Energy Cost Environment as a Determinant of Insulin Export Volume: Evidence from Solar and Fossil Fuel Electricity Shares Across 22 Exporting Countries (2010–2024)

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ABSTRACT

This study examines whether a country's energy cost environment, proxied by solar and fossil fuel electricity shares, determines insulin export volume across 22 exporting countries from 2010 to 2024. Insulin production is among the most electricity-intensive pharmaceutical processes, and its manufacturing cost competitiveness is increasingly shaped by the price of grid electricity. Using entity fixed-effects panel regression with Driscoll-Kraay standard errors, we find that a country's solar electricity share is positively and significantly associated with insulin export volume ($\beta = 0.061$, $p = 0.046$), consistent with the Merit Order Effect, in which rising solar generation displaces costlier fossil fuel plants and lowers electricity prices for manufacturers. Conversely, a country's fossil fuel electricity share is negatively associated with export volume ($\delta = -0.057$, $p = 0.003$). These results are robust to two-way fixed-effects specifications and several alternative estimation methods.

These findings identify an underexplored channel linking domestic energy policy to international trade competitiveness in essential medicines. As countries pursue energy transitions at different paces, relative shifts in electricity generation mix may meaningfully reshape comparative advantage in energy-intensive manufacturing sectors, with direct implications for global supply chain resilience in pharmaceuticals and other energy-intensive traded goods.

Keywords: insulin export; electricity cost; solar energy; Merit Order Effect; medicine security

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