

# How does stakeholder engagement through environmental, social, and governance affect eco-efficiency and profitability efficiency? Zooming into Apple Inc.'s counterparts

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## ABSTRACT

As global ecological degradation intensifies, a trade-off has arisen between environmental protection and production efficiency to achieve sustainable development for the environment, society, and the company itself. However, the potential reverse causality relationship between environmental, social, and governance (ESG) and corporate efficiency may lead to confusion. This study estimates the eco-efficiency of Apple Incorporated's value-chain counterparts in the first stage and creates values and profitability in the second stage of efficiency evaluation. Results obtained from the (i) directional distance function in the two-stage data envelopment analysis (DEA), (ii) additive efficiency decomposition two-stage network DEA model, and (iii) network slacks-based measure model are consistent. That is, Apple counterparts manage more efficient eco-efficiency than profitability efficiency, implying that eco-efficiency is their competitive advantage. We thus also run a regression analysis to examine how the ESG ratings of Apple counterparts explain their eco-efficiency and profitability efficiency. Although the overall ESG rating positively explains the efficiencies, we found that the individual governance rating shows no statistically significant effect. The regression results provide insight for practitioners on the importance of investing in the three aspects of a firm's collective conscientiousness for societal and environmental governance. This paper integrates companies' eco-efficiency and profitability efficiency to resolve the conflict between environmental issues and production efficiency. It also analyzes in depth the effects of ESG and its three individual factors on eco-, profitability, and average efficiencies. The diversity of research methods also provides new ideas for future research related to firm efficiency.

## KEYWORDS

Apple Incorporated; Data envelopment analysis; Eco-efficiency; environmental, social, and governance; Profitability efficiency; Stakeholder engagement; Sustainable development

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