

# LESS MATERIAL PROJECT<sup>1</sup>

## Does material intensity sufficiently represent material efficiency?<sup>2</sup>

*by Sedat Alataş, 20 May 2023*

The ratio of material consumption to GDP (MC/GDP), also known as material intensity, is commonly used to measure material efficiency. The idea is that if the same amount of output is generated with fewer materials, or more simply, if material intensity decreases, the country's performance in terms of material efficiency increases. Therefore, material efficiency and material intensity are employed interchangeably, with the former being understood as the inverse of the latter.

Material intensity is a convenient metric for country comparison because it is reasonably simple to calculate. This straightforward proxy, however, has several serious shortcomings that need to be properly addressed, and thus does not accurately reflect a country's performance in terms of material efficiency. The most important drawback of the material intensity indicator is that it only takes into account materials and output themselves and ignores all other possible factors that might potentially affect material efficiency. In other words, by formulation, an increase or decrease in material intensity is only determined by the changes in material consumption or output. However, material efficiency might be affected by a variety of other factors that have been ignored by material intensity, such as key economic indicators (income, price change, trade structure, or exchange rate volatility), economic structure (the share of industry or carbon-intensive sectors in the economy), or resource-related issues (natural resources abundance, dependence on other countries in terms of resources). In a similar vein, changes in material intensity are not only or necessarily driven by changes in material efficiency. Therefore, the relationship between material intensity and material efficiency has a propensity to be skewed and to not always portray the real picture.

---

<sup>1</sup> This project entitled “Analysing Material Demand and Material Efficiency from Sustainability Perspective: A Comparative Cross-Country Analysis and Assessments for Turkey” (Project Number: 221K081) is funded by TUBITAK (The Scientific and Technological Research Council of Turkey) “1001 – The Scientific and Technological Research Projects Funding Program”.

<sup>2</sup> This blog post is based on our paper entitled "Material Demand and Material Efficiency for Sustainable Development in the European Union Countries: A Stochastic Frontier Analysis" (written by Sedat Alataş, Burcu Hiçylmaz, and Etem Karakaya). Please see the full paper for further information: <https://doi.org/10.1002/sd.2648>. Sedat Alataş can be reached at [sedat.alatas@adu.edu.tr](mailto:sedat.alatas@adu.edu.tr).

There are several methods that can be considered alternatives to empirically measure material efficiency, such as Index Decomposition Analysis (IDA), Data Envelopment Analysis (DEA), or Stochastic Frontier Analysis (SFA). In our recent research article, using the SFA approach, we measure the material efficiency performance of the EU countries for the period between 1995 and 2019, compare it with the MC/GDP ratio to evaluate whether or not the mostly-employed traditional material intensity indicator is a good proxy for capturing the material efficiency performance of the countries in the sample.

**Figure 1** Material efficiency and material intensity in the EU countries (1995-2019)

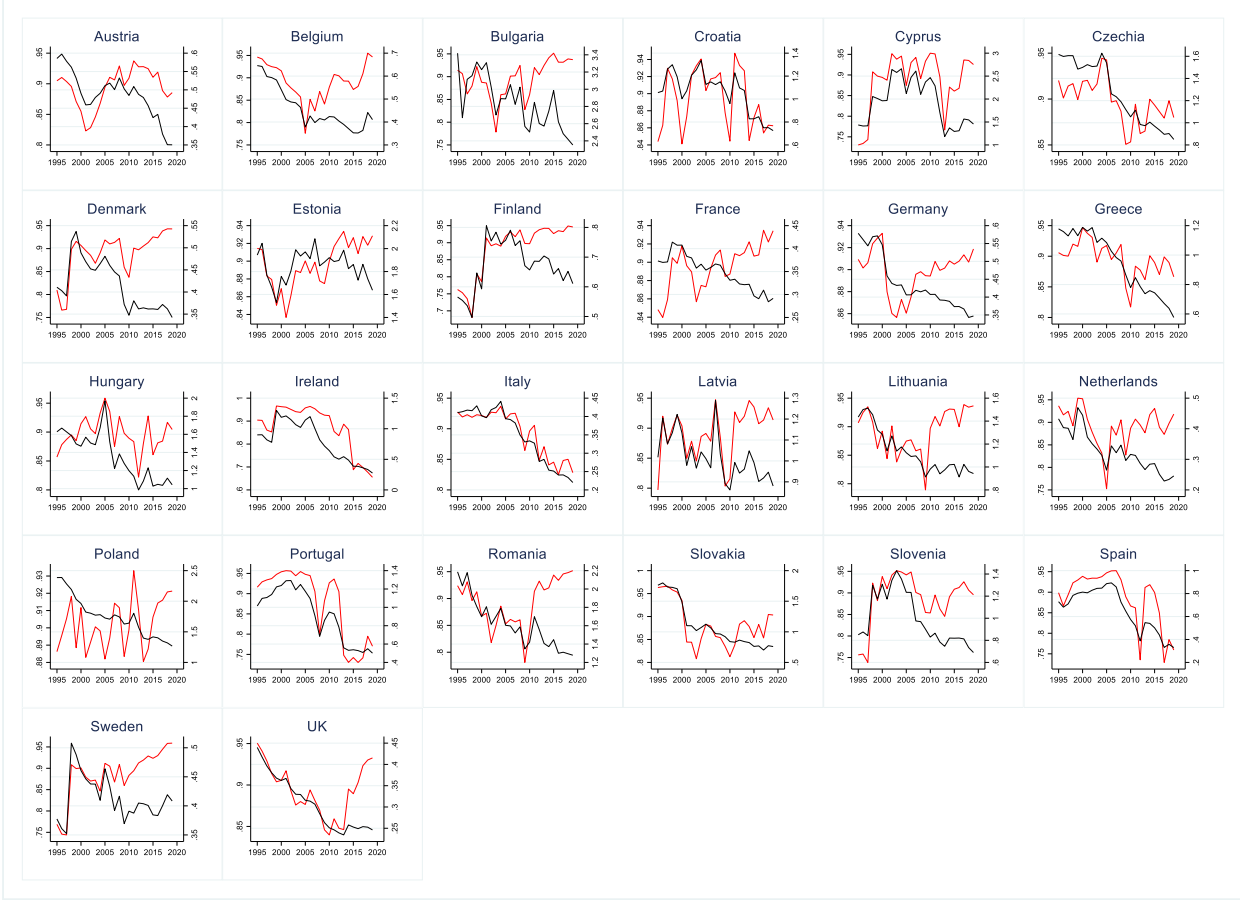


Figure 1 presents the evolution of the estimated SFA-based material efficiency (red line) and material intensity (black line) (the ratio of domestic material consumption to gross domestic product) for the period between 1995 and 2019. If material intensity were a good proxy for material efficiency, these two indicators would be negatively correlated, as discussed above. However, as can be seen, there is no obvious inverse correlation between them, with the exception of a few countries, like France and Germany, Belgium (particularly after 2005), Denmark, Greece, the Netherlands, Romania, and Slovenia (especially after 2010). That is,

material intensity may be a reasonable proxy for material efficiency in some countries (or for some specific periods), but not in others. Therefore, instead of heavily relying on a simple material intensity indicator, we must better quantify material efficiency using alternative methodologies to widen our understanding and better capture material efficiency dynamics.

## References

- [1] S. Alataş, B. Hiçyılmaz, and E. Karakaya, "Material Demand and Material Efficiency for Sustainable Development in European Union Countries: A Stochastic Frontier Analysis," *Unpublished*.

Less Material