Metal Footprint in the context of Investment-led Growth: A Global Time-series Analysis

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Author: Xinzhu ZHENG
Co-Authors: Ranran Wang, Richard WOOD, Edgar Hertwich

In modern society, anthropogenic usage of metals plays an unprecedented role in the process of industrialization and urbanization. Studies indicate a continued growth in metal extraction could risk depleting the reserve base and a continuous decrease in the grade of ores will likely accelerate the impacts of metal extraction on energy demand, water pollution, and land use. The material footprint was introduced as a metric to capture the material use associated with a nationâ€™s consumption. Recently, researchers explored the dynamics between metal use and economic development by comparing national metal footprints and GDP. Based on a cross-sectional analysis, Wiedmann and colleagues (2015) reported an elasticity of metal footprint with respect to income of 0.9 for the year 2008. However, these analyses are based on either individual countries or a specific year. Few studies have investigated the relationships between metal footprint and economic activities across a broad range of countries and time. To fill this gap, this study employs panel analysis to investigate the statistical relationships between metal footprint and income (i.e. affluence), urbanization, and capital formation for 43 countries over the period 1995-2013. The analysis employs first difference methods and is based on the STIRPAT (Stochastic Impacts by Regression on Population, Affluence and Technology) model. The first difference model ensures that omitted variables do not unduly influence the analysis and to control for autocorrelation present in the data. Distinct from the relative decoupling relationship reported by cross-sectional studies, our panel data analysis revealed strong positive income-metal coupling for both developed and developing countries. Every 1% growth of per capita GDP (adjusted by purchasing power parity) was associated with 1.74% increase of per capita metal footprint. A disproportionate share of metal is used for capital formation, and the elastic relationship is due to the growing share of capital formation in GDP as wealth increases. A strong and positive effect of GDP share of capital formation on per capita metal footprint is observed. Controlling for income level, the elasticity of per capita metal footprint with the capital formation share in GDP is 2. While keeping the capital formation share constant, the income elasticity to per capita metal footprint is only around 1. Moreover, urbanization, measured as a countryâ€™s urban population share, also has significant effects on the metal footprint. As urbanization increases, the metal footprint follows an inverted- U-shaped curve, with a turning point at urbanization = 70%. Findings from this study advance the understanding of resource use drivers from the traditional focus on affluence scale to affluence make-up and suggest that a shift from investment-led growth model to consumption-led growth is a potential pathway to reduce the metal elasticity of economic development.