Studies on the Effectiveness of Circular Economy Process in Indian Metal Industry

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ABSTRACT:

The concept of circular economy process has emerged as an important approach in addressing how society can use its resources more efficiently. Circular economy is a much discussed concept of sustainable development towards promoting economic growth by creating new business and job opportunities. Moreover, circular economy process is to benefit the human society, nature, and finally prevent the depletion of the natural resources by applying material loops and facilitating sustainable development. Circular economy is comparatively a new area of research specifically in Indian context and, therefore, literature is scarce in this area with limited availability of data and case studies. This thesis focuses on the effectiveness of circular economy process in Indian metal industry.

Copper industry is a major contributor to the global economy. There are concerns about the depletion of non-renewable resources such as copper ore, which may become scarce for future generations if extraction continues at current rates without sustainable management practices in place. India faces several challenges in moving towards the circular economy regime. In India, the demand for copper is growing fast on account of rising population, economic growth, transition to a more sustainable society and government plans. This research is mainly aimed at the studies on the effectiveness of circular economy process for Indian copper metal industries. Hence the present study considers the modelling of circular economy process utilizing econometrics and system dynamics methodology in the context of India. This thesis initially focuses on the modeling of a dynamic co-flow macroeconomic model to capture the circular economy process in the metal industry. The benefit of the circular economy is measured by rebound effect and, in our research, it is found to be unstable over time.

Further, the thesis focuses on the development of an autoregressive distributed lag model to understand the secondary copper production under the influence of selected economic variables in the context of India using time series data for a period of 38 years. The cointegration bounds

test is carried out to analyze the long-run and the short-run effects of the selected economic variables on secondary copper production. The estimated autoregressive distributed lag model is tested for serial correlation, heteroscedasticity, and stability to ensure the model's fitness. Furthermore, a detailed feedback loop study was conducted to capture the dynamic interactions among the variables in the system considered, which includes primary production, secondary production, scrap utilization, import, demand and supply. Further, the causal loop model developed is transformed to a dynamic stock and flow consistency model to analyze the circular economy process in Indian metal industry. The developed stock and flow model is further utilized to experiment with usable policies to improvise the existing circular economy process in the metal industry for extracting the possible benefits out of the same.

Keywords: Circular economy process; Primary and secondary copper production; Scrap recycling; Co-flow structure; Rebound effect; Economic variables; Autoregressive distributed lag model; System dynamics modeling; Policy experimentation.