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**Predicting Efficiency of Commercial Banks in Vietnam:  
A DEA and Machine Learning Approach**

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## **Abstract**

**Purpose:** This study investigates the effectiveness of a hybrid Data Envelopment Analysis (DEA) and Machine Learning (ML) approach in predicting the efficiency of commercial banks in Vietnam.

**Methodology:** A two-stage model is proposed. First, DEA is employed to evaluate bank efficiency from 2012 to 2021 using data from annual reports. Second, various ML algorithms (ANN-MLP, linear regression, random forest) are used to forecast efficiency scores based on the DEA results. The performance of each ML model is compared to identify the most effective approach.

**Findings:** The findings suggest that the ANN-MLP model outperforms other ML methods in predicting bank efficiency.

**Research limitations/implications:** The study utilizes data from a specific timeframe and may be limited by potential inaccuracies in financial statements. Future research could extend the time period and explore additional data sources.

**Practical implications:** The proposed DEA-ML model can be a valuable tool for bank managers and policymakers to assess and predict bank efficiency, ultimately leading to improved decision-making, greater efficiency, and enhanced competitiveness. The findings might be generalizable to other bank types in similar contexts.

**Social implications:** This research contributes to the development of DEA-ML models, potentially influencing practices in bank efficiency measurement and leading to a more robust financial system.

**Originality/value:** This study offers a novel approach for combining DEA and ML techniques to predict commercial bank efficiency in Vietnam. The findings demonstrate the potential of ANN-MLP for financial applications and provide valuable insights for bank management and financial regulation.

**Keywords:** Vietnamese commercial banks; Efficiency; Data Envelopment Analysis; Machine learning.

**Classification-JEL:** G21, C14, C53

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