is a good proxy for the cost of power purchased during the year.

Thus the MPO metric as defined above is a good proxy for how long a DISCOM takes to pay the invoices against the trade liabilities (majorly the electricity purchased).

Next, the historical time series data for the MPO is quantized, and a discrete distribution ranging from the minimum to the maximum observed values is calculated based on the frequency of occurrence in the sample, and missing values imputed linearly. Thus, for every DISCOM, we arrive at a value for the probability of the MPO being i months, denoted by P[i].

For the “Eastern Power Distribution Company of Andhra Pradesh Limited“ MPO data based on the calculations had the following pattern over the year 2006 to 2016.

Year	Accounts Payable *(INR)*	Cost of Sales *(INR)*	MPO
2006	3601745145	17277300000	2.5
2007	4239161798	19397396000	2.7
2008	5980380161	22524671458	3.2
2009	5980380161	29530935055	2.5
2010	8736156104	33056700000	3.2
2011	9134850743	35894100000	3.1
2012	13688677762	45374300000	3.7
2013	23192985250	54067199544	5.2
2014	17586863932	54937728866	3.9
2015	22198718507	68352300000	4.0
2016	36764746630	75483100000	5.9

Table 2: MPO calculations

These results are then normalized to derive the P[i] pattern mapping the delay probabilities in the payments to the number of months (i) of payment due.

Step three: Calculating probability of credit default for a sample renewable energy project without PSM support

The goal of this step is to arrive at the probability of default by a project in absence of any external PSM support. We make the simplifying assumption that the risks facing the project outside of the counterparty credit risk are uniform for all projects.

Let the probability of default of the project in the event of all risks apart from the counterparty default risk be "y".

Then, using Bayes' Formula, we calculate the probability of credit default by a project without payment support using the Bayes formula, as:

pd|w/o PSM = P(DISCOM defaults)*P(project defaults|DISCOM defaults) + P(DISCOM doesn't default)*P(project defaults|DISCOM doesn't default) = p*1 + (1- p)*y .... (1)

Where p is the probability of default on the payments by the power purchasing entity or the counterparty. And y payment default probability by the project owing to factors other than the irregularities in payments by the counterparty.

To calculate y:

NTPC is a power offtaker with a credit rating of AAA (CRISIL, 2016). As per the transition default probability table published by CRISIL, this has an associated probability of default ~ 0%. Applying the formula above to a project with NTPC as offtaker:

Pd| w/ NTPC = 0*1 + (1-0)*y = y

We use a sample of the probabilities of defaults of three projects with NTPC as the power offtaker, and average these results to reverse engineer a value of the term "y". As per the calculations, we arrive at a value for y as 1.51% over a horizon of 1 year.

Step four: Calculating probability of credit default for a sample renewable energy project with a PSM support for "i" months of payment

Step four seeks to ascertain the impact of PSM upon the project in the form of its probability of default. For this step we form the stochastic cash flow scenarios for the renewable energy projects using certain financial assumptions, in the two cases – no PSM, and with PSM of a certain size available.

Let S be the payment security in terms of the number of months available to the project, and X be the monthly payment outstanding from the DISCOM to the project. Then

Let M = Sum [P[delay = i]*P[S < X*i]] .... (2)

The M gives the total probability of the project default owing to inadequacy of PSM support given payment delay by the DISCOM. Each individual term in the summation above represents the conditional probability of default if the number of months payable outstanding of the DISCOM in the case of default is a certain number of months. In this case, the probability of default of the project in the case of availability of a PSM of a given size is given by:

pd|w/PSM = P(DISCOM default)*P(project default w/PSM|DISCOM default) + P(DISCOM doesn't default)*P(project defaults w/PSM|DISCOM doesn't default).............. (3)

It is important to note a subtle distinction here – even in the case when the DISCOM defaults and the available payment support from the PSM is enough to cover the contractual payment obligations of the DISCOM to the power producer, there is still a possibility that the plant might default, due to financial strain on the power producer owing to factors other than default by the offtaker e.g. inadequate power produced due to low levels of the underlying resource. Hence, P(project default w/PSM|DISCOM default) = P(project default due to risks other than DISCOM default)*1 + [1- P(project default due to risks other than DISCOM default)]*P(project defaults w/ PSM) = y*1 + (1-y)*M ....(4)

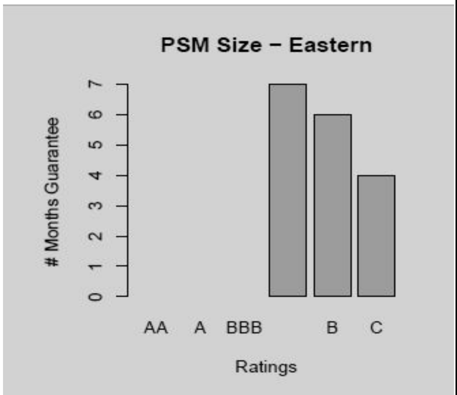
Plugging in equation (4) in equation (3), we get: pd|w/PSM = p*[(1-y)*M + y] + (1-p)*y .... (5)

Step five: Calculating the optimal size of payment support to achieve the target reduction in probability of default

This is the final step to calculate PSM of minimum size to achieve the intended credit rating. For this step we back-calculate the minimum size of the PSM that can help achieve the intended credit enhancement (by linking prob of default to credit ratings using transition matrix published by ratings agencies).

Using the transition default matrix published by credit ratings agencies (India Ratings, 2017; CARE,2017) we arrive at the source and target probabilities of default. Using formulae (1) and (3) above, we can then back-calculate "M". We then use an iterative process (using the Statistical software R) to arrive at the PSM size "S" so as to achieve a value of M lower than or equal to the back-calculated "M" above.

For the Eastern Power Distribution Company of Andhra Pradesh Limited we arrived at the following results for the size of PSM support required and the credit enhancements possible as in table 3:

<table>
<tr><th>Target credit rating</th><th>Number of months of coverage needed to achieve target rating</th><td rowspan="7">

Bar graph - PSM support vs the possible rating enhancement</td></tr>
<tr><td>AA</td><td>Target rating not achievable through PSM</td></tr>
<tr><td>A</td><td>Target rating not achievable through PSM</td></tr>
<tr><td>BBB</td><td>Target rating not achievable through PSM</td></tr>
<tr><td>BB</td><td>8 months</td></tr>
<tr><td>B</td><td>6 months</td></tr>
<tr><td>C</td><td>4 months</td></tr>
</table>

Table 3: Credit enhancement possible vis a vis the number of months of PSM support.

4. Sample Calculations

In Section 4.1, we use the methodological framework discussed in Section 3 to estimate the size of payment support required to achieve various target ratings for projects selling power to a set of sample DISCOMs, using financial data for the DISCOMs available in the public domain. We then analyze these results to discover trends and make other inferences in Section 4.2.

4.1 Results

The Government of India conducts annual integrated ratings of state DISCOMs since 2012, covering 41 DISCOMs across 22 states. These integrated ratings differ from credit ratings by taking into account not only the financial parameters, but also external parameters, compliance with long-term government reforms such as the UDAY scheme, and operational parameters (MoP, 2017).

Using the step-wise process outlined in Section 3, we applied the methods to a sample of 8 DISCOMs spread across the spectrum of ratings. For instance, the Uttarakhand DISCOM (Uttarakhand Power Corporation Limited) has a high rating by the Ministry of Power (MoP) of A+, whereas the West Bengal DISCOM (West Bengal State Electricity Distribution Company Limited) is a low rated DISCOM by the MoP as B. DISCOMs with ratings below B have not been considered due to their poor financial and operational performance, combined with a paucity of financial data in the public domain.

Using this, we arrive at the indicative number of months of payment support needed to be provided by a PSM to ensure that a project with that given DISCOM as the offtaker may achieve a given target credit rating. These results are enumerated in Table 4 for the 8 DISCOMs. An “N/P” result indicates that it is not possible for a PSM of any size to achieve the given credit rating i.e. even by eliminating the counterparty credit risk completely, such a rating may not be achieved.

West Bengal (MoP rating B)		Gujarat (MoP rating A+)		Eastern AP (MoP rating A)		Chamundeshwari (MoP rating A)	
Target credit rating	Payment support needed	Target credit rating	Payment support needed	Target credit rating	Payment support needed	Target credit rating	Payment support needed
AA	N/P	AA	N/P	AA	N/P	AA	N/P
A	N/P	A	N/P	A	N/P	A	N/P
BBB	N/P	BBB	N/P	BBB	N/P	BBB	N/P
BB	N/N	BB	1 months	BB	8 months	BB	17 months
B	N/N	B	0 months	B	6 months	B	16 months
C	N/N	C	N/N	C	4 months	C	14 months
Uttarakhand (MoP rating A+)		**Southern AP (MoP rating B+**		**Chattisgarh (MoP rating B)**		**Northern AP (MoP rating B+)**	
Target credit rating	Payment support needed	Target credit rating	Payment support needed	Target credit rating	Payment support needed	Target credit rating	Payment support needed
AA	N/P	AA	N/P	AA	N/P	AA	N/P
A	N/P	A	N/P	A	N/P	A	N/P
BBB	N/P	BBB	N/P	BBB	N/P	BBB	N/P
BB	62 months	BB	11 months	BB	12 months	BB	13 months
B	57 months	B	10 months	B	11 months	B	12 months
C	45 months	C	7 months	C	9 months	C	10 months

Table 4: DISCOM-wise table of size of payment support needed to achieve target credit ratings. "N/N" indicates PSM not needed and “N/P” indicates PSM is not possible/cannot achieve the target rating.

4.2 Discussion

This section seeks to discuss, analyze and help explain the results of the methodology applied to the sample set of DISCOMs, detailed in Section 4.1. We note some key insights and possible explanations below:

We find that the maximum possible credit enhancement that a PSM can achieve is up to BB rating. As part of the analysis, we assumed that project credit risk differs only due to the credit quality of the offtaker, and the probability of default owing to risk factors excluding the risk of offtaker default was termed as "y" in Section 3. We found that, a project with zero risk of credit default has a probability of default of 1.51%, corresponding to a BBB rating. Subsequently, under our assumptions, projects facing varying levels of DISCOM default risk would have credit ratings of BBB or worse. Since a PSM as defined in this study, however sizeable, will not completely negate the risk of offtaker default, it is rational that the maximum credit enhancement that can be effected using a PSM would be one band below a BBB rating i.e. BB.

Projects associated with certain DISCOMs do not require payment security support. For instance, the Gujarat DISCOM requires minimal payment support (1 month or less) to enhance the credit quality of its projects. This is in line with its high MoP rating of A+, discussed in Section 4.1. Thus, for projects with the Gujarat DISCOM as offtaker, the need for PSM can be done away with by employing a small payment support mechanism in the form of requirement of a 1 month revolving LC to be furnished by the DISCOM.

Similarly, the West Bengal DISCOM, in fact, does not require a PSM at all. Using the modified Z-score approach employed in this study, we find that the West Bengal DISCOM has a very low probability of payment default of 0.61%. However, the integrated rating methodology of the MoP assigns it a rating of B. The mismatch in credit rating using Z-score approach and the integrated MoP rating might be because of poor operational and external parameters for the West Bengal DISCOM, which form part of the integrated rating methodology.

We also find the projects associated with some DISCOMs require impractically high payment support. For example, the unusually high payment support (> 45 months) requirement for Uttarakhand DISCOM, as seen in the results, seems anomalous. On one hand, it may point towards an unusually bad DISCOM. On the other hand, this may be due to the lack of granularity of liability data in the published financial reports, which results in unusually high PMO proxies computed for the Uttarakhand DISCOM.

In general, we find that most DISCOMs require moderately high payment support of 12 months of payments. Barring the above outliers, the rest of the DISCOMs require 8-17 months payment support for associated projects to achieve BB rating. On average, we find that these DISCOMs need about 12 months' worth of payment support. This translates to a fund size equivalent to approximately 10%-20% of the total capital expenditure of the project being supported. The size requirement for this fund may be further reduced to 6%-18% of the capital expenditure by requiring the DISCOM to furnish a revolving letter of credit of 3 months' payment, thus off-loading part of the cost of payment support to the DISCOMs.

5. Conclusions and next steps

This report lays out the framework for a payment support mechanism for single DISCOM offtakers that can effectively achieve credit enhancement in the beneficiary projects. By including transparency in the sizing process, investors can be assured of the efficacy of the intervention in mitigating the counterparty credit risk, thereby ensuring a fair pricing of the cost of capital, ultimately leading to a reduction in harmonized tariffs.

By improving the investment climate in the sector and ensuring projects have a higher credit quality, it may also be possible to attract additional investments from investor classes – both foreign and domestic – that have traditionally shied away from investing into the renewable energy sector owing to low risk tolerance.

The current methodology makes several simplifying assumptions, as outlined in Section 3. Availability of granular empirical data available with central and state government actors such as central aggregators, DISCOMs and regulators about the frequency and length of payment delays by DISCOMs, along with prescribed credit ratings for standard project-financed renewable energy projects associated with said DISCOM can help refine this methodology and derive more accurate results for the optimal sizing of such a PSM.

Further work also needs to be conducted on assessing the cost of implementing such a PSM, building more efficient models for a multi-year horizon. Convening the various stakeholders such as central and state governments, DISCOMs and central power aggregators to discuss institutional structures for implementation would be crucial towards successful implementation of such an intervention.

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