THE EFFECTS OF ECONOMIC CRISIS IN THE MATERIAL CONSUMPTION OF EUROPEAN COUNTRIES

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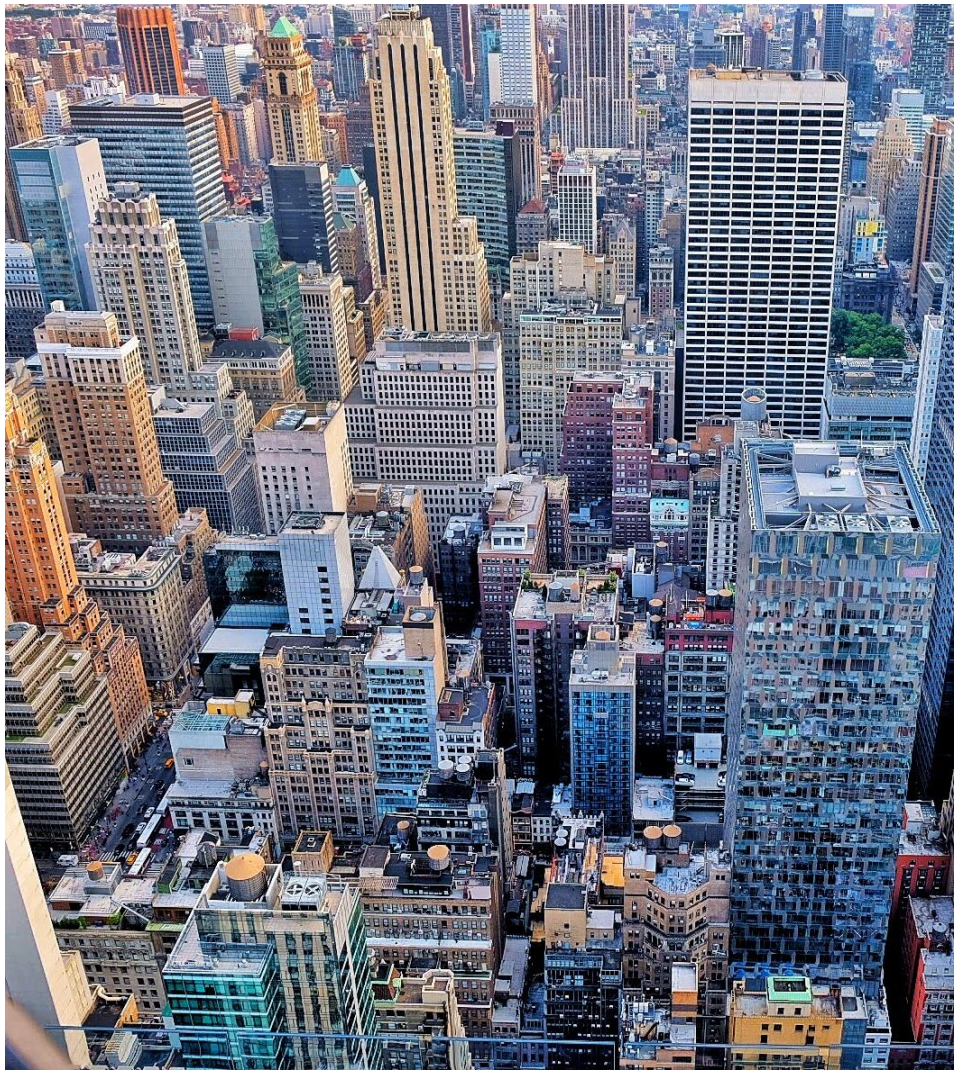


Economic development and resource use

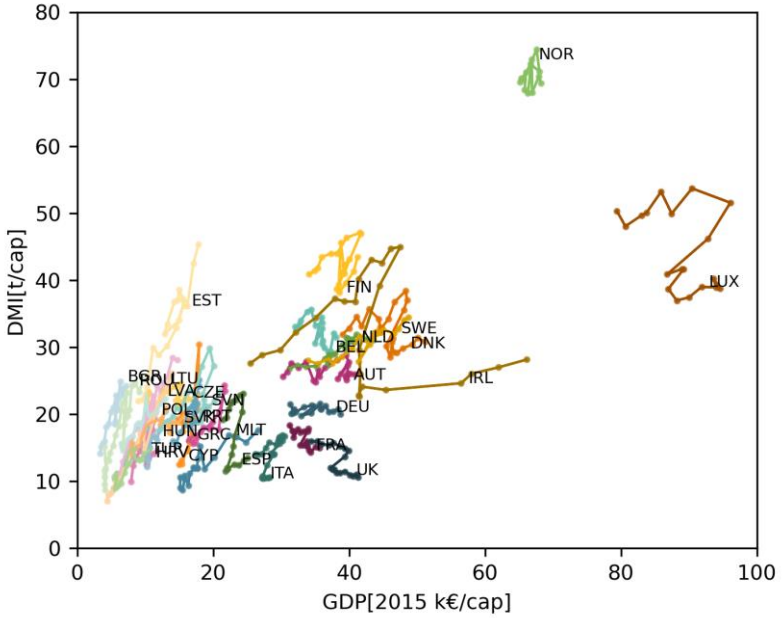
Introduction

Since 1970…

2 x Population

4.7 x GDP

3.4 x DE*



The use of natural resources has fueled economic development, causing a sustainability issue.

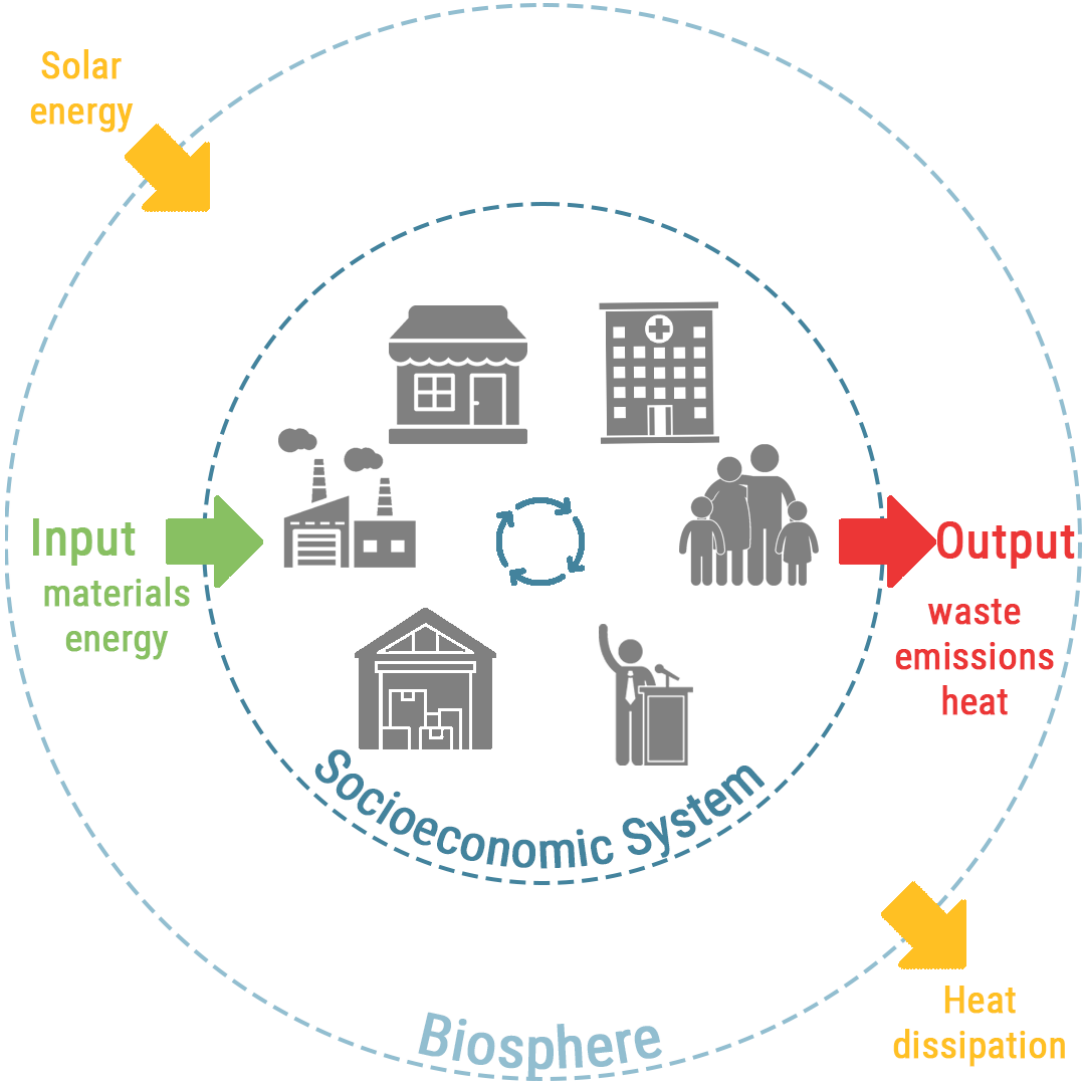
Previous research has found that economic crisis is linked to dematerialization (Wu et al., 2019).

SOCIEOECONOMIC METABOLISM

Key concepts

"Socioeconomic metabolism constitutes the self-reproduction and evolution of the biophysical structures of human society. It comprises those biophysical transformation processes, distribution processes, and flows, which are controlled by humans for their purposes. The biophysical structures of society ('in use stocks') and socioeconomic metabolism together form the biophysical basis of society."

Pauliuk & Hertwich (2015)



Compilation of PIOTs

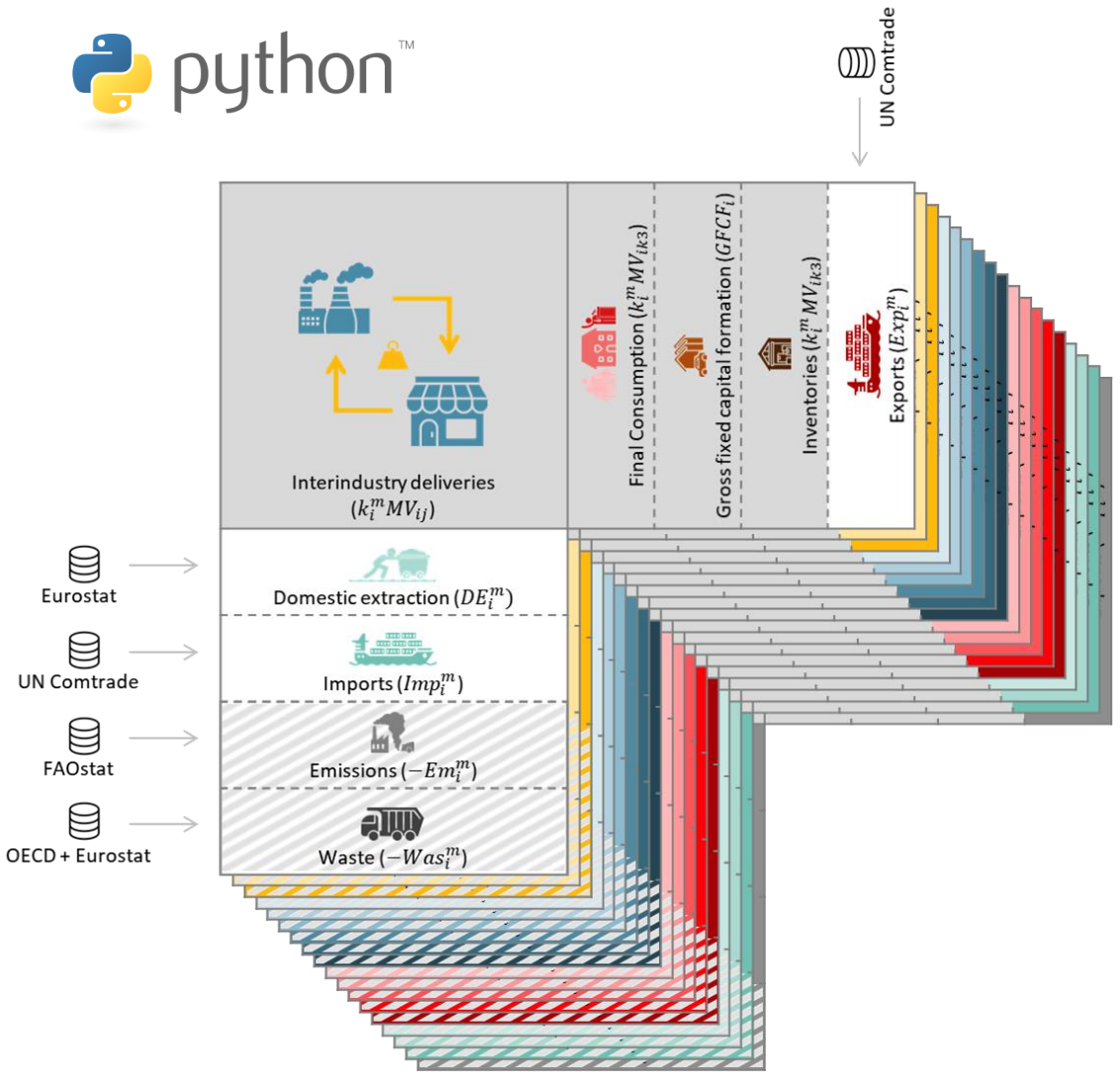
Method

PART I : Known flows (white)

Collect data for known flows and add it to the tables, by disaggregating the flows per sector and material

PART II : Unknown flows (grey)

Calculate the material flows that satisfy the mass balance at the sector and material level, based on the homogeneous price assumption.



The MIOTs were collected from OECD.

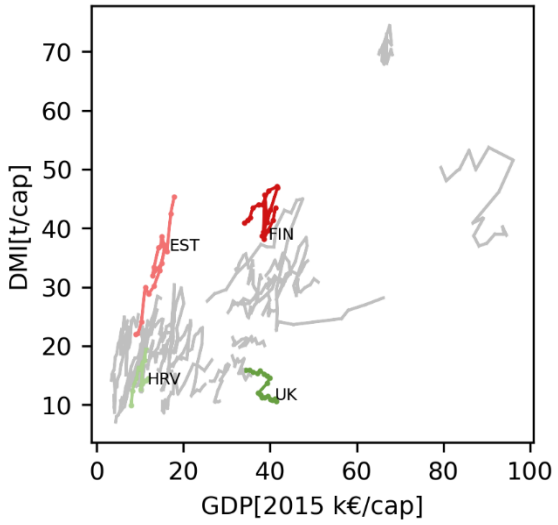
Country selection

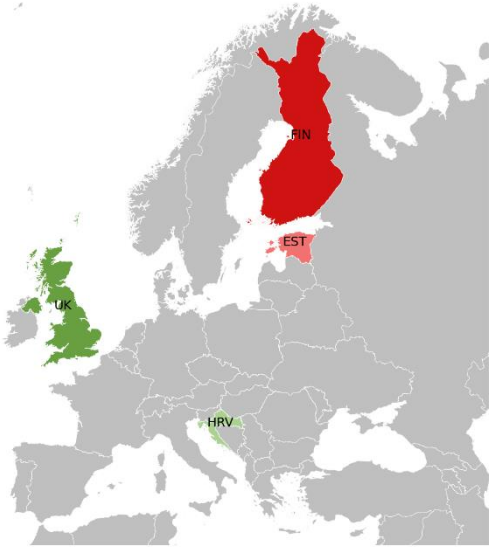
	Low GDP/cap	High GDP/cap
High DMI/cap	Estonia (EST) Coupled	Finland (FIN) Recession
Low DMI/cap	Croatia (HRV) Decoupled	United Kingdom (UK) Decoupled

Four countries were selected:

Estonia, Finland, Croatia, and the UK

- 2 Different GDP/cap levels for 2 different DMI/cap levels
- Different decoupling levels

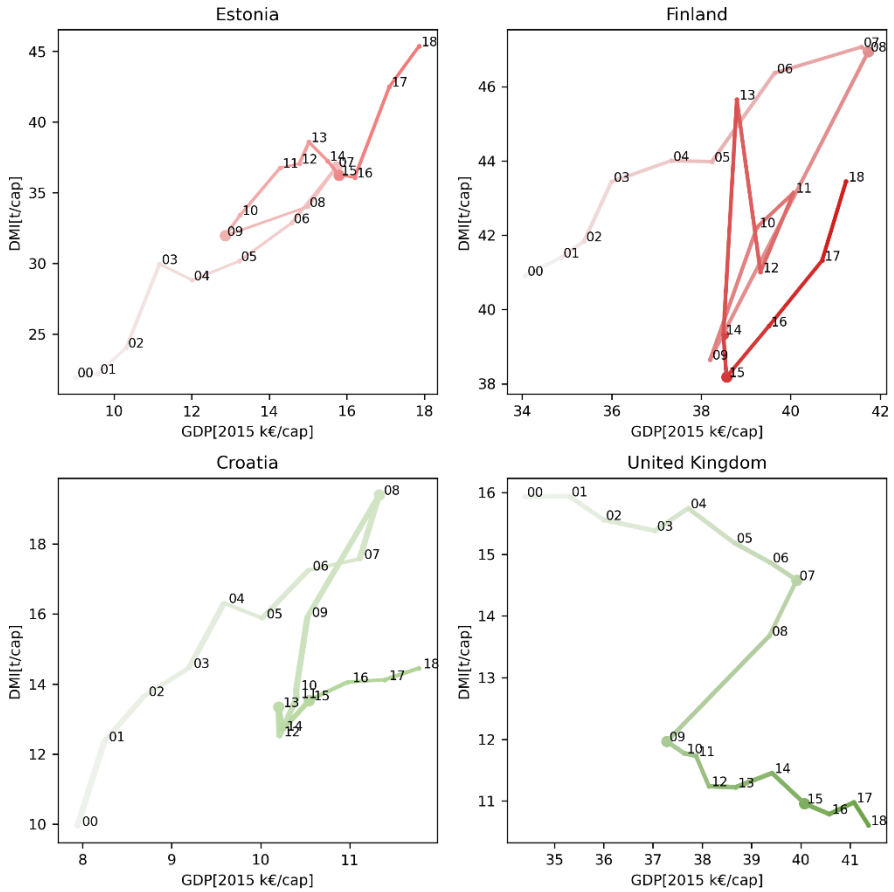




1 Effects of economic crisis on DMI/cap and resource productivity

$$productivity = \frac{GDP}{DMI}$$

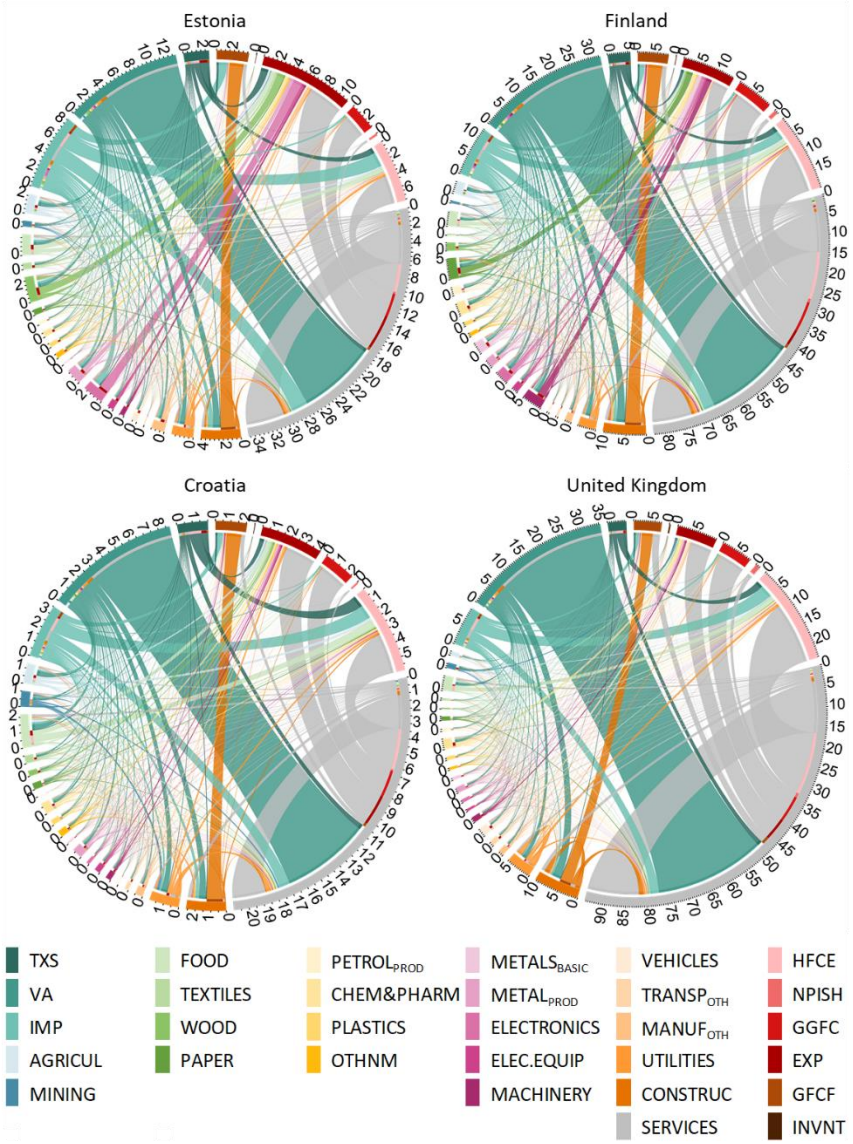
ESTONIA	**FINLAND**
After the economic recession, the country reverted to previous trend, maintaining the same resource productivity	In 2018, hadn't recovered to 2008 GDP/cap, no significant changes in resource productivity
CROATIA	**UK**
Improved resource productivity after the economic crisis	GDP/cap had already shown signs of absolute decoupling before the economic crisis, same trend after but at a lower level of DMI/cap



2 Socioeconomic metabolism

Monetary flows in 2015

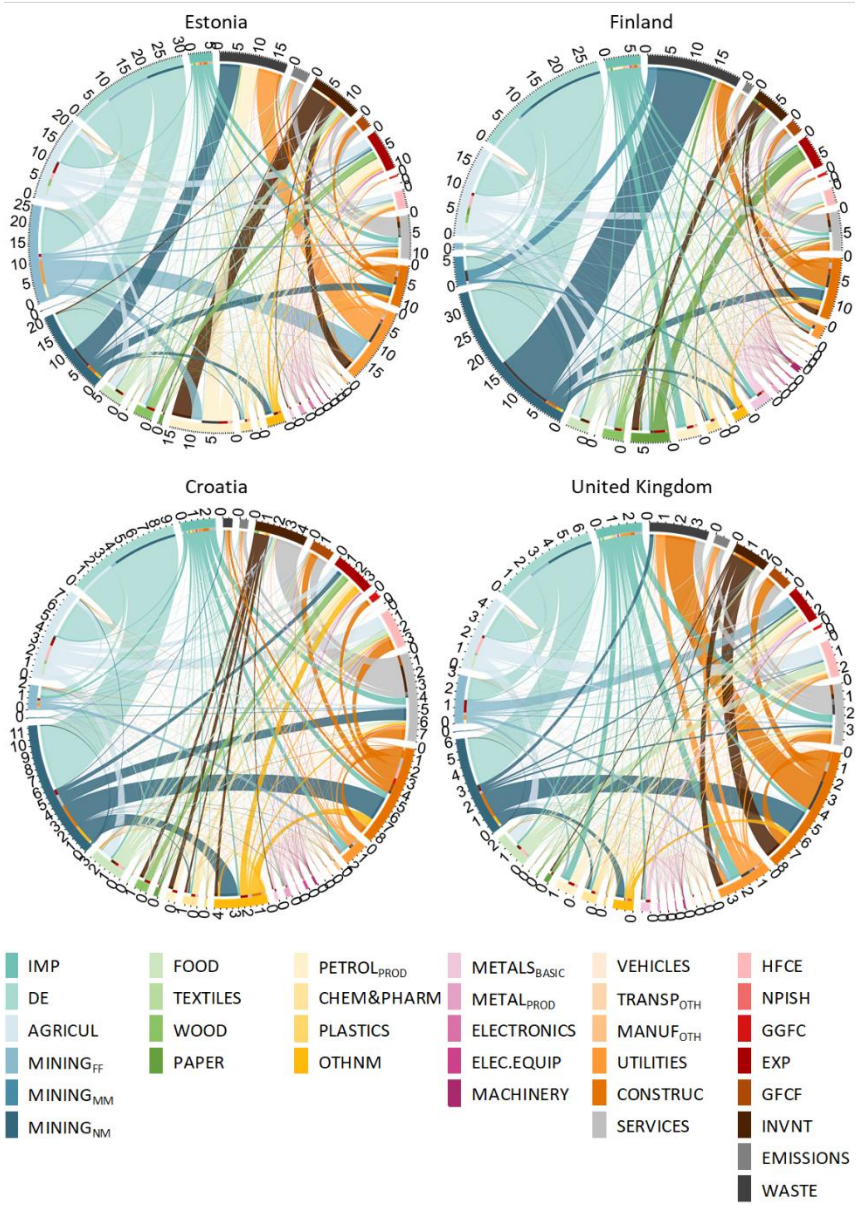
- Services have the largest contribution to VA/cap, especially in the UK.
- Larger exports in high DMI/cap countries.



2 Socioeconomic metabolism

Physical flows in 2015

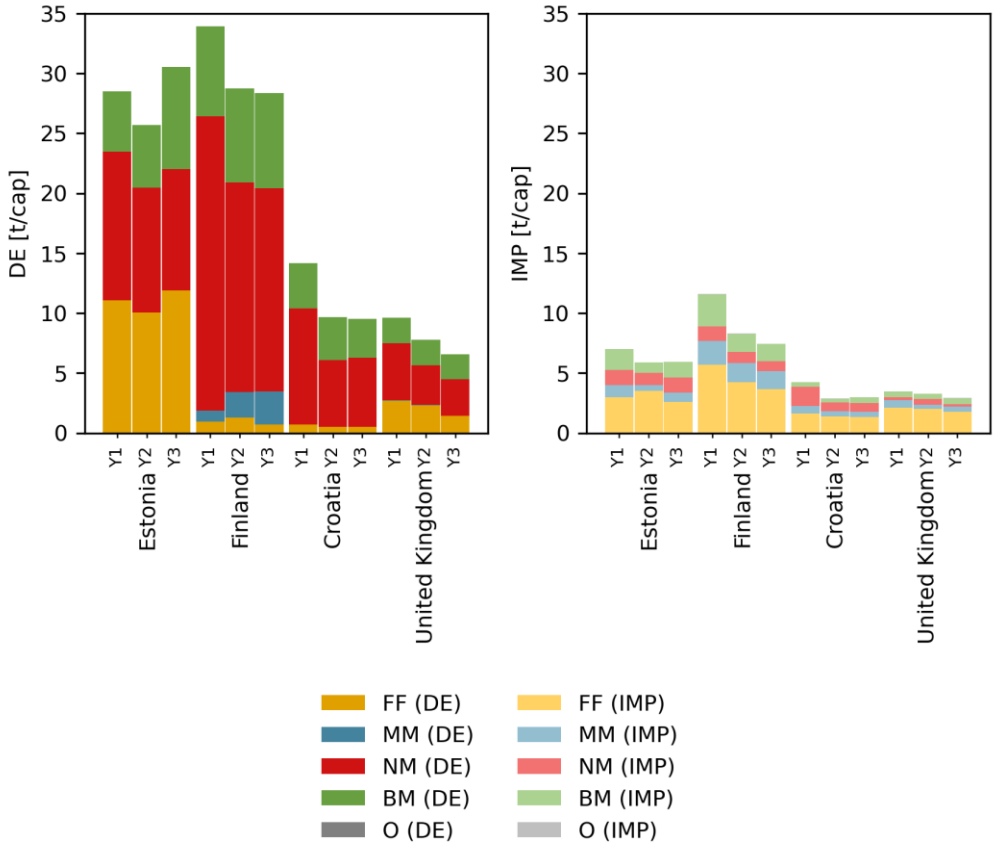
- Flows associated with industrial sectors are more significant in high DMI/cap countries.
- In low DMI/cap most flows are linked to food, housing, and transportation.
- Services account for the largest share of the demand for construction.



3 Materials

How the economic crisis changed the materials in the economy

- DE of NM decreased in all countries
- Key natural resources of high DMI/cap countries either stayed the same or increased.
- Key natural resources of the UK decreased



Y1 – last year before GDP started to decrease

Y2 – Last year before GDP started to increase continuously

Y3 – Latest year with available complete data set (2015)

FF – Fossil fuels

MM – metallic minerals

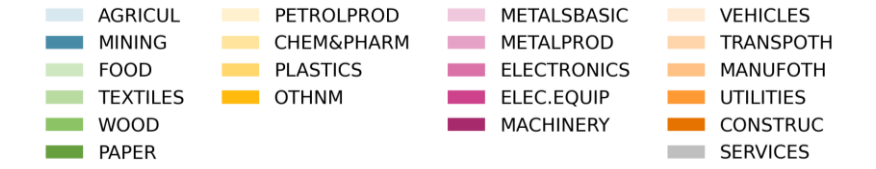
NM – Non-metallic minerals

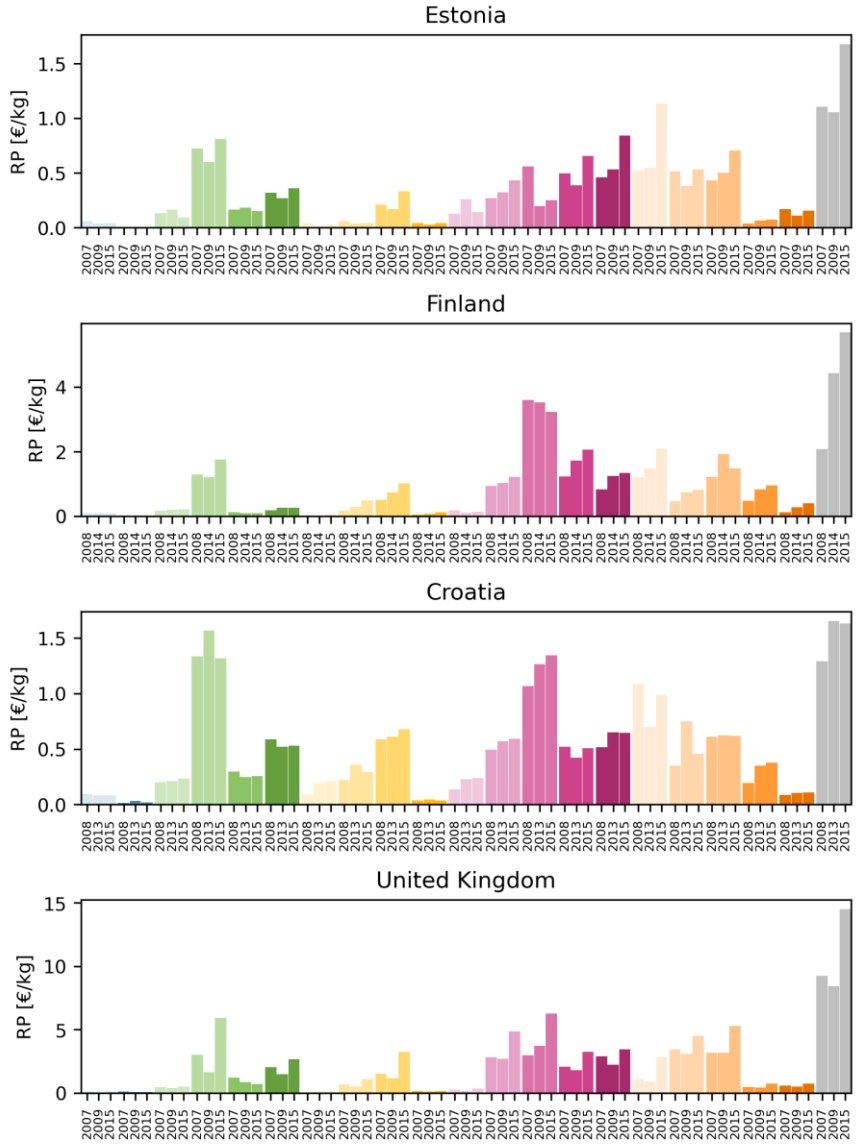
BM - Biomass

4 Economic sectors

How the economic crisis affected the resource productivity of the economic sectors

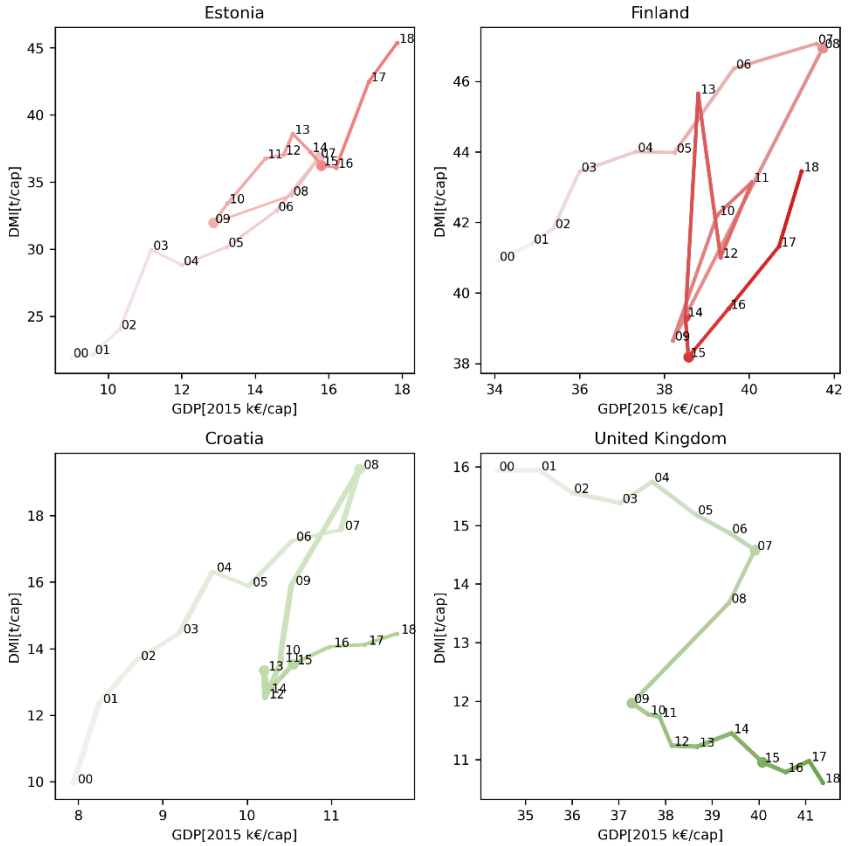
- The resource productivity of services in the UK is significantly higher.
- The resource productivity of services increased in all countries after the economic recession.



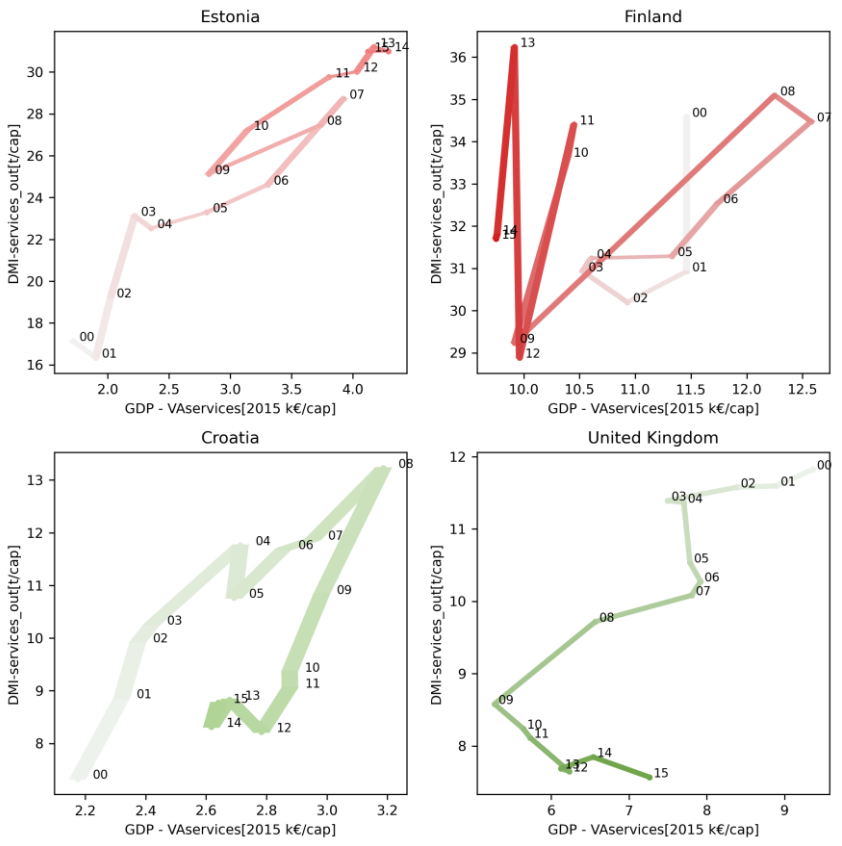


4 The role of services in the recovery from economic crisis

DMI vs GDP (normal)



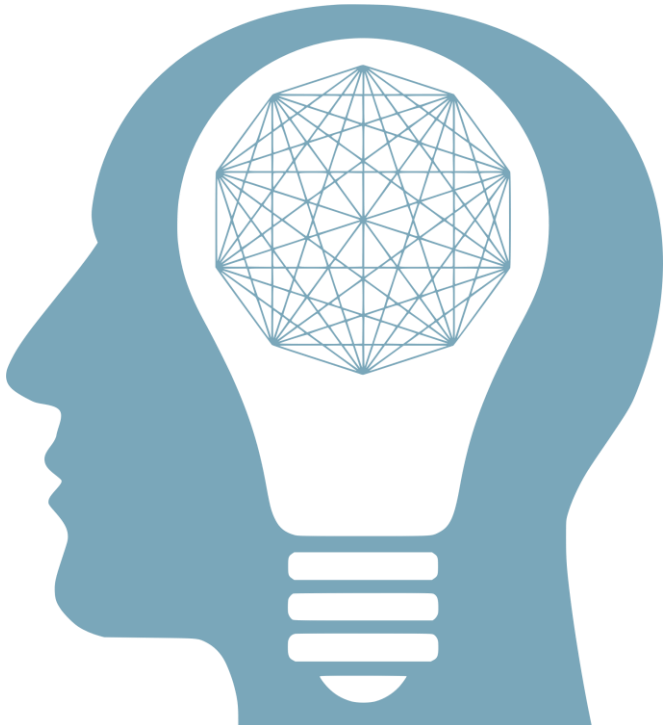
DMI vs GDP without the resource output and VA from services.



The effects of economic crisis in the material consumption of European countries

Conclusions

- Countries with different socio-economic metabolisms were impacted differently by the economic crisis.
- The domestic extraction of key natural resources either remained constant or increased.
- The domestic extraction of non-metallic minerals decreased for all countries.
- The resource productivity of services increased with the recession.
- Services play a key role in how developed economics change with an economic crisis.



More about the methods used in this study

A framework to analyze the dynamics of the socioeconomic metabolism of countries: A Portuguese case study. Journal of Industrial Ecology

By Sónia Cunha and Paulo Ferrão

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METHODS, TOOLS, DATA, AND SOFTWARE

JOURNAL OF INDUSTRIAL ECOLOGY WILEY

A framework to analyze the dynamics of the socioeconomic metabolism of countries

A Portuguese case study

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Abstract

Socioeconomic metabolism dynamics are relevant to identify (un)sustainable development pathways in different economies, particularly if the evolution of resource productivity of critical economic sectors can be quantified. This paper offers a four-step methodological framework to quantify these dynamics for an economy in a way that can be replicated for a series of years and countries. This methodological framework is based on the compilation of economic and physical flows in the form ofinput-output tables in a time series, making use of publicly available data. The data download and processing were automatized using Python, creating an expedited analysis process. The results characterize the flows through and within a country and allow the user to identify structural changes in the economy by tracking both monetary and physical flows for 17 material groups and up to 37 economic sectors. The application of the methodological framework is illustrated in a case study covering the 2008 economic crisis in Portugal, in which the socioeconomic metabolism, the underlying structural changes, and the corresponding environmental impacts are characterized. The use of this information for the design of decoupling policies is discussed, in view of promoting sustainable dematerialization during periods of economic prosperity.

KEYWORDS
dematerialization, industrial ecology, input-output analysis (IOA), socioeconomic, metabolism material flow analysis (MFA), sustainable development

1 | INTRODUCTION

Most human needs and activities, like nourishment, shelter, or transportation, rely on material flows. Between 1970 and 2017, while the population doubled and economic activity grew 4.7 times, extraction of natural resources increased 3.4 times (UN Environment International Resource Panel, n.d.; United Nations, 2018 ; World Bank, 2019). The extraction, use, and disposal of materials impose a pressure on the natural environment, with impacts such as damage to human health and climate change (Oberle et al., 2019).

Decoupling economic growth from material use and its environmental impacts is fundamental for sustainable growth (Krausmann et al., 2017), yet absolute decoupling has mainly been observed during periods of economic recession. Bringezu et al. (2004) studied the relation between resource use and economic growth and found a link between economic recession and material use. Later, Krausmann et al. (2009) stated that between 1900 and 2005, absolute global dematerialization always coincided with periods of economic recession. These findings were supported by a study on European countries between 2005 and 2014, in which the decoupling observed was affected by the economic crisis (Sanyé-Mengual et al., 2019).

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More about the methods used in this study

Can structural changes lead to dematerialization? Lessons from the Portuguese socioeconomic metabolism between 1995 and 2017

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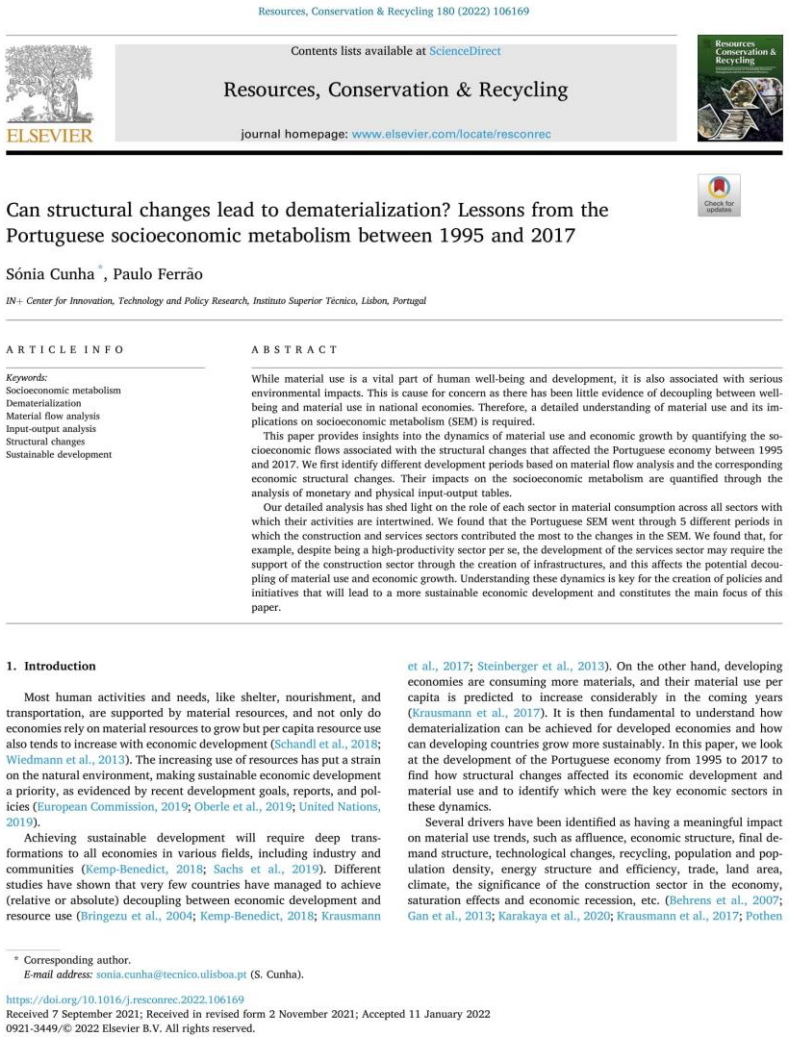

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ABSTRACT

While material use is a vital part of human well-being and development, it is also associated with serious environmental impacts. This is cause for concern as there has been little evidence of decoupling between well-being and material use in national economies. Therefore, a detailed understanding of material use and its implications on socioeconomic metabolism (SEM) is required.

This paper provides insights into the dynamics of material use and economic growth by quantifying the socioeconomic flows associated with the structural changes that affected the Portuguese economy between 1995 and 2017. We first identify different development periods based on material flow analysis and the corresponding economic structural changes. Their impacts on the socioeconomic metabolism are quantified through the analysis of monetary and physical input-output tables.

Our detailed analysis has shed light on the role of each sector in material consumption across all sectors with which their activities are intertwined. We found that the Portuguese SEM went through 5 different periods in which the construction and services sectors contributed the most to the changes in the SEM. We found that, for example, despite being a high-productivity sector per se, the development of the services sector may require the support of the construction sector through the creation of infrastructures, and this affects the potential decoupling of material use and economic growth. Understanding these dynamics is key for the creation of policies and initiatives that will lead to a more sustainable economic development and constitutes the main focus of this paper.

1. Introduction

Most human activities and needs, like shelter, nourishment, and transportation, are supported by material resources, and not only do economies rely on material resources to grow but per capita resource use also tends to increase with economic development (Schandl et al., 2018; Wiedmann et al., 2013). The increasing use of resources has put a strain on the natural environment, making sustainable economic development a priority, as evidenced by recent development goals, reports, and policies (European Commission, 2019; Oberle et al., 2019; United Nations, 2019).

Achieving sustainable development will require deep transformations to all economies in various fields, including industry and communities (Kemp-Benedict, 2018; Sachs et al., 2019). Different studies have shown that very few countries have managed to achieve (relative or absolute) decoupling between economic development and resource use (Bringezu et al., 2004; Kemp-Benedict, 2018; Krausmann et al., 2017; Steinberger et al., 2013). On the other hand, developing economies are consuming more materials, and their material use per capita is predicted to increase considerably in the coming years (Krausmann et al., 2017). It is then fundamental to understand how dematerialization can be achieved for developed economies and how can developing countries grow more sustainably. In this paper, we look at the development of the Portuguese economy from 1995 to 2017 to find how structural changes affected its economic development and material use and to identify which were the key economic sectors in these dynamics.

Several drivers have been identified as having a meaningful impact on material use trends, such as affluence, economic structure, final demand structure, technological changes, recycling, population and population density, energy structure and efficiency, trade, land area, climate, the significance of the construction sector in the economy, saturation effects and economic recession, etc. (Behrens et al., 2007; Gan et al., 2013; Karakaya et al., 2020; Krausmann et al., 2017; Pothen

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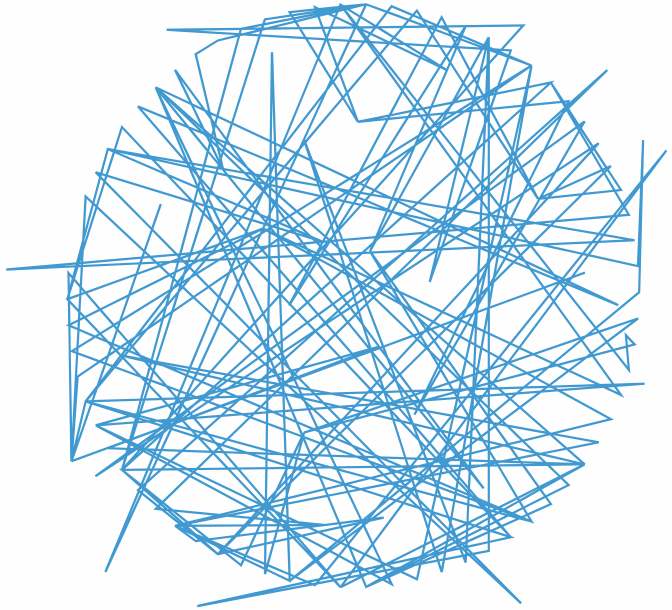

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2 Socioeconomic metabolism

Physical flows in 2015

ESTONIA

Flow between $MINING_{FF}$, UTILITIES, and $PETROL_{PROD}$ Flows linked to WOOD and EXP

FINLAND

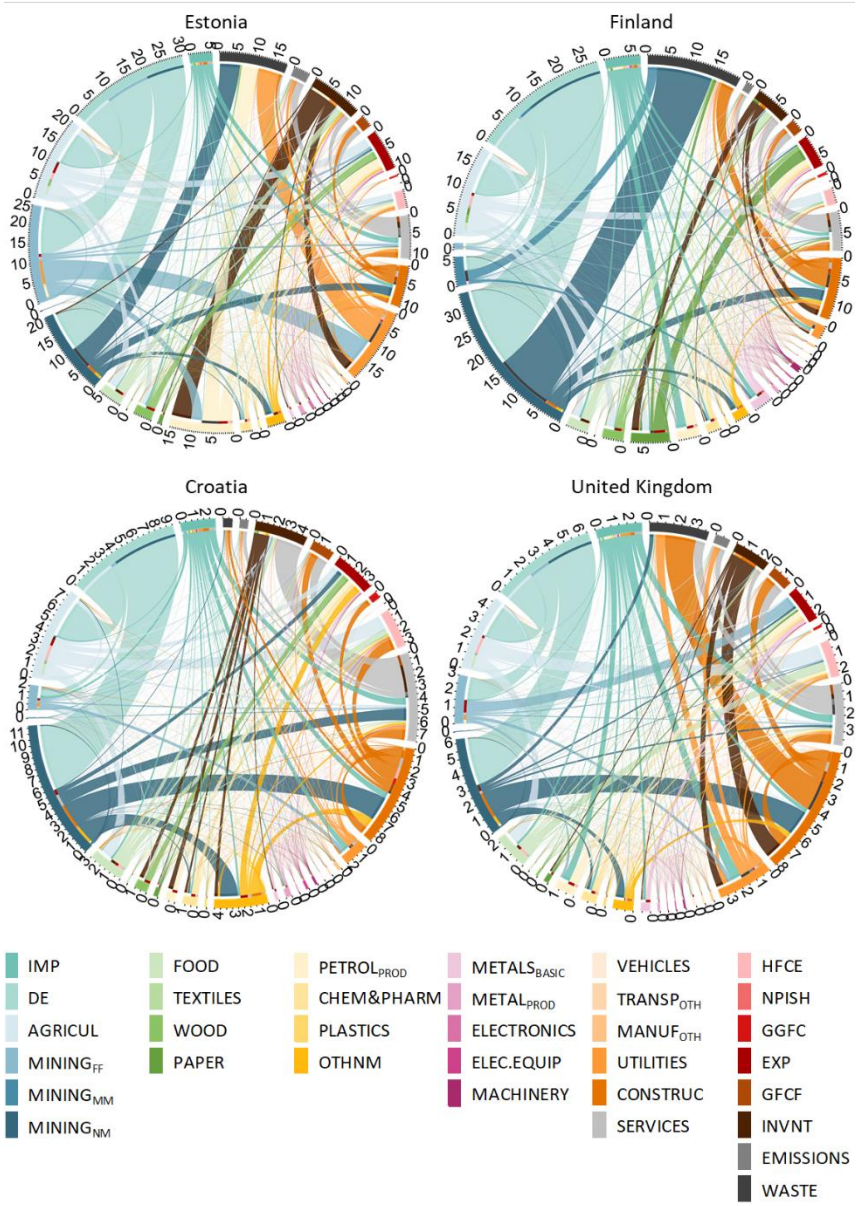
The only country with significant $MINING_{MM}$ flows. PAPER flows Largest $METALS_{BASIC}$ and CONSTRUC sectors

CROATIA

Most predominant flows are linked to agriculture and food or construction.

UK

Contribution from $MINING_{FF.}$ CONSTRUC sector comparable to Croatia.



3 Materials

How the economic crisis changed the materials in the economy

ESTONIA

- DE of FF was not significantly affected
- NM decreased
- DE of BM increased

FINLAND

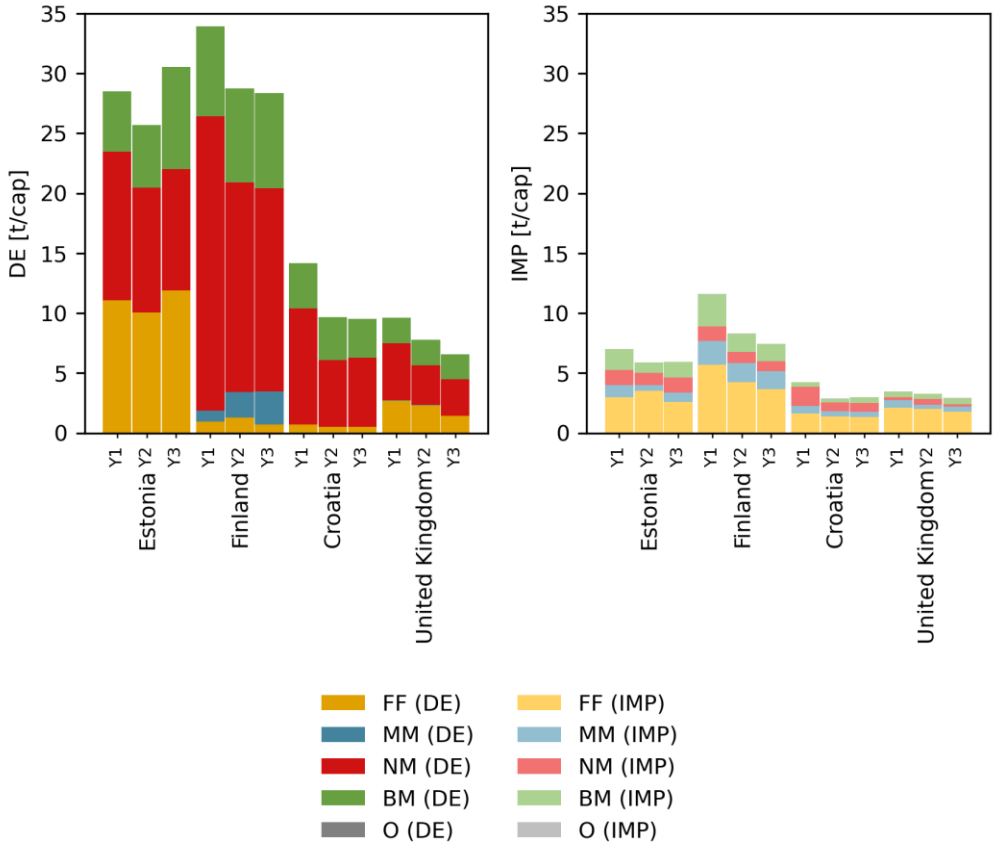
- IMP of FF decreased
- DE of MM increased
- DE of NM decreased

CROATIA

- DE NM decreased

UK

- DE of FF decreased
- DE of NM decreased



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