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Hedging Derivatives and Performance of Renewable Energy Projects in Kenya

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ABSTRACT

Power infrastructure investment in Africa can increase the estimated average current GDP of 4% to 10% but financial constraints due to investor's negative perception of the projects high investment risk has impeded hydro-power investment. The purpose of the study was to determine the extent to which Hedging derivatives influence performance of hydroelectric energy projects in Kenya. The study adopted pragmatism paradigm and descriptive survey design while questionnaires and interview guide were used to collect quantitative and qualitative data from a census of 94 participants. Validity coefficient of 0.775 and reliability coefficient of 0.781 was obtained after pretesting of the instruments amongst 10% of the participants. Descriptive statistic and inferential statistic of Correlation and Regression at a significance level of 0.05 was done while thematic content analysis of qualitative data for triangulation was also done. The result of the hypothesis: H_0: Hedging derivatives does not significantly influence performance of hydroelectric energy projects in Kenya was rejected since $P=0.000<0.05$.Therefore the study concluded that there is significant influence of Hedging derivatives on performance of hydroelectric energy projects in Kenya. It is recommended that Project management and policy makers should integrate Hedging derivatives to improve performance of hydro-power projects besides trading of derivative in stock market for easy access. Further research should be carried out on the determinants of effective utilization of hedging derivatives in power projects in Kenya.

INTRODUCTION

In Kenya, in spite of having an estimated hydropower potential of about 6,000MW for large hydros, only 823.8 MW has been exploited (Ministry of Energy, 2020) due financial challenges. Financial markets can bridge the gap by stimulating private investments into such projects but due to investors negative perception of Kenya's high investment risk and low creditworthiness, the degree of private capital penetration has generally remained low (OECD, 2013). Thus, utilization of hedging derivatives to de-risk renewable energy infrastructure projects is essential for reducing private investment cost.

Hedging derivatives like Swaps, Forwards, Options and Futures have been used by firms to hedge against systemic risks or market risks such as interest rate risk, currency exchange risk, inflation risk besides commodity risk (Giraldo-Prieto *et al.*, 2017) thereby nourishing the liquidity depth and improves the efficiency of financial markets (Sharpe *et. al.*, 2012). Basha (2013) described hedging derivatives as risk management instruments using underlying assets or bonds or market bench marks such as interest rates to derive their value for example interest rate futures and over-the-counter (OTC) derivatives while Waswa and Wepukhulu (2018) conceived derivatives as any security instruments deriving its value from the value of a different asset for example forwards, futures, options and swaps. This study defines hedging derivatives as contractual agreements on a security deriving its value from the value of a different asset for example forwards, futures, options and swaps. The origin of derivative instruments dates back to early 17^{th} Century in Dojima Rice Exchange in Japan where commodity derivatives or futures were initially used (Waswa and Wepukhulu, 2018) which was later advanced in 1848 by the founding of the Chicago Board of Trade (CBT) in USA that established formal hedging contracts as a solution to credit risk (Cheptorus *et al.*, 2017) and expanded to Europe after demutualization and deregulation in the 1980's and 90's. Securities and Exchange Board of India in 2000 endorsed the reintroduction of derivatives for trading (Vashishtha and Kumar, 2010). In Africa it can be associated with the Alexandria's futures market in Egypt where the cotton transaction was first recorded in 1865 and in 1909, cotton forward contracts were legalized while in Kenya it emerged from the mid 2000's amongst stakeholders in the financial industry (Mutende, 2013) though Murage, Murungi and Wanjau (2014) held a contrary observation that it's not yet fully developed. Generally, derivative instruments enhance financial market efficiency through increased liquidity depth (Sharpe *et al.*, 2012).

Since renewable energy projects major hindrance to growth is difficulty in access to finance, financial risk management becomes a key element, however minimal attention has been paid to the appropriate mitigate instruments especially in developing countries (Mutua, Waiganjo and Oteyo, 2014). The purpose of the study is to examine how hedging derivatives influence performance of hydroelectric energy projects in Kenya. The study provides a reference for other scholars, policy makers and investors besides contributing valuable knowledge on appropriate utilization of hedging derivatives in reducing the inherent risks in hydroelectric energy projects thereby attracting securitized financing pools. The study was organized into introduction, literature review, findings and discussion, and conclusion.

LITERATURE REVIEW

Performance of Hydroelectric Energy Projects

An assumption that a successful project is only architect on achieving time schedule, cost budget and quality production "iron triangle", is far from the truth as there are other significant measures such as user satisfaction, safety conditions and efficiency factors that needs further scrutiny (Sibiya, Aigbavboa and Thwala, 2015). Previous studies convergence in measurement of performance in hydroelectric power projects in terms of quality electricity supply, project cost reduction, increased generation capacity, implementation within schedule, operational efficiency, customer satisfaction, environmental safety and increased profitability (Pramangioulis et al., 2019; Waweru and Rambo, 2017; and Elbatran et al., 2015), however, none focused on how the performance of hydroelectric energy projects can be influenced by credit hedging derivatives, a gap which the current study intends to fill. This study defines performance of hydroelectric energy projects as the success in meeting predefined measurable standard objective indicators of quality electricity supply, project cost reduction, increased generation capacity or scope, affordable electricity supply, adherence to implementation time schedule, operational efficiency, customer satisfaction, positive environmental effect and increased profitability.

Hedging Derivatives and Performance of Hydro-Power Projects

Hedging derivatives are important financial risk management instrument that can be used in a project to prevent losses and maintain high returns (Basha, 2013). However, scholars like Giraldo-Prieto, Uribe, Bermejo and Herrera (2017) believe that the instruments themselves carry with them certain risks such as counterparty risk and legal risk which may make the contract enforceable when it's required to perform and thus adequate understanding and supervision of derivatives transaction should be done with maximum accuracy. A study by Basha (2013) investigated derivatives effectiveness in managing financial risk in the energy industry in India by adopting desk review and found that commonly used derivatives in mitigating currency exchange and interest rate risks are forwards, futures, options and swaps; hence it shows that the Indian financial market is highly developed to protect highly risky projects against systemic risks. A contrary opinion was precluded that derivatives themselves contain risks like counterparty risk and legal risk of a party lacking capacity to perform, hence rendering the contract to be enforceable, which necessitates proper understanding on derivatives transaction supervision.

In Kenya, Waswa and Wepukhulu (2018) examined the effect of the utilization of derivative instruments on financial performance of non-financial firms listed in NSE through descriptive survey design and data collected using questionnaire from a sample size of 11 listed non-financial firms out of a census of 47 with annual audited financial reports used to gather secondary data in the period 2013-2017 while analysis involved both descriptive and inferential techniques of regression, correlation and ANOVA. Findings showed a positive relationship between derivative usage and financial performance of NSE listed non-financial companies. However, these studies did not link to renewable energy projects thus prompting further research to provide project context understanding away from the conventional cooperate world.

Away from the cooperate world, Bhattacharya, Gupta, Kar and Owusu (2015) investigated weather derivatives as risk hedging strategies in renewable energy projects in USA through a simulation model from past data and analysis done using Kurtosis and regression methods. Findings showed that weather derivatives have a positive significant relationship on demand and supply risk management of renewable energy projects in case of variations of weather conditions. In specific, power options hedge quantity risks resulting from competitive wholesale electricity market; fixed price load servicing entities risk can be hedged using Value-at-risk (VaR) hedging policy; and an optimal static hedging policy can be used to hedge against volumetric and price risks, while decentralized hedging policy optimizes the cost of electricity procurement for consumers. Thus, weather derivatives, "Heating Degree Days/Cooling Degree Days" (HDD/CDD contracts) on temperature, average daily electrical load demand location and radiation can be used as financial derivative instruments to develop a hedging strategy with weather related risk factor (Bhattacharya *et al.*, 2015).

METHODOLOGY

The study adopted pragmatism paradigm and descriptive survey design which allows the use of mixed method approach for collection of qualitative and quantitative data (Creswell, 2013). A census of 94 participants consisting of 84 respondents and 10 Key Informants were involved in the study while questionnaire and Interview Guide were used to collect data. The data collection instruments were pre-tested in 10% of unselected participants and a validity coefficient of 0.775 and reliability coefficient of 0.781 obtained. Data was analyzed using descriptive statistics of mean and standard deviation and inferential statistics of correlation and regression at a significance level of 0.05 while qualitative data was analyzed through thematic content analysis. The hypothesis took the form: H_0: There is no significant relationship between Contingent capital and performance of hydroelectric energy projects in Kenya

Performance=f (Hedging derivatives, random variable)

$Y= \beta_0+ \beta_1X_1 + \alpha$

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FINDINGS AND DISCUSSION

The study realized a 100% questionnaire return rate. The study sought to assess the extent to which Credit enhancement influence performance of hydroelectric energy projects in Kenya. Participants gave their opinions on their level of agreement or disagreement with the statements of contingent capital on a Likert scale of 1-5 where Strongly agree(SA)=5, Agree(A)=4, Neutral(N)=3, Disagree(D)=2 and Strongly disagree (SD)=1. The results are presented in Table 4.22

Table 4.22: Hedging Derivatives and Performance of Hydroelectric Energy Projects.

Statements	**SA**	**A**	**N**	**D**	**SD**	**Mean**	**Std. dev**
1. Hedging Derivatives enhances profitability of the project	13(15.5%)	71(84.5%)	0(0.00%)	0(0.00%)	0(0.00%)	4.15	0.364
2. Hedging Derivatives maintains liquidity flow within the project	78(92.9%)	6(7.1%)	0(0.00%)	0(0.00%)	0(0.00%)	4.93	0.259
3. Hedging Derivatives reduces market risks for the project	78(92.9%)	6(7.1%)	0(0.00%)	0(0.00%)	0(0.00%)	4.93	0.259
4. Hedging Derivatives reduces counterparty risk in the project	0(0.00%)	5(6.0%)	46(54.7%)	33(39.3%)	0(0.00%)	2.67	0.588
5. Hedging Derivatives ensures price stabilization by managing transaction costs and volatility	1(1.2%)	75(89.3%)	8(9.5%)	0(0.00%)	0(0.00%)	3.92	0.318
6. Hedging Derivatives saves time by reducing transaction bookwork	0(0.00%)	14(16.7%)	62(73.8%)	8(9.5%)	0(0.00%)	3.07	0.510
7. Hedging Derivatives facilitates efficiency in trading through market capitalization	33(39.3%)	50(59.5%)	1(1.20%)	0(0.00%)	0(0.00%)	4.38	0.513
8. Hedging Derivatives reduces cost of capital through systematic risk coverage	47(56%)	35(41.6%)	1(1.2%)	1(1.2%)	0(0.00%)	4.52	0.591
9. Hedging Derivatives facilitates steady revenue flow thus improving liquidity control	3(3.5%)	78(92.9%)	2(2.4%)	1(1.2%)	0(0.00%)	3.99	0.329

10. Hedging Derivatives improves project reputation among lenders and investors	58(69%)	25(29.8%)	1(1.2%)	0(0.00%)	0(0.00%)	4.67	0.545
Composite mean and Composite standard deviation						**4.12**	**0.197**

NB. HD1-10 is the statements of Hedging Derivatives

Ten statements measured the extent to which Hedging Derivatives influence performance of Hydroelectric Energy projects. Statement (1) that 'Hedging Derivatives enhances profitability of the project' had a mean of 4.15 and 0.364 standard deviation. This finding indicate that from 84 respondents, 13(15.5%) strongly agreed that Hedging Derivatives enhances profitability of the project, and 71(84.5%) agreed that Hedging Derivatives enhances profitability of the project. This result indicate that the line statement mean score of 4.15 was above composite mean score of 4.12; implying that Hedging Derivatives enhances profitability of the project and hence positively influencing performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.364 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The study results support finding by Giraldo-Prieto *et al.*, (2017) and Basha (2013) that hedging derivatives are important financial risk management instrument that can be used in a project to prevent losses and maintain high profitability returns.

Statement (2) that 'Hedging Derivatives maintains liquidity flow within the project' had a mean of 4.93 and 0.259 standard deviation. This finding indicate that from 84 respondent, 78(92.9%) strongly agreed that Hedging Derivatives maintains liquidity flow within the project, and 6(7.1%) agreed that Hedging Derivatives maintains liquidity flow within the project. This result indicate that the line statement mean score of 4.93 was above composite mean score of 4.12; implying that Hedging Derivatives maintains liquidity flow within the project and hence positively influencing the performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.259 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The study results support finding by Giraldo-Prieto *et al.*, (2017) and Sharpe *et al.*, (2012) that Derivative instruments enhance financial market efficiency through increased liquidity depth thus preventing losses that would result from systemic risks.

Statement (3) that 'Hedging Derivatives reduces market risks for the project' had a mean of 4.93 and 0.259 standard deviation. This finding indicate that from 84 respondents, 78(92.9%) strongly agreed that Hedging Derivatives reduces market risks for the project, and 6(7.1%) agreed that Hedging Derivatives reduces market risks for the project. This result indicate that the line statement mean score of 4.93 was above composite mean score of 4.12; implying that Hedging Derivatives reduces market risks for the project and hence positively influencing performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.259 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The finding supports Waswa and Wepukhulu (2018) observation that Derivative instruments hedges market risks such as interest rate risk, currency exchange risk, and inflation risk besides commodity risk for smooth project operations.

Statement (4) that 'Hedging Derivatives reduces counterparty risk in the project' had a mean of 2.67 and 0.588 standard deviation. This finding indicate that from 84 respondents, 5(6%) agreed that Hedging Derivatives reduces counterparty risk in the project, 46(54.7%) were neutral that Hedging Derivatives reduces counterparty risk in the project, 33(39.3%) disagreed that Hedging Derivatives reduces counterparty risk in the project. This result indicate that the line statement mean score of 2.67 was below composite mean score of 4.12; implying that Hedging Derivatives does not reduce counterparty risk in the project and hence negatively influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.588 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The findings are similar Giraldo-Prieto *et al.*, (2017) and Basha (2013) observation that hedging derivatives themselves carry with them counterparty risk and legal risk which may make the contract enforceable when it's required to perform and thus adequate understanding and supervision of derivatives transaction should be done with maximum accuracy.

Statement (5) that 'Hedging Derivatives ensures price stabilization by managing transaction costs and volatility' had a mean of 3.92 and 0.318 standard deviation. This finding indicate that from 84 respondents, 1(1.2%) strongly agreed that Hedging Derivatives ensures price stabilization by managing transaction costs and volatility, 75(89.3%) agreed that Hedging Derivatives ensures price stabilization by managing transaction costs and volatility, 8(9.5%) were neutral that Hedging Derivatives ensures price stabilization by managing transaction costs and volatility. This results show that the line statement mean score of 3.92 was marginally below composite mean score of 4.12; implying that Hedging Derivatives moderately ensures price stabilization by managing transaction costs and volatility and hence moderately influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.318 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The finding supports Sharpe *et al.,* (2012) observation that Derivative instruments enhance market price stability by reducing transaction cost and neutralizing volatilities.

Statement (6) that 'Hedging Derivatives saves time by reducing transaction bookwork' had a mean of 3.07 and 0.510 standard deviation. This finding indicate that from 84 respondents, 14(16.7%) agreed that Hedging Derivatives saves time by reducing transaction bookwork, 62(73.8%) were neutral that Hedging Derivatives saves time by reducing transaction bookwork, and 8(9.5%) disagreed that Hedging Derivatives saves time by reducing transaction bookwork. This result indicate that the line statement mean score of 3.07 was below composite mean score of 4.12; implying that Hedging Derivatives does not save time by reducing transaction bookwork and hence negatively influence the performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.510 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The study results contradicts finding by Fernando *et al.*, (2017) that hedging derivatives saves time by reducing transaction bookwork.

Statement (7) that 'Hedging Derivatives facilitates efficiency in trading through market capitalization' had a mean of 4.38 and 0.513 standard deviation. This finding indicate that from 84 respondents, 33(39.3%) strongly agreed that Hedging derivatives facilitates efficiency in trading through market capitalization, 50(59.5%) agreed that Hedging derivatives facilitates efficiency in trading through market capitalization, and 1(1.2%) was neutral that Hedging Derivatives facilitates efficiency in trading through market capitalization. This result indicate that the line statement mean score of 4.38 was above composite mean score of 4.12; implying that Hedging Derivatives facilitates efficiency in trading through market capitalization and hence positively influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.513 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The findings are similar to observations by Giraldo-Prieto *et al.*, (2017) that derivatives use enables market recapitalization and leverage.

Statement (8) that 'Hedging Derivatives reduces cost of capital through systematic risk coverage' had a mean of 4.52 and 0.591 standard deviation. This finding indicate that from 84 respondents, 47(56%) strongly agreed that Hedging derivatives reduces cost of capital through systematic risk coverage, 35(41.6%) agreed that Hedging reduces cost of capital through systematic risk coverage, 1(1.2%) was neutral that Hedging Derivatives reduces cost of capital through systematic risk coverage and 1(1.2%) disagreed that Hedging Derivatives reduces cost of capital through systematic risk coverage. This result indicate that the line statement mean score of 4.52 was above composite mean score of 4.12; implying that Hedging Derivatives reduces cost of capital through systematic risk coverage and hence positively influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.591 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The finding support Sharpe *et al.*, (2012) argument that hedging derivatives in projects provides an umbrella for cost variance in case of market price volatility hence reduces the overall cost of capital.

Statement (9) that 'Hedging Derivatives facilitates steady revenue flow thus improving liquidity control' had a mean of 3.99 and 0.329 standard deviation. This finding indicate that from 84 respondents, 3(3.5%) strongly agreed that Hedging Derivatives facilitates steady revenue flow thus improving liquidity control, 78(92.9%) agreed that Hedging Derivatives facilitates steady revenue flow thus improving liquidity control, 2(2.4%) were neutral that Hedging Derivatives facilitates steady revenue flow thus improving liquidity control and 1(1.2%) disagreed that Hedging Derivatives facilitates steady revenue flow thus improving liquidity control. This results shows that the line statement mean score of 3.99 was marginally below composite mean score of 4.12; implying that Hedging Derivatives moderately facilitate steady revenue flow thus moderately improve liquidity control and hence moderately influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.329 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The finding supports observation by Sharpe *et al.*, (2012) that Hedging derivatives used by firms to hedge systemic risks facilitates steady revenue flow which results into nourished liquidity depth.

Statement (10) that 'Hedging Derivatives improves project reputation among lenders and investors' had a mean of 4.67 and a 0.545 standard deviation. This finding indicate that from 84 respondents, 58(69%) strongly agreed that Hedging derivatives improves project reputation among lenders and investors, 25(29.8%) agreed that Hedging derivatives improves project reputation among lenders and investors and 1(1.2%) was neutral that Hedging Derivatives improves project reputation among lenders and investors. This result indicate that the line statement mean score of 4.67 was above composite mean score of 4.12; implying that Hedging Derivatives improves project reputation among lenders and investors and hence positively influence performance of Hydroelectric Energy projects. The higher line item standard deviation of 0.545 than the composite standard deviation of 0.197 implies that there was divergence of opinion among respondents. The finding is similar to Waswa and Wepukhulu (2018) and Giraldo-Prieto *et al.*, (2017) observation that hedging derivatives in a project reduces market risk and improve financial image and reputation of the project amongst lenders and peers.

The overall composite score of all indicators of Hedging Derivatives had a mean of 4.12 with a standard deviation of 0.197 and further indicated that a majority 68(80.9%) of participants at least agreed that Hedging Derivatives influence performance of Hydroelectric Energy projects. The study results corroborates with similar findings by Bhattacharya *et al.*, (2015) that Hedging Derivatives influence performance of Hydroelectric Energy projects.

These findings were further supported by qualitative data and this is what the participant had to say on influence of Hedging Derivatives on Performance of Hydroelectric Energy Project. The interviewee from NSE said that *"…Nairobi Securities Exchange (NSE) derivatives market facilitates the trading of futures contracts in the Kenyan market as regulated by Capital Markets Authority (CMA) protecting investors' portfolios from potential price declines "a form of insurance,"* for example, *"KenGen subscribed hedging derivatives during Public Infrastructure Bond offer in 2019 for efficiency in offsetting in future, making NSE the second exchange to offer traded derivatives in Africa, after Johannesburg Stock Exchange."*

Similarly, CMA participant attributed that *"…CMA Strategic Plan 2018-2023 envisages the positioning of Kenya's domestic capital markets as the premier choice for investors and issuers of derivatives through robust regulation, supportive innovation and enhanced investor protection besides trading only in secure bourse of Nairobi Securities Exchange (NSE) and working with licensed credit rating agencies."*

Further,*"…to minimize the potential adverse effects of credit, liquidity and market risks, the Authority's risk management policies subscribe to transacting with institutions with good credit ratings."* Equally, *"…the Authority partners with several stakeholders such as Chartered Institute for Securities and Investment, Certified Financial Analyst East Africa (CFA East Africa), Association of Chartered Certified Accountants (ACCA), Financial Sector Deepening Africa (FSD Africa) in awareness activities for hedging derivatives."*

In support, KenGen's participant said that *"…the Company's Finance Division identifies, evaluates and hedges financial risks such as credit risk, liquidity risk, foreign exchange risk, interest rate risk and price risk through derivatives placed in NSE to minimize potential adverse effects on its financial performance."*

Correlation Analysis of Hedging Derivatives and Performance of Hydroelectric Energy Projects

The study sought to examine the relationship between Hedging Derivatives and Performance of Hydroelectric Energy projects. Pearson correlation coefficient was used to test the relationship between Hedging Derivatives and Performance of Hydroelectric Energy projects; this was done at 95% level of confidence. To test the extent of the relationship between Hedging Derivatives and Performance of Hydroelectric Energy projects; all indicators of Hedging Derivatives and Performance of Hydroelectric Energy projects were analyzed based on the following hypothesis 4. H_0: There is no significant relationship between Hedging Derivatives and Performance of Hydroelectric Energy projects. The corresponding mathematical model for the hypothesis was identified as follows: Performance Hydroelectric Energy projects = f(Hedging Derivatives). The research study found that out of the ten statements of Hedging derivatives two statements namely; statement 4(Hedging Derivatives reduce counterparty risk in the project; r=-0.527, P-value=0.302<0.05) and Statement 6(Hedging Derivatives saves time by reducing transaction bookwork; r=-0.353, P-value=0.125<0.05) didn't have significant correlation whereas eight statements namely; Statement 1(Hedging Derivatives enhances profitability of the project; r=0.365, P-value=0.001<0.05), statement 2(Hedging Derivatives maintains liquidity flow within the project; r=0.237, P-value=0.03<0.05), Statement 3(Hedging Derivatives reduces market risks for the project; r=0.247, P-value=0.023<0.05), Statement 5(Hedging Derivatives ensures price stabilization by managing transaction costs and volatility; r=0.256, P-value=0.019<0.05), Statement 7(Hedging derivatives facilitates efficiency in trading through market capitalization; r=0.307, P-value=0.004<0.05), Statement 8(Hedging reduces cost of capital through systematic risk coverage; r=0.448, P-value=0.000<0.05), Statement 9(Hedging Derivatives facilitates steady revenue flow thus improving liquidity control; r=0.247, P-value=0.023<0.05), and Statement 10(Hedging derivatives improves project reputation among lenders and investors; r=0.235 P-value=0.031<0.05) had significant correlation.

Similarly the overall correlation coefficient for Hedging derivatives and Performance of Hydroelectric Energy projects was found to be r=0.923 with a p-value of 0.000<0.05, implying that there is a significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects leading to rejection of the null hypothesis (4. H_0: There is no significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects) and acceptance of the alternative hypothesis, and hence the research findings conclude that there is significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects. The correlation results are in tandem with the descriptive overall composite mean scores of 4.12 and standard deviation of 0.197 which indicated that the participants agreed that Hedging derivatives influence Performance of Hydroelectric Energy projects. This finding is in agreement with studies done by Waswa and Wepukhulu (2018) that there is significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects. The correlations results obtained are shown in Table 4.23

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Table 4.2: Correlations of Hedging Derivatives and Performance of Hydroelectric Energy Projects (n=84)

Hedging derivatives indicators		**Performance of hydroelectric energy projects**
Hedging Derivatives enhances profitability of the project	Pearson Correlation	0.365*
	Sig. (2-tailed)	0.001
Hedging Derivatives maintains liquidity flow within the project	Pearson Correlation	0.237*
	Sig. (2-tailed)	0.03
Hedging Derivatives reduces market risks for the project	Pearson Correlation	0.247*
	Sig. (2-tailed)	0.023
Hedging Derivatives does not reduce counterparty risk in the project	Pearson Correlation	-0.527*
	Sig. (2-tailed)	0.302
Hedging Derivatives ensures price stabilization by managing transaction costs and volatility	Pearson Correlation	0.256*
	Sig. (2-tailed)	0.019
Hedging Derivatives saves time by reducing transaction bookwork	Pearson Correlation	-0.353*
	Sig. (2-tailed)	0.125
Hedging derivatives facilitates efficiency in trading through market capitalization	Pearson Correlation	0.307*
	Sig. (2-tailed)	0.004
Hedging reduces cost of capital through systematic risk coverage	Pearson Correlation	0.448*
	Sig. (2-tailed)	0.000
Hedging Derivatives facilitates steady revenue flow thus improving liquidity control	Pearson Correlation	0.247*
	Sig. (2-tailed)	0.023
Hedging derivatives improves project reputation among lenders and investors	Pearson Correlation	0.235*
	Sig. (2-tailed)	0.031
Overall correlation for Hedging derivatives	**Pearson Correlation**	**0.923***
	Sig. (2-tailed)	**0.000**

Regression Analysis of Hedging Derivatives on Performance Hydroelectric Energy Projects

Simple linear regression was adopted to investigate how Hedging derivatives influence Performance of Hydroelectric Energy projects. The rational of using the simple regression model was to establish how hedging derivatives as a predictor significantly or insignificantly predicted Performance of Hydroelectric Energy projects. The model summary table suggest that there is a positive correlation (R=0.923) between Hedging derivatives and Performance of Hydroelectric Energy projects and those predicted by the regression model. In addition, 85.2% (R^2=0.852) of the variance in the Performance of Hydroelectric Energy projects is explained by Hedging derivatives. The results are consistent with the findings by Giraldo-Prieto *et al.*, (2017); Fernando *et al.*, (2017) and Basha (2013); that suggest significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects. The regression model summary is presented in Table 4.24.

Table 4.3: Regression Model Summary table of Hedging derivatives and Performance of Hydroelectric Energy projects

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.923[a]	0.852	0.850	0.274
a. Predictors: (Constant), aggregated scores of Hedging derivatives Indicators				

The study sought to establish if the regression model is best fit for predicting Performance Hydroelectric Energy projects after use of Hedging derivatives instrument. The ANOVA results indicated that (F-statistics (1,82)=472.230) is significant at P-value =0.000<0.05, implying that the regression model results in significantly better prediction of Performance of Hydroelectric Energy projects. The regression ANOVA output statistics results are shown in Table 4.25

Table 4.4: An ANOVA of the Regression of Hedging derivatives and Performance of Hydroelectric Energy Projects

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	35.573	1	35.573	472.230	0.000[b]
	Residual	6.177	82	0.075		
	Total	41.750	83			
a. Dependent Variable: aggregated Performance of Hydroelectric Energy projects.						
b. Predictors: (Constant), aggregated scores of Hedging derivatives						

The study sought to establish whether there was influence of Hedging derivatives on Performance of Hydroelectric Energy projects. The simple linear regression coefficients results indicated that there was significant influence of Hedging derivatives on Performance of Hydroelectric Energy projects given P-Value =0.000<0.05. The regression model for contingent capital was $Y= 1.002 + 0.786X_4$; implying that for each unit of Hedging derivatives use, Performance Hydroelectric Energy projects marginally changed by 0.786 units. The results are consistent with the findings by Waswa and Wepukhulu (2018); Giraldo-Prieto *et al.*, (2017); Fernando *et al.*, (2017) and Basha (2013) that there is significant influence of hedging derivatives on Performance of Hydroelectric Energy projects. The regression coefficients results are in Table 4.26

Table 4.5: Coefficients for the Regression of Hedging derivatives and Performance of Hydroelectric Energy projects

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	1.002	0.152		6.577	0.000
	Hedging derivatives	0.786	0.036	0.923	21.731	0.000
a. Dependent Variable: Performance of Hydroelectric Energy projects						

CONCLUSIONS

The simple linear regression coefficients p-values (0.000<0.05) as well as the Pearson correlation p-values (0.000<0.05) results indicated that there was significant influence of Hedging derivatives on Performance of Hydroelectric Energy projects; leading to rejection of the null hypothesis H_0: There is no significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects; and so it was concluded that there is significant relationship between Hedging derivatives and Performance of Hydroelectric Energy projects. The findings of this study thus provide significant contributions to the body of knowledge as it establishes the relationship between Hedging derivatives and performance of hydroelectric energy projects. Hedging derivatives enhance financial market efficiency through increased liquidity depth besides maintaining high investment returns and preventing losses that would result from risks such as systemic risks or market risks such as interest rate risk, currency exchange risk, and inflation risk besides commodity risk. Based on the findings, the study recommends targeted policy enactment for inclusion of Hedging derivatives products in hydroelectric energy projects and awareness creation on the operations and trading of hedging derivatives in stock markets to the instruments providers and investors in hydroelectric energy projects. This study was delimited to Kenya and on hydroelectric energy projects alone and therefore, a study can be replicated in other developing countries and in projects other than hydroelectric energy projects to explain the possibility of other environmental factors thereby improving generalizability of the findings. Further research should be done on mechanisms of adopting hedging derivatives in hydroelectric renewable energy.

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