THE ROLE OF RENEWABLE ENERGY SOURCES AS A COMPENSATING FACTOR OF CO_2 EMISSIONS IN SPAIN

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ABSTRACT

This paper analyses the role of Renewable Energy Sources (RES) in Spain as a factor to balance the driving force CO2 emissions. To that end, a multi-sectoral analysis based on the Log-Mean Divisia Index Method (LMDI I) was conducted for the 1995-2009 period.Data came from the World Input-Output Database (WIOD) and determined the period under consideration. The paper focuses on the 35 productive sectors included in the WIOD.Major findings show that RES acted in detriment to the drivers of CO2 emissions. This can be stated for the last few years under consideration. The positive trend for the share of RES in Spain's energy matrix together with the negative tendency in the use of fossil fuels leads us to be optimistic.The results are interesting, not only for researchers but also for utility companies and policy-makers. In fact, this paper speaks directly to the authorities of Spain and their political agenda with regard to RES policy.

1. Introduction

Together with the well-known targets established for Horizon 2020 (H2020), European Union (EU) authorities are currently defining a more ambitious scenario. For 2030–the new scenario—Green House Gas (GHG) emissions must be reduced by 40% (20% for H2020) and Renewable Energy Sources (RES) must account for 27% in the energy matrix (20% for H2020). The benefits of a higher RES share are commonly acknowledged and include the mitigation of GHG emissions, positive employment effects [1], the creation of business opportunities, a reduction in primary energy dependence and thus improvement in energy security [4].

In recent years, the deployment of numerous RES technologies in Spain explains its elevated incorporation into the country's energy matrix as shown in this paper. However, it is not without controversy when contemplating the terms of the legal instruments used to promote said use (Royal Decree 436/2004) and to what extent these instruments are effective [6]. In fact, the application of a number of such legal instruments is now on hold (Royal Decree 1/2012). One of the key questions for future policy decisions is to have better knowledge of the role that RES plays in the mitigation of GHG.

Due to its geographical location and socioeconomic characteristics, Spain is vulnerable to climate change [7]. As a member of the EU, Spain faces strong commitments derived from the H2020 programme—the largest ever EU Research and Innovation programme. Its objectives include fighting against global warning. These objectives involve reducing GHG emissions by 20% with respect to 1990 levels, increasing the renewable energy share and improving energy efficiency by 20% by 2020 [8]. Now, H2030 targets are also relevant as has been mentioned. However, CO_2 emissions in Spain for 2012 were 26.1% higher than in 1990, the base year taken for the Kyoto Protocol obligations. If 2009 is used as the reference year, the last year of the period under consideration in this paper [9], then CO2 emissions are 33.1% higher.

Consequently, Spain has to make efforts to meet the established EU targets for 2020 and 2030, but these efforts should not damage domestic competitiveness. The best way to succeed is to incorporate policies that avoid hindrances for competitiveness.

Only if decoupling is achieved can Spain's economy meet the H2020/H2030 emission target without damaging its competitiveness. This will involve appropriate energy policy decisions based on robust analysis. To aid these political decisions, this paper analyses the role of RES in Spain as a factor to balance the driving force of CO_2 emissions. Not only is this a relevant question; the time is right to pose it. The results are interesting, not only for researchers but also for utility companies and policy-makers. In fact, this paper speaks directly to the authorities of Spain and their political agenda regarding the RES policy.

This paper focuses on CO_2 emissions, the dominant anthropogenic greenhouse gas flux from fuel combustion. Emissions from biomass and marine and aviation bunkers are excluded from the analysis.

To that end, a multisectoral analysis based on the Log-Mean Divisia Index Method (LMDI I) was conducted for the 1995-2009 period [10]. Data came from the World Input-Output Database (WIOD) and determined the period under consideration. This paper focuses on the 35 productive sectors included in the WIOD. A search of the literature failed to discover a similar analysis; however, this paper has benefitted from the work by Alcántara and Padilla [13] and Butnar and Llop [14]. For the case of Spain, similar papers have focused on GHG but not on CO_2; these include Llop [15], Roca and Serrano [16], Tarancón and Del Río [17], Bartoletto and Rubio [19], Alcántara et al. [20], Bhattacharyya and Matsumura [21], Cansino et al. [22] and Demisse et al. [23], among others. Our paper enhances the available literature because i) to our knowledge, this is the first paper that answers the question for the case of Spain from a multisectoral approach and ii) it uses a free access database, thus facilitating the review of our results.

This paper addresses the topic of the Green Energy Economy [24]. According to these authors, the "Green Energy Economy is understood as the scientific subject area that focuses on how the economic system can pursue growth by bringing together economic, environmental, social, and technological aspects through the expansion of clean energy production, distribution and consumption".

This work is structured as follows: the Introduction is followed by Section 2 that offers methodological aspects. The database is described in Section 3. Section 4, which includes the discussion, presents the results obtained and Section 5 presents the conclusions.

2. Methodology

A decomposition analysis was used to quantify changes over time for a wide range of variables. Its application has been particularly prolific in identifying the determinants for variations in GDP levels, energy consumption and import volume.

The two methodological approaches for the decomposition analysis—which are more developed in the literature—include Structural Decomposition Analysis (SDA) and Index Decomposition Analysis (IDA). Both allow variations in an indicator (environmental, socioeconomic, economic and employment, etc.) to be decomposed among its determinants. These techniques have been developed independently and are often used to analyse variations in energy consumption and CO_2 emissions.

In energy and environmental studies, IDA is the most commonly used analysis to better understanding the energy consumption in a specific sector. Researchers using an extended input-output analysis use SDA to study changes in energy consumption or emissions. Ang and Zhang [25] and Ang [26] provide a comprehensive review of the various IDA types.

Essentially, the IDA methodology entails the application of an index number theory for the decomposition of an aggregate indicator. Since the 1980s, literature on decomposition based on Divisia type indices has been extremely prolific. Törnqvist et al. [27], Boyd et al. [28], Liu et al. [29], Ang and Lee [30], Sun and Ang [31], Albrecht et al. [32], Ang [33], Fernández and Fernández [34] and Choi and Ang [35] all presented studies based on these methods and have proven their practical application. Freitas and Kaneko [36] offered an overview of decomposition studies from the seminal paper by Grossman and Krueger [37].

There are differences and similarities between both analyses. Hoekstra and van den Bergh [38] performed the first study comparing IDA and SDA; they provided a review of studies based on these methods up to 2001. A more recent review of both methods was provided by Su and Ang [39]. Comparatively, an IDA has certain advantages over SDA. IDA enables decompositions for any aggregate (value, ratio or elasticity). Also, index-based decomposition analysis requires less data than decomposition methods based on input-output analysis and is useful when decomposing energy intensity changes between its different components.

Herein, we develop a specific methodology based on Divisia type indices. More specifically, the LMDI I method was used, as proposed initially by Ang and Choi [10], and revised by Ang et al. [11] and Ang and Liu [12]. This paper follows the criteria of Ang [26], who evaluated the different decomposition methods. He concluded that LMDI I is a more recommendable method due to both its theoretical base and its set of properties which are satisfactory in the case of index decomposition. LMDI I is a “refined” non-parametric approach based on the Divisia index method, with weighted logarithmic mean. An additional argument that favours LMDI I is that it allows perfect decomposition (that is, without residuals) and provides a simple and direct association between the additive and the multiplicative decomposition form **[40]**.

As previously explained, there are two index-based decomposition methods for multiplicative and additive decomposition. In the first case, the effects are the result of the factorisation of an index, thus being dimensionless. In the second case, the effects are quantified in the measurement units of the decomposition variable.

Below, details are provided for the additive decomposition of the variation for total CO_2 emissions in Spain between 1995 and 2009. This period was chosen as it coincides with the available database. A five-factor decomposition has been proposed to identify, quantify and explain the main determinants of this variations.

The Impact=Population×Affluence×Technology (IPAT) equation is used to assess the contribution of drivers of CO_2 emissions. Specifically, the IPAT model **[41]** and the 'Kaya identity' ¡Error! No se encuentra el origen de la referencia.**[46]** are extended by using IDA **[47][48]** to assess the key drivers behind Spain's CO_2 emissions. The 'Kaya Identity' has been used in a number of studies addressing energy, economy and climate-related intensities at the global level **[49]**.

The principal formula for the CO_2 emissions can be illustrated as:

$$CO_2 = CI \cdot EI \cdot ES \cdot EA \cdot P \tag{1}$$

where the decomposition factors are the Carbon Intensity factor (CI), the Energy Intensity factor (EI), the structural composition of Spain's economy (Economy Structure, ES), the Economic Activity factor (EA) and Population (P), respectively. The CI factor corresponds to the ratio of CO_2 equivalent emissions, measured in Gg, and energy consumed in a given period for every sector, measured in TeraJules (TJ). Carbon intensity represents the quality of the energy mix from a GHG mitigation perspective. An energy mix is composed of high embodied energy and low carbon content which would effectively contribute to mitigating CO_2 emissions.

The EI factor is defined as the ratio of energy consumed and a measure of the output. In this paper, the economic output per sector is measured as the total output in terms of Input-Output Tables. The output is converted into 1995 constant prices. EI is often used as a measure or aggregate proxy of the energy efficiency or technology level of a country's economy **[50]**.

The ES factor shows the structural composition of Spain's economy for each year of the 1995-2009 period. This factor indicates the relative weight of the sectoral output within the total output of the overall economy; it incorporates the relative impact of structural change in Spain's economy in terms of CO_2 emissions for a given year into the analysis.

The EA factor is the output per capita and captures the income effect on CO_2 emission changes from energy consumption. This is the traditional affluence effect in the IPAT equation.

Finally, equation (1) allows the analysis of the effects of population growth as a determinant for energy demand. This is how the P factor is treated.

A decomposition analysis may be performed from equation (1), by independently considering the various economic sectors of a given economy. This allows a multisectoral decomposition analysis to be performed. Applying the decomposition proposed in equation (1) to *n* industrial sectors, the total CO_2 emission may be presented as follows:

$$CO_2 = \sum_{i=1}^{n} CI_i \cdot EI_i \cdot ES_i \cdot EA \cdot P = \sum_{i=1}^{n} \frac{C_i}{E_i} \cdot \frac{E_i}{Y_i} \cdot \frac{Y_i}{Y} \cdot \frac{Y}{P} \cdot P \tag{2}$$

where, C_i represents the CO_2 emissions of sector i; E_i denotes the energy consumption of sector i; Y_i represents the output of sector i; Y denotes the total output, and P represents the Population.

According to the studies by Freitas and Kaneko **[36]**, Ang and Liu **[12]**, Ang **[33]** and Wu et al. **[52]**, CO_2 variations may be decomposed as the sum of the following factors:

$$\Delta CO_2 = CO_{2_t} - CO_{2_{t-1}} = \Delta CI + \Delta EI + \Delta ES + \Delta EA + \Delta P \tag{3}$$

where,

$$\Delta CI = \sum_{i=1}^{n} w_i(t) \cdot \ln \frac{CI_{i,t}}{CI_{i,t-1}} \tag{4}$$

$$\Delta EI = \sum_{i=1}^{n} w_i(t) \cdot \ln \frac{EI_{i,t}}{EI_{i,t-1}} \tag{5}$$

$$\Delta ES = \sum_{i=1}^{n} w_i(t) \cdot \ln \frac{ES_{i,t}}{ES_{i,t-1}} \tag{6}$$

$$\Delta EA = \sum_{i=1}^{n} w_i(t) \cdot \ln \frac{EA_t}{EA_{t-1}} \tag{7}$$

$$\Delta P = \sum_{i=1}^{n} w_i(t) \cdot \ln \frac{P_t}{P_{t-1}} \tag{8}$$

The term $w_i(t)$ is the estimated weight for the additive LMDI I method [33]. This weight is defined as:

$$w_i(t) = \frac{CO_{2_{i,t}} - CO_{2_{i,t-1}}}{\ln CO_{2_{i,t}} - \ln CO_{2_{i,t-1}}} \tag{9}$$

Applying this previously described method for each factor results in a positive or negative value. If the result of a factor is positive, then said factor contributes to increasing emissions; if it is negative, that factor contributes to reducing emissions.

To accommodate cases of zero value, Choi and Ang [10], Ang et al. [11] and Ang and Liu [53] analysed and proposed that the best way to handle it is by substituting zeros for a δ value between 10^{-10} and 10^{-20}. This is known as the small value (SV) strategy. Ang and Liu [54] also showed that the SV strategy is robust when an appropriate value is used, and that it would provide satisfactory results even for highly extreme cases.

3. Database

The data used in this paper comes from the World Input-Output Database (WIOD), as described in Timmer [55] and Dietzenbacher et al. [56]. This is not the only useful database to solve our question; however, it is a well-constructed database from a number of interesting aspects. For example, it is a free-access database. It is financed and developed by the EU and analyses the effects of globalization on trade patterns, environmental pressures and the socioeconomic development of a large group of countries. The WIOD database is heavily grounded upon official statistics from the national statistical institutes. WIOD opened to the public on the 16th of April in 2012.

The data include world input-output tables for the 27 European Union countries and 13 other major world economies. It covers the 1995-2011 period and includes 35 industries and 59 commodities. The WIOD environmental accounts offer information on sectoral energy consumption and CO_2 emissions, but only for 1995-2009. Although other databases offer similar information about energy consumption, CO_2 emissions and macroeconomic variables, the WIOD was chosen to facilitate multisectoral analysis. The same 35 productive sectors appear as data.

The environmental satellites included in the WIOD are defined to cover the broadest range of environmental topics that are reasonably achievable, while maintaining quality data that is well grounded in the empirical availability of primary data. In general, the variables cover: use of energy, emission of main greenhouse gases, emission of other main air pollutants, use of mineral and fossil resources, land use and water use [56]. In the case of air emissions, they may serve to derive a number of environmental impact categories to analyse internationally relevant environmental topics, such as the decoupling between economic growth and CO_2 emissions. The above authors grant utmost importance to three impacts for which operational characterisation methods are internationally well-established, namely: global warming, acidification, and tropospheric ozone formation potential.

Data for per barrel oil prices came from annual free-market commodity price indices (1960 – 2013) provided by the United Nations Conference on Trade and Development (UNCTAD) Statistical Department [58]. Precipitation and population rate data ware taken from Spain's National Statistics Office (Instituto Nacional de Estadística-INE) [59][61]. More specifically, the precipitation data originally came from Spain's National Weather Service (AEMET). The population data are the same as those used as population figures by all international organisations. To elaborate these figures, the main element comes from the Population Census carried out every ten years. In addition to being able to offer updated figures, other statistical instruments were used to measure population developments using the best information available, basically, variations in the census. Population Projections constitute a simulation of future resident population developments, calculated from the population figures, not from the census.

The electricity mix data came from Spain's national electricity distribution operator, Red Eléctrica de España (REE). The time series for annual energy demand developments, expressed in GWh, was obtained from REE publications [62][63] for the years 1997, 1998-2001 and 2002-2009, respectively. For 1995 and 1996, data came from the peninsular balance of electrical energy statistical series [65]. The data referring to Spain's electricity mix show the next generation structure needed to cover the demand, and the percentage of generation coming from renewable and non-renewable energy sources. Additionally, data are offered on the electrical energy demand, corrected for temperature and work patterns; that is to say, corrected for the influence exerted by the work calendar and temperatures on the energy demand, as well as the programmed maximum power demand and the recorded daily energy use.

4. Results

Figure 1 shows CO_2 emission from 1995 to 2009, consecutively. The contribution of the various factors appears in a bar graph in the upper section of the Figure, while total emissions appear as a line. CO_2 emission variations appear as percentages at the bottom of the Figure for each factor. The sum of these variations in absolute values explains the total variation.

From 1996 to 2005, CO_2 emissions increased annually, except in 2003. For the 2005-2009 period, the variation rate for emissions decreased, with the exception of 2007.

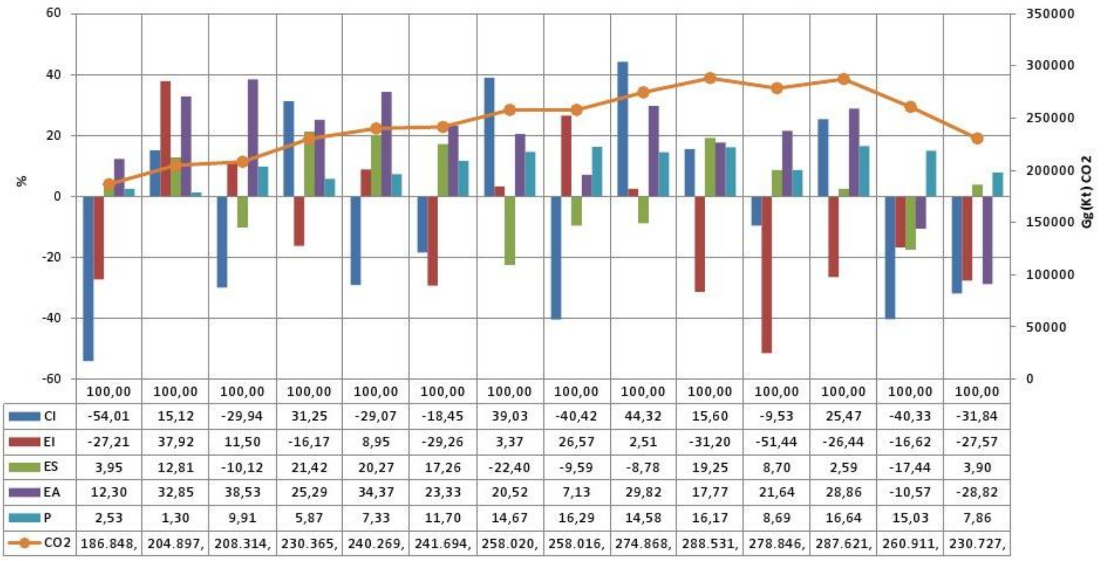

Fig. 1. Decomposition of the CO_2 emissions.
Source: Own production.

The carbonisation factor for CI captures the cleanliness of Spain's energy matrix. CI does not follow a regular pattern during the 1995-2009 period; some years are negative, thus contributing positively to diminishing CO_2; but for other periods, it is positive **[66]**. However, it is possible to carry out a richer analysis based on figures of Tables 1 and A.1.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solid fuels	18,987.4	16,099.8	18,285.4	17,484.7	19,620.9	20,937.6	19,145.2	21,655.4	20,114.9	20,940.3	20,565.7	18,382.9	19,748.3	13,978.7	10,608.6
Total petroleum products	54,885.1	52,629.8	56,086.0	60,455.2	62,984.9	63,966.6	66,268.6	66,402.3	68,244.2	69,942.3	70,457.3	70,138.1	70,673.9	67,703.1	62,852.1
Gas	7,791.6	8,680.1	11,336.7	11,651.2	13,319.1	15,304.7	16,433.3	18,783.9	21,387.3	25,210.0	29,885.6	31,271.9	31,825.9	34,953.6	31,264.1
Nuclear heat	14,304.8	14,530.5	14,264.3	15,217.5	15,181.1	16,046.3	16,433.7	16,255.2	15,960.9	16,407.4	14,842.4	15,509.7	14,214.0	15,212.3	13,609.9
Renewable energies	5,507.3	6,984.7	6,643.7	6,781.9	6,028.0	6,815.1	8,156.6	6,894.1	9,195.7	8,815.6	8,397.7	9,163.9	10,007.5	10,552.3	12,437.8
Hydro power	1,984.5	3,421.0	2,988.2	2,922.5	1,962.4	2,429.6	3,515.7	1,824.9	3,480.9	2,672.7	1,581.5	2,232.1	2,348.2	2,008.9	2,270.9
Wind power	23.2	31.3	63.8	116.3	235.9	406.4	581.2	803.3	1,038.3	1,350.0	1,820.8	2,003.2	2,370.4	2,832.8	3,277.5
Solar thermal	24.6	25.3	22.8	25.2	28.0	31.1	35.7	40.0	44.9	53.2	61.4	73.2	94.5	128.5	197.6
Solar photovoltaic	1.3	1.0	1.1	1.3	1.5	1.5	2.1	2.6	3.5	4.8	3.5	10.2	43.0	220.3	512.6
Solid biofuels (excl. charcoal)	3,300.4	3,319.8	3,388.3	3,537.7	3,605.5	3,623.3	3,671.1	3,811.7	4,061.7	4,137.3	4,176.0	4,206.3	4,231.7	4,207.1	4,579.8
Biogas	75.4	76.7	78.5	81.5	89.9	131.2	134.3	170.0	256.6	295.1	299.5	207.9	216.8	206.8	193.6
Municipal waste (renewable)	93.7	105.5	96.8	93.3	99.4	114.7	139.3	97.4	113.7	122.2	189.3	252.1	309.2	328.1	319.2
Bio-gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.7	98.5	73.9	113.1	114.4	114.4	116.3	150.8
Biodiesels	0.0	0.0	0.0	0.0	0.0	71.8	71.8	67.1	92.2	100.9	145.3	56.5	270.0	492.4	922.1
Geothermal Energy	4.1	4.1	4.1	4.1	5.3	5.4	5.4	5.4	5.4	5.4	7.3	8.0	9.3	11.0	13.7
Electrical energy	385.7	91.1	-264.2	292.5	491.7	381.9	296.6	458.2	108.6	-260.4	-115.5	-282.0	-494.5	-949.2	-696.8
Waste (non-renewable)	214.1	235.6	252.5	250.2	255.6	189.5	139.3	97.4	113.7	122.2	189.3	252.1	309.2	328.1	319.2
All products	**102,076.0**	**99,251.7**	**106,604.4**	**112,133.2**	**117,881.3**	**123,641.6**	**126,873.4**	**130,546.4**	**135,125.3**	**141,177.4**	**144,222.6**	**144,436.7**	**146,284.3**	**141,778.9**	**130,394.9**

Table 1. Gross inland consumption. Thousand tonnes of oil equivalent (TOE)
Source: Eurostat **[66]**.

Table 1 shows the total primary energy consumption in Spain, thus leading to an interesting discussion. During the 2006-2009 sub-period, the CI factor has negative values. As Table 1 indicates for 2006, Spain's energy mix is cleaner, which helps reduce total CO2 emissions. The CI factor is negative, thus coinciding with years when there was a lesser use of coal as a primary energy source, an increase of natural gas (a low carbon emission source) and renewable energy sources. The same happens when we consider the use of total petroleum products as a primary energy source. The exception is 2007. For the 2006-2009 sub-period, a decreased use of coal and total petroleum products is balanced by a greater use of RES.

As a whole, RES shows an increasing trend for 1995-2009 but not all technologies behave in the same manner. Hydroelectric power is unpredictable, as it depends on rainfall. The main contribution within RES is from biomass (solid biofuels) which is used, essentially, for heating purposes but also as a fuel in combined cycled plants for power generation. Wind-power technology advanced greatly between 1995 and 2009. As summarised in Table 1, the negative value of C for most of the years at the end of the period considered is due to a greater contribution of coal, petroleum products and an increase of RES; in other words, a cleaner mix.

It is also possible to analyse the contribution of this factor to the total CO_2 emissions by analysing the contribution of the various technologies to Spain's electricity mix (not primary energy consumption matrix). Table A.1 in the Appendix shows the structure of Spain's electricity mix.

By analysing the contribution of the CI factor from the data in Table A.1. a similar discussion can be established based on the figures in Table 1. In the 1995-2001 sub-period, the contribution of the CI factor does not follow a specific pattern. In 1996 and 1998, the coal and fuel/gas (both high carbon technologies) contribution to the electricity mix decreased in favour of hydro and nuclear technology (clean technologies). During these years, the contribution of the CI factor to the variation in CO_2 emissions was negative. In 1997 and 1999, the situation was exactly the opposite. In 2000, although the contribution of coal and fuel/gas increased slightly, this did not occur at the expense of hydro and nuclear technology, as both increased. Furthermore, wind energy almost doubled its contribution in 1999. There were high levels of precipitation in 2001 [61], coinciding with an increase in the contribution of hydro and nuclear technology and carbon reduction. The results show that the CI factor depends significantly upon the hydroelectric and carbon energy participation in the electricity mix. In years with elevated precipitation, the predominance of hydroelectric contributions makes CI take a negative value. However, when a lack of precipitation reduces the contribution by hydroelectric power and increases the contribution of coal-fired power stations, the CI has a positive value. In Spain, the capacity of large hydroelectric plants has reached its limit.

Between 2002 and 2005, the CI factor was positive, contributing to increase the variation of CO_2 emissions, except in 2003. These years coincide with limited precipitation [61], which produced a major decrease in hydroelectric generation, thus resulting in an increase in the usage of coal. However, in 2003, carbon dependent energy remained stable but a reduction in fuel/gas was seen. By the end of this period, renewable technologies played an important role in the electricity demand in Spain.

During the 2006-2009 period, with the exception of 2007, hydro and wind generated electricity increased with an ensuing decrease in coal and fuel/gas usage. During this time, the contribution of the CI factor was negative. In 2007, a reduction in the contribution of nuclear and fuel/gas was produced with an important increase in the usage of coal, thus producing a positive CI factor. That same year, there was a major increase for net electricity generation. For this period, the energy policy in Spain sought to reduce the participation of coal-fired power stations in the electricity mix. Similarly, the contribution of renewable energy has continued to grow over time. The results show that the value of the CI factor has been negative in most years.

Regarding the EI factor, it must be stressed that, until 2004, EI behaved as the driving force behind CO_2 emissions. In seven of the ten years studied, it showed a positive value. The exceptions correspond to 1996, 1999 and 2011. Since 2005, this factor has been negative, indicating that it contributed to a decrease of the CO_2 emissions in Spain's economy.

Essentially, the progression of the EI factor was due to two causes: i) changes to more or less energy consuming technologies and ii) the effect of the prices on unit consumption and energy saving. The second cause may be provoked by the substitution of certain energy sources for others.

To find a regular pattern in the behaviour of this factor, Table A.2 in the Appendix shows the disaggregated values for the 35 sectors included in the WIOD. Table A.2 allows the behaviour of the EI factor to be analysed by sectors. The two main economic sectors that effectively influence the sign of the EI are the Electricity, Gas and Water Supply Sectors and the Coke, Refined Petroleum and Nuclear Fuel Sectors.

Before continuing with a detailed, year-by-year discussion, the role of the Power Sector requires clarification. This sector is a major electricity consumer associated with transformation processes to obtain final energy from primary energy sources [20]. This implies that from an energy policy perspective, efforts may focus not only on the Power Sector but also on those sectors that are the largest electricity consumers. Those are the cases of Public Administration (which shares 16.7 % in total electricity consumption by larger consumer), Public lighting (16.4 %), Restaurants (4.8 %) and Retail sector (4.1 %). Any improvement in energy efficiency in these sectors will help to reduce energy consumption in Power Sector. We will return to this point in the conclusion.

For 1995, 1997-2000 and 2002-2004, the EI was positive for the Electricity, Gas and Water Supply Sectors and the Coke, Refined Petroleum and Nuclear Fuel Sectors. The same occurred for the average value. However, for 1996, 1999, 2001 and 2005-2009, the value of EI was negative for these sectors, and also for the total average value.

In these years, the Crude Oil-refining Sector developed a number of technologies such as cooling systems, torch networks or steam management to enhance certain production processes by using compressors and turbines. Together with this, the Electricity Generation Sector has implemented better technologies to monitor combustion and turbines in addition to introducing improvements in lighting efficiency. A number of power generation technologies made important investments. For example, many thermal plants enhanced the optimisation of their cooling source, installed or modified pumps, used the heat from vents, installed dry ashtrays and optimised the efficiency of turbo alternators. Spain's nuclear power plants developed an optimisation system for secondary circuits, deployed actions in turbines and auxiliary systems and focused on optimising controls and operations, together with reducing auxiliary devices. Finally, hydroelectric plants introduced changes in rolls and power transformers and rewinding. These changes contributed to inverting the EI factor into negative values. Due to their weight upon all other sectors, the symbol of EI for these sectors had a definite impact upon the symbol of the total average value.

It is important to analyse what occurred in the industrial sector after 2008; it was the first year that Spain's production plummeted as a consequence of the crisis. An increase in energy intensity may arise during periods of decreased production. This could be explained by the decoupling of energy consumption and industrial sector production. Decreased production levels could have provoked an increase in energy consumption per unit produced and a reduction in the use of productive capacities. The low use of productive capacities and maintaining a fixed consumption explains, to a great extent, the increased consumption per production unit. However, this does not correspond with the results of this paper, where a reduction in energy intensity was seen between 2005 and 2008.

The explanation of the symbol change in the EI factor since 2005 is of interest. After 2004, international oil prices began to spike. Figure 2 shows the progress of the price per barrel of crude oil and EI factor values. Due to the significant price increase, it is possible that the industrial and residential sectors responded to that market trend with a decrease in the consumption of oil-derived products.

Spain's Strategy for Energy Saving and Efficiency [67] was approved in November, 2003. This was the most important policy aimed at promoting energy efficiency and savings. Another strategy was the 2008-2012 Action Plan.

In summary, in 2004, two events could explain the symbol change of the EI factor. One was the market trend in the light of increased oil prices, and the other was a policy measure aimed at promoting energy efficiency. A more in-depth study is needed to know which of the two events played a greater role.

The weight of the ES factor as a determinant of the CO_2 emissions variation has failed to show a consistent pattern. This occurred despite the relative weight loss of the Non-Metallic Minerals and Metallurgy and Metallic Product Sectors, linked to the construction sector. Specifically, the Non-Metallic Mineral Sector is generally responsible for the high energy intensity of Spain's industrial sector, given its high energy consumption, which is approximately one quarter of the energy consumption for the industrial sector as a whole ¡Error! No se encuentra el origen de la referencia..

Table A.3 of the Appendix shows that during the 1995 - 2000 sub-period, the sector that most influenced the contribution of this determinant, whether positive or negative, was the refining oil and nuclear fuel. The weight of this sector increased or decreased depending on the production in that year compared with the previous year. However, in 2001, the Other Non-Metallic Minerals and Electricity, Gas and Water Sectors were the cause of the economic structure having a positive contribution to increasing CO_2 emissions. For the rest of the period from 2001 to 2009, the Coke, Refined Petroleum and Nuclear Fuel Sectors, once again, influenced this determinant most. In Spain, refining is the truly important subsector.

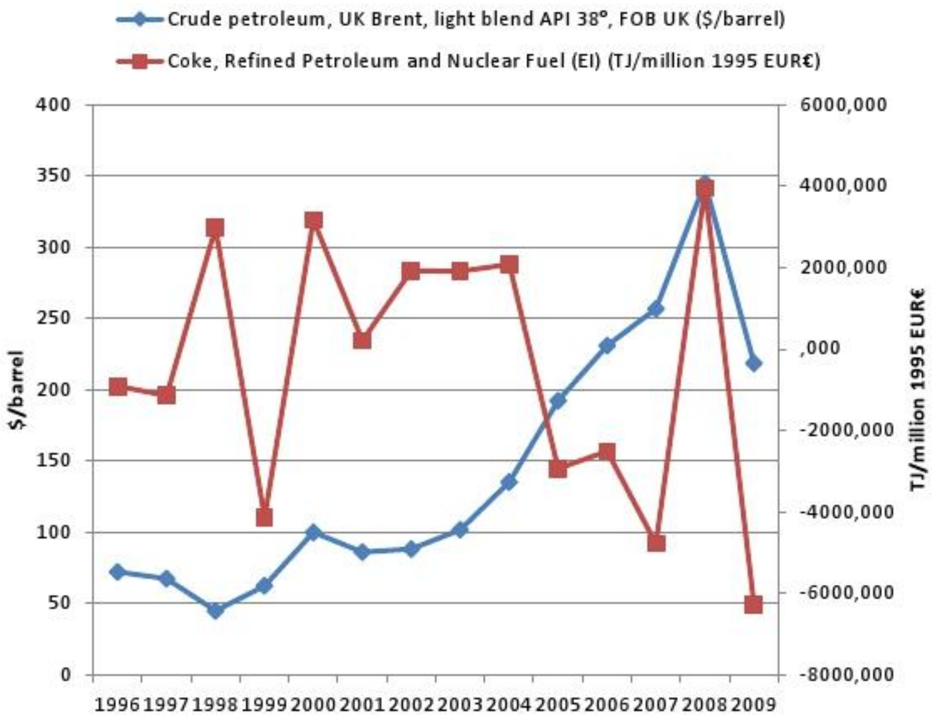

Fig. 2. Oil price per barrel and the contribution of the EI factor for the Coke, Refined Petroleum and Nuclear Fuel sector.
Source: UNCTAD [58].

Overall, the results in Figure 1 show that economic activity and population growth are determinants that contribute positively to increase CO_2 emissions. The contribution of these factors to emissions coincides with the results of Freitas and Kaneko [69]. The real importance of the EA and P factors as determinants of CO_2 emission variation in Spain has been covered previously by Pirlogea and Cicea [70], Wang [71] and Yildirim and Aslan [72]. Authors such as Alcántara and Roca [73], Steve and Tamarit [75] and Sephton and Mann [76] have analysed the relationship between CO_2 emissions and economic growth in the case of Spain, and analysed whether the hypothesis for the environmental Kuznets curve has been fulfilled.

Spain's economic activity increased between 1995 and 2007 as evidenced by the GDP. Figure 1 shows that the weight of the EA, as a determining factor in the variation of emissions, contributes to increase CO_2 until 2007. However, in 2008 and 2009, this weight is negative, contributing to a decrease in emissions. This is because, for the period under review, there is a link between the activity of the Spain's economy and CO_2 emissions from the combustion of fossil fuels. Figure 3 shows that GDP and emissions have an upwards trend until 2007. It is important to stress that, for 2005-2006, indications of "decoupling" can be observed, CI <0, EI<0 with positive economic growth. Alcántara and Padilla [13] pointed out the change in CO_2 emission trends for the years 2005-2007, but remained doubtful as to whether this was a structural change.

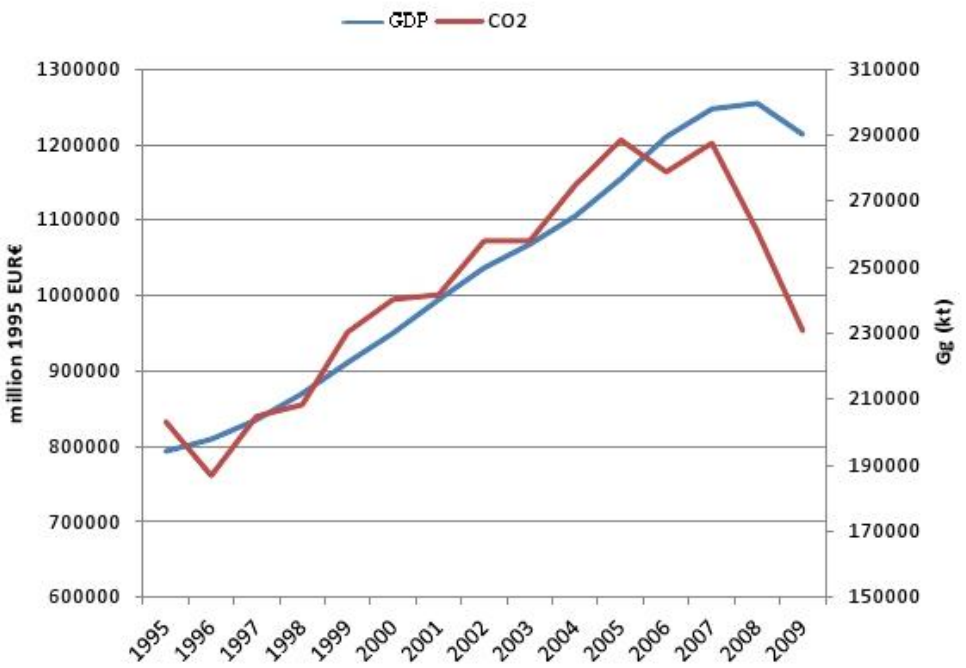

Fig.3. CO_2 emissions and GDP of Spain (1995-2009).
Source: Own production.

The role of population as a driver of CO_2 has been widely considered in the literature. Figure 1 shows that demographic growth has contributed to increased CO_2 emissions in

Spain for the period under consideration. These results are in line with those found for other countries by Freitas and Kaneko [69], Jeong and Kim [77], Wu and Zeng [78], Ren et al. [79] and Wang et al. [80].

5. Conclusions

For the period under consideration, RES acted in detriment of the drivers of CO_2 emissions. This can be stated for the last few years under consideration. Due to the short period in which this happens, we must be cautious. However, the positive trend for the share of RES in Spain's energy matrix together with the negative tendency in the use of fossil fuels leads us to be optimistic.

RES acted against CO_2 drivers but it is not the only factor. Improvements in energy efficiency facilitated this issue.

Previous conclusions could be derived from the methodological approach used this paper. Although the IPAT equation was initially used to emphasise the contribution that a growing global population had on environmental impacts, the 'Kaya Identity' builds upon it and allows an LMDI analysis to be used and answer to our main question.

It can be said that Spain's economy is moving towards a low carbon economy. As of 2006, this is possible thanks to improved performance in the CI and EI factors outweighing the role of affluence and effects of population as traditional drivers of CO_2 emissions. So, RES technologies are a useful tool for reducing that gap. However, the contribution of the economic structure factor remains inconclusive and demands further research.

Spain's carbon intensity reflects a step forward on the path towards independence from fossil fuels with the development of its energy-economy system. Thanks to the rapid expansion of RES, mainly wind energy, and a decreased use of coal, among other aspects, a relatively sustained decarbonisation of its energy supply mix can be seen as of 2000, with improvements compared to previous years. In fact, absolute reductions of CO_2 emissions can also be seen until 2006, prior to the onset of the economic crisis.

The estimated energy intensity provides an indication of greater efficiency in Spain's energy-economy system when compared to previous years. The statistics show a "decoupling" trend; that is a situation in which resource or environmental impacts decline with regards to economic growth. A relatively sustained reduction in energy intensity can be observed for the 2005-2009 sub-period.

In any case, these results must be viewed cautiously. Mundaca et al. [81] found a rebound effect in CO_2 emissions for various developed regions in a post-crisis scenario. IDAE ¡Error! No se encuentra el origen de la referencia. noted that the energy intensity decreased until 2009 -the last year for which information is available in WIOD-, but increased in 2010.

It must be born in mind that despite the consistency in carbon and energy intensity trends, their negative values in the decomposition analysis carried out only coincide with a positive economic growth for 2006. Together with this, the influence of oil prices on the energy efficiency path needs further consideration.

In accordance with the results obtained, the energy intensity of the Power Sector and the Refining Sector must continue to receive specific attention due to their determinant role in the behaviour of the CI factor for the entire group of sectors. Those sectors that act as drivers of electricity consumption must receive specific attention too. Over the forthcoming years, two types of energy policy recommendations should be developed.

Firstly and focusing on the Power Sector, the gradual reduction of energy consumption since 2005 has been due to the greater share of wind and solar technologies. The auxiliary services for these technologies have lower electrical consumption needs compared to thermal power stations. In future years, although a very intense development of solar-electrical technology is not expected, wind power seems to have reached grid-parity and is likely to continue increasing its share in Spain's electricity mix; this will help reduce the sector's energy intensity.

Secondly, energy efficiency improvements in the industrial sector as a whole will encourage the installation of new cogeneration plants at industrial sites. The primary energy savings achieved by cogeneration in industrial activities with respect to 2007, measured in ktoe, have been 17.4 (2008), 44.6 (2009) and 55.2 (2010) ¡Error! No se encuentra el origen de la referencia.. Renewal by substituting high-intensity generation equipment and vehicles for lower consumption machinery must form part of this strategy. In this regard, public support with the acquisition of new, more efficient machinery should be limited to guaranteed energy efficient goods. Generally, all users requesting the support of the public sector to co-finance their energy efficiency improvement plans must incorporate auditing systems that facilitate the verification of whether efficiency improvements have actually been produced. Other measures, such as eco-labelling, aimed at changing consumer patterns, educational programmes and green taxes might remain in force.

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Appendix

Tabla A.1. Annual evolution of the coverage of electricity demand. Peninsular electricity system (GWh). Source: REE [62-65].

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hydraulics	21,929	37,655	33,168	33,992	24,171	27,842	39,424	22,598	38,874	29,777	19,170	25,330	26,352	21,428	23,862
Nuclear	55,445	56,329	55,298	59,003	58,852	62,206	63,708	63,016	61,875	63,606	57,539	60,126	55,102	58,973	52,761
Coal	64,737	52,394	62,098	60,190	72,315	76,374	68,091	78,768	72,249	76,358	77,393	66.006	71,833	46,275	33,862
Fuel/gas	3,868	2,149	6,843	5,658	9,925	10,249	12,398	16,474	8,027	7,697	10,013	5,905	2,397	2,378	2,082
Combined cycle								5,308	14,991	28,974	48,840	63,506	68,139	91,286	78,279
Ordinary regime	145,979	148,527	157,407	158,843	165,263	176,671	183,621	186,164	196,016	206,412	212,955	154,933	223,823	220,340	190,846
Consumption in generation	-6,248	-5,511	-6,351	-6,309	-7,224	-7,827	-7,584	-8,420	-8,162	-8,649	-9,080	-8,904	-8,753	-8,338	-7,117
Special regime			16,161	19,733	24,253	26,613	30,278	35,401	41,412	45,868	50,365	51,633	57,548	68,045	80,353
Hydraulics	2,223	3,544	3,429	3,578	3,740	3,836	4,289	3,771	4,942	4,592	3,650	4,149	4,125	4,638	5,474
Wind	160	304	620	1,237	2,474	4,462	6,600	9,257	11,720	15,753	20,377	22,881	27,249	31,758	37,401
Photovoltaic solar	20	21	21	22	22	23	23	5	9	18	40	102	463	2,406	5,896
Solar thermal electric													8	15	103
Other renewable							2,107	2,830	2,946	3,038	4,005	3,758	4,121	4,463	4,689
Non-renewable							17,282	19,543	21,804	22,481	22,332	20,744	21,582	24,764	26,788
Net generation	149,326	146,885	155,126	157,371	164,275	177,165	206,338	213,150	229,275	243,645	254,279	197,663	272,618	280,046	264,080
Consumption in pumping	-2,082	-1,523	-1,761	-2,588	-3,666	-4,907	-4,131	-6,957	-4,678	-4,605	-6,709	-5,307	-4,432	-3,803	-3,794
International exchanges	4,489	1,059	-3,073	3,402	5,719	4,441	3,458	5,329	1,264	-3,027	-1,343	-3,273	-5,750	-11,040	-8,086
Demand (b.c.)	151,733	156,208	162,383	173,081	184,345	194,992	205,643	211,516	225,850	235,999	246,187	255,022	262,436	265,206	252,201

Table A.2. EI weight factor for the 35 industrial sectors.
Source: Own production.

	1996-1995	1997-1996	1998-1997	1999-1998	2000-1999	2001-2000	2002-2001	2003-2002	2004-2003	2005-2004	2006-2005	2007-2006	2008-2007	2009-2008
Agriculture, Hunting, Forestry and Fishing	-1389.83	-733.03	-404.33	1345.98	852.27	-349.37	-227.13	1961.54	1357.71	364.88	-2016.46	-340.45	-715.55	-873.63
Mining and Quarrying	-220.99	-94.86	190.63	-5.77	430.90	-515.88	67.55	-271.61	-51.79	379.34	-245.41	15.39	-80.13	172.32
Food, Beverages and Tobacco	-139.33	167.83	172.76	-407.59	-195.58	-146.74	735.62	-75.72	-180.45	-337.33	-636.98	-13.32	258.04	-298.03
Textiles and Textile Products	-50.08	88.91	44.43	38.19	-56.81	-245.34	110.71	-5.57	106.09	-35.52	-553.99	-67.27	-47.24	252.24
Leather, Leather and Footwear	-15.95	-4.37	10.34	23.76	66.55	-7.48	23.47	-3.20	37.30	8.02	-55.49	-13.37	-20.80	21.63
Wood and Products of Wood and Cork	-47.46	73.00	79.93	375.07	-81.40	1.19	13.67	40.09	139.46	-73.97	-125.30	80.70	-24.38	121.89
Pulp, Paper, Paper , Printing and Publishing	-162.79	315.88	69.26	633.65	-196.88	-234.32	205.09	760.77	-519.52	87.04	-322.42	288.78	-149.52	-75.79
Coke, Refined Petroleum and Nuclear Fuel	-913.43	-1141.39	2969.25	-4133.00	3170.27	207.42	1924.69	1908.07	2079.37	-2931.20	-2509.45	-4777.88	3950.99	-6281.25
Chemicals and Chemical Products	-832.48	563.16	-129.26	-345.49	577.87	-271.82	175.15	-307.90	-225.85	-734.58	-63.12	-616.59	-79.02	-963.57
Rubber and Plastics	-97.97	108.37	-24.42	-33.66	151.42	10.89	50.63	-64.57	241.33	211.65	-452.77	467.15	-123.25	32.72
Other Non-Metallic Mineral	2867.70	2128.04	-1631.85	136.27	1613.17	-3295.78	-5431.02	7017.62	-4805.39	-176.86	-7740.79	-131.06	360.19	6358.57
Basic Metals and Fabricated Metal	-179.33	1025.98	100.39	-1674.83	527.44	772.80	-565.13	554.50	141.76	-1841.45	-1992.51	74.49	-320.30	-677.24
Machinery, Nec	-13.68	59.38	3.36	-25.35	86.47	70.11	-30.32	63.05	-59.27	-39.38	-126.01	-5.85	-15.72	57.23
Electrical and Optical Equipment	1.97	25.70	7.92	-25.60	44.35	40.13	-1.52	7.63	30.28	19.34	-139.78	75.96	-27.63	18.20
Transport Equipment	-2.32	48.32	141.52	-27.66	45.25	2.58	-94.55	163.18	-6.63	-366.94	-377.45	107.97	48.66	259.66
Manufacturing, Nec; Recycling	-85.19	83.26	11.92	-85.78	50.00	4.31	45.38	-33.71	147.30	160.16	-471.24	317.40	-80.73	41.81
Electricity, Gas and Water Supply	-5261.92	3656.85	-698.69	976.43	-4055.03	-7728.37	2953.57	-4633.59	1277.65	-6370.24	-5723.59	1442.08	-6264.64	-12372.76

Construction	-809.00	599.87	388.99	-238.96	-302.39	-240.84	-355.41	-255.01	436.97	260.00	-774.19	446.66	-270.80	-200.70
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	-5.24	11.16	145.30	-49.19	49.48	94.14	-88.04	-71.32	57.06	147.31	184.22	-280.11	121.23	-205.86
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	51.80	6.35	62.73	42.58	51.99	86.16	-3.18	-79.58	93.82	157.36	222.16	-232.89	58.89	-119.44
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	59.56	-20.66	88.42	33.76	93.45	64.94	-16.72	11.93	95.00	-28.94	206.85	-122.39	-57.31	-122.78
Hotels and Restaurants	16.36	13.73	28.62	18.00	-43.35	20.99	8.77	10.99	23.90	2.38	18.23	-23.79	-7.48	-16.08
Inland Transport	15.04	589.79	58.34	-885.91	409.15	1189.76	93.53	2451.29	-1358.75	725.13	-537.52	-398.02	-1852.04	-1068.41
Water Transport	115.20	-241.67	-2.71	-110.32	-246.91	-60.16	93.16	75.63	-95.68	-85.34	227.81	-257.00	-165.53	-207.86
Air Transport	-85.80	-158.65	18.50	-943.56	-611.82	1497.41	1206.64	-424.43	1173.30	-623.10	763.41	-581.58	-727.78	5345.60
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	1.24	-39.59	-12.84	-34.73	-56.26	-64.07	59.87	-119.47	57.51	-40.66	-24.87	-181.29	-10.01	-26.59
Post and Telecommunications	-22.75	-44.18	-10.91	7.99	79.78	-24.05	-9.39	-17.18	10.36	-7.87	53.32	-37.75	-13.42	-22.92
Financial Intermediation	19.95	-0.46	13.00	4.48	-66.97	-13.98	-19.99	-19.58	-32.05	-68.93	-1.96	-38.15	-3.04	13.83
Real Estate Activities	3.75	5.37	6.88	1.92	50.09	-1.49	-0.18	3.63	5.71	5.84	15.03	-6.70	0.06	-15.11
Renting of M&Eq and Other Business Activities	1.66	-1.14	10.77	1.90	-17.62	4.32	5.55	-2.15	16.96	0.94	9.61	-14.53	-2.32	-13.37
Public Admin and Defence; Compulsory Social Security	17.64	3.45	41.01	8.36	14.99	11.17	6.06	-13.52	27.70	-37.49	63.86	-40.37	-10.25	-29.30
Education	0.50	-0.84	2.96	1.64	3.26	0.52	1.09	-1.10	2.77	-2.08	1.39	-2.59	-1.26	-1.35
Health and Social Work	17.44	13.98	62.59	26.07	-93.33	32.56	8.70	-7.96	65.49	-24.65	33.06	-46.16	-51.56	-32.69
Other Community, Social and Personal Services	-38.53	-263.42	162.40	81.72	-226.29	-18.84	51.98	124.69	222.90	-43.75	387.26	-10.63	-24.48	47.20
Private Households with Employed Persons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.3. ES weight factor for the 35 industrial sectors.
Source: Own production.

	1996-1995	1997-1996	1998-1997	1999-1998	2000-1999	2001-2000	2002-2001	2003-2002	2004-2003	2005-2004	2006-2005	2007-2006	2008-2007	2009-2008
Agriculture, Hunting, Forestry and Fishing	1188.48	-23.25	-324.73	-726.64	-88.96	-675.31	-332.44	-305.22	-428.37	-1568.16	490.76	444.83	-318.12	574.25
Mining and Quarrying	-64.78	41.23	-225.98	-17.72	-303.64	78.69	-35.53	85.61	-70.00	-108.51	-44.89	-52.60	-54.48	-318.49
Food, Beverages and Tobacco	-148.33	42.38	-81.45	-142.92	-129.05	128.26	-271.21	-90.65	44.64	-190.25	-436.13	-149.51	-122.37	261.24
Textiles and Textile Products	-18.16	36.66	-63.32	-13.19	-28.52	-97.84	-101.53	-75.02	-208.49	-102.18	-127.96	-203.54	-47.34	-318.59
Leather, Leather and Footwear	2.38	8.59	-3.27	-27.00	-23.37	-11.03	-22.10	-20.52	-21.05	-24.48	-21.11	-17.05	3.55	-32.57
Wood and Products of Wood and Cork	-8.10	6.10	14.27	11.57	19.92	-3.01	-13.22	-12.80	-26.30	-18.90	-12.92	-45.80	-30.45	-144.66
Pulp, Paper, Paper , Printing and Publishing	-18.77	-69.25	29.68	-44.79	107.13	-90.07	-29.86	-112.21	-51.60	1.56	-111.06	-139.44	-174.37	-75.31
Coke, Refined Petroleum and Nuclear Fuel	467.30	866.12	-2459.08	2948.45	-4338.30	-1286.94	-2851.53	-2380.85	-2006.90	2261.55	1807.28	3542.29	-3723.92	5820.66
Chemicals and Chemical Products	10.97	-150.50	373.27	-267.91	-96.85	75.44	-394.99	-12.17	-354.44	-168.45	-365.93	155.47	-90.05	562.32
Rubber and Plastics	0.41	2.78	28.43	-4.86	27.94	20.88	0.73	-7.85	-13.01	6.71	-63.08	-7.39	40.93	-48.84
Other Non-Metallic Mineral	-2234.23	2000.31	1739.94	2494.64	868.12	5223.88	-918.32	-1200.35	388.15	1984.16	212.76	-841.54	-2870.50	-9276.23
Basic Metals and Fabricated Metal	-116.19	-24.64	223.14	742.84	162.38	23.05	63.65	-224.90	377.15	-409.02	2.00	195.56	-425.07	-1829.96
Machinery, Nec	37.37	-1.89	31.63	4.91	-16.62	44.60	-13.66	-23.03	10.17	-46.02	21.44	-12.75	12.00	-64.27
Electrical and Optical Equipment	13.61	-1.53	5.18	0.43	1.30	10.13	-27.93	-13.48	-8.32	-5.19	0.90	-5.00	-3.17	-33.53
Transport Equipment	19.05	83.77	15.83	11.76	57.38	-52.63	-21.37	7.96	-47.71	-80.24	-31.42	29.07	-87.36	-349.37
Manufacturing, Nec; Recycling	9.30	1.06	12.63	10.68	2.97	-9.12	-12.37	-8.78	14.37	-19.31	-20.30	-18.24	-4.56	-57.03
Electricity, Gas and Water Supply	1648.63	-589.46	-787.15	1384.13	7790.63	3692.89	-127.45	1778.99	1212.38	4870.33	3696.97	-2375.87	2652.95	6340.50

Construction	-169.20	-80.94	65.65	79.05	16.22	172.46	619.03	148.74	-142.54	189.13	132.66	-353.24	-100.72	-98.73
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	15.41	27.33	37.77	-39.92	-39.71	32.79	-7.95	-12.14	71.66	28.04	-153.19	79.39	-103.09	249.44
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	11.28	14.22	-11.61	8.04	-56.76	-34.94	-26.76	53.27	34.42	-60.53	-30.23	65.47	-62.07	-79.97
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	0.78	-6.39	-4.07	-5.16	-8.97	10.37	4.11	-7.18	26.76	15.88	5.52	27.65	75.83	40.59
Hotels and Restaurants	-8.59	-6.55	-8.71	-6.66	-22.53	-19.58	-12.68	6.00	-1.95	-14.14	-9.83	-5.75	0.27	16.92
Inland Transport	244.43	157.07	-248.64	423.36	346.66	-1229.62	-878.77	-731.31	-96.73	-81.89	-423.43	-30.13	346.98	334.91
Water Transport	-87.14	-17.58	4.43	21.41	47.89	21.62	-230.17	58.50	199.93	-24.11	-268.23	-120.23	-54.32	-166.24
Air Transport	243.82	52.71	-106.77	142.45	455.21	-664.19	-977.46	-77.38	-845.78	442.63	-458.13	178.35	-1688.49	-25.50
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	9.26	-14.28	0.24	7.47	-11.26	12.86	-13.75	-9.27	7.86	11.92	36.22	18.08	-7.66	-5.52
Post and Telecommunications	28.14	13.55	8.37	14.02	23.75	11.78	7.58	4.78	13.42	18.23	-8.25	9.38	9.46	12.08
Financial Intermediation	-11.41	4.87	-3.91	-28.13	14.67	-1.44	10.02	8.59	35.05	38.31	39.32	16.08	-0.17	-1.78
Real Estate Activities	-0.30	-1.01	-0.60	-1.07	-1.81	-0.65	1.83	0.46	-1.62	-2.26	-3.21	-1.21	1.33	0.73
Renting of M&Eq and Other Business Activities	2.99	1.29	4.80	10.81	3.36	-2.96	-6.90	-2.74	1.79	7.97	14.54	9.44	3.40	4.79
Public Admin and Defence; Compulsory Social Security	-8.40	3.88	-10.16	-11.59	-0.60	-1.32	-5.38	10.67	7.80	-1.83	-3.22	10.11	27.31	33.82
Education	-0.23	-0.16	-0.27	0.33	-0.64	-0.42	-0.37	-0.08	-0.19	-0.80	-0.85	0.32	1.11	2.18
Health and Social Work	-7.86	-10.09	-15.31	7.07	10.04	-29.11	-2.50	17.69	35.09	23.24	-14.60	28.78	61.53	90.34
Other Community, Social and Personal Services	-8.36	-54.26	21.07	-5.26	9.81	22.66	2.20	-10.72	49.03	24.60	-10.85	51.12	69.91	119.85
Private Households with Employed Persons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00