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From Sustainability to Solvency: ESG's Role in Predicting Financial Distress in Energy Companies

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Introdução

Predicting financial distress is critical for investors, creditors, and managers as it highlights firms' ability to meet obligations and supports economic stability. Models began with qualitative assessments in the 1930s and advanced with Altman's (1968) Discriminant Analysis, later evolving to logistic regression and machine learning. However, gaps remain in integrating ESG variables into corporate distress prediction.

Problema de Pesquisa e Objetivo

Despite growing interest in ESG, its influence on corporate financial stability—especially in South America's energy sector—remains uncertain. This study examines how environmental, social, and governance practices affect creditworthiness of listed electric utilities. The objective is to quantify the individual and combined impacts of ESG pillars on distress prediction using machine learning techniques

Fundamentação Teórica

Drawing on Stakeholder Theory, ESG practices strengthen ties with investors, customers, and communities, mitigating operational and reputational risks. Environmental factors cover resource efficiency and access to green finance; Social includes employee retention and customer loyalty; Governance entails transparency and reduced agency conflicts. Prior research shows high ESG scores correlate with lower capital costs and reduced insolvency risk.

Metodologia

Sample: 30 electric utilities listed in South America (2016–2023), yielding 776 observations after data cleaning. Variables: firm size (SIZE), return on assets (ROA), leverage (LEV), liquidity (LIQ), asset turnover (TURNOVER), plus Refinitiv ESG scores (ENV, SOC, GOV). Models: logistic regression, SVM, XGBoost, neural networks, Random Forest, and a bagging ensemble. Evaluation: AUC, DeLong tests, Type I/II errors, sensitivity, specificity, MAE, and RMSE

Análise dos Resultados

Incorporating ESG variables improved AUC and accuracy across all models, with governance yielding the largest performance gains, followed by social and environmental pillars. The bagging ensemble achieved the best performance (test AUC = 0.9705) and significantly reduced Type II errors, enhancing sensitivity to distress cases. DeLong tests confirmed these improvements were statistically significant.

Conclusão

ESG factors add significant predictive value to solvency models, complementing traditional financial metrics. Governance stands out as the primary early-warning driver, followed by social and environmental dimensions. Integrating ESG into machine learning enhances early alert capabilities, aiding more informed decisions by investors, managers, and regulators.

Contribuição / Impacto

This study is the first to evaluate individual and combined effects of ESG pillars on distress prediction in the South American electric utility sector using robust statistical tests (DeLong) and advanced machine learning. It offers practical guidance for investors in portfolio adjustment, managers in policy enhancement, and policymakers in designing incentives to strengthen financial stability and sustainability.

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