A Study on Weather Risk Management Disclosure Practices in Power Generation and Transmission Companies in India

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Abstract

The goal of this study is to assess how well Indian power generation and transmission firms' disclosure their exposure to weather risks in their annual reports. The analyses utilised the textual content analysis approach and hand-collected data from annual reports of firms. Ten power generating and transmission firms that are listed on the NSE are considered in the research. These firms' primary line of work is the production and distribution of electricity from various energy sources, including coal, biomass, wind, hydro, and biogas. For the study, the annual reports from 2010–11 to 2019–2020 were collected and analyzed. It is found that the majority of firms, including those that dealt with currencies, commodities, financial, and interest rates, reported using derivatives. No information is provided in the annual report about the management or reduction of weather-related risk, and no weather derivative methods or management techniques are employed.

Keywords: Weather risk, disclosure, derivatives, power generation, hedge

1. Introduction

Power is a critical infrastructure and key ingredient for economic growth and attainment of high-quality life. Electricity is an essential requirement for all sectors, and it has been recognized as a basic human need. While India is the third-largest producer of electricity in the world. The power sector of India has witnessed a paradigm shift towards establishing clean and green electricity generating capacities. However, India is exposed to a wide range of weatherrelated risks such as droughts, floods, storms, landslides, and extreme temperatures. Indian's economic losses from weather-related events have double over the last thirty years (Charanjit. et al. 2019). Therefore, effective risk management is essential for achieving sustainable longterm growth in the power and economy sectors. Traditional risk management tool like insurance is only hoping for the companies to mitigate these risks. However, a recent innovation in the financial markets involves developing a rainfall-index-based derivative product as a risk management tool to hedge weather-related risk. India has a well-developed financial market, and it has been experiencing hassle-free trading for the past two decades. Securities and Exchange Board of India (SEBI) has actively considered a proposal to allow trading in weather derivatives. Therefore, India too needs such derivative products, as companies and other stakeholders are more aware about these products, this instrument would be a game-changer for many companies and other stakeholders.

The main objective of this study is to provide insight into the impact of weather-related risk on power generation and transmission companies in India. The study aims to examine whether power generation companies identify their relevant weather-related risk exposures and evaluate the impact of weather-related risk on their efficiency. The study also intends to explore the extent of implementing risk management tools to mitigate weather-related risk by the power generation and transmission companies in India.

2. Power Sector in India

India's power sector is one of the most diversified in the world. The power sector comprises generation, transmission, and distribution. Sources of power generation range from Non-renewable sources such as coal, lignite, natural gas, oil, and nuclear power. Renewable sources such as hydro, wind, solar, and agricultural and domestic waste. Electricity demand has increased rapidly in the country over the years, and it is expected to rise in the near future. The Indian Power sector is undergoing a significant change that has redefined the outlook of the industry. According to Central Electricity Authority (CEA) reports, the total installed capacity of all the power stations in India as of March 31, 2020, was 3,70,106 MW. Out of this, 2,30,600 MW from Thermal, 45,699 MW from Hydro, 87,027 MW from Renewable energy, and 6,780 MW from Nuclear power. About 35.85% of electricity generation from renewable sources, and the remaining 64.15 % from non-renewable sources. India has enormous hydropower potential and ranks amongst the topmost countries in the world for possessing feasible hydropower. However, the power sector is facing some difficulties, especially hydro generation. Deficit rainfall in the monsoon season leads to water scarcity resulting in the loss of electricity generation. Electricity shortage will impact all sectors of the economy. The impact of insufficient monsoon rainfall is likely to create power outages. The electricity demand will also be higher due to deficient monsoon causing more heat. About 12.34 percent of installed power generation comes from hydropower. The deficit in hydropower generation leads to a higher demand for electricity in summer, which has resulted in a severe power crisis. Therefore, the monsoon season rainfall is vital for hydropower generation in the country.

3. Weather Risk Management in Power Sector

The power sector is one of the essential components of economic infrastructure development. Its continuous and adequate supply to agriculture and other industries is crucial for the rapid growth of the Indian economy. The impact of weather-related risk events may potentially hit the power sector in various ways, such as by damaging its infrastructure, decreasing power generation capacity, and so on. A poor power generation scenario acts as a strong deterrent in attracting foreign direct investment. At the present stage, when the Indian economy is trading on an accelerated growth path, the county cannot overlook this problem.

Weather derivatives are designed to hedge the financial loss due to variability in daily climatic conditions. Rainfall risk is volume risk in the power sector as both demand and supply for power depend on weather-related factors. On the demand side, the energy required for heating or cooling purposes highly depends on the rainfall. On the supply side, hydro-based power generation depends on annual rainfall from June to September. If there is not enough rainfall, power producers will experience less power production, and consequently, many need to buy costly power from the spot market to meet their contractual obligations. This would represent a high risk for hydro-based power producers (Sharma, & Vashishtha, 2007). The introduction and widespread use of weather derivatives in the power sector may be expected to mitigate much of the power generation problems (Bharath and Kotreshwar 2020; 2021, 2022).

4. Objective of the Study

Based on the literature review and conceptual analysis the study aimed at to analyse the weather-related risk disclosure in the annual report of Power Generation and Transmission Companies in India.

5. Hypotheses of the Study

 H_0 : there is no significant difference in the reporting of weather risk disclosure in the select companies.

 H_1 : there is significant difference in the reporting of weather risk disclosure in the select companies.

6. Research Design and Method

The study uses textual content analysis as a research method. The study is based on companies' risk disclosures in the annual reports, mainly related to weather-related risk. The company discloses the information on weather-related exposure, and these exposures are important for the company's performance. This study content analysis method has been adopted to statistically evaluate the financial data disclosed in the annual report of the selected companies. Content analysis transforms the qualitative textual communication into a set of variables that distinguish with a higher degree of comparability. This method has a defined set

of data collection and criteria for classifying the textual information that obtains an unbiased dataset.

The instrument used in the study is the disclosure index for measuring the level of weather risk management disclosure in the annual reports of selected power generation and transmission companies. The disclosure index is constructed based on requirements that are necessary for derivative accounting. The adopted framework collects the weather risk management disclosure in the selected companies operating in the Indian power generation and transmission companies listed on National Stock Exchange (NSE) India. Listed companies on the NSE are obliged to report their activity and publish their annual reports regularly. The company's annual report is a comprehensive document which deals with all aspects of accounting information. The two elements of the company's annual reports are considered as a subject of content analysis. The company's annual reports disclose the weather-risk-related information in the financial statement and Management Discussion and Analysis (MD&A) part. In the financial statement, the companies explain the risk related to their performance. According to the Companies Act 2013, listed companies are requested to disclose their risk management systems actions against these risks in the Management Discussion and Analysis (MD&A) part.

The study considers ten power generations and transmission companies that are listed on NSE. The selected companies are Power Grid Crop., NTPC, Adani Power, Tata Power, NHPC, Torrent Power, JSW Energy, CESC, NLC India Ltd, SJVN Ltd. the main business activity of these companies are generation and distribution of electricity from coal, biomass, wind, hydro and biogas, etc.,. The annual reports from 2010-11 to 2019-2020 are collected and examined for the study.

The following research question is used for the interpretation of the collected textual data. Question 1 & 2 address the identification and evaluate the impact of weather-related risk in the company's annual reports. Question 3 & 4 address the risk management practices by verifying the information on methods/measures used to hedge/manage Weather-related risk. The textural information obtained from the company's annual reports is coded, and the coding framework is attached in *Annexure -I*.

7. Results and Discussion

The study is based on inductive method to arrive at arguing for the disclosures of weather risk related reporting. Accordingly under each question the disclosures of weather risk reporting has been analysing through by calculating Overall Quality of Weather Risk Disclosure Index (OQWRDI) scores based on the company's disclosure information presented in the annual reports.

SL No.	Companies	Q1	Q2	Q3	Q4
	Power Grid Crop.	0.9	0.9	0.9	0.5
	NTPC	1.2	1.4	1.8	1.2
	Adani Power	1.2	1.4	1.4	1.6
	Tata Power	1.2	1.5	1.4	1.6

 Table 1: Weather Risk Disclosure Practices among Selected Power and Generation

 Companies in India

NHPC	1.1	0.1	0.1	0.2
Torrent Power	1.8	1.8	0.2	1.3
JSW Energy	0.8	0.4	0.3	1.5
CESC	0.8	0.4	0.6	1.9
NLC India Ltd	1.3	0.6	0.4	1.6
. SJVN Ltd	0.8	0.7	0.7	1.2
Average Disclosure	1.1100	0.9200	0.7800	1.2600

Note: Green =high, Red = low, Yellow = Moderate 0= No disclosure, 1= some disclosure, 2= high disclosure Source: Annual Reports of Companies.

The practises used by an Indian power and generating firms to disclose weather risks are shown in Table 1. The first question (Q1) concerns whether the firm can identify its relevant weather-related vulnerabilities in its annual report. The level of weather-risk-related disclosure in their annual reports was 1.110, which was high. The aforementioned table shows that all of the selected firms reported high values based on the disclosure values. It is revealed that all of the chosen firms have had weather-related risk exposures.

In the cost-revenues component of its annual report, does the company include the impact of weather-related risk? At 0.92, the level of weather-risk-related disclosure in their annual reports was low. According to the disclosure values, Power Grid Crop., NTPC, Adani Power, Tata Power, and Torrent Power reported high values, JSW Energy, CESC, NLC India Ltd., and SJVN reported moderate values, and NHPC reported low values, according to the above table. It has been observed that most companies consider the impact of weather-related risk in the cost-revenues dimension.

The third question (Q3) concerns whether the company discloses information on the methods taken to manage/hedge weather-related risk. At 0.78, the level of weather-risk-related disclosure in their annual reports was low. According to the disclosure values, the companies Power Grid Crop, NTPC, Adani Power, and Tata Power reported high values, JSW Energy, CESC, NLC India Ltd., and SJVN reported moderate values, and NHPC and Torrent Power reported low values, as shown in the above table. It has been shown that the majority of companies do not provide information or do not take the appropriate actions or tactics for hedging or managing weather-related risk in their annual reports.

The fourth question (Q4) relates to the company's annual report's consideration of the use of derivatives and hedging of weather-related exposures. At 1.26, the degree of weather-risk-related disclosure in their annual reports was high. According to the disclosure values, the following companies reported high values: NTPC, Adani Power, JSW Energy, CESC, NLC India Ltd., Torrent Power, SJVN enterprises, and Tata Power. Power Grid Crop indicated moderate values, while NHPC reported low values. It is found out that the majority of firms reported using derivatives, including those related to currencies, commodities, financial, and interest rates. No information is disclosed or weather derivative methods or management techniques are employed in the annual report to control or manage weather-related risk.

Analysis of Weather risk Disclosure Practices among Select Companies Based on the Categorisation

For the purpose of analysing the difference in disclosure of weather related risk among select companies, Overall Quality of Weather Risk Disclosure Index (OQWRDI) values are computed by considering four questions for the last 10 years. Based on OQWRDI values descriptive statistics was performed (i.e., mean, standard deviation, high and low values are calculated) and select companies were classified into three categories based on their OQWRDI.

SL No.	Companies	Overall	Rank
1	Power Grid Crop.	0.8	7
2	NTPC	1.4	2
3	Adani Power	1.4	2
4	Tata Power	1.425	1
5	NHPC	0.375	9
6	Torrent Power	1.275	3
7	JSW Energy	0.75	8
8	CESC	0.925	5
9	NLC India Ltd	0.975	4
10	SJVN Ltd	0.85	6
	Average Disclosure	1.0175	

Table 2: Ranking of Weather Risk Disclosure Practices by Indian Power and	
Generation Companies	

Table 2 displays the ranking of selected Indian Power and Generation firms' weather risk disclosure practices. In terms of overall disclosure, it is seen that Adani and NTPC have equal disclosure values of 1.4, whereas Tata Power has the highest disclosure score of 1.425. In terms of overall disclosure, JSW Energy has the lowest disclosure value. In their annual reports, Tata Power, NTPC, Adani, and Torrent Power companies provide extensive disclosures on their policies for disclosing weather-related risks. Power Grid Crop, JSW, CESE, NLC India Ltd., and SJVN, however, makes no mention of weather-related risk disclosure standards in their annual reports. It was shown that the majority of companies reported the impact of weather-related risk in their annual reports.

v			0	1	
Companies	Q1	Q2	Q3	Q4	Overall
Power Grid Crop.	0.9	0.9	0.9	0.5	0.8
NTPC	1.2	1.4	1.8	1.2	1.4
Adani Power	1.2	1.4	1.4	1.6	1.4
Tata Power	1.2	1.5	1.4	1.6	1.425
NHPC	1.1	0.1	0.1	0.2	0.375

Table 3: Analysis Weather Risk Disclosure Practices among Select Companies in India

Note: Green =*high, Red* = *low, Yellow* = *Moderate 0*= *No disclosure, 1*= *some disclosure, 2*= *high disclosure* Source: Annual Reports of Companies.

Torrent Power	1.8	1.8	0.2	1.3	1.275
JSW Energy	0.8	0.4	0.3	1.5	0.75
CESC	0.8	0.4	0.6	1.9	0.925
NLC India Ltd	1.3	0.6	0.4	1.6	0.975
SJVN Ltd	0.8	0.7	0.7	1.2	0.85
Average Disclosure	1.1100	0.9200	0.7800	1.2600	1.0175
ANOVA F-Value : 26.25, df:9. Sig: 0.000					

Note: Green =high, Red = low, Yellow = Moderate 0= No disclosure, 1= some disclosure, 2= high disclosure Source: Annual Reports of Companies.

Testing of Hypothesis

H₀: there is no significant difference in the reporting of weather risk disclosure in the select companies.

H₁: there is significant difference in the reporting of weather risk disclosure in the select companies.

Based on the OQWRDI values, it can be seen from table 3 that the firms Tata Power, NTPC, Adani, and Torrent Power make high disclosures about their practices for disclosing weather-related risks. However, in their annual reports, Power Grid Crop, JSW, CESE, NLC India Ltd., and SJVN pay little attention of weather-related risk disclosure criteria. The ANOVA F-Value is significant at the 5% level, as can also be seen from the table above. As a result, the alternative hypothesis is accepted and the null hypothesis is rejected. As a result, the reporting of weather risk disclosure in the chosen firms differs significantly.

8. Findings and Discussion

- 1. It is made clear that each of the selected companies has experienced weather-related risk exposures.
- 2. It has been noted that most firms take the cost-revenues dimension into account when analysing the impact of weather-related risk.
- 3. It has been found that more than half of firms do not provide information on how they hedge or manage weather-related risk in their annual reports, or they do not employ the proper measures or strategies.
- 4. The majority of firms reported adopting derivatives, including those that dealt with currencies, commodities, financial markets, and interest rates, it was reported. In order to manage or reduce weather-related risk, no information is given in the annual report, and no weather derivative methods or management approaches are used.

9. Conclusion

The purpose of this research was to assess how well Indian power and generation firms recognized and addressed weather risks. The studies employed the textual content analysis approach and hand-collected data from annual reports of firms. Ten NSE-listed power generating and transmission firms are taken into account in the research. These businesses' primary line of work is the production and distribution of electricity from various energy

sources, including coal, biomass, wind, hydro, and biogas. For the study, the yearly reports from 2010–11 to 2019–2020 were collected and processed. The study found that majority of firms reported adopting derivatives, including those that dealt with currencies, commodities, financial markets, and interest rates, it was reported. In order to manage or reduce weather-related risk, no information is given in the annual report, and no weather derivative methods or management approaches are used.

10. Limitation and further scope of the study

The study was conducted only based on secondary sources of information so the future researcher can focus on conducting research by considering the primary opinions of various stakeholders. Further, to address potential issues that are considered significant, future study in this area may increase the number of underlying research questions (with clearly defined coding guidelines).

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Annexure-I

Data coding framework used for content analysis

- 1. The company identify its relevant weather-related risk exposures.
 - 0-not disclosed
 - 1-identified with reference to generation and distribution
 - 2-identified with reference to other business processes as well
- 2. The company evaluate the impact of weather-related risk in the cost-revenues dimension.
 - 0-not addressed
 - 1-evaluated in general way
 - 2-evaluated in detailed way
- 3. The company disclose the information on methods/measures used to hedge/manage Weather-related risk?
 - 0-not reported
 - 1-in general way
 - 2-more detailed actions
 - 4. The company report on the use of derivatives and hedging weather-related exposures with derivatives?

0-not reported

- 1-company reports the use of derivatives other than rainfall derivatives
- 2–company repots the use of rainfall derivatives