Abstract

In this paper, we use an alternative measure of scholarly quality, namely TOP-curves in order to rank journals in the field of environmental and resource economics. This measure summarizes the journals’ highly cited articles’ incidence, intensity and inequality. Moreover, TOP-curves allow analysts to rank journals according to TOP-dominance. If such a ranking is impossible, the area below the curves can be used as a secondary criterion. The journal ranking based on the TOP-dominance criterion does not coincide with the ranking according to the journals’ impact factors. Indeed TOP-curves provide more detailed information on the relative ranking of journals since they take the composition and the distribution of citations within the top group into account.
I. Introduction

Journal rankings are important determinants for evaluating research output, for academic promotions, and for allocating funds. Therefore, it is quite surprising that the journals in the field of environmental and resource economics have not yet been subject to extensive evaluation studies. The analyses performed by Kodrzycki and Yu (2006) and Rousseau (in press) indicate the difficulty of ranking environmental and resource economics journals in a univocal way. The main reason is that the quality of academic journals is a multifaceted notion and the ordering of journals largely depends on the indicators used.

Over the past decades the impact of publications in a research area has been measured in several ways (van Raan, 2004). The dominant measure of journal visibility, which is used by research institutions, policy makers, and journal editors alike, is the impact factor as published by Thomson Scientific (also called ISI impact factor). This performance indicator is based on averages, measuring the average number of citations to an article published during the previous two years. More precisely, the ISI journal impact factor of a particular journal in 2007, for instance, is the ratio of cites in 2007 to articles published in 2005 and 2006 to the total number of publications in those years (ISI Web of Science). The ISI impact factor is, therefore, biased in favor of journals revealing a rapid maturing phase in citation impact (Moed, 2005). Although this measure does correct for differences in the sizes of journals’ annual volumes, this correction leads to another type of bias which is in favor of review journals. A recent overview on the use of impact factors, and the ISI impact factor in particular, can be found in Moed (2005).

Scientific tradition requires, at least since the 19th century, that scientists writing articles refer to earlier articles which relate to the paper’s theme. Eugene Garfield
(1979, p.1) notes: ‘(Publications) cite – generally by title, author and where and when published – documents that support, provide evidence for, illustrate or elaborate on what the author has to say. Citations are the formal, explicit linkages between papers that have particular points in common.’ Since the foundation of the Eugene Garfield Associates in 1954, renamed as the Institute of Scientific Information (ISI) in 1960, citation counts have been commonly used to indicate concepts such as ‘research performance’, ‘scholarly quality’, ‘influence’ or ‘impact’ (Moed, 2005).

Previous research (Rousseau, 2002) suggests that the citation-based ISI impact factor, as an indicator of scholarly quality, should be supplemented with more detailed measures in order to unequivocally evaluate a journal’s influence. After all, the ISI impact factor captures only one dimension of scholarly quality. The existing impact factor has already been complemented by Frandsen et al. (2006) with a series of diffusion factors in order to measure the influence across the literature of a particular journal title. Also, Yue and Wilson (2004) have developed an integrated conceptual model of journal evaluation to study the external factors affecting journal citation impact. Kodrzycki and Yu (2006) extend the ISI impact factor as well by using a flexible, citations- and reference-intensity-adjusted ranking technique in order to evaluate economics journals. Finally, Rousseau (in press) has used a perception-based approach rather than a citation-based approach in order to rank journals in the field of environmental and resource economics. We discuss the results of these latter two studies in more detail in the next section.

In this contribution, we focus on an alternative measure of performance and use TOP-curves (Egghe et al., 2007) to analyze the most influential - defined as the most cited - articles of a journal. TOP-curves capture several characteristics of the journal’s most
cited papers and provide more detailed information on the relative ranking of journals than the impact factor used by Thomson Scientific.

II. Data and literature overview

The assessment focuses on journals specializing in environmental and resource economics and monitored by Thomson Scientific. The field of environmental and resource economics is generally defined as the study of the different aspects of the interactions between environmental quality and the economic behavior of individuals, groups of people and firms. While natural resource economics focuses on the role of nature as a provider of raw materials and inputs, environmental economics examines the economy’s residual flows and their impact on the natural world. More specifically, we include the *American Journal of Agricultural Economics*, *Australian Journal of Agricultural and Resource Economics*, *Ecological Economics*, *Energy Economics*, *Energy Journal*, *Environment and Development Economics*, *Environment and Resource Economics*, *Journal of Agricultural and Resource Economics*, *Journal of Environmental Economics and Management*, *Land Economics*, *Natural Resources Journal*, and *Resource and Energy Economics*. Table 1 lists the abbreviations of these twelve journals which we use for the rest of the text.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Journal of Agricultural Economics</td>
<td>AJAE</td>
</tr>
<tr>
<td>Australian Journal of Agricultural and Resource Economics</td>
<td>AJARE</td>
</tr>
<tr>
<td>Ecological Economics</td>
<td>ECOL</td>
</tr>
<tr>
<td>Energy Economics</td>
<td>ENEC</td>
</tr>
<tr>
<td>Energy Journal</td>
<td>EJ</td>
</tr>
<tr>
<td>Journal</td>
<td>Abbreviation</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Environment and Development Economics</td>
<td>EDE</td>
</tr>
<tr>
<td>Environment and Resource Economics</td>
<td>ERE</td>
</tr>
<tr>
<td>Journal of Agricultural and Resource Economics</td>
<td>JARE</td>
</tr>
<tr>
<td>Journal of Environmental Economics and Management</td>
<td>JEEM</td>
</tr>
<tr>
<td>Land Economics</td>
<td>LAND</td>
</tr>
<tr>
<td>Natural Resources Journal</td>
<td>NRJ</td>
</tr>
<tr>
<td>Resource and Energy Economics</td>
<td>REE</td>
</tr>
</tbody>
</table>

Table 1: List of journals

Our dataset includes only articles and reviews. Analogously to the calculation of the journals’ impact factor, publications that are described in the ISI WoS database as editorial material, book reviews, corrections or letters are excluded. Furthermore, we limit the analysis to articles that were published in 2001, 2002, 2003 and 2004. Going back up to six years, about the average cited half-life (i.e. the median age of a journal’s cited articles in the WoS; i.e. the Web of Science) for the field journals in our analysis, allows the articles, and especially the widely cited ones among them, to grow to their full potential. Hence, this measure is less biased towards journals revealing a rapid maturing or declining phase in citation impact than a journal’s impact factor is. We extracted the data from the WoS on October 2, 2007. In Table 2 we list the total number of publications, the total cites, the average cites per article and review published, and the ISI journal impact factor for 2005 for the journals in our sample.
<table>
<thead>
<tr>
<th>Journal</th>
<th>Articles &amp; Reviews published between 2001-2004</th>
<th>Total cites to art. &amp; rev. published between 2001-2004</th>
<th>Average number of cites</th>
<th>Impact factor 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJAE</td>
<td>446</td>
<td>1709</td>
<td>3.83</td>
<td>0.967</td>
</tr>
<tr>
<td>AJARE</td>
<td>94</td>
<td>292</td>
<td>3.11</td>
<td>0.867</td>
</tr>
<tr>
<td>ECOL</td>
<td>426</td>
<td>2968</td>
<td>6.97</td>
<td>1.179</td>
</tr>
<tr>
<td>ENEC</td>
<td>179</td>
<td>668</td>
<td>3.73</td>
<td>0.564</td>
</tr>
<tr>
<td>EJ</td>
<td>81</td>
<td>348</td>
<td>4.30</td>
<td>0.707</td>
</tr>
<tr>
<td>EDE</td>
<td>119</td>
<td>281</td>
<td>2.36</td>
<td>0.323</td>
</tr>
<tr>
<td>ERE</td>
<td>276</td>
<td>1108</td>
<td>4.01</td>
<td>0.49</td>
</tr>
<tr>
<td>JARE</td>
<td>136</td>
<td>313</td>
<td>2.30</td>
<td>0.347</td>
</tr>
<tr>
<td>JEEM</td>
<td>208</td>
<td>1440</td>
<td>6.92</td>
<td>1.529</td>
</tr>
<tr>
<td>LAND</td>
<td>162</td>
<td>913</td>
<td>5.64</td>
<td>0.974</td>
</tr>
<tr>
<td>NRJ</td>
<td>128</td>
<td>194</td>
<td>1.52</td>
<td>0.556</td>
</tr>
<tr>
<td>REE</td>
<td>75</td>
<td>384</td>
<td>5.12</td>
<td>1.541</td>
</tr>
</tbody>
</table>

Table 2: Description of the data

The journals we include in our analysis have previously been ranked by Kodrzycki and Yu (2006) and Rousseau (in press). For this reason, we discuss the results from these two analyses in more detail. Firstly, Kodrzycki and Yu (2006) use an approach for evaluating economics journals that weighs citations according to the influence of the citing journal and computes this influence by applying an iterative process. In the end, journals that are themselves cited heavily, or that are cited in other journals that are cited heavily, rank higher than journals that draw fewer citations or that tend to be cited in less influential journals. Specifically, the study ranks economics journals according to
their overall impact as well as their influence on the economics literature and on economics-related policy research. The rankings derived from these exercises are presented in Table 3 for eleven journals included in our sample (the *Natural Resources Journal* was not included in this study). For sake of comparison, the most influential economics journal according to each specific criterion is also mentioned as well as the rankings in the total sample of 181 economics journals.

<table>
<thead>
<tr>
<th>Within economics</th>
<th>Policy impact</th>
<th>Overall impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM ECON REV 1</td>
<td>AM ECON REV 1</td>
<td>J HEALTH ECON 1</td>
</tr>
<tr>
<td>1 JEEM 49</td>
<td>AJAE 27</td>
<td>AJAE 27</td>
</tr>
<tr>
<td>2 AJAE 60</td>
<td>JEEM 35</td>
<td>JEEM 36</td>
</tr>
<tr>
<td>3 ERE 74</td>
<td>LAND 40</td>
<td>LAND 48</td>
</tr>
<tr>
<td>4 LAND 75</td>
<td>ECOL 51</td>
<td>ECOL 49</td>
</tr>
<tr>
<td>5 ECOL 83</td>
<td>ERE 55</td>
<td>ERE 56</td>
</tr>
<tr>
<td>6 EDE 86</td>
<td>EJ 64</td>
<td>JARE 110</td>
</tr>
<tr>
<td>7 EJ 90</td>
<td>EDE 78</td>
<td>EDE 111</td>
</tr>
<tr>
<td>8 JARE 98</td>
<td>ENEC 97</td>
<td>EJ 114</td>
</tr>
<tr>
<td>9 REE 107</td>
<td>REE 118</td>
<td>REE 126</td>
</tr>
<tr>
<td>10 ENEC 132</td>
<td>AJARE 119</td>
<td>ENEC 140</td>
</tr>
<tr>
<td>11 AJARE 151</td>
<td>JARE 157</td>
<td>AJARE 157</td>
</tr>
</tbody>
</table>


Secondly, using an online survey, Rousseau (in press) has asked researchers in the field of environmental and resource economics how they themselves would rank a
representative list of journals in their field. The respondents, participants of the 2006 World Conference of Environmental and Resource Economists (Kyoto, Japan), were asked to indicate for eleven journals (Energy Economics was not included in the sample) whether they consider the journal to belong to the ‘top’ or ‘subtop’ in the field of environmental and resource economics. Based on 150 answers, implying a response rate of thirty percent, the journals were ranked according to the number of experts who considered the journal to be a ‘top’ journal. The result of this perception-based ranking (see Figure 1) is then compared to the citation-based ordering of the journals’ impact factors of 2006 as published by Thomson Scientific. The two sets of rankings turn out to be significantly different from each other and this suggests that researchers interpret the current quality of journals by taking into account other factors besides impact factors. Researchers apparently consider aspects in their assessment such as: their personal publication record, research experience, current research topics, journals’ availability or their familiarity with the different journals. Indeed, Axarloglou and Theoharakis (2003) have found significant variations in journal quality perceptions by economists worldwide and these variations depend on the respondents’ geographic location, school of thought, field of specialization, research orientation and focus, type of employment, and journal affiliation. These additional evaluation criteria do not coincide (completely) with the journal's impact factor and this might lead to sizeable differences in the respective evaluations. A case in point is the Australian Journal of Agricultural and Resource Economics (AJARE), which is ranked last by the experts questioned by Rousseau (in press), but occupies the sixth position when using the impact factors. Another example is Environmental and Resource Economics (ERE). This journal seems to be more highly appreciated by researchers than indicated by its relative impact factor.
Other scientometric studies that analyze the related field of ecological sciences include Costanza et al. (2004) and Krauss (2007). Costanza et al. (2004) assessed the degree of influence of selected papers and books in ecological economics using citation analysis. They looked at both the internal influence of the publications on the field of ecological economics and the external influence on the broader academic community. For this analysis, they counted the total number of ISI citations as well as the total number of citations in the journal *Ecological Economics*. By plotting the number of citations versus the date of publication, Costanza et al. (2004) were able to identify those publications that are projected to be most influential. Krauss (2007), on the other hand, looks at the impact of self-citations on the impact factors of journals in the field over ecological sciences (i.e. journals in the ISI subject category ‘ecology’). His analysis shows that, on average, self-citation was responsible for roughly 16 percent of the impact factor in 2004 and he suggests taking journal-specific self-citation rates into account for journal rankings. However, the study does not provide an explicit ranking of the journals since the names of the journals are not mentioned.
III. Methodology

In this evaluation study, we use the TOP-curve as a criterion for ranking the environmental and resource economics journals. TOP-curves are defined as a kind of mirror image of TIP-curves\(^1\), which are used in poverty studies (Jenkins and Lambert, 1997), and represent simultaneously the incidence, intensity and inequality among the top. Egghe et al. (2007) show that TOP-curves possess the properties necessary to study a group of top performers: for instance, the journal’s publications that are most frequently cited. TOP-curves can be considered as generalized Lorenz-curves. As information science, and research evaluation in particular, is more interested in the top performers than in the low producers, Egghe et al. (2007) introduce the concept of TOP-curves as a performance indicator. Articles belong to the group of top performers if they receive at least a predetermined minimum of citations.

Let \( X = (x_1, x_2, ..., x_N) \) denote an array of \( N \) journal articles where \( x_j \geq 0 \) for \( j = 1, ..., N \), denotes the total number of citations of the \( j \)th article. In the current evaluation, only citations in journals included in the ISI citation index are taken into account. We assume that the articles are ranked in decreasing order of citations. Next the notion of a top line is introduced as a threshold, denoted as \( t > 0 \), separating the ‘top’ articles from the rest. This threshold is the minimum number of citations an article must receive (over a given period) in order to be included in the ‘top’ group.

The TOP-array of \( X \), given \( t \), is then defined as the array which includes for those articles with at least \( t \) citations, the number of citations and equals \( t \) for all other articles. More formally, the TOP-array of \( X \) given \( t \) equals:

\(^1\) TIP-curves are defined as ‘Three ‘I’s of Poverty’ curves by Jenkins and Lambert (1997).
\[ T_X = \left( \max(x_j, t) \right)_{j=1}^w \]

This allows us to construct the surplus array, denoted as \( S_X \), by taking the difference \( T_X - T \) with \( T = (t, \ldots, t) \). As the articles included in the array \( X \) are ranked in decreasing order, so will the surplus array be (Egghe et al., 2007):

\[
S_X(j) = x_j - t \quad \text{for} \quad 1 \leq j \leq j_0 \\
= 0 \quad \text{for} \quad j_0 + 1 \leq j \leq N
\]

The first \( j_0 \) components of the surplus area are equal to the number of citations to an article minus the top line. The last \( N - j_0 \) components of this array are zero. The surplus array shows by how many citations a particular article exceeds the top line. It is zero if the cites to a paper are below or on this threshold.

The formal definition of a TOP-curve can now be stated (Egghe et al., 2007):

The \textit{TOP-curve of} \( X = (x_1, x_2, \ldots, x_N) \) \textit{plots against} \( p = k/N, \ 1 \leq k \leq N \), \textit{the sum of the first} \( k/N \) \( S_X \) \textit{values, divided by} \( N \). \textit{This TOP-curve is denoted as} \( \text{TOP}_X(p), 0 \leq p \leq 1 \).

More precisely: \( \text{TOP}_X(0) = 0; \ \text{TOP}_X\left(\frac{k}{N}\right) = \frac{\sum_{j=1}^{k} S_X(j)}{N}, \ \text{for} \ k = 1 \ldots N; \ \text{at intermediate points} \ \text{TOP}_X(p) \ \text{is determined by linear interpolation.} \)

Figure 2 illustrates this concept. The TOP-curve is, by definition, a concavely increasing curve and reflects three dimensions of a journal’s impact. First of all, incidence, defined as the percentage of the papers that belong to the top group, provides a general measure of the journal’s quality. Secondly, the intensity of the top performers describes the cumulative excess citation per published article and represents the influence of the top articles within a journal. Thirdly, the inequality the top performers feel among themselves is an indicator of the consistency with which the top articles
obtain top results. In this contribution, we use the concept of a TOP-curve to compare journals’ performances in the field of environmental and ecological economics and to analyze the characteristics of the group of most cited articles in each journal.

The work by Egghe et al. (2007) also introduces the notion of TOP-dominance. Their definition states that the N-array $X$ TOP-dominates the N-array $Y$ if:

$$TOP_X(p) \geq TOP_Y(p) \text{ for all } p \in [0,1].$$

TOP-dominance determines a partial order in the space of N-arrays given a threshold line $t$ (i.e. the top line). The TOP-curves can be interpreted as reflecting a general sense of dominance: the higher the TOP-curve of a journal, the higher the impression of dominance among the highest cited papers. For instance, when the incidence is the
same, the journal with a larger intensity dominates. In other words, the articles in the
latter journal that belong to the top group are quoted more frequently, even though the
percentage of articles that belong to the top group is the same. If two journals have the
same intensity, the journal with the smallest incidence dominates. Although the latter
journal has fewer articles in its top group, they are cited more often.

IV. Results

This section describes the TOP-curves for the selected journals in the field of
environmental and resource economics. Recall that we use the number of citations
recorded on the WoS on October 2, 2007 for articles and reviews published in 2001,
2002, 2003, and 2004. We show how TOP-curves are able to rank the journals and how
they can supplement the ISI impact factor as a performance indicator.

The construction of TOP-curves is based on the most cited articles in journals. Hence,
we need a top line which distinguishes these articles from the articles that are less
widely cited. We use four as a threshold. With a top line of four, the top group for each
journal contains all articles which were cited at least four times. As a robustness check,
we also performed the analysis with a top line of eight. Since the results are very
similar, we only discuss the results for top line four in detail and present a summary of
the ranking obtained by using top line eight in Figure 7. The number of articles and
reviews that received four (eight) or more citations differs substantially over the
journals, as is shown in Table 4. This table also lists the highest number of citations one
item in a particular journal received in our sample. Again the variation between journals
is considerable. It is noteworthy that the most cited article over the complete dataset is
Carson et al. (2001) published in *Environmental and Resource Economics*. In the
appendix we list the eleven most widely cited articles in our dataset.
<table>
<thead>
<tr>
<th>Journal</th>
<th>Articles &amp; Reviews published between 2001-2004</th>
<th>Number of publications cited at least four times</th>
<th>Number of publications cited at least eight times</th>
<th>Number of cites to most cited publication within journal</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJAE</td>
<td>446</td>
<td>171 (38%)</td>
<td>68 (15%)</td>
<td>34</td>
</tr>
<tr>
<td>AJARE</td>
<td>94</td>
<td>28 (30%)</td>
<td>9 (10%)</td>
<td>20</td>
</tr>
<tr>
<td>ECOL</td>
<td>426</td>
<td>274 (64%)</td>
<td>144 (34%)</td>
<td>56</td>
</tr>
<tr>
<td>ENEC</td>
<td>179</td>
<td>67 (37%)</td>
<td>25 (14%)</td>
<td>35</td>
</tr>
<tr>
<td>EJ</td>
<td>81</td>
<td>31 (38%)</td>
<td>14 (17%)</td>
<td>36</td>
</tr>
<tr>
<td>EDE</td>
<td>119</td>
<td>25 (21%)</td>
<td>6 (5%)</td>
<td>12</td>
</tr>
<tr>
<td>ERE</td>
<td>276</td>
<td>95 (34%)</td>
<td>34 (12%)</td>
<td>76</td>
</tr>
<tr>
<td>JARE</td>
<td>136</td>
<td>24 (18%)</td>
<td>9 (7%)</td>
<td>30</td>
</tr>
<tr>
<td>JEEM</td>
<td>208</td>
<td>130 (63%)</td>
<td>66 (32%)</td>
<td>45</td>
</tr>
<tr>
<td>LAND</td>
<td>162</td>
<td>84 (52%)</td>
<td>36 (22%)</td>
<td>53</td>
</tr>
<tr>
<td>NRJ</td>
<td>128</td>
<td>16 (13%)</td>
<td>2 (2%)</td>
<td>11</td>
</tr>
<tr>
<td>REE</td>
<td>75</td>
<td>34 (45%)</td>
<td>17 (23%)</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 4: Number of articles and reviews with more than four (eight) citations

The TOP-curves of the eleven journals are depicted in Figure 3 and Figure 4. Table 5 summarizes the results numerically.
<table>
<thead>
<tr>
<th></th>
<th>Incidence</th>
<th>Intensity</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECOL</td>
<td>0.64</td>
<td>3.84</td>
<td>3.31</td>
</tr>
<tr>
<td>JEEM</td>
<td>0.63</td>
<td>3.76</td>
<td>3.29</td>
</tr>
<tr>
<td>LAND</td>
<td>0.52</td>
<td>2.94</td>
<td>2.64</td>
</tr>
<tr>
<td>REE</td>
<td>0.45</td>
<td>2.44</td>
<td>2.20</td>
</tr>
<tr>
<td>EJ</td>
<td>0.38</td>
<td>1.85</td>
<td>1.70</td>
</tr>
<tr>
<td>ERE</td>
<td>0.34</td>
<td>1.78</td>
<td>1.68</td>
</tr>
<tr>
<td>AJAE</td>
<td>0.38</td>
<td>1.59</td>
<td>1.46</td>
</tr>
<tr>
<td>ENEC</td>
<td>0.37</td>
<td>1.47</td>
<td>1.35</td>
</tr>
<tr>
<td>AJARE</td>
<td>0.30</td>
<td>1.10</td>
<td>1.04</td>
</tr>
<tr>
<td>JARE</td>
<td>0.18</td>
<td>0.90</td>
<td>0.87</td>
</tr>
<tr>
<td>EDE</td>
<td>0.21</td>
<td>0.45</td>
<td>0.87</td>
</tr>
<tr>
<td>NRJ</td>
<td>0.13</td>
<td>0.14</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Table 5: Results

Figure 3: TOP curves
The TOP-curve for *Environmental and Resource Economics* crosses five other TOP-curves which makes this journal difficult to compare with the other journals. The reason for this is that ERE has a few articles which are heavily cited, while the other papers
have lower citation counts. This is shown by the histogram of the citations received by articles in ERE compared to those published in JEEM (see Figure 5). The shape of the histograms is clearly different for each journal.

V. Discussion of the results

If we compare the incidence, intensity, and inequality measures with the impact factor, the TOP-curves reveal that two nearly identical impact factors can mask some considerable differences between journals. As a case in point, the 2005 impact factor did not allow us to distinguish between the influence of *Land Economics* (LAND) and the *American Journal of Agricultural Economics* (AJAE). However, the TOP-curves show that LAND TOP-dominates AJAE. LAND has both a higher incidence and a higher intensity than AJAE. This implies that LAND publishes more top performing articles than AJAE. Also, the *Journal of Agricultural and Resource Economics* (JARE) and *Environmental and Development Economics* (EDE) have similar impact factors in 2005. Nevertheless, JARE TOP-dominates EDE.

We now investigate in more detail which journals TOP-dominate which other journals. Table 6 shows whether the journal in the first column TOP-dominates (‘TOP’) or whether it is TOP-dominated (‘DOM’) by each of the other journals: for example, AJAE TOP-dominates AJARE and is TOP-dominated by ECOL. When the TOP-curves of two journals intersect, it is not possible to use the TOP-dominance criterion and a question mark is added to Table 6.
Table 6: TOP-dominance among the journals

<table>
<thead>
<tr>
<th></th>
<th>AJAE</th>
<th>AJARE</th>
<th>ECOL</th>
<th>ENEC</th>
<th>EJ</th>
<th>EDE</th>
<th>JARE</th>
<th>JEEM</th>
<th>LAND</th>
<th>NRJ</th>
<th>REE</th>
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</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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The analysis in Table 6 allows us to rank the journals according to the TOP-dominance criterion. However, as shown in Egghe et al. (2007), this criterion does not always allow a full ranking of the journals in a sample. Since some TOP-curves intersect each other, some journals cannot be ranked and are grouped together. The result is shown in Figure 6. The *Natural Resources Journal* is TOP-dominated by all other journals in our sample. Also *Ecological Economics*, the *Journal of Environmental Economics and Management*, and *Land Economics* TOP-dominate (>$\text{TOP}$) all other journals, with the exception of *Environmental and Resource Economics*. 
TOP-curves, being just a small variation of the idea of TIP-curves (Jenkins and Lambert, 1997), offer the same advantages, portraying incidence, intensity and inequality among the top producers. They lead to a natural partial ordering referred to as the TOP-dominance order. Since the TOP-curves of some journals intersect, some journal pairs cannot be ordered according to the TOP-dominance criterion. However, it is possible to construct measures that respect the TOP-dominance order. The area under the TOP-curve is one such measure, as is the length of the TOP-curve. Other measures respecting the TOP-dominance criterion are theoretically possible. This situation is similar to the case of the traditional Lorenz-curve for which there exist a plethora of inequality measures respecting the corresponding partial order. Once a measure has been applied, one obtains a stricter order (usually even a total order), but different measures usually lead to different rankings (of course only among intersecting TOP-curves). Measures differ according to their sensitivity with respect to changes in incidence, intensity and equality. Hence, we use the area under the TOP-curve only as a secondary criterion and the associated ranking of the journals is presented in Figure 7 for both top lines four and eight. Sensitivity aspects of poverty curves (the dual of our TOP-curves) are discussed in, among others, Zheng (2000).

Note that the relative rankings are, in essence, robust to changes in the top line, as is shown in Figure 7, which presents the results with a top line of four and with a top line
of eight. The only differences between these two rankings, in terms of TOP-dominance, concern JEEM and ECOL (the latter being TOP-dominated by the former) and AJARE and ENEC (the former being TOP-dominated by the latter). In terms of the area under the curve, JEEM and ECOL as well as EJ and ERE switch places. However, the overall picture which emerges is quite consistent if one compares both rankings.

![Figure 7: Final ranking of the journals: left for top line 4 and right for top line 8](image-url)
VI. Conclusion

Research institutions, policy makers and journal editors are all interested in measuring the relative performance of academic journals. The most widely used measure, the ISI impact factor, has been subject to some criticism (see, among others, Frandsen et al., 2006 and Yue and Wilson, 2004). In this paper, we use an alternative measure of scholarly quality, namely TOP-curves (developed in Egghe et al., 2007), in order to rank journals in the field of environmental and resource economics. This measure focuses on the most frequently cited articles and summarizes the journals’ highly cited articles’ incidence, intensity and inequality. TOP-curves allow analysts to rank journals according to TOP-dominance. If such a ranking is impossible, the area below the curves can be used as a secondary criterion. Furthermore, TOP-curves allow one to rank journals based on any one of the three I’s: incidence, intensity and inequality.

The analysis allows identifying quality groups of journals for environmental and resource economics. The three journals that are found to be most influential in the field are the *Journal of Environmental Economics and Management*, Ecological Economics and *Land Economics*. Based on the TOP-dominance criterion, these three journals TOP-dominate all other journals, which the exception of *Environmental and Resource Economics*. When the top line is set at eight, the *Journal of Environmental Economics and Management* TOP-dominates all other journals, with the exception of *Land Economics* and *Environmental and Resource Economics*. Using the area under the TOP curve as a ranking criterion, the same group of most influential journals appears, with JEEM and ECOL switching places depending on the top line. The least influential journals are, on the other hand, the *Natural Resources Journal* and *Environment and Development Economics*. Both are TOP-dominated by all other journals.
The journal ranking based on the TOP-dominance criterion does not coincide with the ranking according to the journals’ impact factors. TOP-curves indeed provide more detailed information on the relative ranking of journals than the impact factor used by Thomson Scientific. They take the composition and the distribution of citations within the top group into account and allow describing three of the driving factors behind a journal’s performance, analyzing its incidence, intensity and inequality. The incidence, for instance, clearly allows researchers to determine if, and to what extent, a journal’s influence is due to a limited number of widely quoted articles or whether the majority of journal’s papers are included in the top group. This insight is unavailable if one focuses on a measure that relates the total number of citations to articles published over a given period of time, such as the journal’s impact factor.
Appendix: Eleven most cited articles in sample

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<th>Authors</th>
<th>Title</th>
<th>Journal</th>
<th>Times cited</th>
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<tr>
<td>Carson RT; Flores NE; Meade NF</td>
<td>Contingent valuation: Controversies and evidence</td>
<td>ERE 2001</td>
<td>76</td>
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<td>de Groot RS; Wilson MA; Boumans RMJ</td>
<td>A typology for the classification, description and valuation of ecosystem functions, goods and services</td>
<td>ECOL 2002</td>
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<td>Polasky S; Camm JD; Garber-Yonts B</td>
<td>Selecting biological reserves cost-effectively: An application to terrestrial vertebrate conservation in Oregon</td>
<td>LAND 2001</td>
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<td>Sanchirico JN; Wilen JE</td>
<td>A bioeconomic model of marine reserve creation</td>
<td>JEEM 2001</td>
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<td>Stern DI; Common MS</td>
<td>Is there an environmental Kuznets curve for sulfur?</td>
<td>JEEM 2001</td>
<td>41</td>
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<td>Tol RSJ</td>
<td>Estimates of the damage costs of climate change. Part 1: Benchmark estimates</td>
<td>ERE 2002</td>
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<td>Turner RK; Paavola J; Cooper P; Farber S; Jessamy V; Georgiou S</td>
<td>Valuing nature: lessons learned and future research directions</td>
<td>ECOL 2003</td>
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<td>Irwin EG</td>
<td>The effects of open space on residential property values</td>
<td>LAND 2002</td>
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<td>List JA; Gallet CA</td>
<td>What experimental protocol influence disparities between actual and hypothetical stated values?</td>
<td>ERE 2001</td>
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<td>Joskow PL; Kahn E</td>
<td>A quantitative analysis of pricing behavior in California's wholesale electricity market during Summer 2000</td>
<td>EJ 2002</td>
<td>36</td>
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<td>Muradian R</td>
<td>Ecological thresholds: a survey</td>
<td>ECOL 2001</td>
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</table>
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