

The eco-efficiency development of economic sectors in Europe

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Abstract

The decoupling of environmental impacts from economic activities has been identified as one of the most important objectives for the 21st century. This paper discusses a specific decoupling indicator at the level of disaggregated industrial sectors. This indicator – environmental impact, indicated in E99 points per economic performance of an industrial class – makes use of the emission data base European Pollutant Emission Register (EPER) respectively PRTR in combination with the method Eco-indicator 99. The approach makes it possible to compare an economic sector in different countries of the European Union as well as to analyse different economic sectors in one country and gives an overall picture of the sector-specific eco-efficiency in the European Union. The contribution to the conference is a description of the development of sector-specific eco-efficiency indicators and a discussion of the results for the period from 2001 to 2004.

1 Introduction

Eco-efficiency analysis is an approach to combining the environmental and the economic dimensions of sustainable development. Eco-efficiency analysis can be used as an instrument to decrease the environmental impacts of economic activities [1, 2, 3]. This quantitative approach shows the ratio of environmental impacts or damages to the economic value added of an economic activity [4]. Eco-efficiency can be described over time, and the results can be applied as decoupling indicators. Decoupling indicators assess the efforts of economies, sectors, or companies to decouple economic performance from the environmental impacts of their activities [5, 6].

There are different approaches to calculating eco-efficiency. These are, on the one hand, micro-economic approaches which assess the eco-efficiency of products or processes and, on the other hand, macro-economic approaches to estimating the eco-efficiency of national economies. Missing is a link between the micro-economic and macro-economic approaches. Strategic planning and decision making, however, require a differentiated approach to consider eco-efficiency on a disaggregated macro-economic level [7]. In this paper we therefore introduce a new approach at the mesoscale which can be used to analyse the eco-efficiency of economic sectors in Europe in terms of their temporal and spatial patterns on a disaggregated macro-economic level.

2 Approach

The approach is defined by different parameters. The geographic area covered is the EU 25 and Norway. Due to the availability of data, the years 2001 and 2004 are presented. Economic sectors are described on the two-digit numerical code of the NACE classification [8]. The environmental data are based on the European Pollutant Emission Register, EPER [9]. This register contains the quantities of 50 pollutants emitted into the air and water that contribute to different environmental impact categories, e.g. climate change and air and water pollution. Industrial enterprises listed in Annex 3 of Commission Decision 2000/479/EG have to report emissions of their economic activities every three years. Since 2007 there has been a new reporting register called the Pollutant Release and Transfer Register (PRTR), which includes inter alia annual reporting and the reporting for 91 pollutants [10].

The environmental impacts of the economic activities are assessed with the life cycle impact assessment method Eco-indicator 99 [11] and calculated as the product of sector-specific emissions and the corresponding impact factors. The eco-efficiency indicator is calculated by dividing the environmental impact by the gross value added (1). Data for the gross value added of the economic sectors are based on the EUROSTAT database [12]. The eco-efficiency of each economic sector is given by the unit Eco-indicator points per million euros.

$$EE_{ijk} = \frac{EI_{ijk}}{GVA_{ijk}} \quad (1)$$

where

\forall economic sectors $i= 1, \dots, m$

\forall countries $j= 1, \dots, n$

\forall years $k= 1, \dots, o$

EI = environmental impact

GVA = gross value added

EE = eco-efficiency

This eco-efficiency indicator is called environmental intensity [5]. Environmental intensity has the advantage of being simultaneous applicable as a decoupling indicator [14]. Environmental intensity is defined as environmental impact per economic performance [13]. It is interpreted as follows: the lower the damage points per gross value added, the higher the eco-efficiency of an economic sector.

3 Results

The results show the eco-efficiency of 47 economic sectors in 26 countries of the European Union. Altogether 590 values have been calculated for the eco-efficiency indicator. This number corresponds to 25% of the theoretically possible number of results, indicating gaps in the availability of data and differences within the structure of the data sources. There are 408 values available to show the temporal comparison of eco-efficiency and a possible decoupling of economic sectors between the years 2001 and 2004.

The distribution of results shows an ambivalent picture of the eco-efficiency of economic sectors in Europe in 2004 (Fig. 1). No eco-efficiency indicators could be calculated for the area without bars in Fig. 1 for 2004 due to the lack of availability of data.

The overall average for eco-efficiency in 2004 is approximately 9×10^3 damage points per million euros. The sectors with a low eco-efficiency are characterized by a numerousness of damage points per million euros. Such economic sectors in different countries are (the number in brackets gives the two-digit numerical code in the NACE classification [8]), for example, electricity, gas, steam and hot water supply (40); manufacture of coke, refined petroleum products and nuclear fuel (23); and manufacture of other non-metallic mineral products (26) (Fig. 1). Economic sectors with a low eco-efficiency in few countries are mining of metal ores (13) within Slovakia, mining of coal and lignite; extraction of peat (10) in the Czech Republic and Spain and extraction of crude petroleum and natural gas; and service activities incidental to oil and gas extraction excluding surveying (11) in France.

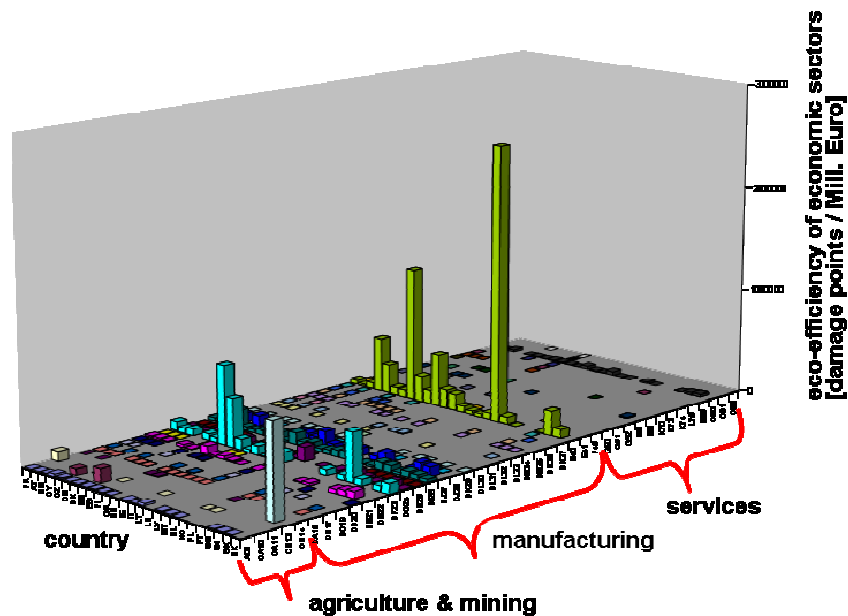


Fig. 1: Eco-efficiency indicators of economic sectors in Europe in 2004 [15]

Apart from annual considerations regarding sector-specific eco-efficiency measures, the approach can also be employed to analyse a series of the eco-efficiency indicator values over time. For example, the development of eco-efficiency in the economic sector manufacture of other non-metallic mineral products (26) is shown in Fig. 2 for 17 European countries for the period from 2001 to 2004. In nine countries the eco-efficiency indicator increased in this sector, meaning there was a worsening of eco-efficiency between 2001 and 2004. In the countries Spain, Netherlands, Ireland and Sweden the eco-efficiency indicator increased more than 30% in terms of the damage points per million euros gross value added. The indicator increased in France more than 27%, whereas in Germany, Hungary, Finland and Denmark the increase was between 0 and 15%. In contrast to this, in eight countries the eco-efficiency indicator decreased, reflecting an improvement in eco-efficiency. For example, in Norway there was a decrease in the eco-efficiency indicator of 30%. The improved eco-efficiency in Norway is the result of a decline in the environmental impacts and a simultaneous increase in gross value added. Accordingly, an absolute decoupling took place in Norway within the period of time considered.

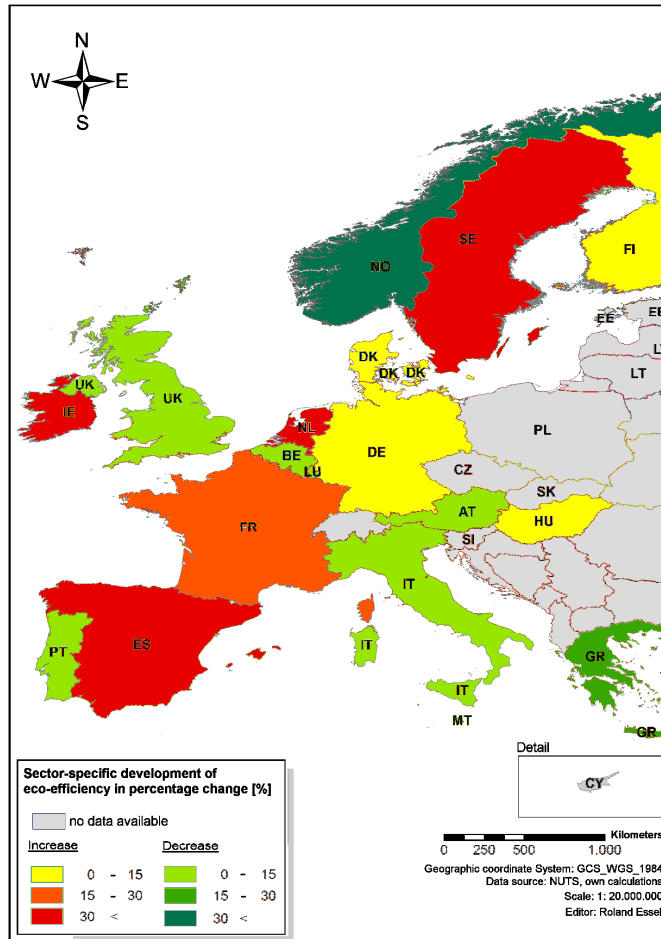


Fig. 2: Development of eco-efficiency in the economic sector manufacture of other non-metallic mineral products (26) in Europe from 2001 to 2004 [15]

This approach shows the spatial and temporal patterns of sector-specific eco-efficiency and the decoupling of economic growth from the environmental impacts of sectors. The data sources make it possible to compare the eco-efficiency patterns in Europe for 408 values and to analyse 204 sectors for the time period from 2001 to 2004. A worsening in eco-efficiency was detected in 93 of these 204 sectors. For 111 sectors there was an increase which is an improvement in eco-efficiency between 2001 and 2004. An absolute decoupling of economic growth and the resulting environmental impacts are identified in 60 cases, which represent 29% of the available results of the model. Absolute

decoupling is given when the environmental impact is stable or decreasing while the economic parameter is growing. [16]

4 Discussion

The approach presented here for analysing eco-efficiency on a mesoscale combines advantages from two different points of view. On the one hand, the analysis of eco-efficiency indicators in different countries describes the European economy at a macro-economic level. On the other hand, the sector-specific eco-efficiency analysis is comparable to a micro-economic point of view, resulting in a detailed description of the different economic sectors. A further disaggregation of the economic sectors, that is with regard to the classification of a four-digit numerical code (or the classes) of the NACE nomenclature [8], would further improve the support for decision making [7]. However, the economic variable, gross value added is not available at the level of classes in all European countries. The eco-efficiency indicator was used to compare the eco-efficiency of 47 economic sectors in 26 European countries. This demonstrates that eco-efficiency indicators can be used for benchmarking in both the more and the less eco-efficient economic sectors. Since the data sources are updated regularly, the indicators could also be used for monitoring purposes, e.g. to describe a potential decoupling process between economic growth and environmental impacts of economic activities.

As in all analyses, the results of the eco-efficiency analysis depend on the quality and completeness of the raw data. The emission reporting in the EPER data source is based on listed plants and activities as well as on defined thresholds for the capacity of plants and pollutants. On questions regarding the completeness of EPER for eco-efficiency indicators, see [7].

The calculated environmental impacts have so far been focused on emissions in air and water and exclude other environmental impacts. The new PRTR source provides data on additional pollutants and is an enlargement concerning emissions in soil and the reporting of waste. To integrate resource consumption within this eco-efficiency indicator, additional data sources should be accessed. Furthermore, a possible improvement of the approach presented here could be to represent the results as partial eco-efficiency indicators according to specific impact categories such as climate change or eco-toxicity.

5 References

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