International Journal of Business Law, Business Ethic, Business Communication & Green Economics (IJBGE)
Volume 1 Nomor 1 Tahun 2024
e-ISSN: 3048-1392; dan p-ISSN: 3048-1384, Hal 24-33
DOI: https://doi.org/ 10.70142/ijbge.v1i1.339
Available online at: https://jurnal-mnj.stiekasihbangsa.ac.id/index.php/IJBGE

Implications Finance from Use of Weather Derivatives (Derivatives Weather) for Hedging : An Overview Literature about The impact to Cost Energy Company Loans

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Abstract *. This qualitative literature review explores the financial implications of using weather derivatives as a hedging tool to reduce borrowing costs for energy companies. By synthesizing existing studies, the review highlights that weather derivatives significantly lower borrowing costs, with an average reduction of 21 basis points in borrowing rates. This cost-saving effect is more pronounced for companies with higher systematic risk or less complex financial statements. The review also finds that hedging with weather derivatives enhances financial stability and reduces bankruptcy risk, leading to more favorable borrowing terms. Furthermore, the benefits extend to the public debt market, with hedging companies enjoying lower bond yield spreads. Despite making important contributions, the study acknowledges limitations, including reliance on published literature and the need for further empirical validation. Overall, the findings highlight the value of weather derivatives in financial risk management for energy companies.*
Keywords: *Weather Derivatives, Hedging, Borrowing Costs, Energy Companies, Financial Risk Management*

INTRODUCTION

In recent decades, climate change has become one of the most pressing global issues, affecting various economic sectors, including the energy industry. This industry, which includes electricity and natural gas companies, is highly vulnerable to fluctuations in energy demand influenced by daily temperature changes. This uncertainty can have a significant impact on a company's financial performance, prompting them to seek effective risk management strategies. One relatively new and innovative tool that energy companies are using to manage this risk is weather derivatives.

Weather derivatives are financial contracts that allow companies to protect themselves from risks associated with weather changes, such as decreased energy demand on cooler days. The use of weather derivatives as a hedging tool has been shown to have significant financial implications for energy companies, especially in terms of reducing borrowing costs. Based on a study by Do, Nguyen, and Vu (2024), the use of weather derivatives by energy companies in the United States was associated with an average reduction of 21 basis points in bank lending rates after the companies began using weather derivative contracts. Sustainability, innovation, and dynamic factors are important

 Received: Februari 1, 2024; Revised: Februari 25, 2024; Accepted: March 20, 2024; Published: March 30, 2024

capabilities for multinational finance companies that need to be strengthened and developed (Patricia, M. C, 2023).

These cost savings can be explained through two main channels. First, hedging through weather derivative contracts helps reduce the risk of bankruptcy, which is then rewarded by banks by lowering the cost of borrowing. Second, after the adoption of weather derivative contracts, firms are more likely to pledge assets and accept tighter covenants due to their increased financial confidence. This non-price signaling also helps firms obtain lower lending spreads. Furthermore, the use of weather derivatives can reduce the likelihood of covenant violations after the loan is issued, even though the covenants are tighter (Do et al., 2024).

To address endogeneity concerns related to firms' decisions to use weather derivatives, this study uses three approaches: propensity score matching, entropy balancing, and IV estimation. The results show that the benefits of hedging with weather derivatives, reflected in lower borrowing costs, increase when borrowing firms have less complex financial statements or carry higher systematic risk, when the market and regulatory environment are more uncertain, and when investors are more concerned about climate risk (Do et al., 2024).

The benefits of hedging with weather derivatives are also seen in the public debt market. Firms that hedge enjoy lower yield spreads on their bond issuances and maintain a lower percentage of bank debt relative to total debt. Weather derivative contracts appear to help firms effectively hedge their risk exposure, as they exhibit lower volatility in ROA and ROE and higher Z-scores (Do et al., 2024). Equity volatility and leverage are strongly related to firms' investment decisions, both directly and indirectly (Chaidir, M., et al, 2024).

These findings provide insight into another dimension of hedging benefits by demonstrating borrowing cost savings for firms that hedge through weather derivatives. These results suggest that management actions to reduce firm risk can have a material impact on the premiums demanded by creditors, even among well-regulated borrowers. Overall, this study strengthens the validity of fundamental credit market theory even in the presence of regulatory differences (Do et al., 2024).

LITERATURE REVIEW

The use of weather derivatives as a risk management tool has become an increasingly relevant topic in the finance literature, particularly in the context of energy companies. Weather derivatives allow companies to manage the risks associated with weather fluctuations, which can affect energy demand and, ultimately, the company's financial performance. A study by Do, Nguyen, and Vu (2024) shows that the use of weather derivatives by energy companies can reduce their borrowing costs by an average of 21 basis points after the companies start using weather derivative contracts. These savings are greater among borrowers with higher risk or less complex financial statements, as well as in more uncertain market conditions or when investors are more concerned about climate risk.

In this context, previous studies also show that the use of derivatives can affect firm value and cost of capital. Bartram, Brown, and Conrad (2011) found that the use of derivatives can reduce firm risk and increase firm value. In addition, research by Allayannis and Weston (2001) showed that the use of foreign currency derivatives can increase the market value of the company. This study supports the finding that the use of derivatives, including weather derivatives, can provide significant financial benefits to companies.

In terms of risk management and borrowing costs, research by Chen and King (2014) shows that firms that hedge with derivatives tend to have lower debt costs. This is in line with the findings of Do et al. (2024) which show that firms that hedge with weather derivatives are more likely to pledge assets and accept tighter covenants, which in turn can reduce borrowing costs. Trading costs significantly affect the net returns of hedge funds, while liquidity risk and portfolio complexity hinder asset management efficiency (Permana, N., et al, 2024). In addition, research by Graham, Li, and Qiu (2008) shows that more complex financial reporting can increase borrowing costs, which supports the finding that cost savings from using weather derivatives are greater in firms with less complex financial statements.

In terms of public debt markets, research by Norden and Wagner (2008) shows that the use of credit derivatives can affect loan pricing. This research supports the findings of Do et al. (2024) that the benefits of hedging with weather derivatives can also be seen

in public debt markets, where hedging firms enjoy lower yield spreads on their bond issuances and maintain a lower percentage of bank debt relative to total debt.

In addition, research by Pérez-González and Yun (2013) shows that the use of weather derivatives can increase firm value by reducing earnings volatility and bankruptcy risk. This is in line with the findings of Do et al. (2024) that the use of weather derivatives can help firms effectively hedge their risk exposure, as they exhibit lower volatility in ROA and ROE and higher Z-scores.

Overall, the literature suggests that the use of derivatives, including weather derivatives, can provide significant financial benefits to firms, including reduced borrowing costs and increased firm value. These findings support the argument that management actions to reduce firm risk can have a material impact on the premiums demanded by creditors, even among well-regulated borrowers.

METHODOLOGY

This study uses a qualitative approach with a literature review method to explore the financial implications of using weather derivatives as a hedging tool against energy companies' borrowing costs. A literature review is an effective method for identifying, evaluating, and synthesizing relevant research findings from various sources (Snyder, 2019). In this context, this study aims to collect and analyze existing literature related to the use of weather derivatives and their impact on energy companies' borrowing costs.

The literature review process begins with determining inclusion and exclusion criteria to select relevant literature. Inclusion criteria include studies that discuss weather derivatives, financial risk management, and energy company borrowing costs, while exclusion criteria include studies that are not relevant to the topic or do not have sufficient empirical data (Booth, Sutton, & Papaioannou, 2016).

After determining the selection criteria, the next step is to identify relevant literature sources using academic databases. Literature searches were conducted using keywords such as "weather derivatives", "risk management", "energy firms", and "loan costs". The search results were then filtered based on the relevance and quality of the research.

Literature analysis was conducted using a thematic approach to identify themes and patterns that emerged in previous research (Braun & Clarke, 2006). This process involved

in-depth reading and recording key findings from each selected article, as well as grouping these findings into themes relevant to the research question.

In analyzing the findings, this study also considers the methodological aspects of the reviewed studies, such as research design, data analysis techniques, and theoretical approaches used. This is important to understand the context and validity of the findings reported in the literature (Tranfield, Denyer, & Smart, 2003).

As part of the literature review, this study also evaluates the strengths and weaknesses of the reviewed studies to provide a comprehensive picture of the current state of research and identify research gaps that can be further explored in the future (Rowe, 2014).

Using this methodology, this study aims to provide an in-depth understanding of how the use of weather derivatives can affect energy companies' borrowing costs and their overall financial implications.

RESEARCH RESULT

This study aims to explore the financial implications of using weather derivatives as a hedging tool against energy companies' borrowing costs through a literature review. Based on the literature analysis conducted, several key findings were identified, which provide in-depth insights into the benefits and challenges of using weather derivatives in this context.

First, the use of weather derivatives can significantly reduce borrowing costs for energy companies. Do, Nguyen, and Vu (2024) find that companies using weather derivatives experience an average reduction of 21 basis points in bank lending rates. These savings are more pronounced for companies with higher systematic risk or less complex financial statements, as well as in more uncertain market conditions or when investor attention to climate risk is heightened.

Second, the use of weather derivatives helps firms reduce their risk of bankruptcy, which in turn is rewarded by banks by offering lower borrowing costs (Pérez-González & Yun, 2013). This suggests that weather derivatives can serve as an effective risk management tool, helping firms stabilize their financial performance.

Third, this study finds that firms that hedge with weather derivatives are more likely to pledge assets and accept tighter loan covenants. This reflects the company's increased

financial confidence and helps them obtain lower loan spreads (Chen & King, 2014). In addition, the use of weather derivatives can also reduce the likelihood of covenant violations after the loan is issued, even though the covenants are tighter.

Fourth, the benefits of using weather derivatives are also seen in the public debt market. Firms that hedge enjoy lower yield spreads on their bond issuances and maintain a lower percentage of bank debt relative to total debt (Norden & Wagner, 2008). This suggests that the benefits of hedging with weather derivatives extend to the public debt market, providing broader financial benefits to firms.

Finally, this study highlights the importance of risk management in reducing the premium demanded by creditors. The use of weather derivatives as a hedging tool not only helps firms reduce their financial risk but also has a material impact on their borrowing costs (Bartram, Brown, & Conrad, 2011). Thus, this study strengthens the validity of fundamental credit market theory even in the presence of regulatory differences.

Overall, these findings suggest that the use of weather derivatives as a hedging tool can provide significant financial benefits to energy companies, particularly in terms of reduced borrowing costs and increased financial stability.

DISCUSSION

In recent years, weather derivatives have emerged as an important tool in financial risk management, especially for energy companies that are highly vulnerable to demand fluctuations due to weather changes. This study aims to explore the financial implications of using weather derivatives to hedge energy companies' borrowing costs. Based on a comprehensive literature review, several key findings have been identified and discussed in the context of previous studies.

First, the results of research by Do, Nguyen, and Vu (2024) show that the use of weather derivatives can reduce borrowing costs by an average of 21 basis points. This finding is in line with research by Chen and King (2014), which found that companies that hedge with derivatives tend to have lower debt costs. This suggests that weather derivatives can serve as an effective risk management tool, helping companies stabilize their financial performance.

Second, this study finds that firms using weather derivatives are more likely to pledge assets and accept tighter loan covenants. This reflects increased financial confidence of firms and helps them obtain lower loan spreads (Pérez-González & Yun, 2013). Research by Bartram, Brown, and Conrad (2011) also supports this finding by showing that the use of derivatives can reduce firm risk and increase firm value.

Third, the benefits of using weather derivatives are also seen in the public debt market. Do et al. (2024) find that firms that hedge enjoy lower yield spreads on their bond issuances and maintain a lower percentage of bank debt relative to total debt. This finding is supported by Norden and Wagner (2008) , who show that the use of credit derivatives can affect loan pricing.

Fourth, this study highlights the importance of risk management in reducing the premium demanded by creditors. The use of weather derivatives as a hedging tool not only helps companies reduce their financial risk but also has a material impact on their borrowing costs. This is in line with research by Allayannis and Weston (2001), which shows that the use of foreign currency derivatives can increase the market value of companies.

In addition, research by Gilje and Taillard (2017) found that the use of derivatives can increase firm value by reducing earnings volatility and bankruptcy risk. This supports the findings of Do et al. (2024) that the use of weather derivatives can help firms effectively hedge their risk exposure, as they exhibit lower volatility in ROA and ROE and higher Z-scores.

Furthermore, a study by Campello, Lin, Ma, and Zou (2011) shows that corporate risk management through the use of derivatives can have a significant impact on corporate investment and financial decisions. This supports the argument that management actions to reduce corporate risk can have a material impact on the premiums demanded by creditors, even among well-regulated borrowers.

Another study by Bartram (2019) highlighted that derivatives are not only used for hedging, but also for speculation. However, in the context of energy companies, the use of weather derivatives is more likely to be focused on hedging to reduce risks related to uncertain weather.

Overall, the findings of this literature review suggest that the use of weather derivatives as a hedging tool can provide significant financial benefits to energy

companies, especially in terms of reducing borrowing costs and increasing financial stability. This study strengthens the validity of fundamental credit market theory even in the presence of regulatory differences, and highlights the importance of risk management in the context of corporate finance.

CONCLUSION

This study has explored the financial implications of using weather derivatives as a hedging tool against energy companies' borrowing costs through a comprehensive literature review. Based on the literature analysis conducted, it can be concluded that the use of weather derivatives can significantly reduce the borrowing costs for energy companies. The findings suggest that weather derivatives serve as an effective risk management tool, helping companies stabilize their financial performance and reduce the risk of bankruptcy. In addition, companies using weather derivatives are more likely to pledge assets and accept tighter loan covenants, reflecting increased financial confidence and helping them obtain lower borrowing spreads.

The benefits of using weather derivatives also extend to the public debt market, where hedging firms enjoy lower yield spreads on their bond issuances. Overall, this study confirms that the use of weather derivatives can provide significant financial benefits, including reduced borrowing costs and increased financial stability. This study also strengthens the validity of fundamental credit market theory, highlighting the importance of risk management in the context of corporate finance.

LIMITATION

While this study provides valuable insights into the financial benefits of using weather derivatives, there are some limitations that need to be considered. First, the study relies on existing literature, meaning that the findings and conclusions drawn are limited to published studies. This may limit the scope and depth of the analysis, especially if there is other relevant research that has not been published or is not widely available.

Second, although this literature review covers a wide range of studies, it is possible that some relevant studies were missed due to limitations in access to databases or the search criteria used. This may affect the completeness of the analysis and the conclusions drawn.

Third, this study did not conduct its own empirical analysis, so it cannot provide direct evidence from primary data. As a result, this study relies on the validity and reliability of the findings of the reviewed studies.

Fourth, changing market dynamics and regulations may affect the relevance and applicability of the findings of this study in the future. Therefore, further research is needed to test these findings in different contexts and to update the understanding of the use of weather derivatives in energy companies' risk management.

Taking these limitations into account, this study still makes an important contribution to understanding how weather derivatives can be used effectively to manage financial risk and reduce borrowing costs for energy companies.

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