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Driving Foreign Investment to Renewable Energy in India: A Payment Security Mechanism to Address Off-Taker Risk

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Driving Foreign Investment to Renewable Energy in India: A Payment Security Mechanism to Address Off-Taker Risk

Arsalan Ali Farooquee and Gireesh Shrimali

Abstract

India's ambitious renewable energy targets of 175 GW by 2022 will require significant foreign investment. A major issue facing foreign investment in India is offtaker risk or the risk of the public sector distribution companies (DISCOMs) being unable to make payments on time for the procurement of power. Ultimately, this will require long-term financial structural fixes for DISCOMs, some of which are currently under consideration. However, in the short-term, one solution is a government-supported payment security mechanism to build investor confidence. Though the government has used payment security mechanisms before, in the Jawaharlal National Solar Mission (JNNSM), it is not clear if they attracted much interest from foreign investors. This is likely due to a lack of transparency around the frameworks of the payment security mechanisms, resulting in an inability to assess adequate risk coverage. In this paper, we develop a framework, in order to enable assessment of an existing payment security mechanism. More transparency around the frameworks used will help to mobilize additional foreign investment, and thus will also help in the efficient use of public money that has been allocated to payment security mechanisms. We built our framework using elements of credit and financial guarantees – probability of default, exposure at default, and recovery after default. We applied the framework to estimate the size of payment security mechanism for involving a central aggregator during JNNSM Phase 2, Batch1. We estimated this size to be INR 4160 million or INR 5.55 million/MW, or less than 10% of capital costs, but more than 2.5 times the size of a previously proposed facility. In other words, the existing facility did not provide adequate coverage of off-taker risk.

Keywords: credit risk, probability of default, renewable energy, power purchase agreement

1. Introduction

India's renewable energy targets of 175 GW by 2022 is an ambitious path to meeting increasing energy demands, which will likely double by 2030. Raising enough finance will be essential to achieving these targets.

However, India faces a shortage of attractive capital to meet its renewable energy targets. Inferior terms of domestic debt, specifically high cost, short tenor, and variable interest rates, increase the cost of renewable energy in India by 30% compared to the US (CPI, 2012). This directly increases the cost of government support. **Foreign investment may be an attractive source of more capital**, given that cheaper, longer-term, fixed-rate foreign loans have the potential to reduce the cost of renewable energy and, therefore, the cost of government support (CPI, 2012; CPI, 2014).

However, **foreign investors face two major risks to investing in renewable energy in India — currency risk and off-taker risk.**[1]

Currency risk is the risk of unexpected and volatile devaluations in the currency exchange rate. Because currency exchange rates can be volatile, when a renewable energy project is financed by foreign capital, it requires a currency hedge to protect against currency risk; otherwise, foreign investors risk losing their gains due to depreciations in the Indian currency. In a previous publication, Reaching India's Renewable Energy Targets Cost-Effectively: A Foreign Exchange Hedging Facility (CPI, 2015), we examined currency risk and proposed a government sponsored foreign exchange hedging facility that has the potential to reduce the cost of renewable energy by up to 19%.

The second major risk to foreign investment is off-taker risk. An off-take agreement is a power purchase agreement between a producer and buyer (or off-taker) of power, typically negotiated prior to construction of a project, that guarantees that the buyer will purchase a certain amount of electricity at a certain price. This makes it easier for the producer to secure financing. Off-taker risk is the risk that the buyer/off-taker will not fulfil its contractual obligations. Off-taker risk is a key contributor to the overall credit risk of a power project.

One short-term (next five years) solution to mitigate off-taker risk is a government-sponsored standalone fund, called a payment security mechanism, that would provide assurance that the payments under power purchase agreements are made on time. In India, there is precedent in the government providing financial support for payment security mechanisms to support power procurement. However, there has not been much interest from foreign investors, likely due to a lack of transparency around the frameworks of the payment security mechanisms, resulting in an inability to assess adequate risk coverage. **In this paper, we examine off-taker risk and payment security mechanisms as a short-term solution, and propose a more transparent framework that could be a good starting point for the Indian government.**

2. Off-taker risk and the case for a payment security mechanism

A renewable energy power purchase agreement is an agreement between a project developer (power seller) and an off-taker (power buyer) for a certain amount of electricity. Figure 1 shows the flows of power and cash among the key entities. Any renewable project is exposed to the credit risk of the off-taker, or in other words, the ability of the off-taker to make payments for power purchased under the power purchase agreement.

1 From our discussions with investors in renewable energy

Figure 1: Cash flows in a renewable energy project

The ability of an off-taker to make payments depends on its credit worthiness. In India, the majority of off-takers are state-level public sector electricity distribution companies (DISCOMs). Most DISCOMs in India are in a poor financial state. State-level DISCOMs, with collective debt of INR 3.04 trillion and losses of INR 2.52 trillion, are on the brink of financial collapse (Livemint, 2014).

Our discussions with project developers in India revealed that the off-taker risk in renewable energy projects in India is characterized by default only in the form of delays, with 100% expected recovery post delays. Further, because DISCOMs are public sector entities, the government frequently steps in to provide financial assistance to ensure that the payments are eventually made; that is, the government provides an implicit guarantee. However, investors perceive DISCOMs to be at risk of failing to make payments on time. Delayed payments still are a major contributor to off-taker risk. **Off-taker risk in India can be summarized as expected delays in payments, assured payments post delays, and implicit government guarantees.**

Off-taker risk has become a major concern among foreign investors. While the investment philosophies and local business expertise of domestic investors make them comfortable in dealing with these risks, foreign investors are deterred by these risks, despite these risks not really representing classic default. In fact, off-taker risk is perceived to be so high among foreign investors that SunEdison claimed that its recent low solar tariff bid (INR 4.63/unit) in India was possible due to the low credit risk of a financially sound off-taker, the National Thermal Power Corporation (The Hindu BusinessLine, 2015).[2] That is, if the DISCOMs were the off-takers instead of the National Thermal Power Corporation, the bid (which reflects the per unit cost of delivering energy) would have been much higher due to the higher cost capital resulting from higher credit risk. Further, in addition to being a credit risk, off-taker risk has also been seen as a key risk factor factoring into foreign investor's decisions on whether to make the investment at all.[3]

The long-term (beyond ten years) solution to off-taker risk lies in the proper management of the financial problems of DISCOMs and associated stakeholders. In order to decrease investor perception of the risk of delayed payments, a comprehensive set of measures is required to improve the financial state of DISCOMs, including financial restructuring, tariff setting, revenue realization, subsidies, metering, and audit and monitoring. In addition, states should assume full responsibility of running the utilities on sound commercial principles (Ministry of Power, 2012). In the past, the central government has introduced schemes

2 Further, Rocha and Garcia (2005) in their analysis mapped the credit rating of power generation investment to the rating of DISCOMS.

3 Based on discussions with foreign investors in Europe and the USA

for financial restructuring of DISCOMs, but none of them have produced the intended outcomes. The most recent example, introduced by the current government, is a financial restructuring scheme called UDAY (Indian Express, 2015).[4]

While a financial overhaul of DISCOMs is the necessary long-term solution to mitigate off-taker risk, **there are also short-term solutions that can help drive renewable energy investments.** Depending on the creditworthiness of the off-taker and the development of the energy sector in a country, a liquidity facility and/or a sovereign guarantee could support the off-takers' obligations (OPIC, 2015). In this paper, **we examine such a short-term solution, called a payment security mechanism. A payment security mechanism is a standalone fund that is a form of guarantee that covers the risk of payment default in a power purchase agreement.**

2.1 The case for a government-sponsored payment security mechanism

A theoretical case for a government-supported payment security mechanism can be made if (Arrow and Lind, 1970; Anginer et al., 2014): off-taker risk is fat-tailed; the payment security mechanism addresses collective friction – e.g., resulting from positive externalities; investors are risk averse when investing in renewable energy; and the government has informational or enforcement advantage while dealing with DISCOMs – i.e., agency friction is present.

We find that, for the case of renewable energy off-take in India, though there is no empirical evidence if off-taker risk is fat-tailed, the other three criteria are satisfied, making a potential case for the government-sponsored payment security mechanism: there are un-internalized positive externalities in renewable energy investments (IMF, 2010); investors can be assumed to be risk averse when investing in renewable energy; and the government has an informational/enforcement advantage since it owns the DISCOMs as well as the public sector banks that are the major lenders to DISCOMs.

Thus, **the government may be in the best position to manage off-taker risk through a government-supported payment security mechanism, primarily because DISCOMs are public entities, and the government has an informational and enforcement advantage with them. Further, as discussed earlier, the government is already providing an implicit credit guarantee, which can now be made explicit.**

2.2 The case for a more transparent framework for a payment security mechanism in India

In India, there is precedent in the government providing financial support for payment security mechanisms to support power procurement, and a few payment security mechanisms already exist for the government's major solar power initiative, called the Jawaharlal National National Solar Mission (JNNSM), by the central entities NTPC Vidyut Vyapar Nigam and Solar Energy Corporation of India (MNRE, 2011; SECI, 2014). Table 1 summarizes the different aspects of existing payment security mechanisms, and Box 1 summarizes key terms.

4 UDAY is the financial turnaround and revival package for DISCOMs initiated by the Government of India with the intent to find a permanent solution to the financial mess that DISCOMs are in. The scheme comprises four initiatives - improving operational efficiencies of DISCOMs, reducing the cost of power, reducing the interest cost of DISCOMs and enforcing financial discipline on DISCOMs through alignment with state finances. It allows state governments, which own the DISCOMs, to take over 75% of their debt as of September 30 2015, and pay back lenders by selling bonds. DISCOMs are expected to issue bonds for the remaining 25 percent of their debt.

Table 1: Existing payment security mechanisms (MNRE, 2011; SECI, 2014)

Program	Central aggregator	Method for estimating the payment security mechanism size	Size of payment security mechanism fund (INR Crore)	Renewable energy deployment target	Letter of credit linked to escrow account
Case 1: National Solar Mission Phase 1	NTPC Vidgut Vyapar Nigam (NVVN)	Default rate of 35%	486	1000 MW	6 months
Case 2: National Solar Mission Phase II Batch 1	Solar Energy Corporation of India (SECI)	Corpus to cover 3 months payment	170	750 MW	1 month

Box 1: Key terms for payment security mechanisms

- **Central aggregator:** A central aggregator buys power on behalf of DISCOMs from different project developers and then subsequently sells it to DISCOMs. A central aggregator brings mediation power over DISCOMs, but the default risk of DISCOMs has a direct pass-through to project developer.
- **Letter of credit:** A letter of credit is a document, typically from a bank, assuring that a seller (Beneficiary) will receive payment up to the amount of the letter of credit, as long as certain documentary delivery conditions have been met. Under a power purchase agreement, the central aggregator provides a monthly unconditional, revolving and irrevocable letter of credit to the solar power developer, in respect to payment of its monthly bills and/or supplementary bills, which may be drawn upon when required.
- **Default escrow agreement:** An escrow account refers to money held by a third party on behalf of transacting parties. This is a mechanism to provide collateral where the central aggregator will route incremental receivables when required for the letter of credit to an escrow account. Incremental receivables is the amount received by the central aggregator on account of sale of power under the power selling agreement (PSA).

However, these payment security mechanisms have not attracted much interest from foreign investors (Livemint, 2015). This is likely due to two reasons. First, **our analysis indicates that current payment security mechanisms appear to be inadequate in covering the risk of delayed payments.** But more importantly, and underlying the first reason, **even an examination of the adequacy of these mechanisms is not easily possible, because the frameworks for these mechanisms are not publicly available.** These two reasons, perception of inadequacy and lack of transparency, may have deterred investor interest.

These existing mechanisms don't clearly answer the following questions:

- **What is the framework used to estimate the payment security mechanism fund size?** While Case 1 used a default rate of 35%, Case 2 used a corpus to cover three months' payments.[5] Both these methodologies are very different. Were they designed for the same purpose?

- **Which risk is this payment security mechanism trying to address?** If it's risk of delay in payments, then why does it provision for only three months in Case 2? If it's the risk of default, then why was 35% used as the default rate over a limited horizon in Case 1? Do these mechanisms treat all delays as different from default?

5 Our primary research also reveals that a typical payment security mechanism in India tends to cover payments for six months, as opposed to the international practice of 36 months. The theoretical underpinnings of these rules of thumb are still unknown.

Payment security mechanisms which are not attracting investor interest are not effectively using the government funds that have been allocated to them. **In order to attract more interest from foreign investors, and therefore better use existing government funds, a more transparent framework for developing payment security mechanisms is required, which can demonstrate adequate risk coverage. As a starting point, we developed a methodological framework and applied it to an existing payment security mechanism in order to assess its adequacy in risk coverage.**

3. CPI's framework for a payment security mechanism

3.1 Background

We built on the existing frameworks for credit and project guarantees. The guarantees generally used in project finance can be broadly categorized in the following two categories.

Credit guarantees: Credit guarantee is a form of credit enhancement where the guarantor provides an unconditional obligation to make a timely payment of debt service. Credit guarantees are structured in different ways such as partial (i.e., not full) credit guarantees and generally provide protection against default regardless of the reasons for the interruption of the project cash flow.

Contingent capital facilities: Contingent capital is another form of credit enhancement. It is a risk-financing approach designed to optimize a project's capital structure by reducing the cost of financing. The insurer provides a facility under which capital is injected into the project in the form of debt, equity, or hybrid securities upon the occurrence of a predefined trigger event or a set of events.

Although a payment security mechanism more closely resembles a contingent facility, we used elements from both the credit guarantees and contingent facilities to design a framework for payment security mechanism. Our framework is influenced by Hsiao (2001) and Marrison (2001); we briefly mention these below.

Hsiao (2001) discussed that the total cost for a contingent capital facility usually comprises three elements – a commitment fee during the commitment period;[6] a yearly or up-front fee during the cover period,[7] and an interest payment or dividend once the facility has been triggered. He also argued for the advantage of contingent capital, stating that because the trigger events are well-defined, the cost of a contingent capital solution may be more economical than the cost of a credit guarantee at the time when a project is experiencing financial distress.

Marrison (2001) discussed a broad methodological framework for project finance guarantees. He proposed the use of a generic probability density function and calculation of expected loss and probable loss at different levels. Further, while discussing the policy implication of his design, he mentioned that payments to create the guarantee fund can come from four potential sources: equity from the guarantor, subsidies from the government or agency, fees charged to the projects benefiting from the guarantees, and equity from private investors.

3.2 The methodological framework

Payment risk is similar to credit risk: both are legal obligations, where credit risk is related to the default risk in debt payments, and payment risk is related to accounts payable. For the purpose of this paper, we assume that defaulting on any legal obligation is equivalent, and hence the defaulting on debt payments is the same as defaulting on accounts payable.

6 The commitment period runs from closure of the contract to the time when the insurer's risk cover commences, often at the beginning of operations.

7 The cover period or availability period is when a project has the right to draw the capital upon the occurrence of the trigger event.

A framework for a payment security mechanism will have at least the following elements: the default probability (PD), the exposure at default (EAD), loss given default (LGD), expected size (Size), and expected loss (EL). These are then used to calculate the expected size of the payment security mechanism as well as the expected costs. These terms are described below.

The default probability (PD): **The probability of default is the chance that a DISCOM will default on its payments** over a certain predefined time period. For the purpose of this paper, this time period is taken as one year, as discussed below.

There is no standard definition of the term 'default' and its meaning varies according to the context. Bank of International Settlements (BIS) has provided the following definition of default in the context of credit risk (BIS, 2001):

> "A default is considered to have occurred with regard to a particular obligor (borrower) when one or more of the following events has taken place:
>
> (a) It is determined that the obligor is unlikely to pay its debt obligations (principal, interest, or fees) in full;
>
> (b) a credit loss event associated with any obligation of the obligor, such as charge-off, specific provision, or distressed restructuring involving the forgiveness or postponement of principal, interest, or fees;
>
> (c) the obligor is past due more than 90 days on any credit obligation; or
>
> (d) the obligor has filed for bankruptcy or similar protection from creditors."

For payment risk in a power purchase agreement, we used the above definition of default, replacing credit risk with payment risk; in particular (c).

The exposure at default (EAD): **The exposure at default is the maximum payments owed by the facility to project developers in an event of default.** In the case of DISCOMs, we took the time period for calculating EAD as one year. This consists of the following elements, adding to 12 months: 3 months (delay of more than 3 months is identified as default according to (c) above); 2 months (consultation period post default per a standard power purchase agreement); 3 months (three months after consultation period the project developer can terminate the power purchase agreement); 4 months (additional time to find another buyer).[8] These estimations have been taken from a standard power purchase agreement (SECI, 2014).

The expected recovery after default (RAD)[9]: **The recovery after default is the expected percentage of the exposure at default that can be recovered.** This is equal to 1 minus Loss Given Default (LGD). As discussed earlier, since there is assured payment (post-delay) for the DISCOMs, the RAD is nearly 100% for off-taker payments in India.

Expected size (Size): This can be estimated as the expected amount required in the facility – that is, t**he expected size of a payment security mechanism is the product of default probability and exposure at default** – i.e.:

$$\text{(I)}\quad \text{Size} = \text{PD}*\text{EAD}$$

8 This assumes that the developer is further exposed to market risk related to finding an alternate off-taker. This risk can be significant and, based on our primary research, may require a termination security mechanism (e.g., a guaranteed buy-out of the assets). Design of this termination security mechanism is a promising avenue for future research.

9 RAD in commercial credit risk applications is generally modelled using Beta distribution but, given the slightly different interpretation in the Indian electricity market, we have derived RAD from primary research.

Expected loss (EL): Expected loss (EL)/cost of payment security mechanism as an amount can be calculated as the product of the expected size of the facility and the loss given default – i.e.,

(II) EL= Size*LGD

Note that LGD = 0 in the case of DISCOMs in India; therefore EL = 0, despite Size > 0. This also indicates that, given EL = 0, the payment security mechanism will eventually replenish itself; however, given that the probability of default may change year-to-year due to changing financial conditions, the payment security mechanism may need to be resized every year. Finally, in addition to EL above, there will be interest on delayed payments, which we explicitly calculate.

3.3 Application of our methodological framework

A power purchase agreement can either have a single counterparty as the off-taker (e.g., a DISCOM) or a central aggregator as the off-taker (e.g., SECI). We illustrate the use of our framework first for power purchase agreements involving a single DISCOM, and then for power purchase agreements involving central aggregators.

A PAYMENT SECURITY MECHANISM FOR A SINGLE OFF-TAKER

Without loss of generality, we considered the following:

- The power purchase agreement counterparty is the Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL).
- The power purchase agreement size is 100 MW.
- Cost per unit of electricity = INR 5.5[10]

Using equation (I), to estimate the size of payment security mechanism, we need to estimate the probability of default (PD) and exposure at default (EAD). As discussed in Box 2, **the use of a modified version of the popular Z-score methodology is suitable to estimate its probability of default** (Altman, 2000). This modified version is suitable for private firms, including for DISCOMs in India.

Using the financial statements of the year 2013-14,[11] we estimated the Z-score of APEPDCL as 1.1009. Further, using the normal density function (as discussed in Box 2), this Z-score was converted into a probability of default i.e. 45.98%. That is,

PD = 45.98%

Further, 100 MW = 179.58* 10^6 units in a year; and cost/unit = INR 5.5; where 1 unit = 1 kWh. This gives exposure at default as:

EAD = Units/year * cost/unit = 179.58* 10^6 * 5.5 = INR 98.77 Crore

We determined the size of the payment security mechanism to be:

Size = PD * EAD = 0.45 * 98.77 = INR 45.41 Crore or INR 4.5 million/MW

Further, if 10% interest rate is charged on delayed payments, **the payment security mechanism size for APEPDCL would be INR (45.41+ 2.45), or INR 4.78 million/MW.**

10 Under the VGF based process, the tariff rate during NSM Phase 2 Batch 1 was INR 5.45; see http://www.intersolar.in/en/news-press/news/industry-news/jnnsm-phase-2-batch-1-selection-process-begins.html
11 Latest available financial statements in public domain, which suffices given that this exercise is for demonstration purpose.

Box 2: Estimating the probability of default

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)[1] 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 CreditRisk+ (Linda et al, 2004) developed by Credit Suisse uses the reduced-form model.

The Z-score developed by Altman is perhaps the most widely recognized and applied accounting based 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 benchmark 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:

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

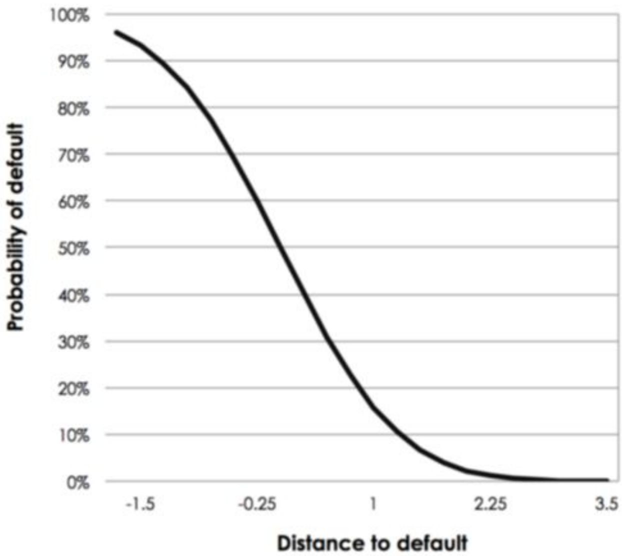
X1 = working capital/total assets
X2= retained earnings/total assets
X3= earnings before interest and taxes/total assets
X4= book value of equity/book value of total liabilities
X5= sales/total assets

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



1 It was developed by KMV Corporation in the late 1980s. Moody's bought KMV in 2002.

A PAYMENT SECURITY MECHANISM FOR A CENTRAL AGGREGATOR (SECI)

As mentioned in Table 1, Solar Energy Corporation of India (SECI) is the central aggregator in National Solar Mission (NSM) from Phase II onwards. Therefore, we assume SECI to be the central aggregator. That is, the flow of power is as follows (with the flow of payments in the reverse direction):

Solar project developers >> SECI >> DISCOMs

A payment security mechanism fund of INR 170 crore was announced for NSM Phase II Batch 1. Using the financial statements of different DISCOMs that are available for 2013-2014, which match the timelines of NSM Phase II Batch I, we applied our payment security mechanism framework retrospectively to estimate the adequate size of this specific payment security mechanism.

SECI as a true central procurer would be exposed to the pooled credit risk of the DISCOMs. However, currently SECI doesn't take the credit risk of DISCOMs on its balance sheet but with an adequate payment security mechanism and its mediation power over DISCOMs, it can serve as a truly central procurer from a project developer's perspective. Thus it may be useful to investigate the cost of payment security mechanism under pooled credit risk of DISCOMs.

The application of pooled credit risk for the electric utilities has precedence. The new Brazilian Electric Sector Regulation issued in 2004 introduced two negotiation markets for the energy supply: the regulated pool (ACR) and the free market (ACL). Competition is enforced via energy auctions, where the winning generator has to sign long-term power purchase agreements simultaneously with all distributors at the bidding-price.

There are 39 state-owned DISCOMs in India. The Ministry of Power in its report (MoP, 2013) had released an aggregate credit rating of all the 39 DISCOMs (Table 2). However, that rating was done by a methodology different from that used for credit risk assessment in the market (by banks). Hence those ratings, unlike credit ratings, cannot be directly converted into probability of default. However, those ratings did reflect the relative rankings of DISCOMs based on credit risk. We used these ratings to create a representative pool of selected DISCOMs that will reflect the credit risk of the pool. These DISCOMs were selected based on the availability of financial statements and to represent the actual pool.

Table 2: MoP ratings of DISCOMs

MoP rating	Number of utilities
A+	4
A	2
B+	11
B	10
C+	8
C	4

For each rating we started by choosing DISCOMs in the same proportion as the original pool, and further modified based on availability of financial statements (in 2013-14). Table 3 presents 8 DISCOMs so that this sub-sample largely represents the original pool of DISCOMs in Table 2.

Table 3: Representative DISCOM pool

MoP rating	Number of utilities	Name of utility
A+	1	(1) Dakshin Gujarat Vij Company Limited
A	1	(1) West Bengal State Electricity Distribution Company Limited
B+	3	(1) Southern Power Distribution Company of Andhra Pradesh Limited, (2) Chhattisgarh State Power Distribution Company Limited, (3) Eastern Power Distribution Company of Andhra Pradesh Limited
B	2	(1) Chamundeshwari Electricity Supply Corporation Limited, (2) Northern Power Distribution Company of Andhra Pradesh Limited
C+	1	(1) Uttarakhand Power Corporation Limited
C	0	NA

As discussed in Box 2, the Z-scores for the eight DISCOMs were calculated and then converted into probability of default using Figure 2.

Table 4: Z-scores and probability of default

UTILITY	Z-score	Probability of default
West Bengal State Electricity Distribution Company Limited	3.508101731	0.61%
Dakshin Gujarat Vij Company Limited	2.388766551	8.25%
Eastern Power Distribution Company of Andhra Pradesh Limited	1.100960561	45.98%
Chamundeshwari Electricity Supply Corporation Limited	0.607071965	65.28%
Uttarakhand Power Corporation Limited	0.606964955	65.29%
Southern Power Distribution Company of Andhra Pradesh Limited	0.530806606	68.05%
Chhattisgarh State Power Distribution Company Limited	0.237143433	77.72%
Northern Power Distribution Company of Andhra Pradesh Limited	-0.727388652	95.80%

In Table 4, we obtained the probability of default of all the DISCOMs in the representative pool. The renewable energy deployment target in NSM Phase II Batch 1 was 750 MW. Given 750 MW = 1346.85 * 10^6 units in a year and per unit cost of INR 5.5 (Headway Solar, 2014), we obtained the expected exposure at default as:

EAD = INR 740.76 Crore

This EAD would typically be distributed in a pooled credit mechanism. For the purpose of demonstration we assumed that this distribution is uniform (i.e., equally divided among the 8 DISCOMs as 740.76/8 = 92.6 Crores) and estimated the size[12] of the payment security mechanism using equation (I) as shown in Table 5. The sum of the required size of the payment security mechanism for each DISCOM in the pool gives the net size of the payment security mechanism for the entire pool. This ignores the correlation among defaults.

Table 5: Size of the payment security mechanism

UTILITY	Probability of default	Exposure at default (INR Crore)	Required size of payment security mechanism fund (INR Crore)
West Bengal State Electricity Distribution Company Limited	0.61%	92.6	0.56486
Dakshin Gujarat Vij Company Limited	8.25%	92.6	7.6395
Eastern Power Distribution Company of Andhra Pradesh Limited	45.98%	92.6	42.57748
Chamundeshwari Electricity Supply Corporation Limited	65.28%	92.6	60.44928
Uttarakhand Power Corporation Limited	65.29%	92.6	60.45854
Southern Power Distribution Company of Andhra Pradesh Limited	68.05%	92.6	63.0143
Chhattisgarh State Power Distribution Company Limited	77.72%	92.6	71.96872
Northern Power Distribution Company of Andhra Pradesh Limited	95.80%	92.6	88.7108

12 Ignoring correlation among defaults

If correlation (if data is available) is taken into account, then it will reduce the size of the payment security mechanism due to diversification benefits.

Size of payment security mechanism fund= INR 395.38 Crore

Further, if 10% interest is charged on delayed payments then the payment security mechanism size would be INR (395.38 + 21.41), or 416.79 Crore. That is, given current capital costs of approx. INR 6 crores/MW, **a payment security mechanism to cover the pooled credit risk of DISCOMs in India would be less than 10% of the capital cost.** However, **this is much larger (more than 2.5 times) that the PSM of 170 Crore proposed by SECI.** That is, our preliminary results indicate that the existing payment security mechanism may not have been adequate in covering the risk of delayed payment from DISCOMs.

4. Conclusions

Our application of a methodological framework to existing payment security mechanisms demonstrates the need for the government to provide transparent frameworks for payment security mechanisms, in order to enable assessment of the mechanisms' adequacy in covering the risk of delayed payments. Investors will be more attracted to payment security mechanisms that can demonstrate their adequate coverage of off-taker risk. Therefore, these payment security mechanisms would be using allocated government funds more effectively. The payment security mechanism framework that CPI has developed could be a good starting point for the Indian government to develop a more transparent framework.

The payment security mechanism framework suggested in this paper was built using elements of credit and financial guarantees – probability of default, exposure at default, and recovery after default. We applied the framework to estimate the size of payment security mechanism for involving a central aggregator (SECI) during NSM Phase 2, Batch1. We estimated this size to be INR 4160 million or INR 5.55 million/MW, or less than 10% of capital costs. This is much larger (more than 2.5 times) than the PSM proposed by SECI for the same coverage, indicating that the SECI PSM may not have proved adequate to address the issue of off-taker risk for investors, especially foreign investors.

Future areas for further work on payment security mechanisms include: the impact of payment security mechanisms on the cost of debt for a renewable energy project; the impact of payment security mechanisms on the credit risk of a renewable energy project; a more robust design and framework for payment security mechanisms; and the impact of payment security mechanisms on the mobilization of additional foreign investments in renewable energy. Another promising avenue for future work is the design of a termination security mechanism that complements the payment security mechanism.

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