

ANALYSIS OF ECONOMIC GROWTH'S SCALE EFFECT ON EMISSION LEVELS IN G20 DEVELOPING COUNTRIES

By Narayana Alif Athallah

Abstract

This study analyzes the effect of Gross Domestic Product (GDP), Foreign Direct Investment (FDI), and energy consumption on carbon dioxide (CO₂) emissions in ten G20 developing countries for the 2005–2024 period. Applying an extended Environmental Kuznets Curve (EKC) framework, this research employs panel data regression with a Random Effect Model estimated via Feasible Generalized Least Squares (FGLS). The results demonstrate that GDP has a significant positive effect, while GDP squared has a significant negative effect on carbon emissions, confirming the inverted U-shaped EKC hypothesis. Meanwhile, FDI exerts an insignificant negative effect, energy consumption has a significant positive impact, and the COVID-19 dummy variable shows an insignificant effect. These findings indicate that G20 developing countries are still in the initial phase of the EKC curve, where economic growth is accompanied by rising carbon emissions (scale effect) and fossil energy consumption remains dominant. This study recommends accelerating the energy transition toward renewable energy, strengthening environmental regulations, and directing foreign direct investment inflows toward eco-friendly green sectors to promote sustainable economic development.

Keywords ; Carbon Emissions, GDP, FDI, Energy Consumption, EKC

ANALISIS *SCALE EFFECT* PERTUMBUHAN EKONOMI TERHADAP TINGKAT EMISI DI NEGARA BERKEMBANG G20

Oleh Narayana Alif Athallah

Abstract

Penelitian ini menganalisis pengaruh Produk Domestik Bruto (PDB), *Foreign Direct Investment* (FDI), dan konsumsi energi terhadap emisi karbon dioksida (CO₂) di sepuluh negara berkembang G20 periode 2005–2024. Menggunakan kerangka *extended Environmental Kuznets Curve* (EKC), penelitian ini menerapkan regresi data panel dengan *Random Effect Model* yang diestimasi melalui *Feasible Generalized Least Square* (FGLS). Hasil penelitian menunjukkan bahwa PDB berpengaruh positif signifikan sedangkan PDB kuadrat berpengaruh negatif signifikan terhadap emisi karbon, mengonfirmasi hipotesis EKC berbentuk U terbalik. Sementara itu, FDI berpengaruh negatif tidak signifikan, konsumsi energi berpengaruh positif signifikan, dan variabel *dummy* COVID-19 tidak berpengaruh signifikan. Temuan ini mengindikasikan bahwa negara berkembang G20 masih berada pada fase awal kurva EKC, di mana pertumbuhan ekonomi diiringi peningkatan emisi karbon (*scale effect*) dan konsumsi energi fosil masih mendominasi. Penelitian ini merekomendasikan percepatan transisi energi menuju energi terbarukan, penguatan regulasi lingkungan hidup, serta pengarahannya investasi asing langsung menuju sektor-sektor hijau yang ramah lingkungan guna mendukung keberlanjutan ekonomi.

Kata Kunci : Emisi Karbon, PDB, FDI, Konsumsi Energi, EKC