Global Determinants of Carbon Dioxide Emissions: Are all Countries Equal?

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Global determinants of carbon dioxide emissions: are all countries equal?

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1. Introduction

In recent decades, the effects of climate change and its consequences, such as floods, extreme temperatures and natural disasters, have increased the urgency of global cooperation agreements to effectively reduce the level of emissions to the atmosphere. Climate change is characterized as a global problem, exponential and persistent. It is global because the consequences of this phenomenon affect the whole planet; exponential because every time, human and non-human activities are increasing the speed of climate change; and persistent because, despite being the problem solved currently, emissions would take many decades to disappear from the atmosphere.

What is more, the current economic structure and the role played by its performance in the generation of emissions suggest that it would be necessary strategies to reduce GHG emissions in 40%-70% by 2050 (IPCC, 2014). As a consequence, the United Nations have included as one of the 17 Sustainable Development Goals to combat climate change and the implications of this phenomena.

The different international agreements (Kyoto Protocol 1997, FCCC/INFORMAL/83) and more recently, the Paris Agreement (ratified in December 2015) are examples of the need of strengthen global responses to the threat of climate change and to move in the direction of decarbonizing the global economy (FCCC/CP/2015/L.9/Rev.1).Paris Agreement explicitly recognize that "sustainable lifestyles and sustainable patterns of consumption and production, with developed country Parties taking the lead, play an important role in addressing climate change" (FCCC/CP/2015/10/Add.1) as well as need of involving all levels of government and social and economic actors.

The role of consumer lifestyles and production patterns regarding environmental impacts and responsibilities in an increasingly globalized world, has been widely explored in the literature (Gallego et al. (2005), Lenzen (2007), Lenzen et al. (2007), Rodrigues et al. (2005), Jacobs et al. (2012)). On the one hand, international trade, technological progress and the recent process of globalization have resulted in increasingly globalized supply chains (Yu et al. 2013), causing the vast majority of economic sectors to increase the use of pollutants in their production processes. From the consumer side, pollution is generated by consumption both directly and indirectly; directly through the use of energy goods and indirectly through the consumption of goods and services. In that line works such as Biesiot and Noorman (1999), Wier et al. (2001), Lenzen et al. (2004), Carlsson-Kanyama et al. (2005) and Moll et al. (2005) have studied the relationship between consumption patterns and emissions, concluding that different levels of income by households lead to different levels of emissions. In other words, there is a scale effect as it can be seen in Vringer and Blok (1995), Lenzen et al. (2006) and Kerkhof et al., 2009b among others.

Besides, differences in the productive structures between the countries and the changes experienced after the outbreak of the international crisis in 2008 have had repercussions and consequences on the environment. For this reason, recently, several works have focused on studying the processes of convergence and divergence in environmental emissions between countries (see Duro et al. (2016), Teixidó-Figueras (2016), Bolea et al. (2018) among others)

The role of structural characteristics of countries explaining CO2 emissions (and other environmental pressures) has been also highlighted in the literature, with different trade patterns, energy intensities and development stages affecting these impacts (see Fan et al. (2006), Duarte at al. (2018a, 2018b), among others).

So, in line with previous literature and acknowledging the multisectoral and multiregional character of global production flows and the associated emissions, our paper makes use of the multiregional input-output model (MRIO) for the world economy to analyze whether CO2 emissions[1] should be taken as a global or rather regional phenomenon, and if so, study the factors that explain in each case the generation of these emissions. The response given to this question is of great relevance for the formulation and evaluation of global policies against climate change as we provide some insight about the scale in which

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[1] We focus on CO2 emissions as the most representative GHG

this kind of policies should be taken. Besides, we mainly focus on technology and structural change as drivers of CO2 emissions as well as the role played by trade in an increasing internationalized and fragmentation world.

This document is structured as follows. Section 2 presents the materials and methods that we have used to calculated the emissions embodied from a global perspective and to identify the main factors that are behind all these processes. In Section 3, we show the results obtained in this work that reveals certain differences among countries. Finally, in Section 4 we will discuss the main ideas and conclusions that we have obtained in this work.

2. Materials and Methods.

Using the MRIO tables from the World Input-Output Database (WIOD) (Timmer et al., 2015) for the world economy and data on CO2 emissions from the associated Environmental Accounts of WIOD (Genty et al., 2012), we analyze the evolution of CO2 emissions and study the main factors that contribute in the generation of emissions from a regional perspective[2]. Taking into account this variable of emissions, we have the bilateral exchanges of CO2 (kilotons) for 41 countries from 1995 to 2009. In addition, WIOD tables (WIOTs) describe the economic relations across 28 European countries and 15 non-European countries, covering almost 80% of total international trade from 2000 to 2014. For this reason, we had to harmonize environmental data with WIOTs.

On the one hand, our sample consist of 43 countries (without RoW), so we had to calculate the emissions data for Croatia (HRV), Norway (NOR) and Switzerland (CHE) as an average of the emissions generated by its bordering countries.

On the other hand, our analysis refers to the period 2000 to 2014, so in the case of data on CO2 emissions we extend data up to 2014 for all countries and sectors of the sample. As in Bolea et al. (2018), emissions are updated as follows:

$$\mathrm{c_{ij}}.\left(1+\mathrm{AAGR_{ij_{2000-2009}}}\right)^{\mathrm{n}}.\,\mathrm{GDP_{jt}} \qquad (1)$$

Being $\mathrm{c_{ij}}$ the quotient of the emissions generated by sector *i* of the country *j* in 2009 over the total emissions generated in that year in the country *j* Moreover, $\mathrm{AAGR_{ij(2000-2009)}}$ is

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[2] Other databases that we consider are EUROSTAT, OECD, CAIT and the World Bank.

the average annual growth rate of these coefficients from 2000 to 2009, again by sector and country, raised to a coefficient *n* that represents the difference of years between 2009 (the last year for which data are available in WIOD) and the corresponding year, from 2010 to 2014. And finally, $\mathrm{GDP}_{\mathrm{jt}}$ corresponds to the GDP generated by each country in the years that we have estimated CO2 emissions data (*j*=2010,…,2014).

Once we have all data for the same sample of countries and years, we can estimate an environmentally MRIO model on the basis of input-output methodology as follow

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y} \qquad (2)$$

Equation 2 represents the equilibrium equation in a global multiregional context, where $\mathbf{x}$ denotes the total output; $\mathbf{A}$ is the matrix of technical coefficients where each of its elements (a_{ij}^{rs}) reflects the intermediate input *i* of a country *r* necessary to produce a unit of output *j* in country *s*; and $\mathbf{y}$ is the vector of final demand of countries of the sample. This equation can be also expressed in terms of the well-known Leontief inverse matrix $\mathbf{L}$ as follow

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} = \mathbf{L}\mathbf{y} \qquad (3)$$

Once we have the multiregional economy with this equation, if we pre-multiply this result by a diagonalized vector of emissions generated by each country and sector, we obtain the emissions generated in all the world and incorporated in all goods ($\boldsymbol{\omega}^{\mathbf{emi}}$)

$$\boldsymbol{\omega}^{\mathbf{emi}} = \hat{\mathbf{e}}.\mathbf{L}.\hat{\mathbf{y}} \qquad (4)$$

This matrix contains the CO2 emissions associated with the trade among countries and with the domestic consumption of each country.

On the basis of this equation, our first aim is to identify whether CO2 emissions must be considered in global or regional terms. To do this, i.e., to identify the existence of common and differential behaviours between countries following some geographical and/or economic criteria, we have developed a cluster analysis applying the Ward's criterion, taking the variance as dissimilarity metric (Ward's, 1963). The objective is to divide the observations into homogenous groups so that the observations within each group are similar. In this way, clubs of countries are sorted by levels of emissions (our target variable of study) on which we will study their behavior.

Besides, once the clusters are formed, we want to analyse the effect of different variables over CO2 emissions in order to get some insight about the determinants of CO2 emissions as well as the any existence of difference among regions if so.

In order to do that, we use a panel data model. Being our dependant variable CO2 emissions per capita (we have previously explained how we calculate it) (Fan et al. (2006), Grunewald et al. (2016), Duarte et al. (2018), etc) we use as independent variables, in accordance with literature, the following ones: output per capita (outputpc) that we obtain from WIOD (2016 release) and we consider as a proxy of income, the ratio exports over output (exoutput) that we introduce as a representation of trade, a relative specialization index for different block of sectors (primary sector (PS), energy sector (ES), high and medium-high technology industries (HMHT), medium-low technology industries (MLT) and low technology industries (LT)) that are calculated from WIOD (2016 release) and can be considered as a proxy of economic structure/technology, backward linkages (backward) also calculated from WIOD (2016 release) and considered as a proxy of pure technology, use of renewable energies (renewable) that is obtained from The World Bank and measures the percentage of energy use by households that come from renewable sources, energy use per capita (energyusepc), also obtained from The World Bank, measures the energy use in the country using as unit kg of oil equivalent per capita, a variable that measures the Kyoto protocol (Kyoto) that we calculate through input-output tables (WIOD, 2016 release), labour productivity obtained from the Social WIOD accounts and economic performance index that we get from Yale centre for environmental law and policy and represents which are the countries that have the best practices in order to care environment and achieve environmental policy goals.

We have to note that, in order to capture the influence of the Kyoto protocol, it is usual in the literature to consider a dummy variable (Bergstrand, et al. (2015), Grunewald et al. (2016)). This option cannot be implemented in our analysis given the limitations of our sample with our estimations reporting exact collinearity. As we are splitting the sample in function of cluster analysis in one of them all countries have ratified Kyoto protocol. In our case, the potential influence of signing (or not) the Kyoto protocol on the Co2 emissions embodied is calculated for each country through the share of imports of each country coming from countries that does not ratified (or sign at the beginning) Kyoto protocol. It can be expected that embodied emissions would be higher in those countries in which the share of imports coming from this countries is higher.

Moreover, trade as CO2 determinant has been further explored (Eaton et al. (2002), Aichele et al. (2015), Duarte et al. (2018)). However, although different measures can be introduced, as we are not taken into account embodied CO2 emissions we decided to include only a traditional indicator. In relation with energy variables and output per capita, great part of literature shows them as significant indicators (Feenstra et al. (2001), Fan et al. (2006), Grunewald et al. (2016)). Finally, as shown by Fan et al. (2006) technology plays an important role. One of the variables introduced is backward linkages that are calculated as the total of each column of matrix A and represents those sectors/countries that push other sectors/countries.

Therefore, we propose a logarithm model as follows

$$\begin{aligned} &\ln\left(CO_2\right)=\alpha+\beta_1\ln\left(outputpc\right)+\beta_2\ln\left(expoutput\right)+\beta_3\ln\left(ps\right)+\beta_4\ln\left(es\right)\\ &+\beta_5\ln\left(hmht\right)+\beta_6\ln\left(mlt\right)+\beta_7\ln\left(lt\right)+\beta_8\ln\left(backward\right)+\beta_9\ln\left(renowable\right)\\ &+\beta_{10}\ln\left(energyusepc\right)+\beta_{11}\ln\left(kyoto\right)+\beta_{12}\ln\left(labourprod\right)+\beta_{11}\ln\left(epi\right)+\mu \end{aligned} \tag{5}$$

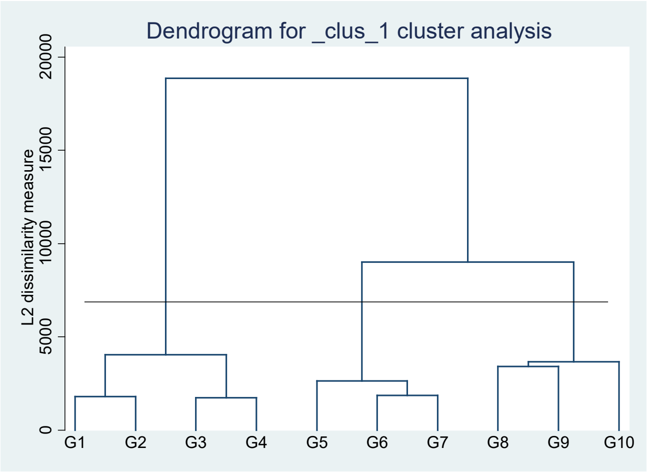
It is a fixed effect model, as Haussman test let us reject the null hypothesis of random effects and it is robust to herocedasticity, in that way coefficients are not biased by either autocorrelation or herocedasticity problems.

3. Results.

3.1. Cluster results.

Applying the Ward's criterion and taking the variance as dissimilarity metric (Ward's, 1963), we obtain the following dendogram. When applying an agglomerative hierarchical method, the dendrogram starts with as many clusters as there are observations in the sample (in this case it has been decided to start with the data grouped into 10 significant groups) and ends with a single cluster where all of them are grouped.

Figure 1. Dendogram for the cluster analysis, 2000-2014.



Source: Elaborated with Stata

As can be seen in Figure 1, we obtain three clear groups of countries with different characteristics in the generation of CO2 emissions. Each cluster is formed by the following countries[3]:

- Cluster 1: Australia, Bulgaria, Brazil, Canada, China, Indonesia, India, Korea, Latvia, Mexico, Poland, Russia, Slovakia, Turkey, Taiwan.
- Cluster 2: Austria, Switzerland, Czech Republic, Denmark, Spain, Estonia, Greece, Croatia, Hungary, Ireland, Lithuania, Luxembourg, Malta, Portugal, Slovenia and Romania.
- Cluster 3: Belgium, Germany, Finland, France, United Kingdom, Italy, Japan, Netherlands, Norway, Sweden and USA.

Because Ward's criterion is hierarchical, the first group of countries is the one that contains countries with the highest pollution intensity (remember that we are working with CO2 emissions per capita). If we look at the composition of the groups (totally logical with the hierarchical classification), we can see how most of Asian countries and some other developing countries like Brazil are in Cluster 1. Cluster 2 contains the countries of Eastern Europe and some peripheral countries such as Spain and Portugal. Finally, Cluster 3 is formed by most developed countries, such as Germany or the US. Therefore, taking into account the existence of three clear groups of countries in terms of generation of per capita CO2 emissions and the hypothesis of a clear process of

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[3] Cyprus has been eliminated from the analysis because it does not belong to any cluster.

divergence in emissions worldwide in recent years, it is necessary to analyze these scenarios. As introduced previously, the objective is to verify if the generation of CO2 emissions in the world can really be treated as a regional process, with different structural and technological characteristics among groups of countries; or it has to be treated as a global process.

3.2. CO2 emissions drivers.

After the cluster analysis, in this section we show the role played by a series of indicators in order to explain the behavior of carbon dioxide emissions in each cluster. As we said previously in section 2, the variables that we include in our regression in order to explain CO2 per capita emissions are output per capita, the ratio of exports over output, a relative advantage comparative index for five sectoral blocks (primary sector, energy sector, high and medium high technology industries, medium technology industries and low technology industries), the backward coefficient, use of renewable energies, use of energy in per capita terms, trade with those countries that do not ratified Kyoto protocol, labor productivity and environmental performance index.

Our results reveal interesting information. The first issue that we can see at the beginning is that, in each cluster, variables behave in a different way, what is especially visible in the case of Cluster 2 (where are included low income European countries). In table 1 we can observe that the only significant variable at a level of 90% in this cluster is output per capita that appears, as expected, with positive sign. That means the higher the income the higher the CO2 emissions. This is in coherence with previous economic literature (Fan et al. (2006), Grunewald et al. (2015), Duarte et al. (2018), among others). It is also coherent with the sample of Cluster 2. Here we can find countries from Switzerland and Denmark, but also others such as Czech Republic, Croatia, Hungary or Malta. Despite that we have to note that the R square obtained is quite small, mainly in comparison with the values obtained for the other two clusters. That is showing us that the variables that we have included[4] do not explain CO2 emissions in the case of Cluster 2 and other variables should be considered in future research.

If we take a look at Cluster 1, where we can find all Asiatic countries plus other developing countries of the sample such as Brazil or Turkey, we can see that almost all

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[4] Remember that we have introduced the same variables in the three regressions.

the variables introduced reveals significant (at difference levels) with the exception of the specialization index in primary sector and in low-technology industrial sectors, and environmental performance index. This result was expected, having applied Ward's criterion in the formation of the clusters. As previously mentioned, this is a hierarchical criterion, therefore, Cluster 1 countries are the most intensive in pollution, and thus, this group of countries presents a large number of significant variables in the analysis. Again, income per capita reveals significant and positive but coefficient is much lower than in the case of Cluster 2, what could be showing that income differences are higher in Cluster 2 than in Cluster 1. Nevertheless, as previous literature claim, our results confirm that income is an important variable to explain CO2 emissions worldwide.

Table 1: CO2 emissions determinants by clusters.

VARIABLES	Cluster 1	Cluster 2	Cluster 3
outputpc	0.0956***	0.414*	0.0278
	(0.0171)	(0.232)	(0.0288)
expoutput	0.0738**	-0.261	-0.142***
	(0.0345)	(0.278)	(0.0467)
ps	-0.00669	0.121	-0.106**
	(0.0778)	(0.116)	(0.0466)
es	0.0947**	-0.0815	-0.162***
	(0.0479)	(0.412)	(0.0381)
htmht	0.0777**	-0.0319	-0.0931
	(0.0380)	(0.265)	(0.0570)
mlt	-0.0371***	-0.0778	-0.00276
	(0.0113)	(0.130)	(0.0121)
lt	0.01000	0.0148	-0.00167
	(0.0131)	(0.156)	(0.0135)
backward	-0.509*	-1.496	0.129
	(0.289)	(1.681)	(0.188)
renowable	-0.174***	-0.00157	0.0111
	(0.0357)	(0.0168)	(0.0211)
energyusepc	0.808***	-0.122	0.559***
	(0.0737)	(0.413)	(0.0925)
kyoto	0.237***	-0.0959	0.0173
	(0.0417)	(0.182)	(0.0365)
labourprod	-0.00421*	-0.000674	0.00126
	(0.00252)	(0.0180)	(0.00192)
epi	-0.0131	-0.0485	-0.00104
	(0.0201)	(0.112)	(0.0165)
Constant	4.883***	1.999	2.622***
	(0.503)	(2.323)	(0.410)

Observations	225	245	160
R-squared	0.823	0.030	0.690
Number of id	26	25	16

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Own elaboration with STATA.

In addition, the variable of trade (measured as the weight of exports on the output generated in each country) also appears significant what indicates the importance of trade in explaining CO2 emissions. Its sign is positive, then the higher the exports are the higher are the CO2 emissions, which is in coherence with literature. It is interesting to see that this variable is also significant in Cluster 3 but the sign is the opposite, negative. That means that increases in their exports decreases CO2 emissions. We have to note that Cluster 3 is formed by most developed countries, such as Germany or the US. This might be showing that their imports come from more polluted countries thus increases in exports of this countries could favor a decrease of production of most pollutant ones.

Three of the specialization indexes included also reveals significant, they are energy sector, high and medium-high technology industries and medium-low technology industries. In the case of energy sector sign is positive what means that the higher the share of energy sector the higher the CO2 emissions. This could be reflecting that countries included in Cluster 1 are less efficient in producing energy than their trade partners. High and medium-high technology industries have a positive sign what means that increases in the shares of industries will led to increases of CO2 emissions. If we compare with the sign obtained for medium-low technology industries, which is negative, our results might be showing that the group of countries that formed Cluster 1 are still changing their productive structure and then they need more technological improvements to have “clean” high technology industries, which most probably is still not mature enough.

In that way, backward coefficient that is a representation of technological level become significant and negative in Cluster 1 what means that technological improvements will reduce CO2 emissions. This confirms what we have being commenting in previous lines, as the sample that constitutes Cluster 1 is mainly formed by countries in development the level of technology in this countries is far from the level that already have most developed countries that are part of the other two clusters in which our database is divided. In fact, neither in Cluster 2 or Cluster 3 backward linkage or coefficient appears significant, what reinforces the previous idea. Moreover, labor productivity, another indicator of technology, also becomes significant and negative what is line with we have been talking about previously.

The use of renewable energies is also significant as well as the use of energy per capita. In the first case the sign is negative and in the second case positive, as expected from literature (Fan et al. (2006), Gales et al. (2007), Malik et al. (2016) among others). Increases in the use of renewable energies will reduce CO2 emissions. This seems to be especially important in Cluster 1 as is the only in which this variable remains significant and negative. As Fan et al. (2006) explains, it might be explaining by the lower share and efficiency of renewable energies in less developed countries. In the case of energy use the sign is positive. Its interpretation is clear, increases in energy use led to increases in CO2 emissions.

As we explained in section 2, we cannot include Kyoto variable as a dummy because of collinearity problems. Because of that we have calculate the variable as imports that come from those countries that did not ratify or did not sign from the beginning the Kyoto protocol. For Cluster 1 it is significant and positive what means that higher imports from these countries increase the level of CO2 emissions generated. This is in line with literature (Iwata et al. (2010), Aichele et al. (2012), Grunewald et al. (2015)) that shows that, although moderate, Kyoto protocol has had a positive effect. Besides, it is the only cluster in which is significant what can be related with the volume of trade with these countries.

Finally, focusing on Cluster 3, where, as it was said previously, appear most developed countries they are significant the ratio exports over output, energy sector and energy use. As we have commented before the negative sign that appears might be related with the levels of pollution of their trade partners. In the case of energy sector, in contrast with Cluster 1, in Cluster 3 appears negative what is showing that increases of the share of Energy sector will decrease CO2 emissions, what can be explained by their great amount of imports of oil and petroleum, which, broadly speaking, come from most polluted countries. Energy use per capita appears with positive sign as expected. Increases in energy use will led to increases of CO2 emissions. We have to note that the coefficient is lower than in the case of Cluster 1 (0.559 and 0.808 respectively) what might be reflecting differences of efficiency in function of the level of development as previous literature show (Fan et al. (2006), Grunewald et al. (2015)).

4. Discussion and Conclusions

Most recent papers working on climate change, GHG emissions and its determinants, such as Kyoto protocol, trade or energy intensities drive these topics distinguishing their sample in function of the level of income of countries they are working with. In fact, they get different results for different income countries, what means that countries do not performance in the same way and then determinants of GHG emissions are different and this issue has implications in policy terms.

However, most part of literature considers that these differences are only related with income levels, while from our point of view there are much more different features marking them. At the best of our understanding, this is the first paper explicitly dealing with this issue.

While doing a cluster analysis we obtained that, in fact, our sample can be divided in three different clusters. The first cluster is formed by all Asiatic countries plus other developing countries such as Brazil and Turkey. To the second cluster belongs less developed European countries such as Croatia, Czech Republic or Hungary plus some south European countries such as Spain. In this cluster we can also find some high income countries such as Switzerland, Luxemburg or Denmark. Finally, the third cluster is formed by most developed countries such as Germany or the US. So we can see that CO2 emissions can be structured in different regions and clusters. Thus, the question that arises here is whether determinants of these emissions are the same for each cluster.

From a fixed effect panel data model we can conclude that, in fact, there are differences and that the same variables do not explain in the same way CO2 emissions. For instance, the case of Cluster 2 is really visual as only one variable of the ten included become significant what is output per capita. What is more, R squared is quite small especially in comparison with the values obtained for clusters 1 and 3.

While for Cluster 2 the variables that we have included in our regression seem not work, an opposite situation we can find for Cluster 1. In this case are significant all variables except the relative specialization index for primary sector and low technology industries as well as the environmental performance index. We should remark that results obtained for this cluster show the importance of technological improvements in order to reduce CO2 emissions. This is shown by the significant and negative sign of backward linkage and labor productivity coefficients and, also, by the results that we can see for the other relative specialization indexes, such as the positive sign of energy sector and the negative one for medium-low technology industries.

We have also to note that differences among regions are not only visible in the variables significance but also in the sign of the variable. This is visible for example for the ratio exports over output. While achieving a positive coefficient in Cluster 1, it achieves a negative sign in Cluster 3. This result might be indicating that most developed countries are trading with more pollutant economies and then is preferable an increase of their exports and then an increase of their production, whereas their partners might reduce their output. The case of energy sector is another example.

Differences are also visible in the coefficient. Energy use per capita is significant in Cluster 3 but coefficient is lower than the one obtained for cluster 1, most probably showing again differences in efficiency between developed and developing countries.

Thus, we can see much dissimilarity among regions and, so on, among countries. If CO2 emissions in countries are explained by different reasons, why do all countries must follow the same policy? In fact, we can see from our conclusions that those policies that are convenient for one country might have an opposite effect in another. Let's take an example. For most developing countries of our sample technological improvements seems to be "the solution" to reduce GHG emissions, but this is not the case for most developed ones. Concretely, what they should do is to reform their energy sector and produce a higher share of energy domestically while reducing their imports from some of the most pollutant countries.

Besides, this idea is reinforced by the performance of Kyoto protocol in our analysis. Broadly speaking, Kyoto protocol seems to have had a moderate success as expected from previous literature but only for some countries. While seems to work for countries in development, it seems not to have any effect in more developed countries, which are captured by clusters 2 and 3.

All these issues are showing that climate change policies might be design in function of the particular characteristics of each region. It is clear that it is a global issue and agreements should be done, but in these agreements each country/region might be considered in function of its own features and determinants of GHG emissions. In other words, policies designed to reduce them must suit each region performance.

The strongest limitation of this paper is the sample that we consider as the database we use is constituted by 43 countries; most part are developed countries and more than a half belong to the European Union. As a future extension we should work with a wider database (EORA, GTAP, etc) in order to be able to capture also the tendency of most developing countries such as South Africa, Latin America etc. and regionalize the CO2 emissions and its determinants worldwide. In that way we can give more insight in relation to that topic to literature and, also, policy makers.

All in all we can say that although climate change and GHG emissions are a global issue because affects worldwide, countries are different and then determinants of these emissions are different depending of the country we are looking at. In that way, GHG emissions must be considered in regional terms and, thus, policies against climate change.

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