DOCUMENT DE TREBALL

XREAP2012-17

Ecological Footprint Inequality across countries: the role of environment intensity, income and interaction effects

Juan Antonio Duro (GRIT, XREAP)
Jordi Teixidó-Figueras (GRIT, XREAP)

XARXA DE REFERÈNCIA EN ECONOMIA APLICADA

Ecological Footprint Inequality across countries: the role of environment intensity, income and interaction effects

Juan Antonio Duro and Jordi Teixidó-Figueras
Department of Economics, CREIP and XREAP
Rovira i Virgili University

Abstract

Recently, White (2007) analysed the international inequalities in Ecological Footprints per capita (EF hereafter) based on a two-factor decomposition of an index from the Atkinson family (Atkinson (1970)). Specifically, this paper evaluated the separate role of environment intensity (EF/GDP) and average income as explanatory factors for these global inequalities. However, in addition to other comments on their appeal, this decomposition suffers from the serious limitation of the omission of the role exerted by probable factorial correlation (York et al. (2005)). This paper proposes, by way of an alternative, a decomposition of a conceptually similar index like Theil's (Theil, 1967) which, in effect, permits clear decomposition in terms of the role of both factors plus an inter-factor correlation, in line with Duro and Padilla (2006). This decomposition might, in turn, be extended to group inequality components (Shorrocks, 1980), an analysis that cannot be conducted in the case of the Atkinson indices. The proposed methodology is implemented empirically with the aim of analysing the international inequalities in EF per capita for the 1980-2007 period and, amongst other results, we find that, indeed, the interactive component explains, to a significant extent, the apparent pattern of stability observed in overall international inequalities.

*Key words***:** ecological footprint; international environmental distribution; inequality decomposition

1. Introduction

The concept of ecological footprint has received a great deal of attention in the literature on the environment. The Ecological Footprint (EF hereafter), introduced by Rees (1992) and developed by Wackernagel and Rees, (1996), addresses the use of resources associated with productive and human activities, homogenizing it based on the amount of bioproductive land necessary to produce the required resources[1]. In this respect, an interesting analysis would be to examine the international distribution of this indicator as an exercise to compare the level of equality in the use of resources between countries, in a context of limitations on the planet's biocapacity and the accelerated growth in consumption. This analysis, which has already been done by authors such as White (2007) and Dongjing et al (2010) in an international context[2], would appear to be more comprehensive than the typical analyses that focus on partial environmental indicators such as CO_2, energy intensities or local pollutants.

In particular, an interesting analysis in the context of an international distributive analysis of this measurement, would be one that evaluates the role of environmental intensity (i.e. EF/GDP), and level of affluence as explanatory factors of global inequalities in EF, following in the wake of the IPAT model and the Kaya identity (Kaya (1989)). In particular, intensity is seen as an indicator of environmental efficiency, by relating the volume of productive and human activity with the associated need for resources (York et al. (2005)). In this context, White (2007) suggests decomposing an index such as Atkinson's with an inequality aversion parameter equals to 1 (Atkinson (1970)) in the multiplication of individual factorial indices (hence associated with environmental intensity and average income) and a component that covers

[1] The EF has been adopted by a growing number of government authorities, agencies and policy makers as a measure of ecological performance. Noteworthy examples are those international applications such as the European Environment Agency (EEA (2010), the European Parliament and the European Commission (Best et al, 2008), who consider the EF to be a useful tool for measuring the environmental performance of the EU, or the United Nations Development Programme which considers EF as capturing the environmental dimension of human development (UNDP, 2010).

[2] Also Wu and Xu (2010), for example, are conducting the analysis for the Chinese provinces.

factorial averages. Hence, among other aspects worth noting, this decomposition does not precisely consider the role that might be played by the probable correlation between the two factors, which has already been clearly documented by York et al (2005). In this way, the factors included in White's (2007) exercise, or one of them, appear as a type of black box that can contain both the partial impacts and the indirect impacts arising from the interactions between them and, consequently, the decomposition seems rather ambiguous.

In view of these circumstances, this paper proposes the usefulness of alternatively decomposing an index such as the Theil index (Theil (1967)), which is cardinally equivalent to the Atkinson index mentioned earlier, which can, indeed, be decomposed (in an additive way, furthermore) in the partial contribution of both factors (intensity and GDP per capita) plus a factorial interaction component. This decomposition can be immediately extended with the aim of analysing the group inequality components (Shorrocks (1980)). This paper also undertakes an empirical illustration of this proposed decomposition in order to analyse the international inequalities in EF per capita during the 1980-2007 period and the group inequality components according to the regionalization criteria adopted by the IEA, which contemplates nine world regions. Among the early results obtained is the fact that the apparent stability of the international inequalities in EF per capita are explained to a large extent by the effect of the interactive component, without which the global inequalities would have been significantly smaller.

This paper is therefore structured as follows: the second section addresses the main methodological elements of the proposed decomposition. The third section presents the main findings obtained after applying this methodology to the analysis of inequalities in EF per capita during the 1980-2007 period. Finally, a section is devoted to summarizing the main conclusions drawn from this analysis.

2. Ecological footprint inequalities and the role of environment intensities, income and interaction effects: methodological aspects

One of the most interesting approaches designed to investigate the explanatory factors behind ecological footprint by country consists of breaking down, by multiplication, their level of intensity in the use of resources and the average income (York et al. (2005)):

$$e_i = \frac{E_i}{P_i} = \frac{E_i}{Y_i} * \frac{Y_i}{P_i} = I_i * y_i \qquad (1)$$

where E is the ecological footprint of country i; P is its population and Y is its GDP; e is the ecological footprint per capita; I is the environmental intensity factor, and y is the GDP per capita.

Thus the use of resources per capita would be broken down in the part associated with intensity of use and global economic activity (i.e. the scale effect). In the first case, its importance would be associated with factors such as environmental efficiency.

In this respect, and with the aim of evaluating the inequalities in EF and the role of the two previous multiplicative components, White (2007) used the Atkinson index (Atkinson (1970)), with an inequality aversion parameter equals to 1[3]. Specifically, the aversion parameter used would indicate the presence of a progressive-type inequality index (sensitive to changes in the lower part of the distributive ranking by countries) but not extreme (Atkinson (1970)). To be specific, this index would be expressed as follows (already adapted to the analysis of the ecological footprint per capita in his notation):

$$A(e) = 1 - \Pi_i \left(\frac{e_i}{\mu^e} \right)^{p_i} \qquad (2)$$

where μ^e is the global average of e; and p_i is the relative population of country i

[3] The use of an index from the Atkinson family is slightly surprising, given the objective difficulties in decomposing it in parts (Bourguignon (1979)).

Replacing (1) by (2) and manipulating the equation, we find that:

$$1 - A_e = \left(\frac{\mu_i * \mu_y}{\mu_e} \right) * \Pi_i \left(\frac{y_i}{\mu^u} \right)^{p_i} * \Pi_i \left(\frac{I_i}{\mu^I} \right)^{p_i} \quad (3)$$

And thus White (2007) established that:

$$1 - A_e = \left(\frac{\mu_i * \mu_y}{\mu_e} \right) * (1 - A_y) * (1 - A_i) \quad (4)$$

where 1-A_e would be an equality index (according to the author); μ^I the global average of environmental intensities, and μ^y the average global income.

However, if we analyse this in detail, it is not difficult to see that the last multiplication of (3) is not exactly an Atkinson index. Indeed, if it were, the weight vector would have to be consistent with the actual variable analysed, in this case the environmental intensity. This is indeed the case for 1-A_y, where the weighting in the expression (3) comes from population-shares. In the case of 1-A_I the weightings of the differences across countries should, if we are talking about the Atkinson index in the strictest sense, be done based on GDP-shares. This is not a trivial difference. Indeed, it is plausible that, on an empirical level, the value of this pseudo-Atkinson index could reach negative signs, which would indicate that it contains factorial correlation components. In this way, therefore, one of the components detailed in the decomposition, i.e. 1-A_i, is not strictly speaking an Atkinson index and, moreover, the factorial correlation is not individualized.

In this respect, it would be interesting to have a decomposition which: firstly, decomposes the global index in a series of strict inequality indices (or partial factorial contributions) for each of the factors; secondly, it would be interesting if the decomposition were to include, separately, the role of the factorial correlation; thirdly, it would be good for the decomposition of inequality to be additive, as is the case with other more familiar decompositions of inequality indices[4].

In these circumstances, we suggest the usefulness of using an alternative decomposition technique for an index such as Theil's second measure, or T(β=0) (Theil (1967)), which is easier to decompose than the Atkinson index mentioned earlier and, in fact, would achieve analogue distributive rankings to the Atkinson index with a sensitivity parameter equals to 1[5]. In particular, as is well known, this Theil index (β=0) (hereinafter referred to as T) would be calculated based on the following formula (now adapted to the analysis of inequalities in the ecological footprint per capita):

$$T_e = \sum_{i=1}^{n} p_i \ln\left(\frac{\mu^e}{e_i}\right) \qquad (5)$$

where p_i is the relative population of country i; μ^e would represent the world ecological footprint per capita; e_i denotes the ecological footprint per capita of country I and ln is the Neperian logarithm.

This index could demonstrate that it is a growing monotonic transformation of the Atkinson index with ε=1 (i.e., A(1)), used referentially by White (2007) in the following form:

$$\mathrm{T} = -\ln(1 - \mathrm{A}(1)) \qquad (6)$$

The minimum value that this Theil index could hypothetically reach is zero, a circumstance that would describe a scenario of absolute equality. The maximum value is not uniformly defined but depends on the specific details of

4 This would be the case of decomposition by groups (Shorrocks (1980))or by sources (Shorrocks (1982).

5 Duro and Padilla (2006) applied a similar methodology to analyse international inequalities in per capita carbon emissions but in a three-factor scenario.

each case. However, a figure close to one could be understood as being synonymous with high inequality. Meanwhile, you can see that this measure is not defined by values equal to zero, a circumstance which, however, is unlikely in the analysis in question.

The decomposition of the inequalities in ecological footprint per capita measured by this index would start with the initial factorial decomposition expressed in (1). We now need to define to fictitious national ecological footprint vectors. According to Duro and Padilla (2006), in each case we allowi only one of the factors to vary, setting the other at the global average. We would then find that:

$$e^I = I_i * y \qquad (7)$$

$$e^y = I * y_i \qquad (8)$$

If we apply the Theil index, according to formula (5) for each of the fictitious factors above, we would be measuring the partial role of each of these factors.

This being the case, we would find that:

$$T\left(e^I\right) = \sum_i p_i \ln\left(\frac{\mu(e^I)}{e_i^I}\right) \qquad (9)$$

$$T\left(e^y\right) = \sum_i p_i \ln\left(\frac{\mu(e^y)}{e_i^y}\right) \qquad (10)$$

If we add both factors, we find that:

$$T\left(e^I\right) + T\left(e^y\right) = \sum_i p_i \ln\left(\frac{\mu(e^I)}{e_i^I} * \frac{\mu(e^y)}{e_i^y}\right) = \sum_i p_i \ln\left(\frac{\mu(e^I)}{y * I_i} * \frac{I \sum_i p_i * y_i}{I * y_i}\right) = \sum_i p_i \ln\left(\frac{\mu(e^I)}{I_i} * \frac{y}{y_i}\right)$$

(11)

We can now see that if we add the term $\ln\left(\frac{\mu}{\mu(e^I)}\right)$ to the previous total and group them, we find that:

$$T(e^I)+T(e^y)+\ln\left(\frac{\mu}{\mu(e^I)}\right)=\sum_i p_i \ln\left(\frac{\mu(e^I)}{I_i}*\frac{y}{y_i}\right)+\ln\left(\frac{\mu}{\mu(e^I)}\right)=\sum_i p_i \ln\left(\frac{\mu(e^I)}{I_i}*\frac{y}{y_i}*\frac{\mu}{\mu(e^I)}\right)=\sum_i p_i \ln\left(\frac{\mu(e^I)}{I_i}*\frac{y}{y_i}*\frac{\mu}{\mu(e^I)}\right)=$$

$$=\sum_i p_i \ln\left(\frac{e}{e_i}\right)=T(e)$$

(12)

It is easy to corroborate that, indeed, this added component can be rewritten in terms of a covariance component term between both homogenized factors. Thus, it can be easily demonstrate thatl[6]:

$$\ln\left(\frac{\mu}{\mu(e^I)}\right)=\ln(1+\frac{\sigma_{I,y}}{\mu(e^I)})\approx\frac{\sigma_{I,y}}{\mu(e^I)} \qquad (13)$$

This being the case, the final outcome would be that the international inequalities in ecological footprint per capita could be decomposed strictly in terms of the sum of the partial factor's contribution and the correlation factor:

$$T(e)=T(e^I)+T(e^y)+\ln\left(1+\frac{\sigma_{I,y}}{\mu(e^I)}\right)$$

(14)[7]

[6] Demonstration available from the author on request

[7] Thus one could consider decomposing, analogously, the first Theil measurement, or T(β=1) (Theil (1967)). This measurement is characterised by weighting the differences based on the share dictated by the numerator, in this case the EF-share per country. Given that the only difference between this index and the T(β=0), which has been proposed in the main text, is also the weighting vector and the position of variables within the logarithm we would immediately seem to be trying to decompose this measure too. However, in this case the decomposition is much less natural and attractive than that of the T(0), expressed in (14). In particular, the problem is that the term we have called 'factorial interaction' is, in this case, a type of adjustment component with a much less attractive meaning than that of the T(0). In particular, it can be demonstrated that:

Likewise, this decomposition can be easily extended to the analysis of the intra- and inter-group components of the global international inequality. These components, as we know, emerge from the capacity of this index to break down into a weighted average the inequalities inside the subgroups under observation (intra-group or internal component) and the inequality shown between the subgroups (inter-group or external component) (Shorrocks (1980) and Bourguignon (1979)). We would thus need to select a criterion to demarcate the groups of countries which would be intuitive and, a priori, relevant. An immediate option is the use of the International Energy Agency aggregations which identify nine main regions. The implications that emerge from this analysis by groups could be interesting. For example, in terms of environmental policy, the findings would offer clues as to the suitability of implementing re-balancing policies in terms of a global regional design. On the other hand, from a more academic point of view, the results might be used to test the informative value of the aggregations themselves. Thus a high value in the intergroup component (or a small one in the intragroup one) would be perceived as an endorsement of the proposed regional synthesis.

In algebraic terms, the decomposition by T(0) groups would be expressed by the following formula:

$$T(e) = T(e)_W + T(e)_B = \sum_{i=1}^{G} p_g T_g(e) + \sum_{g=1}^{G} p_g \ln\left(\frac{\mu^e}{e_g}\right) = \sum_{i=1}^{G} p_g T_g(e) + T(e_g) \quad (15)$$

where $T(e)_W$ is the intragroup component and $T(e)_B$ is the intergroup component; g refers to country groups; p_g and y_g are the relative population

$$T_I(e) = T_I\left(e^I\right) + T_I\left(e^y\right) + \ln\left(\frac{\sum_i \alpha_i * e_i - \sigma_{I,y}}{\mu}\right)$$

where α_i is the EF-share

In this way, the additional term depends inversely on the covariance as well as an element that reflects a pseudo-global EF per capita average when using the EF-share instead of the population-share.

and the average EF corresponding to the g group, respectively, and $T_g(e)$ is the inequality between countries in the g group.

This being the case, and given the expression that takes both components, it is worth looking at breaking them down immediately in the form suggested in (14). Note that the intergroup component is none other than a Theil index, in this case applied to the groups of countries as basic units of the study. The intragroup component, meanwhile, is a weighted average of regional Theil indices which, in turn, can be decomposed multiplicative form above. In particular, the decomposition of the group components would come out as shown below:

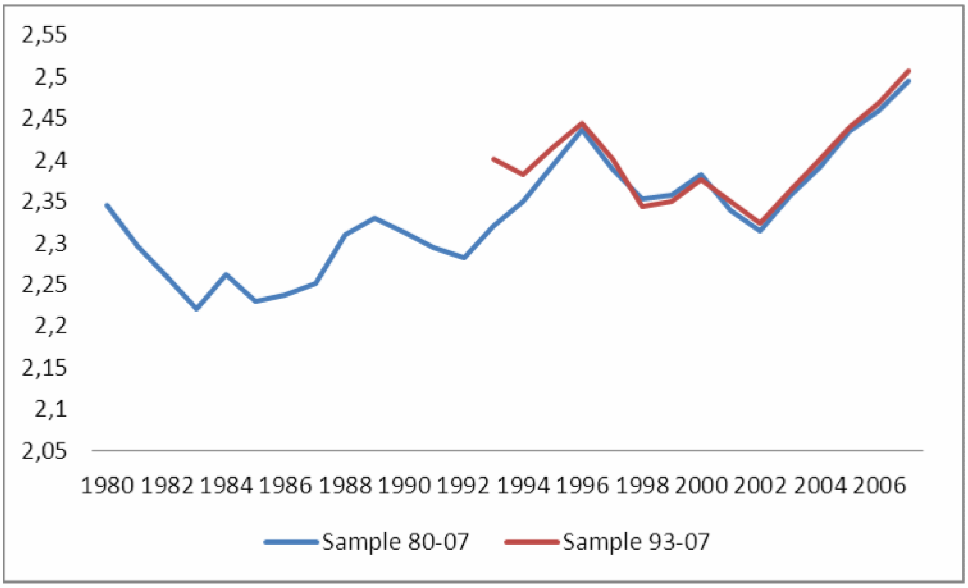
Up to now, so far as we are aware, two studies have been conducted in the international sphere to examine inequalities in EF per capita. White (2007), for example, examined them using the Gini coefficient and the Atkinson index, but only for 2003, and also decomposed the latter, as we have seen, by multiplication factors. Dongjing et al (2010), meanwhile, analysed these inequalities by taking the Gini coefficient as a benchmark measurement of inequality for selected years during the 1996-2005 period. In our particular case, therefore, we are focusing on a specific methodological aspect, the decomposition of inequalities, by multiplication and by groups, and undertaking an empirical analysis over a longer period of time.

3. Main Empirical Results

The data used came from the Global Footprint Network in the case of the Ecological Footprint by country, and from the World Bank (World Bank Indicators) for the GDP and population factors. The joint analysis of the available variables made it advisable to differentiate two periods of time for the samples. The first included 105 countries during the 1980-2007 period, which together accounted for almost 80% of the World Ecological footprint generated in 2007. In the second, the analysis was restricted to the period of 1993-2007, which allowed us to use data for 136 countries generating 89% of the World Ecological footprint of 2007.

First and foremost, in the contextual period there has been a gradual increase in the EF per capita at a global level, rising from 2.23 in 1985 to 2.49 in 2007, i.e. an increase of just over 10%. There was a slight drop between 1980 and 1985 and a global tendency to rise since then, with ups and downs. The use of the 1993-2007 sample did not produce any significant changes either to the time pattern or the overall level of the world EF per capita.

Figure 1: Evolution of the world EF per capita, 1980-2007



Source: Drawn up by the authors using Global Footprint Network and World Bank data

Table 1 shows the main results obtained after decomposing the international inequalities in EF per capita, taking the Theil index as a reference and for selected years in the different periods. In this respect, the main results can be summed up as follows:

Firstly, for the aggregate period the international inequalities would have dropped, especially up to 1995. Between 1995 and 2007 there is barely any variation[8]. Indeed, we cannot conclude that there is a substantial variation in an almost thirty-year period (plus or minus 10%). This finding, for example, is lower than the reduction experienced in international inequalities in CO_2 per capita, which over the 1971-2006 period was 38%, or those reflected by energy intensities, whose inequalities were mitigated by 45% since 1971 (Duro (2012)).

Secondly, however, both the partial contribution to global inequality attributable to the intensity factor and to the affluence factor (which is the most important factor) drop significantly, especially the second one, thus leading to a broad reduction in global EF inequalities per capita. Thus the partial disparities attributable to the intensity factor drop from 0.37 in 1980 to almost 0.21 in 2007 (a reduction of almost 50%). The income factor, meanwhile, which maintains a relatively larger contribution, sees its contribution reduced from 1.03 in 1980 to 0.60 in 2007 (a drop of almost 40%). The drop in the intensity factor takes place essentially up to 2000, after which it becomes stable. However, the income factor drops throughout the whole period.

Thirdly, given the significantly equalizing contribution of the abovementioned factors, the interaction factor is the one which, in effect, explains the less clear-cut result seen in the evolution of international inequalities in EF per capita.

[8] In this paper we have focused on the evidence provided by the Theil index as a reference indicator of inequality. This is because the paper focuses on the investigation of the role of environmental intensity and affluence as explanatory factors and, therefore, in a context of multiplicative decomposition. This being the case, it does not reflect the results obtained from using other inequality indices that are not easy to decompose in this context. In any event, the calculation of indices such as the Gini, the Atkinson ones and the Coefficient of Variation (following Duro (2012) does not throw up any particularly significant changes to the time pattern of international inequalities in EF per capita. These calculations are available on request.

Thus factorial interaction plays a significant role, with a negative sign[9]. Indeed, its value is similar to that of affluence, with a changed sign. And it is the significant drop in the value of this component (less the negative sign) which explains the lower drop in global inequalities. Without this contribution, i.e. with a hypothetical zero interaction factor, the international inequalities in EFP per capita would have dropped from an imaginary 1.4 in 1980 to 0.81 in 2007.

Meanwhile, we have taken advantage of the decomposition facilities of T(0) to decompose by multiplication the global inequalities by group components (Shorrocks (1980)). In other words, we have initially decomposed the global inequality in EF per capita into two parts: the first, the one attributed to the differences between groups of countries when these are regional, and secondly the one attributed to the scale of the internal heterogeneities of the groups in accordance with the regionalization criteria used by the IEA. The point is that each of these synthetic components is thus decomposable based on the previous multiplicative format. Table 2 shows the results associated with the between-groups component, and Table 3 shows those associated with the within-groups component.

With regard to the between-groups inequality, we can see the following basic results: firstly, it is the between component which has the greater explanatory power of global inequalities in EF per capita. In fact, its weight is typically close to 80% of the total, when not exceeding it. This weight illustrates, amongst other aspects, the explanatory capacity of these exogenous groups for the EF pc inequalities as well (Duro and Padilla (2006)). Secondly, it also confirms the not very substantial drop in global inequalities accompanied by the larger drop in individual factorial inequalities, especially in the affluence factor. Thirdly, it confirms the high incidence of the interaction component and its particular influence on the apparent stability of the between component of global inequality. Indeed, the interaction component, with a negative sign, declines

[9] The factorial correlation coefficient typically moves between -0.37 and -0.48 in the case of the 1980-2007 sample, and between -0.43 and -0.49 in the case of the 1993-2007 sample. More detailed information is available on request.

significantly, which considerably contributes to offsetting the drop in individual factorial inequalities.

Finally, with regard to the within component, this has a lower overall weight in the explanation of global inequalities, reaching maximum explanatory values of around 20% of the total. In this case, the pattern outlined is different from that of the between component. For example, in this case the inequalities rose during the period, explained by the evolution in both factors. In contrast, the interactive component now increases its negative value in the 1971-2007 sample, contributing to reducing the inequalities, and remains stable in the sample that starts in 1993.

Table 1: International inequalities in the Ecological Footprint per capita and its decomposition by multiplication factors, 1980-2007

	T(e)	$T(e^l)$	$T(e^y)$	Interact term
1980	0.2764	0.3714 (134%)	1.0261 (371%)	-1.1212 (-406%)
1985	0.2726	0.2869 (105%)	0.9309 (341%)	-0.9452 (-347%)
1990	0.2676	0.2493 (93%)	0.8838 (330%)	-0.8655 (-323%)
1995	0.2459	0.2197 (89%)	0.7769 (316%)	-0.7507 (-305%)
2000	0.2591	0.2043 (79%)	0.7378 (285%)	-0.6829 (-264%)
2005	0.2622	0.2057 (78%)	0.6470 (247%)	-0.5905 (-225%)
2007	0.2445	0.2056 (84%)	0.6043 (247%)	-0.5654 (-231%)
1993	0.2433	0.2457 (101%)	0.7896 (325%)	-0.7920 (-326%)
1995	0.2398	0.2313 (96%)	0.7576 (316%)	-0.7490 (-312%)
2000	0.2485	0.2144 (86%)	0.7259 (292%)	-0.6918 (-278%)
2005	0.2522	0.2179 (86%)	0.6428 (255%)	-0.6084 (-241%)
2007	0.2387	0.2128 (89%)	0.6038 (253%)	-0.5779 (-242%)

Source: Drawn up by the authors using Global Footprint Network and World Bank data

Table 2: Between-groups Inequalities in Ecological Footprint per capita and their decomposition by multiplication factors, 1980-2007

	$T(e)_B$	$T(e^I)_B$	$T(e^y)_B$	Interaction term
1980	0.2350 (85%)	0.3411 (145%)	0.9341 (397%)	-1.0402 (-443%)
1985	0.2313 (85%)	0.2313 (100%)	0.8365 (362%)	-0.8365 (-362%)
1990	0.2255 (84%)	0.1942 (86%)	0.7821 (347%)	-0.7508 (-333%)
1995	0.1972 (80%)	0.1285 (65%)	0.6588 (334%)	-0.5901 (-299%)
2000	0.2146 (83%)	0.0886 (41%)	0.6221 (290%)	-0.4961 (-231%)
2005	0.2143 (82%)	0.0666 (31%)	0.5316 (248%)	-0.3838 (-179%)
2007	0.1950 (80%)	0.0598 (31%)	0.4889 (251%)	-0.3537 (-181%)
1993	0.1960 (81%)	0.1478 (75%)	0.6647 (339%)	-0.6166 (-315%)
1995	0.1892 (79%)	0.1199 (63%)	0.6261 (331%)	-0.5568 (-294%)
2000	0.2031 (82%)	0.0865 (43%)	0.5975 (294%)	-0.4808 (-237%)
2005	0.2041 (81%)	0.0685 (34%)	0.5158 (253%)	-0.3802 (-186%)
2007	0.1886 (79%)	0.0615 (33%)	0.4774 (253%)	-0.3503 (-186%)

Source: Drawn up by the authors using Global Footprint Network and World Bank data

Table 3: Within-groups Inequalities in Ecological Footprint per capita and their decomposition by multiplication factors, 1980-2007

	$T(e)_W$	$T(e^I)_W$	$T(e^y)_W$	Interaction term
1980	0.0414 (15%)	0.0624 (151%)	0.0920 (222%)	-0.1130 (-273%)
1985	0.0413 (15%)	0.0627 (152%)	0.0945 (229%)	-0.1158 (-280%)
1990	0.0421 (16%)	0.0607 (144%)	0.1017 (242%)	-0.1203 (-286%)
1995	0.0487 (20%)	0.0648 (133%)	0.1182 (243%)	-0.1343 (-276%)
2000	0.0446 (17%)	0.0676 (152%)	0.1157 (260%)	-0.1388 (-311%)
2005	0.0479 (18%)	0.0747 (156%)	0.1155 (241%)	-0.1423 (-297%)
2007	0.0495 (20%)	0.0766 (155%)	0.1153 (233%)	-0.1424 (-288%)
1993	0.0473 (19%)	0.0769 (163%)	0.1249 (264%)	-0.1545 (-327%)
1995	0.0506 (21%)	0.0757 (150%)	0.1315 (260%)	-0.1566 (-310%)
2000	0.0454 (18%)	0.0703 (155%)	0.1284 (283%)	-0.1534 (-338%)
2005	0.0482 (19%)	0.0764 (159%)	0.1270 (264%)	-0.1553 (-322%)
2007	0.0501 (21%)	0.0774 (155%)	0.1264 (252%)	-0.1537 (-307%)

Source: Drawn up by the authors using Global Footprint Network and World Bank data

4. Concluding Remarks

This paper explores the international inequalities in the Ecological Footprint per capita, an indicator that has proved very popular in recent years as being representative of the use of resources associated with productive and human activities. In particular, this work makes two essential contributions, one methodological and the other empirical.

Firstly, it proposes a decomposition of international inequality in this indicator by multiplication factors, i.e. by separating the effect of intensity of use and affluence, which we believe surpasses the decomposition proposed for an index such as the Atkinson index by White (2007). In particular, the proposed decomposition not only allows us to identify the partial role played by each factor individually, but also to include an interaction factor, already referred to as significant by York et al (2005) though not contemplated by White (2007). Furthermore, the proposed decomposition (for the Theil index) can be extended to the group inequality components (Shorrocks (1980)).

Secondly, the paper makes an empirical implementation of the proposed analysis in order to examine the international inequalities in EF per capita for the 1980-2007 period (and increasing the analysis period of the existing literature). Amongst other findings, the evidence suggests that the apparent stability of, or lower reduction in, the international inequalities in EF per capita is attributed, to a large extent, to the role of the interaction factor, given that the contribution of the two multiplication factors that explain it (intensity of use and affluence) would have dropped significantly. Meanwhile, an analysis of the inequality by groups of countries suggests that it is the inequality component between groups (regional) of countries that primarily explains the global results and also that the nine regions considered (according to International Energy Agency classification) may be relevant not only descriptive but also in terms of policy

Acknowledgments

The authors acknowledge support from the project ECO2010-18158.

References

Atkinson, A.B. (1970) On the measurement of inequality. *Journal of Economic Theory*, 2, 244-263.

Best, A., Giljum, S., Simmons, C., Blobel, D., Lewis, K., Hammer, M., et al. (2008). *Potential of the ecological footprint for monitoring environmental impacts from natural resource use: Analysis of the potential of the ecological footprint and related assessment tools for use in the EU's thematic strategy on the sustainable use of natural resources. Report to the European Commission.* DG Environment.

Dongjing, C., Xiaoyan, M., Hairong, M., and Peiying, L. (2010). The inequality of natural resources consumption and its relationship with the social development level based on the ecological footprint and the HDI. *Journal of Environmental Assessment Policy and Management, 12*(1), 69-85.

Duro, J. A. and Padilla, E. (2006). International inequalities in per capita CO2 emissions: A decomposition methodology by kaya factors. *Energy Economics, 28*(2), 170-187.

Duro, J.A., (2012), On the automatic application of inequality indexes in the analysis of the international distribution of environmental indicators, *Ecological Economics*, 76, 1-7.

EEA. (2010). *The European environment — state and outlook 2010. consumption and environment* European Environment Agency.

Gini, C., 1912. Variabilità e mutabilità, contributo allo studio delle distribución e relazioni statistiche, Studi Economico-Giuridici dell' University di Cagliari. 3, part 2, 1-158.

Global Footprint Network, 2010 Edition, www.footprintnetwork.org**.**
Kaya Y, 1989, "Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios", paper presented to the Energy and Industry Subgroup, Response Strategies Working Group, Intergovernmental Panel on Climate Change, Paris, France.

Rees, W. E. (1992). Ecological footprints and appropriated carrying capacity: What urban economics leaves out. *Environment and Urbanization}, 4*(2), 121-130.

Shorrocks, A. (1980), The class of additively decomposable inequality measures, Econometrica 48, 613-625.

Shorrocks, A. (1982), Inequality decomposition by factor components, Econometrica 50, 139-211.

Theil, H. (1967). Economics and Information Theory. Amsterdam: North Holland.

UNDP. (2010). *Human development report 2010. the real wealth of nations. pathways to human development published for*. New York: United Nations Development Programme.

Wackernagel, M., & Rees, W. (Eds.). (1996). *Our ecological footprint. Reducing human impact on the earth.* New Society Press.

White, T. J. (2007). Sharing resources: The global distribution of the ecological footprint. *Ecological Economics, 64*(2), 402-410.

World Bank, *World Development Indicators and Global Development Finance*, http://databank.worldbank.org/ddp/home.do

Wu, C., & Xu, Z. (2010). Spatial distribution of the environmental resource consumption in the Heihe river basin of north-western China. *Regional Environmental Change, 10*(1), 55-63.

York. R. et al (2005). The Ecological Footprint Intensity of National Economies. *Journal of Industrial Ecology*, 8 (4), 139-154.

Appendix

Countries included into groups:

OECD-Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom.
OECD-NA: Canada, Mexico, United States.
OECD-Pacific: Australia, Japan, Korea, New Zealand.
Non-OECD Europe countries: Albania, Bulgaria, Cyprus, Gibraltar, Malta, Romania, Former USSR, Former Yugoslavia
Africa: Algeria, Angola, Benin, Cameroon, Congo, Democratic Republic of Congo, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Kenya, Libya, Morocco, Mozambique, Nigeria, Senegal, South Africa, Sudan, United Republic of Tanzania, Togo, Tunisia, Zambia, Zimbabwe, Other Africa
Latin America: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela, Other Latin America.
Middle East: Bahrain, Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen
Asia: Bangladesh, Brunei Darussalam, Chinese Taipei, India, Indonesia, Dem. People's Rep. of Korea, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam, Other Asia.
China: People's Republic of China, Hong Kong.

2006

CREAP2006-01
Matas, A. (GEAP)**; Raymond, J.Ll.** (GEAP)
"Economic development and changes in car ownership patterns"
(Juny 2006)

CREAP2006-02
Trillas, F. (IEB)**; Montolio, D.** (IEB)**; Duch, N.** (IEB)
"Productive efficiency and regulatory reform: The case of Vehicle Inspection Services"
(Setembre 2006)

CREAP2006-03
Bel, G. (PPRE-IREA)**; Fageda, X.** (PPRE-IREA)
"Factors explaining local privatization: A meta-regression analysis"
(Octubre 2006)

CREAP2006-04
Fernàndez-Villadangos, L. (PPRE-IREA)
"Are two-part tariffs efficient when consumers plan ahead?: An empirical study"
(Octubre 2006)

CREAP2006-05
Artís, M. (AQR-IREA)**; Ramos, R.** (AQR-IREA)**; Suriñach, J.** (AQR-IREA)
"Job losses, outsourcing and relocation: Empirical evidence using microdata"
(Octubre 2006)

CREAP2006-06
Alcañiz, M. (RISC-IREA)**; Costa, A.; Guillén, M.** (RISC-IREA)**; Luna, C.; Rovira, C.**
"Calculation of the variance in surveys of the economic climate"
(Novembre 2006)

CREAP2006-07
Albalate, D. (PPRE-IREA)
"Lowering blood alcohol content levels to save lives: The European Experience"
(Desembre 2006)

CREAP2006-08
Garrido, A. (IEB)**; Arqué, P.** (IEB)
"The choice of banking firm: Are the interest rate a significant criteria?"
(Desembre 2006)

CREAP2006-09
Segarra, A. (GRIT)**; Teruel-Carrizosa, M.** (GRIT)
"Productivity growth and competition in spanish manufacturing firms:
What has happened in recent years?"
(Desembre 2006)

CREAP2006-10
Andonova, V.; Díaz-Serrano, Luis. (CREB)
"Political institutions and the development of telecommunications"
(Desembre 2006)

CREAP2006-11
Raymond, J.L.(GEAP)**; Roig, J.L..** (GEAP)
"Capital humano: un análisis comparativo Catalunya-España"
(Desembre 2006)

CREAP2006-12
Rodríguez, M.(CREB)**; Stoyanova, A.** (CREB)
"Changes in the demand for private medical insurance following a shift in tax incentives"
(Desembre 2006)

CREAP2006-13
Royuela, V. (AQR-IREA)**; Lambiri, D.**; **Biagi**, **B.**
"Economía urbana y calidad de vida. Una revisión del estado del conocimiento en España"
(Desembre 2006)

CREAP2006-14
Camarero, M.; Carrion-i-Silvestre, J.LL. (AQR-IREA)**.**;**Tamarit**, **C.**
"New evidence of the real interest rate parity for OECD countries using panel unit root tests with breaks"
(Desembre 2006)

CREAP2006-15
Karanassou, M.; Sala, H. (GEAP)**.**;**Snower** , **D. J.**
"The macroeconomics of the labor market: Three fundamental views"
(Desembre 2006)

2007

XREAP2007-01
Castany, L (AQR-IREA)**; López-Bazo, E.** (AQR-IREA)**.**;**Moreno** , **R.** (AQR-IREA)
"Decomposing differences in total factor productivity across firm size"
(Març 2007)

XREAP2007-02
Raymond, J. Ll. (GEAP)**; Roig, J. Ll.** (GEAP)
"Una propuesta de evaluación de las externalidades de capital humano en la empresa"
(Abril 2007)

XREAP2007-03
Durán, J. M. (IEB)**; Esteller, A.** (IEB)
"An empirical analysis of wealth taxation: Equity vs. Tax compliance"
(Juny 2007)

XREAP2007-04
Matas, A. (GEAP)**; Raymond, J.Ll.** (GEAP)
"Cross-section data, disequilibrium situations and estimated coefficients: evidence from car ownership demand"
(Juny 2007)

XREAP2007-05
Jofre-Montseny, J. (IEB)**; Solé-Ollé, A.** (IEB)
"Tax differentials and agglomeration economies in intraregional firm location"
(Juny 2007)

XREAP2007-06
Álvarez-Albelo, C. (CREB)**; Hernández-Martín, R.**
"Explaining high economic growth in small tourism countries with a dynamic general equilibrium model"
(Juliol 2007)

XREAP2007-07
Duch, N. (IEB)**; Montolio, D.** (IEB); **Mediavilla, M.**
"Evaluating the impact of public subsidies on a firm's performance: a quasi-experimental approach"
(Juliol 2007)

XREAP2007-08
Segarra-Blasco, A. (GRIT)
"Innovation sources and productivity: a quantile regression analysis"
(Octubre 2007)

XREAP2007-09
Albalate, D. (PPRE-IREA)
"Shifting death to their Alternatives: The case of Toll Motorways"
(Octubre 2007)

XREAP2007-10
Segarra-Blasco, A. (GRIT); **Garcia-Quevedo, J.** (IEB); **Teruel-Carrizosa, M.** (GRIT)
"Barriers to innovation and public policy in catalonia"
(Novembre 2007)

XREAP2007-11
Bel, G. (PPRE-IREA); **Foote, J.**
"Comparison of recent toll road concession transactions in the United States and France"
(Novembre 2007)

XREAP2007-12
Segarra-Blasco, A. (GRIT);
"Innovation, R&D spillovers and productivity: the role of knowledge-intensive services"
(Novembre 2007)

XREAP2007-13
Bermúdez Morata, Ll. (RFA-IREA); **Guillén Estany, M.** (RFA-IREA), **Solé Auró, A**. (RFA-IREA)
"Impacto de la inmigración sobre la esperanza de vida en salud y en discapacidad de la población española"
(Novembre 2007)

XREAP2007-14
Calaeys, P. (AQR-IREA); **Ramos, R.** (AQR-IREA), **Suriñach, J**. (AQR-IREA)
"Fiscal sustainability across government tiers"
(Desembre 2007)

XREAP2007-15
Sánchez Hugalbe, A. (IEB)
"Influencia de la inmigración en la elección escolar"
(Desembre 2007)

2008

XREAP2008-01
Durán Weitkamp, C. (GRIT)**; Martín Bofarull, M.** (GRIT) ; **Pablo Martí, F.**
"Economic effects of road accessibility in the Pyrenees: User perspective"
(Gener 2008)

XREAP2008-02
Díaz-Serrano, L.; Stoyanova, A. P. (CREB)
"The Causal Relationship between Individual's Choice Behavior and Self-Reported Satisfaction: the Case of Residential Mobility in the EU"
(Març 2008)

XREAP2008-03
Matas, A. (GEAP)**; Raymond, J. L.** (GEAP)**; Roig, J. L.** (GEAP)
"Car ownership and access to jobs in Spain"
(Abril 2008)

XREAP2008-04
Bel, G. (PPRE-IREA) **; Fageda, X.** (PPRE-IREA)
"Privatization and competition in the delivery of local services: An empirical examination of the dual market hypothesis"
(Abril 2008)

XREAP2008-05
Matas, A. (GEAP); **Raymond, J. L.** (GEAP); **Roig, J. L.** (GEAP)
"**Job accessibility and employment probability**"
(Maig 2008)

XREAP2008-06
Basher, S. A.; Carrión, J. Ll. (AQR-IREA)
Deconstructing Shocks and Persistence in OECD Real Exchange Rates
(Juny 2008)

XREAP2008-07
Sanromá, E. (IEB)**; Ramos, R.** (AQR-IREA); Simón, H.
Portabilidad del capital humano y asimilación de los inmigrantes. Evidencia para España
(Juliol 2008)

XREAP2008-08
Basher, S. A.; Carrión, J. Ll. (AQR-IREA)
Price level convergence, purchasing power parity and multiple structural breaks: An application to US cities
(Juliol 2008)

XREAP2008-09
Bermúdez, Ll. (RFA-IREA)
A priori ratemaking using bivariate poisson regression models
(Juliol 2008)

XREAP2008-10
Solé-Ollé, A. (IEB), **Hortas Rico, M.** (IEB)
Does urban sprawl increase the costs of providing local public services? Evidence from Spanish municipalities
(Novembre 2008)

XREAP2008-11
Teruel-Carrizosa, M. (GRIT), **Segarra-Blasco, A.** (GRIT)
Immigration and Firm Growth: Evidence from Spanish cities
(Novembre 2008)

XREAP2008-12
Duch-Brown, N. (IEB), **García-Quevedo, J.** (IEB), **Montolio, D.** (IEB)
Assessing the assignation of public subsidies: Do the experts choose the most efficient R&D projects?
(Novembre 2008)

XREAP2008-13
Bilotkach, V., **Fageda, X.** (PPRE-IREA), **Flores-Fillol, R.**
Scheduled service versus personal transportation: the role of distance
(Desembre 2008)

XREAP2008-14
Albalate, D. (PPRE-IREA), **Gel, G.** (PPRE-IREA)
Tourism and urban transport: Holding demand pressure under supply constraints
(Desembre 2008)

2009

XREAP2009-01
Calonge, S. (CREB)**; Tejada, O.**
"A theoretical and practical study on linear reforms of dual taxes"
(Febrer 2009)

XREAP2009-02
Albalate, D. (PPRE-IREA)**; Fernández-Villadangos, L.** (PPRE-IREA)
"Exploring Determinants of Urban Motorcycle Accident Severity: The Case of Barcelona"
(Març 2009)

XREAP2009-03
Borrell, J. R. (PPRE-IREA)**; Fernández-Villadangos, L.** (PPRE-IREA)
"Assessing excess profits from different entry regulations"
(Abril 2009)

XREAP2009-04
Sanromá, E. (IEB)**; Ramos, R.** (AQR-IREA), **Simon, H.**
"Los salarios de los inmigrantes en el mercado de trabajo español. ¿Importa el origen del capital humano?"
(Abril 2009)

XREAP2009-05
Jiménez, J. L.; Perdiguero, J. (PPRE-IREA)
"(No)competition in the Spanish retailing gasoline market: a variance filter approach"
(Maig 2009)

XREAP2009-06
Álvarez-Albelo,C. D. (CREB)**, Manresa, A.** (CREB)**, Pigem-Vigo, M.** (CREB)
"International trade as the sole engine of growth for an economy"
(Juny 2009)

XREAP2009-07
Callejón, M. (PPRE-IREA)**, Ortún V, M.**
"The Black Box of Business Dynamics"
(Setembre 2009)

XREAP2009-08
Lucena, A. (CREB)
"The antecedents and innovation consequences of organizational search: empirical evidence for Spain"
(Octubre 2009)

XREAP2009-09
Domènech Campmajó, L. (PPRE-IREA)
"Competition between TV Platforms"
(Octubre 2009)

XREAP2009-10
Solé-Auró, A. (RFA-IREA)**,Guillén, M.** (RFA-IREA)**, Crimmins, E. M.**
"Health care utilization among immigrants and native-born populations in 11 European countries. Results from the Survey of Health, Ageing and Retirement in Europe"
(Octubre 2009)

XREAP2009-11
Segarra, A. (GRIT)**, Teruel, M.** (GRIT)
"Small firms, growth and financial constraints"
(Octubre 2009)

XREAP2009-12
Matas, A. (GEAP)**, Raymond, J.Ll.** (GEAP), **Ruiz, A.** (GEAP)
"Traffic forecasts under uncertainty and capacity constraints"
(Novembre 2009)

XREAP2009-13
Sole-Ollé, A. (IEB)
"Inter-regional redistribution through infrastructure investment: tactical or programmatic?"
(Novembre 2009)

XREAP2009-14
Del Barrio-Castro, T., **García-Quevedo, J.** (IEB)
"The determinants of university patenting: Do incentives matter?"
(Novembre 2009)

XREAP2009-15
Ramos, R. (AQR-IREA), **Suriñach, J.** (AQR-IREA)**, Artís, M.** (AQR-IREA)
"Human capital spillovers, productivity and regional convergence in Spain"
(Novembre 2009)

XREAP2009-16
Álvarez-Albelo, C. D. (CREB), **Hernández-Martín, R.**
"The commons and anti-commons problems in the tourism economy"
(Desembre 2009)

2010

XREAP2010-01
García-López, M. A. (GEAP)
"The Accessibility City. When Transport Infrastructure Matters in Urban Spatial Structure"
(Febrer 2010)

XREAP2010-02
García-Quevedo, J. (IEB), **Mas-Verdú, F.** (IEB), **Polo-Otero, J.** (IEB)
"Which firms want PhDs? The effect of the university-industry relationship on the PhD labour market"
(Març 2010)

XREAP2010-03
Pitt, D., **Guillén, M.** (RFA-IREA)
"An introduction to parametric and non-parametric models for bivariate positive insurance claim severity distributions"
(Març 2010)

XREAP2010-04
Bermúdez, Ll. (RFA-IREA), **Karlis, D.**
"Modelling dependence in a ratemaking procedure with multivariate Poisson regression models"
(Abril 2010)

XREAP2010-05
Di Paolo, A. (IEB)
"Parental education and family characteristics: educational opportunities across cohorts in Italy and Spain"
(Maig 2010)

XREAP2010-06
Simón, H. (IEB), **Ramos, R.** (AQR-IREA), **Sanromá, E.** (IEB)
"Movilidad ocupacional de los inmigrantes en una economía de bajas cualificaciones. El caso de España"
(Juny 2010)

XREAP2010-07
Di Paolo, A. (GEAP & IEB), **Raymond, J. Ll.** (GEAP & IEB)
"Language knowledge and earnings in Catalonia"
(Juliol 2010)

XREAP2010-08
Bolancé, C. (RFA-IREA), **Alemany, R.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"Prediction of the economic cost of individual long-term care in the Spanish population"
(Setembre 2010)

XREAP2010-09
Di Paolo, A. (GEAP & IEB)
"Knowledge of catalan, public/private sector choice and earnings: Evidence from a double sample selection model"
(Setembre 2010)

XREAP2010-10
Coad, A., **Segarra, A.** (GRIT), **Teruel, M.** (GRIT)
"Like milk or wine: Does firm performance improve with age?"
(Setembre 2010)

XREAP2010-11
Di Paolo, A. (GEAP & IEB), **Raymond, J. Ll.** (GEAP & IEB), **Calero, J.** (IEB)
"Exploring educational mobility in Europe"
(Octubre 2010)

XREAP2010-12
Borrell, A. (GiM-IREA), **Fernández-Villadangos, L.** (GiM-IREA)
"Clustering or scattering: the underlying reason for regulating distance among retail outlets"
(Desembre 2010)

XREAP2010-13
Di Paolo, A. (GEAP & IEB)
"School composition effects in Spain"
(Desembre 2010)

XREAP2010-14
Fageda, X. (GiM-IREA), **Flores-Fillol, R.**
"Technology, Business Models and Network Structure in the Airline Industry"
(Desembre 2010)

XREAP2010-15
Albalate, D. (GiM-IREA), **Bel, G.** (GiM-IREA), **Fageda, X.** (GiM-IREA)
"Is it Redistribution or Centralization? On the Determinants of Government Investment in Infrastructure"
(Desembre 2010)

XREAP2010-16
Oppedisano, V., **Turati, G.**
"What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
(Desembre 2010)

XREAP2010-17
Canova, L., **Vaglio, A.**
"Why do educated mothers matter? A model of parental help"
(Desembre 2010)

2011

XREAP2011-01
Fageda, X. (GiM-IREA), **Perdiguero, J.** (GiM-IREA)
"An empirical analysis of a merger between a network and low-cost airlines"
(Maig 2011)

XREAP2011-02
Moreno-Torres, I. (ACCO, CRES & GiM-IREA)
"What if there was a stronger pharmaceutical price competition in Spain? When regulation has a similar effect to collusion"
(Maig 2011)

XREAP2011-03
Miguélez, E. (AQR-IREA); **Gómez-Miguélez, I.**
"Singling out individual inventors from patent data"
(Maig 2011)

XREAP2011-04
Moreno-Torres, I. (ACCO, CRES & GiM-IREA)
"Generic drugs in Spain: price competition vs. moral hazard"
(Maig 2011)

XREAP2011-05
Nieto, S. (AQR-IREA)**, Ramos, R.** (AQR-IREA)
"¿Afecta la sobreeducación de los padres al rendimiento académico de sus hijos?"
(Maig 2011)

XREAP2011-06
Pitt, D., **Guillén, M.** (RFA-IREA), **Bolancé, C.** (RFA-IREA)
"Estimation of Parametric and Nonparametric Models for Univariate Claim Severity Distributions - an approach using R"
(Juny 2011)

XREAP2011-07
Guillén, M. (RFA-IREA), **Comas-Herrera, A.**
"How much risk is mitigated by LTC Insurance? A case study of the public system in Spain"
(Juny 2011)

XREAP2011-08
Ayuso, M. (RFA-IREA), **Guillén, M.** (RFA-IREA), **Bolancé, C.** (RFA-IREA)
"Loss risk through fraud in car insurance"
(Juny 2011)

XREAP2011-09
Duch-Brown, N. (IEB), **García-Quevedo, J.** (IEB), **Montolio, D.** (IEB)
"The link between public support and private R&D effort: What is the optimal subsidy?"
(Juny 2011)

XREAP2011-10
Bermúdez, Ll. (RFA-IREA), **Karlis, D.**
"Mixture of bivariate Poisson regression models with an application to insurance"
(Juliol 2011)

XREAP2011-11
Varela-Irimia, X-L. (GRIT)
"Age effects, unobserved characteristics and hedonic price indexes: The Spanish car market in the 1990s"
(Agost 2011)

XREAP2011-12
Bermúdez, Ll. (RFA-IREA), **Ferri, A.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"A correlation sensitivity analysis of non-life underwriting risk in solvency capital requirement estimation"
(Setembre 2011)

XREAP2011-13
Guillén, M. (RFA-IREA), **Pérez-Marín, A.** (RFA-IREA), **Alcañiz, M.** (RFA-IREA)
"A logistic regression approach to estimating customer profit loss due to lapses in insurance"
(Octubre 2011)

XREAP2011-14
Jiménez, J. L., **Perdiguero, J.** (GiM-IREA), **García, C.**
"Evaluation of subsidies programs to sell green cars: Impact on prices, quantities and efficiency"
(Octubre 2011)

XREAP2011-15
Arespa, M. (CREB)
"A New Open Economy Macroeconomic Model with Endogenous Portfolio Diversification and Firms Entry"
(Octubre 2011)

XREAP2011-16
Matas, A. (GEAP), **Raymond, J. L.** (GEAP), **Roig, J.L.** (GEAP)
"The impact of agglomeration effects and accessibility on wages"
(Novembre 2011)

XREAP2011-17
Segarra, A. (GRIT)
"R&D cooperation between Spanish firms and scientific partners: what is the role of tertiary education?"
(Novembre 2011)

XREAP2011-18
García-Pérez, J. I.; **Hidalgo-Hidalgo, M.**; **Robles-Zurita, J. A.**
"Does grade retention affect achievement? Some evidence from PISA"
(Novembre 2011)

XREAP2011-19
Arespa, M. (CREB)
"Macroeconomics of extensive margins: a simple model"
(Novembre 2011)

XREAP2011-20
García-Quevedo, J. (IEB), **Pellegrino, G.** (IEB), **Vivarelli, M.**
"The determinants of YICs' R&D activity"
(Desembre 2011)

XREAP2011-21
González-Val, R. (IEB), **Olmo, J.**
"Growth in a Cross-Section of Cities: Location, Increasing Returns or Random Growth?"
(Desembre 2011)

XREAP2011-22
Gombau, V. (GRIT), **Segarra, A.** (GRIT)
"The Innovation and Imitation Dichotomy in Spanish firms: do absorptive capacity and the technological frontier matter?"
(Desembre 2011)

2012

XREAP2012-01
Borrell, J. R. (GiM-IREA), **Jiménez, J. L.**, **García, C.**
"Evaluating Antitrust Leniency Programs"
(Gener 2012)

XREAP2012-02
Ferri, A. (RFA-IREA), **Guillén, M.** (RFA-IREA), **Bermúdez, Ll.** (RFA-IREA)
"Solvency capital estimation and risk measures"
(Gener 2012)

XREAP2012-03
Ferri, A. (RFA-IREA), **Bermúdez, Ll.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"How to use the standard model with own data"
(Febrer 2012)

XREAP2012-04
Perdiguero, J. (GiM-IREA), **Borrell, J.R.** (GiM-IREA)
"Driving competition in local gasoline markets"
(Març 2012)

XREAP2012-05
D'Amico, G., **Guillen, M.** (RFA-IREA), Manca, R.
"Discrete time Non-homogeneous Semi-Markov Processes applied to Models for Disability Insurance"
(Març 2012)

XREAP2012-06
Bové-Sans, M. A. (GRIT), Laguado-Ramírez, R.
"Quantitative analysis of image factors in a cultural heritage tourist destination"
(Abril 2012)

XREAP2012-07
Tello, C. (AQR-IREA), **Ramos, R.** (AQR-IREA), **Artís, M.** (AQR-IREA)
"Changes in wage structure in Mexico going beyond the mean: An analysis of differences in distribution, 1987-2008"
(Maig 2012)

XREAP2012-08
Jofre-Monseny, J. (IEB), **Marín-López, R.** (IEB), **Viladecans-Marsal, E.** (IEB)
"What underlies localization and urbanization economies? Evidence from the location of new firms"
(Maig 2012)

XREAP2012-09
Muñiz, I. (GEAP), **Calatayud, D.**, **Dobaño, R.**
"Los límites de la compacidad urbana como instrumento a favor de la sostenibilidad. La hipótesis de la compensación en Barcelona medida a través de la huella ecológica de la movilidad y la vivienda"
(Maig 2012)

XREAP2012-10
Arqué-Castells, P. (GEAP), **Mohnen, P.**
"Sunk costs, extensive R&D subsidies and permanent inducement effects"
(Maig 2012)

XREAP2012-11
Boj, E. (CREB), **Delicado, P.**, **Fortiana, J**., **Esteve, A.**, **Caballé, A.**
"Local Distance-Based Generalized Linear Models using the dbstats package for R"
(Maig 2012)

XREAP2012-12
Royuela, V. (AQR-IREA)
"What about people in European Regional Science?"
(Maig 2012)

XREAP2012-13
Osorio A. M. (RFA-IREA)**, Bolancé, C.** (RFA-IREA), **Madise, N.**
"Intermediary and structural determinants of early childhood health in Colombia: exploring the role of communities"
(Juny 2012)

XREAP2012-14
Miguelez. E. (AQR-IREA)**, Moreno, R.** (AQR-IREA)
"Do labour mobility and networks foster geographical knowledge diffusion? The case of European regions"
(Juliol 2012)

XREAP2012-15
Teixidó-Figueras, J. (GRIT)**, Duró, J. A.** (GRIT)
"Ecological Footprint Inequality: A methodological review and some results"
(Setembre 2012)

XREAP2012-16
Varela-Irimia, X-L. (GRIT)
"Profitability, uncertainty and multi-product firm product proliferation: The Spanish car industry"
(Setembre 2012)

SÈRIE DE DOCUMENTS DE TREBALL DE LA XREAP

XREAP2012-17
Duró, J. A. (GRIT), **Teixidó-Figueras, J.** (GRIT)
"Ecological Footprint Inequality across countries: the role of environment intensity, income and interaction effects"
(Octubre 2012)

xreap@pcb.ub.es