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Changes in the GHG emission intensity in EU-15: Lessons from a decomposition analysis

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ABSTRACT

This paper analyses the reduction in greenhouse gas emissions in 15 countries of the European Union between 1990 and 2007 to find out the contribution of different countries. Using the log-mean Divisia index decomposition approach, it identifies the driving factors of emissions related to energy and other industrial activities. It also focuses on two success cases (namely Germany and the United Kingdom) and contrasts the developments with two less successful cases (namely Spain and Italy). A scenario analysis is then used to indicate the emission reduction possibility through cross-learning. The study shows that the emission intensity has reduced significantly in both energy-related activities and other processes at the aggregate level, while the performance varies significantly at the individual country level. Changes in the energy mix, a reduction in energy intensity and a reduction in the emission intensity from other process-related emissions were mainly responsible for the success in the EU-15.

1. Introduction

According to the 2009 data on greenhouse gas emissions from Annex 1 parties, available from the United Nations Framework Convention of Climate Change (UNFCCC) website,[2] Australia, Canada, Japan and the United States have failed to reduce their greenhouse gas (GHG) emissions below 1990 levels in 2007 while the European Union has been successful in controlling its emissions. The European Environment Agency in its recent submission to the UNFCCC [5] has reported that in 2007 the EU-15 emitted 4.3% less of GHG relative to 1990 levels without counting for the removal from LULUCF (Land Use, Land Use Change and Forestry), while the 27 members of the EU have achieved an overall reduction of 9.3% compared to the 1990 level (see Fig. 1). Clearly, when other major Annex 1 countries are struggling to contain their emissions, the success of EU can provide lessons for others in devising public policy strategies for combating the climate change menace.

A number of studies have applied the decomposition analysis in order to explain factors affecting GHG emissions (e.g. [4,9,10,15,16,18]) but most of the studies focus on the industrial (or manufacturing sector) or the power sector due to better data availability (see also [11,12,13,17,20]). However, changes in the relative importance of GHG emission and the emission pattern of member states of the European Union (EU) have received inadequate attention. This paper focuses on the GHG emissions in its totality (excluding the effect of LULUCF) and covers the emissions from energy and other activities[3] separately for 15 EU members. Most of the studies on decomposition analysis just rely on a single element of decomposition for mathematical simplicity. This paper extends the method to consider both energy and non-energy-related emissions simultaneously and shows that the method can be generalised to such cases. Upon identifying the most important contributors to the reduction of emissions, we focus on a comparative analysis of a selected set of countries to contrast their performance with the objective of providing policy guidance for other countries, both developed and developing. For space reasons, we do not present a detailed country level analysis here.

The paper is organised as follows: the second section provides an overview of the GHG emission in the EU, with a main emphasis on EU-15. Section 3 presents the decomposition methodology used in this work and discusses the data used for the study. Section 4

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[2] http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php – see table for total CO_2 equivalent emissions without land use, land use change and forestry.

[3] Others include all emissions excluding energy activities and LULUCF.

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Abbreviations

EU	European Union
GHG	Greenhouse gas
UNFCCC	United Nations Framework Convention on Climate Change
EEA	European Environment Agency
LULUCF	Land Use, Land Use Change and Forestry
CEEC	Central and Eastern European Countries
GDP	Gross Domestic Product
OECD	Organisation for Economic Co-Operation and Development
AT	Austria
BE	Belgium
DK	Denmark
FI	Finland
FR	France
DE	Germany
GR	Greece
IE	Ireland
IT	Italy
LU	Luxemburg
NL	The Netherlands
PT	Portugal
ES	Spain
SE	Sweden
UK	United Kingdom
IEA	International Energy Agency
IMF	International Monetary Fund
ESDS	Economic and Social Data Service
EMC	Energy-related emission coefficient
EI	Energy intensity
OI	Other (non-energy) intensity
S	Share of a member country's GDP in the group's GDP

presents the results of the decomposition analysis while section 5 presents some concluding remarks.

2. Overview of GHG emissions in the European Union

In 1990, the GHG emission from the 15 members of the European Union was 4.2Gt excluding LULUCF. This volume has declined to 4.06Gt in 2007, thereby recording a fall of about 4.3% [5]. About 77% of the GHG emission in 1990 came from energy-related activities while the remaining originated from other industrial processes and activities. The share of the energy-related emissions has increased slightly in 2007, reaching almost 80% of all GHG emissions of the region.

Clearly, different members contributed differently to the GHG emissions in EU-15 (see Fig. 2). Germany and the United Kingdom are the dominant emitters in the region, contributing about 47% of the emissions in 1990 but in 2007, their share has fallen to 39%. France and Italy are two other large emitters in the region – each contributing about 13% each to the regional GHG emission. Spain accounts for about 10% of the emissions. Taken together, these five members account for about 75% of the GHG emission in EU-15.

As illustrated in Fig. 1, western European countries, who jointly committed to an 8% removal for the Kyoto period (2008-2012), have achieved some reduction and this trend appears to be gaining momentum but so far these countries have not reached their committed goal. On the other hand, Central and Eastern European Countries (CEECs) (EU12) already have an emission level well below their 1990 levels by more than 8% – essentially due to their economic slow-down in the post-Soviet era. The total GHG removal in EU-15 was about 178.5Mt between 1990 and 2007 (Fig. 3). Germany and the United Kingdom were most effective in mitigating the emission: Germany reduced 259Mt of GHG while the United Kingdom mitigated about 134Mt. On the other hand, Spain, Italy, Portugal, Ireland, and Greece (among others) contributed negatively (i.e. their emission increased during this period): Spain added 154Mt of extra emissions while Italy added another 36Mt. About one half of the members were not able to reduce their emissions, which cancelled out other countries' better performance.

We have regrouped the emission data into two categories – energy-related and others, where others include all emissions excluding energy activities and LULUCF. As can be seen from Table 1, the share of energy-related emissions vary across member states: Ireland has the lowest share of energy-related emission – less than 70% in 2007, while Luxembourg has the highest share, followed by the United Kingdom.

GHG emission per person in EU-15 was, on average, 11.7t in 1990 but this has declined to 10.4t in 2007. Luxembourg had the highest emission per person in EU-15 in 1990 while Portugal had the least. In 2007, Sweden has displaced Portugal to emerge as the lowest emitter in per capita terms while Luxembourg continues as the highest emitter (see Table 1).

GHG emission intensity, defined as the ratio of CO_2 equivalent GHG emission to GDP (in real money terms), follows a different pattern in EU-15 (see Table 1). Sweden has the lowest emission intensity, followed by France and Denmark. Ireland, on the other hand, had the highest GHG emission intensity in the group in 1990 but it was displaced by Greece in 2007 to emerge as the most GHG intensive economy in EU-15. Most of the member countries have realised significant reductions in GHG intensity between 1990 and 2007.

Given the diversity in the emission intensity, overall size of emissions and the economy, a better understanding of the changes in the emission intensity can be obtained through a decomposition analysis. This is presented in the following sections.

3. Methodology

In order to explain the difference in the emission reduction in the member states, the decomposition analysis is used in this paper. This section presents the methodology, followed by a brief description of the data sources and assumptions.

3.1. Mathematical formulation of the methodology

As indicated above, GHG emissions can be grouped into two broad categories for simplicity: energy-related and from other

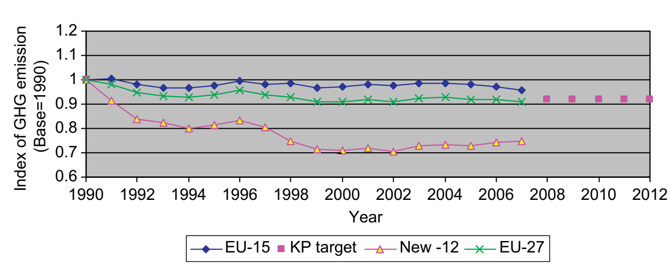

Fig. 1. GHG emission trend in EU-15 (Base = 1990). Data Source: UNFCCC website and [5].