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Carbon Dioxide Emissions vs. Allocation Rights: Spanish Case Analysis

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ABSTRACT: The market for carbon dioxide rights emerged as one of the tools applicable to the implementation of the measures adopted by the Kyoto Protocol to combat climate change. In this paper we analyze the case of Spain, because their peculiar administrative division into seventeen Autonomous Communities, it is relevant to a detailed study of emissions and allowances of the industries that make up the different regions for the period between 2005 and 2009. Allowing us to test the efficiency and compliance with the requirements and conditions prescribed in the regulations for each one of those territorial units. Statistical analysis shows significant differences found between emissions and allocations for several regions.

Key words: Carbon dioxide, National Allocation Plan, Emissions, Allocation Rights

INTRODUCTION

Over recent decades many people have been environmentally-conscious, and their altruistic method has alerted the world to what was going to occur. However, they have lived ignored and silenced by the knowledge of a reality that would entail a major change with significant adverse consequences for the planet, both biological (Walther *et al.*, 2002) and economic (Stern, 2008), while the position of irresponsible politicians others indifferent to those events has caused climate change that is becoming a major threat to the planet. The main manifestation of climate change presents great variations in climatic parameters, such as temperature, precipitation, etc. These effects may be due to both natural causes (Crowley and North, 1988) and anthropogenic (Oreskes, 2004), with the latter holding greater weight, as corroborated by the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

Actions such as the indiscriminate cutting of trees, water misuse, overuse of land and the uncontrolled emission of greenhouse gases by industrialized economies (Halek *et al.*, 2008), are among the factors that aggravate the situation most drastically, causing an unprecedented global warming attributed to the so-called "greenhouse effect", which produces abnormal changes in global temperature (Lean and Rind, 2008). Once we are aware of the detrimental, and hopefully not irreversible, effects of human actions on the environment, it is time to take appropriate measures, as we, mankind, are to blame, and therefore also the only ones responsible for stopping what destruction what we can.

January 1, 2005 saw the launch of this market for carbon dioxide (CO_2) laws (Rickles *et al.*, 2010), the most ambitious to date (Directive 2003/87/EC, transposed into Spanish law by Law 1 / 2005), which covers the 27 Member States in CO_2 emissions of the following activities: power plants, cogeneration and other combustion plants above 20MW, thermal power plants, refineries, and steel, cement, ceramics, glass and paper plants. At the community level, more than 10,000 installations and over 2,000 billion tons of CO_2 have been affected, about 45% of the total emissions of greenhouse gases in the entire European Community, which is a huge turnover in circulation for the purchase and sale of rights (Benz and Trück, 2009), with a high economic impact (Sims *et al.*, 2002, Frunza and Guegan, 2009).

This paper highlights the situation in Spain in terms of the emissions and rights assignments of CO_2 following the 2005 approval the first National Allocation Plan Policy (NAP I: 2005-2007) and

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continuing in 2008 with the second plan (NAP II: 2008-2012), creating a real market for rights. Having analyzed the market for industrial sectors in previous work (Mondéjar-Jiménez *et al.*, 2010; Quesada *et al.*, 2010; Vargas-Vargas *et al.*, 2010), we consider relevant in this new analysis further segments in the seventeen Autonomous Communities that made up the Spanish state. This way we can determine which regional government exerts more pressure on their industries in the area of environmental awareness, just as we can see which Spanish territories are more aggressive in this market.

MATERIALS & METHODS

The data for emissions and CO_2 emission rights allocations for industries in each of the regions has been taken from the "Global balances sector implementation of Act 1/ 2005" as the "application reports, plant by plant" of each year, made public by the Ministry of Environment and Rural and Marine Affairs of the Government of Spain. The years at the beginning and end of the period analyzed (2005-2009) are marked by the availability of data, and by 2005, the first year of operation of this market, and by 2009, the latest year for which data are available.

To first obtain a visual idea of the differences between CO_2 emissions and allocations for each of the CCAA, we graphically represent the cloud of points in both data sets and adjust each set with a "natural spline." To compare the emission allowances, we first performed a Shapiro-Wilk Normality test, concluding that the observations are not normal for some of the groups at a significant level of 5%. In cases where we cannot assume normality, we use a nonparametric test for related samples, the test of the signed ranks of Wilcoxon, and in those cases where normality can be assumed, we use a "T" test for related samples (paired). The analysis model allows us to conduct an independent study for each of the regions, with particular emphasis on those in which the difference between allocations and emissions are significant, as well as an overview of the aggregate total.

RESULTS & DISCUSSION

Following the completion of the tests discussed above, of the seventeen regions analyzed, only 5 have statistically significant differences between CO_2 emissions and assignments. In Fig. 1. we plot the rights (one right equivalent to the allocation of one ton of CO_2) assigned to four of the five autonomous regions, as well as tons of CO_2 emitted by each of them.

The evolution of the CO_2 market performance for these four regions has a number of common characteristics, marked mainly by two facts. First are the only ones that throughout the period have been running the market and keeping the volume of allowances up over emissions, i.e. there is an excess of rights that enables them to earn extraordinary profits derived from the sale. Second, the region next to the Canary Islands (Fig. 3) presented a statistically significant difference between emissions and allowances, to an impressive level of 10%, with the

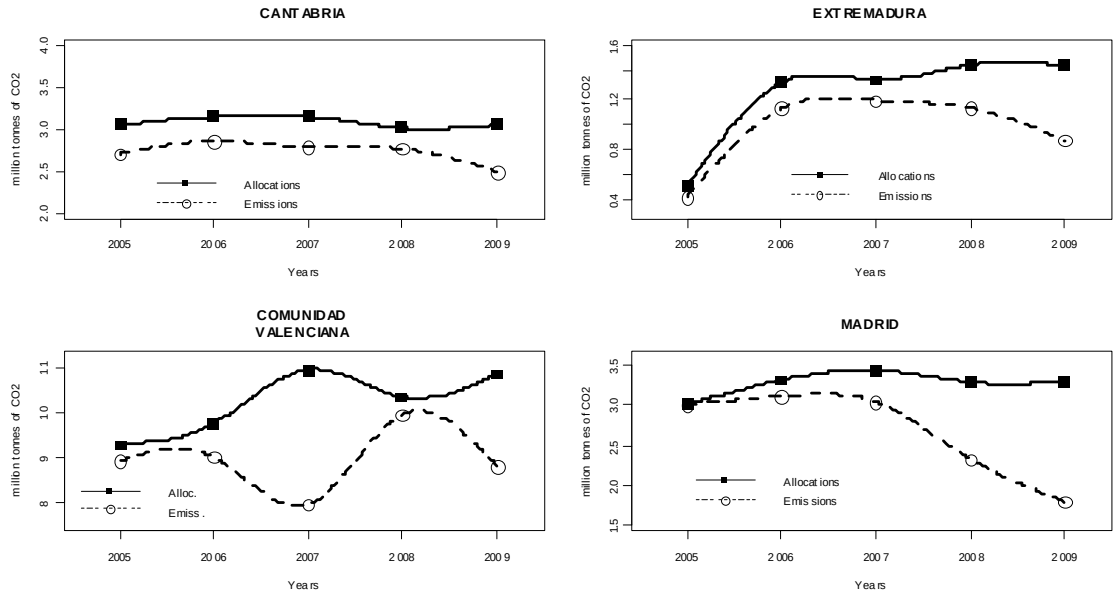

Fig. 1. Emissions and allocations of CO_2. Case of Cantabria, Extremadura, Comunidad Valenciana and Madrid

Canary Islands and Cantabria being especially relevant, with a significant level of 5%, each corresponding to a p-value of 0,025 and 0,002 respectively.

In the case of Cantabria we can see an almost steady evolution over time in both emissions and allowances, while in Extremadura there is a clear growth in 2006 over 2005, with the addition of 13 new industries that second year, then stabilizing with a tendency toward a gap between allocations and emissions. Madrid is characterized by a progressive divergence between allocations and emissions over time, beginning in 2005, a year in which both were consistent with a situation in 2009 in which there is a difference of 1.5 million tons of CO_2. Most unique is the case of Valencia, marked by the existing differential in 2007 between allocations and emissions, the latter reduced significantly in 2007 over 2006, while the opposite happens to the assignments, producing an increase one of the same, leading to a differential of 3 million tons of CO_2 that year.

In Fig. 2. we can distinguish two groups with quite similar developments, the first group being formed by the regions of Asturias, Galicia and Castilla-León, all of them presenting a linearly decreasing volume of assignments, justified by annual appropriations cuts during the first and the second national allocation plans. In emissions we also see a gradual reduction over the years, except in all of 2007, when this trend reverses and emissions are increased compared to the previous year.

The second group would consist of Castilla-La Mancha, Aragón and Catalonia, showing virtually constant assignments over the years, with an annual average of 9.4 million allowances in Aragón and Castilla-La Mancha, and in the case of Catalonia, annual allocations are also constant, except in 2007, a year which allocated 20.74 million tons of CO_2, or approximately 1.5 million tons more than the average of other years. With regard to the volume of emissions, a uniformity is represented, which is reflected during the NAP I (2005-2007). This presents an average of 10.5 million tons per year in Castilla-La Mancha and Aragón, and an average 19.91 million tons in Catalonia. There is a turning point in the year 2008, with the implementation of NAP II (2008-2012), which led to a progressive reduction in the volume of emissions in the three regions in the years 2008 and 2009.

The four regions we show in Fig. 3 are characterized by a common feature especially in regard to assignments, and we can see, in all of Andalusia, the Canary and Balearic Islands, and the Basque Country, that there is a very similar evolution, maintaining an almost constant volume of allowances over the span of NAP I. There is a turning point with the change from one plan to another, and in 2008, with the adoption of the NAP II allocations are significantly reduced to correct the errors in NAP I. The major differences compared to the volume of allowances allocated from one plan to another are set, in absolute terms, in Andalusia, where in 2008 7.4 million less tons

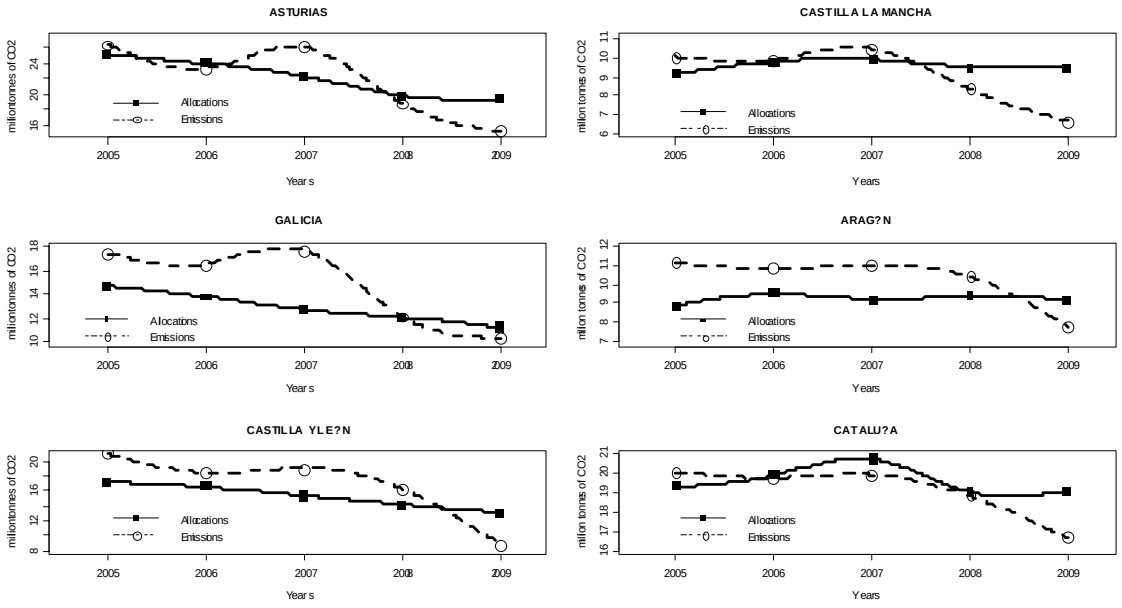

Fig. 2. Emissions and allocations of CO_2. Case of Asturias, Galicia, Castilla-León, Castilla-La Mancha, Aragón and Catalonia

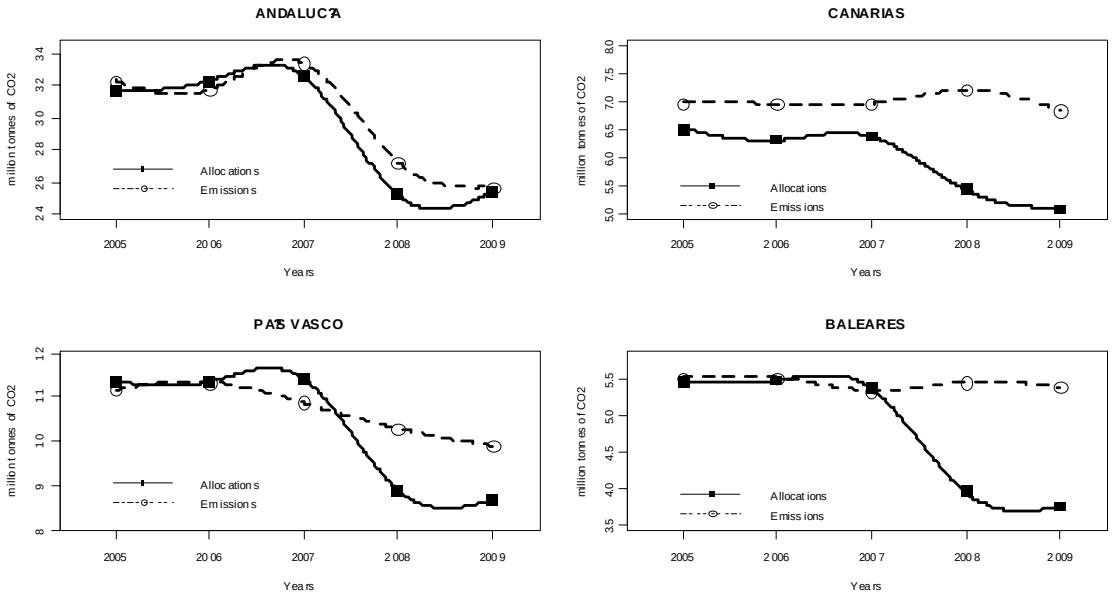

Fig. 3. Emissions and allocations of CO_2. Case of Andalusia, Canary Islands, Basque Country and Balearic Islands

of allowances are allocated than in 2007, while in relative terms, the biggest difference would be in the Balearic Islands, with a reduction of 26%.

As the volume of CO_2 emissions on the one hand highlight the almost constant evolution of the Canary and Balearic Islands over time, regardless of the reduction in allocations for the NAP II, the Basque Country, on the other hand, presents a decreasing trend in the volume of CO_2, lagging behind what was allocated in 2007, but not sufficiently reduced during the years 2008 and 2009, remaining well above the allocated volume which forces most industries to purchase rights. And finally, to comment on the case of Andalusia, where emissions move almost seamlessly with the assignments, being practically the same in 2005 and 2009, in the intervening years there are slight deviations both above and below. It is worth emphasizing, as can be seen by comparing the ordinate axis of the graphs of the different regions, that Andalusia is the region with the highest volume of emissions and allowances in all of Spain, and with reference to the last year of the series, 2009, it is worth noting that Andalusia includes 17% of all national allocations and 19% of all national emissions.

The three regions that are shown in Fig. 4 show fairly heterogeneous behaviour over time. From the standpoint of assignments, La Rioja and Navarra are similarly characterized by a general trend towards the reduction of allocations with the exception of 2007, a year in which the allocations are higher than those of 2006. These same circumstances can be seen in Navarra in 2009, with an increase in allocations over the previous year. Murcia shows a clear upward trend during NAP I, with a maximum in 2007, from which allocations are significantly reduced.

Regarding emissions of Murcia, we see a clear upward trend in emissions over the first four years of implementation of the CO_2 market, changing the trend in 2009 with a reduction in emissions reaching 5.5 million tons of CO_2 in all industries of the region, a figure very close to the allocations received. La Rioja has a virtually opposite emission evolution, with a predominance in reducing emissions, except in 2006 when emissions were higher than 2005. In Navarra, emission volume is marked by the change from one plan to another, with the NAP I witnessing a progressive reduction of emissions, therefore falling below the allocations granted. However, in 2008, with the entry of NAP II, the trend is reversed and emissions rise above allocations, to the point that in 2009 both emissions and allocations coincide with a volume of 2.6 million allowances.

Fig. 5 provides an overview of the 17 regions that make up the whole of Spanish industries, totalling 1,106 facilities in 2009, and representing an emission volume of 136.93 million tons of CO_2, or about 45% of the total national emissions of all greenhouse gases, and a total of 151.23 million allocations. This indicates that 2009 is the first year of operation in this market, in which emissions are lower than allocations, carrying definite improvement and progress in environmental awareness by the Spanish industries, unlike previous years, as

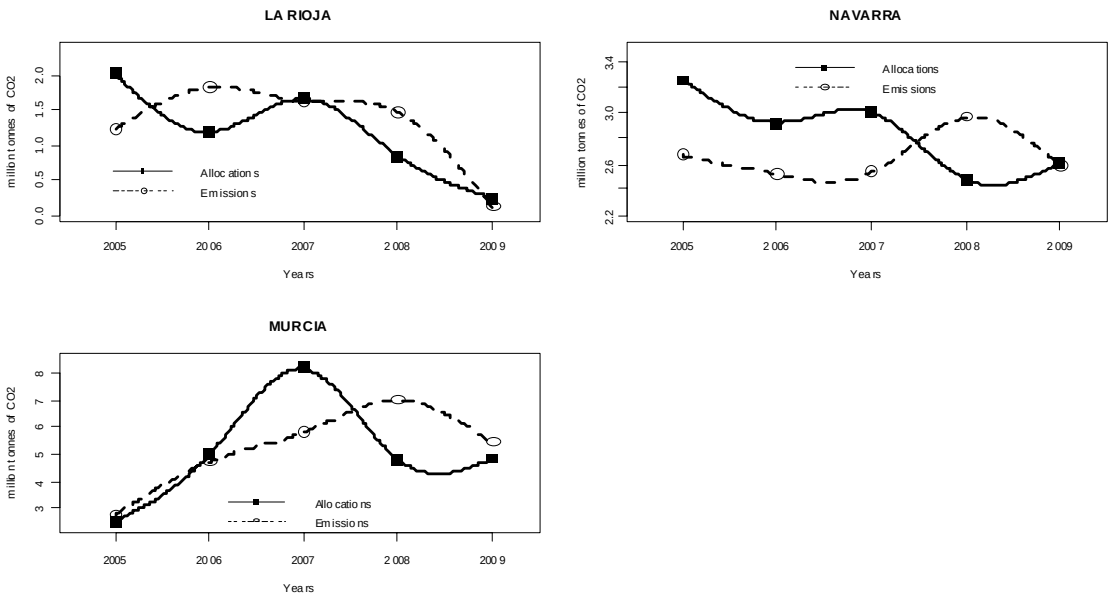

Fig. 4. Emissions and allocations of CO_2. Case of La Rioja, Navarra and Murcia

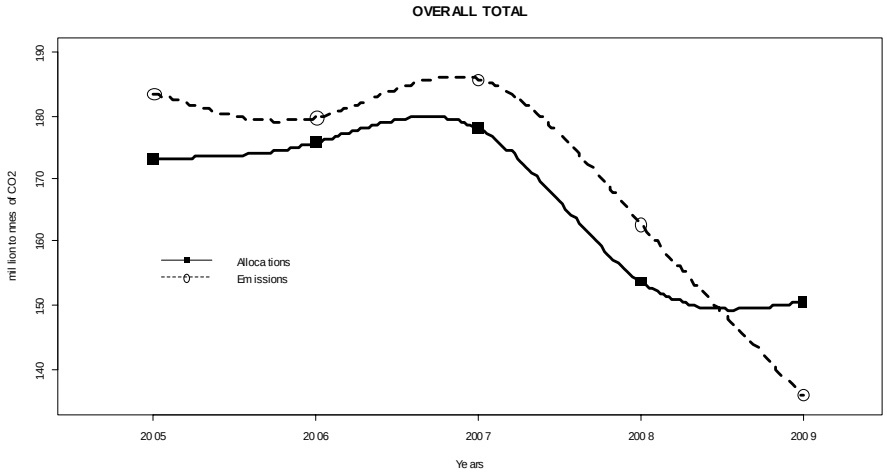

Fig. 5. Global Emissions and Allocations for the Spanish Industry

despite the large volume of allowances for the NAP I, emissions were an average of 7 million tons above the allocations. In 2008, although there is a noticeable reduction in both allocations and emissions, the latter continued to remain ahead. So we hope that Spanish industry as a whole continues on this path toward emission reduction, which we will see once the data for 2010 is made public.

CONCLUSION

The results of our analysis of emissions and allocations on an individual basis for each of the 17 regions that make up the industrial fabric of Spain provide us with the following conclusions. Firstly, statistical analysis highlights significant differences (at a level of 5%) found between emissions and allocations for the Canary Islands and Cantabria, followed by Valencia, Extremadura and Madrid with significant differences at 10 %, but without any significant differences from the rest of the regions. Secondly, as shown in Figure 1, only four regions have a volume exceeding allocations issued during the operation of this market. It is remarkable that allocations show a consistent trend for most of the regions, with nine of the seventeen ending in 2009 with a lower volume than the starting year in 2005. On the other hand, five regions have a nearly constant volume of allocations, and only 3 of them (Extremadura, Valencia and Murcia) have increased allocations.

Finally, Andalusia is highlighted as the region which accounts for the largest percentage of emissions

(an average of 18%) of the national total, just like allowances (also half of 18%), followed by Asturias and Catalonia. On the other hand, La Rioja has the lowest volume of emissions, with around 1% of all national emissions, which is in line with its demographic (being the region with the lowest population size) and economic data, having the lowest volume of gross domestic product of the national total. From a global perspective, the adoption of the Kyoto Protocol was primarily aimed at a reduction, or where appropriate, limitation of air emissions of greenhouse gases by the same signatory countries. Thus, the European Union made a commitment to reduce emissions by 8% during 2008-2012, as compared to base year levels during that period. Spain has a commitment to limit the growth of their emissions by 15% over the values of the base year, 1990. However, as seen from the results obtained in this work, Spain has breached its commitment to limit emissions during the first four years of the CO_2 trading market, thereby increasing their emissions relative to 1990 in recent years, as follows: 2005: 52%, 2006: 49%, 2007:54%, 2008: 43% and 2009: 13%.

In 2009, Spain made commitments under the Kyoto Protocol, setting an emission volume of 136.93 million tons, an increase below the threshold of 15% compared to the base year, while allowing the volume of allowances allocated for 2009 to be higher, which generates a surplus of rights and options with consequential benefits. Part of this change in trend is driven by the awareness of renewable energy use, so for example, in 2009, Spain was the fourth largest worldwide leader in the installation of wind power, surpassed only by the United States, Germany and China. Spain has to continue this trend in coming years, which would be the main tool to fight climate change and one way to stop the deterioration of the planet that sustains us.

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