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Analysis

Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions

Andreas G.F. Hoepner [a,b], Benjamin Kant [c], Bert Scholtens [d,*], Pei-Shan Yu [a]

[a] School of Management, University of St. Andrews, The Gateway, North Haugh, St. Andrews, KY16 9SS, UK
[b] Academic Fellow, Principles for Responsible Investment, PRI Secretariat, c/o UN Global Compact, DC2-612,United Nations, New York, NY 10017, USA
[c] Sustainable Living LLC., Lake Forest, Illinois, 60045, USA
[d] Energy and Sustainability Centre, Department of Economics, Econometrics and Finance, Faculty of Economics and Business, University of Groningen, P.O. Box 800, 9700 AV, Groningen, The Netherlands

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ABSTRACT

We investigate the influence of articles, authors, journals and institutions in the field of environmental and ecological economics. We depart from studies that investigated the literature until 2001 and include a time period that has witnessed an enormous increase of importance in the field. We adjust for the age effect given the huge impact of the year of an article's publication on its influence and we show that this adjustment does make a substantial difference — especially for disaggregated units of analysis with diverse age characteristics such as articles or authors. We analyse 6597 studies on environmental and ecological economics published between 2000 and 2009. We provide rankings of the influential articles, authors, journals and institutions and find that Ecological Economics, Energy Economics and the Journal of Environmental Economics and Management have the most influential articles, they publish very influential authors and their articles are cited most. The University of Maryland, Resources for the Future, the University of East Anglia and the World Bank appear to be the most influential institutions in the field of environmental and ecological economics.

1. Introduction

We investigate the influence of articles, authors, journals and institutions in the field of environmental and ecological economics on the basis of citation analysis. Increasingly, performance measurement and impact analysis have come to play a role in research and education policy and in the assessment of departments and faculty. A lot of research is done on the assessment of the impact of journals and there is a lot of debate going on (see Harzing, 2010). It appears that in the classic journal impact factor, article age adjustment is missing. The conventional two and five year impact factors furthermore have the problem that they only use a two year and five year after publication window for papers to receive citations. We do not pursue this classic journal impact analysis but will rely on citation analysis. This type of analysis puts the article itself in the spotlight and not the journal. We think it is the article that makes the difference as the article is communicating the research. We are well aware of the fact that citations have their limitations too (see Costanza et al. (2004: 262)). For example, the influence of a paper need not be restricted to an academic audience, there is a bias to the journals that are in the database, and it takes time for citations to appear in the literature. However, authors such as Costanza et al. (2004) and Kim et al. (2006) are confident of the virtues of citation analysis to base their study on. We apply citation analysis to environmental and ecological economics, which has become an increasingly important field in both research and policy in the 21st century due to climate change, globalization, and the rapid advance of renewable energy.

Citation analyses within environmental and ecological economics were first published in the 21st century, even though they mainly analysed 20th century publications due to the time required for citation and publication. Kohlstad (2000: 294) identifies "the most 'useful' (i.e. cited)" articles published in two sub-areas of environmental and ecological economics (energy economics and exhaustible resources economics) over five 5-year periods from 1974 to 1998. To define his sample, he searches for area specific keywords in 34 (general) economics journals. Kohlstad finds an age effect, as he observes older papers to receive more citations than younger peers with the exception of Perron's (1989) seminal econometric paper on oil price

* Corresponding author. Tel.: +31 503637064; fax: +31 50 36372074.
E-mail address: L.J.R.Scholtens@rug.nl (B. Scholtens).

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shocks. This result implies that citation counts might need to be annualized in some form when comparing journal articles. Kohlstad also lists the five journals with the highest number of citations per article in each sub-area during each decade in his sample and finds a noticeable degree of inconsistency among the top journals of each decade. This implies that journal rankings need to be updated regularly to reflect changes in journal impact.

Furthermore, Smith (2000) reviews research on the non-market valuation of environmental resources published in the Journal of Environmental Economics and Management (JEEM) over the period 1978–1998. His review includes a list of all JEEM papers in this subarea which have been cited more than 50 times by 1998. The list is dominated by older studies. This, again, implies that age can have an impact: the age effect, which we define as a significant positive relationship between the age of a study and its number of total citations.

Ma and Stern (2006) analyse the overlap between JEEM and Ecological Economics (EcE) based on articles published between 1994 and 2003. They find high correlations between the journals citing JEEM and EcE as well as those journals referenced in JEEM and EcE, which implies a significant overlap between the two journals in specific areas and in the areas of environmental and ecological economics in general. Ma and Stern (2006) also list 30 articles which received the highest number of total citations in each journal. However, since they use total citations as their measure of influence, the youngest article in both lists is published in 1999, while the oldest appeared in 1931. Recently, two citation studies focus on evaluating journals in the field of environmental and ecological economics (Aufhammer, 2009; Rousseau et al., 2009). However, both are fully exposed to the age effect discussed above and, in case of Aufhammer (2009), also to the biases associated with Google Scholar data (see, for instance, Jacsó, 2005, 2006a, 2006b, 2008; Shultz, 2007).

To the best of our knowledge, the only age adjustment in citation analysis of environmental and ecological economics to date has been conducted by Costanza et al. (2004). They examine the influence of 251 individual publications related to EcE which are published between 1920 and 2001. They assess articles nominated for their quality by the EcE Editorial board, highly cited articles published in EcE or articles and books published elsewhere that were highly cited by EcE articles. While Costanza et al. (2004: 264) mainly analyse total citations, they explicitly acknowledge that total citations as a measure of influence is biased towards older publications, which simply had more time to be cited. Hence, they do not only employ total citation as a measure of total influence but also calculate the "*average number of citations per year … [as] 'predictor' of ultimate influence that can better compare older and younger articles*". This adjusted measure, for instance, aids the comparison of two of the most influential publications in their sample: Costanza et al.'s (1997) 'Value of the world's ecosystems and natural capital' and Hardin's (1968) 'Tragedy of the Commons'. While the latter has more than five times more citations than the former (499 to 2525), since it is 29 years older, the former received marginally more citations per year (71.3 to 70.1) in Costanza et al.'s (2004) citation analysis.

To sum up, the previous studies make substantial contributions to the understanding of influence and citation patterns in the increasingly important field of environmental and ecological economics. However, they do not assess the influence of individual authors or institutions and are, with the exception of Costanza et al. (2004), exposed to a substantial age effect. Costanza et al. (2004) implement their age adjustment only for individual articles published up to 2001, and no age adjusted ranking of articles published subsequently has been published to date. Similarly, no ranking of journals in the field of environmental and ecological economics has been published that adjusts for the age of a journal's most cited articles. If the article age effect is not controlled for in the journal rankings, the journals are virtually assessed on their performance in the earlier years of the data sample and improvements over time are inappropriately considered. Furthermore, journals vary the number of articles over time. Hence, journals which increased (decreased) their number of published articles during a sample period are disadvantaged (advantaged) due to the age effect which favours older over younger articles

These gaps in the citation analysis literature of environmental and ecological economics provide us with the opportunity to employ an age effect adjusted citation analysis approach and a 21st century data sample. Therefore, we ask the following four research questions which are original in the context of our study:

(1) Which are the influential *articles* published in environmental and ecological economics journals?
(2) Which are the influential *journals* focused on publishing articles in environmental and ecological economics?
(3) Which are the influential *authors*, who published in environmental and ecological economics journals?
(4) Which are the influential *institutions*, whose affiliates published in environmental and ecological economics journals?

In summary, this paper builds on previous citation analyses in the field of environmental and ecological economics or its sub-areas (Costanza et al., 2004; Kohlstad, 2000; Ma and Stern, 2006; Smith, 2000). We extend their scope substantially by pursuing – to the best of our knowledge – a citation analysis of the field of environmental and ecological economics, which makes the following four contributions. First, we conduct the first analysis of the influential authors in the field. Second, we pursue the first investigation of the influential institutions in the area. Third, we conduct the first rating of journals in the field of environmental and ecological economics in the 21st century which is not exposed to age effect. Fourth, we compile the first list of the influential papers in the area published in this century, in which the importance of at least some areas of environmental and ecological economics dramatically increased (e.g. climate change, renewable energy).

Our paper is structured in three further sections. In the following (second) section, we discuss our data set. Section 3 discusses our analysis and results with regard to each individual research question, before we conclude in the last section.

2. Data Sample

We follow an increasing literature that frequently employs citations for their virtues as non-subjective, reasonably comprehensive measure of study influence (e.g. Alexander and Mabry, 1994; Borokhovich et al., 1994; 2000; Costanza et al., 2004; Kim et al., 2006; Ma and Stern, 2006). Employing a standard approach to sample selection in citation analysis, we define our research field based on academic journals specialising in it (e.g. Coupé, 2003; Kim et al., 2006; Pieters and Baumgartner, 2002). Insofar, we follow Ma and Stern (2006), who use publications in JEEM and EcE as approximations for the field of environmental and ecological economics respectively (thus, we describe the research area of environmental and resource economics short as environmental economics). We extend Ma and Stern's sample by adding the economics journals which are heavily cited in JEEM or EcE or heavily cite JEEM or EcE and focus on environmental and ecological economics.

Hereby we define four relevant concepts as follows: First, we define any journal as an economics journal if it includes the term Economic(s) in its title or if it is indexed in the subject category Economics of Thomson Reuter's Web of Knowledge (WoK) database, which represents the quasi standard in citation research (Archambault et al., 2006) (this database was formerly provided by the Institute for Scientific Information and is still well known under this name). Since our analysis is based on citation data from the WoK database, which has a large coverage in Economics, we do not restrict the sample by employing its subject category Economics. Second, we define journals heavily cited in JEEM or EcE as

those journals, which received more than 30 citations from JEEM or EcE in Ma and Stern's analysis (see Ma and Stern, 2006: Tables 6 and 7, respectively). Third, we define journals heavily referencing JEEM or EcE as the top 20 journals citing JEEM or EcE identified by Ma and Stern (2006, Table 4). Fourth, we define journals as focusing on environmental and ecological economics, if they carry an environmental or ecological concept in their title.

This sample selection process results in a sample of the following 14 journals: Agricultural Economics (AE), American Journal of Agricultural Economics (AJAE), Ecological Economics (EcE), Energy Economics (EnE), Energy Journal (EJ). Environment and Development Economics (EDE), Environmental & Resource Economics (ERE), Journal of Agricultural and Resource Economics (JARE), Journal of Agricultural Economics (JAE), Journal of Environmental Economics and Management (JEEM), Land Economics (LE), Marine Resource Economics (MRE), Resource and Energy Economics (REE), and Resources Policy (RP).

We retrieve citation data from Thomson Reuter's Web of Knowledge (WoK) database, which represents the quasi standard in citation research especially within the economics discipline (Archambault et al., 2006; Kim et al., 2006; Pieters and Baumgartner, 2002). As our sample period, we select the first decade after the millennium (2000–2009). We start in 2000, as previous papers have already conducted insightful analysis of article and journal influence in the environmental and ecological economics discipline of the late 20th century (Costanza et al., 2004; Ma and Stern, 2006). We end our sample as recent as end of 2009 to ensure that our citation analysis is as timely as possible. For this sample period, we retrieve citation data for any document published in one of the 14 journals which is classified by WoK as journal article. Thus, we exclude other document types from our analysis, such as editorials and book reviews. We are also forced to exclude publications in EDE before 2001 and publications in MRE before 2007, as these were not covered by the WoK database.

The age effect adjustment in our analysis controls for this data availability constraint. In total, we retrieve data for 6597 journal articles on the 19th of September 2010.[1] For each journal article, we retrieve the following data points: authors, authors' affiliation, title, journal name, year, volume, issue, publication month, page numbers, and number of times citations. Our citation data refers to total citations as recorded in WoK. We acknowledge that previous work (Costanza et al., 2004; Ma and Stern, 2006) analysed both, total WoK citations and citations originating purely from the sample journals. However, these previous studies use the latter type of citations (i.e. sample journals) to assess articles published at any time in history from 1931 onwards, which allows them to receive citation rates despite the much smaller subset of potentially citing journals. We experiment with the use of sample journal citation in addition to total WoK citations but since our focus is on journal articles published after the millennium (2000–2009), overall citations rates appear clearly too small for a meaningful analysis of citations originating from sample journals only.

In total, our resulting dataset comprises about 60,000 data points. As several environmental and ecological economics journals have a much wider international participation in their editorial processes than other types of economics journals (e.g. financial economics), we also manually collect information on the country affiliation of editors and associate editors of the journals in our sample. We collected these data on September 29th 2010. We consider someone to be an 'Editor' if the person carries the title 'Editor', 'Editor in Chief' or 'Managing Editor'. We define a scholar to be an 'Associate Editor' if s/he has been awarded the title 'Associate Editor' or 'Co-Editor'.

Table 1 has the descriptive characteristics of the fourteen journals which constitute our sample. This table shows that by far the largest number of articles has been published in Ecological Economics (24% of total). The American Journal of Agricultural Economics ranks second with 12% of total, Environmental & Resource Economics ranks third (10% of total). It appears that with most journals, the editor or editors of the journal are based in the US. This is the case for seven of the journals (AE, AJAE, EcE, JARE, JEEM, LE, and MRE). In four other journals, at least one of the editors is from the US. There are two journals (ERE and JAE) with only British editors. Resources Policy does have an Australian editor and EDE has an editor who is located in Greece. The number of associate editors ranges from one for the Energy Journal to 35 for Energy Economics; Resource and Energy Economics has not assigned an associate. The associated editors in most cases are located in a wide range of countries, with the exception of the Energy Journal (Canada only) and Resources Policy (Chile and Ghana). The Journal of Agricultural Economics' associate editors are located in the UK. The Journal of Agricultural and Resource Economics has all the associates located in the US.

3. Analysis, Results and Discussion

The main measure in our age effect adjusted analysis of the influence of articles, journals, authors and institutions is *citations per year since publication* (*Cites p.a.*) (Costanza et al., 2004; Keloharju, 2008; Schwert, 2007). Keloharju (2008) advocates this measure as sufficient adjustment for the age effect, as he finds it to result in a fairly uniform distribution of publication years among influential studies. Conceptually, *Cites p.a.* represents the ratio of the total citations received by an article divided by the decimal years passed since an article's publication. Technically, we calculate *Cites p.a.* as shown in Eq. (1),

$$Cites\ p.a._{\cdot j} = \frac{Citations_j}{DY + \frac{DD}{365} - \left(PY_j + \frac{PM_j}{12}\right)} \quad (1)$$

where $Citations_j$ are the citations received by journal article j, and PY_j and PM_j are the publication year and publication month of the journal article, respectively. *DY* and *DD* are Download Year and Download Day of our analysis, respectively (i.e. 2010 and 262, as September 19th represents the 262nd day in a standard (non-leap) year). Based on our *Cites p.a.* calculation, we identify the age adjusted influence of 6597 studies in the area of environmental and ecological economics published between 2000 and 2009. For this dataset, we find the absolute correlation between *Cites p.a.* and *PY* to be less than 6%. This reinforces Keloharju's (2008) view that *Cites p.a* are sufficiently adjusting for the age effect. Similarly, we find the absolute correlation between *Cites p.a.* and number of pages per article to be less than 8%.

As the inclusion criterion for a list of most influential studies, previous literature has either used a minimum citation threshold (Kim et al., 2006) or a minimum rank threshold such as 'Top 300 only' (Keloharju, 2008). We use a combined threshold and include in our list of influential studies only those articles, which received more than 5 *Cites p.a.* and that are ranked 300th or better. This combined threshold results in a list of 265 studies, which we display in Table 2 and analyse in the following.

Thus, Table 2 gives the influential articles. The ordering of the rank is based on *Cites p.a.* Most *Cites p.a.* are received by the De Groot et al. (2002) paper in EcE on classifying ecosystem attributes. This overview article has 25 citations per annum and, therefore, is to be regarded as the most influential paper in environmental and ecological economics published in the 21st century. Second is another review paper, namely Engel et al. (2008), with almost 17 citations per year.

[1] Journal articles published in ERE were erroneously omitted in the September 19th data retrieval. Information on them was retrieved immediately after the error was detected on September 28th. This nine day delay appears inconsequential but to ensure good conservative research practice the subsequent age adjusted citation statistics have been adjusted to reflect this nine day delay.

Table 1
Sample of journals in the field of environmental and ecological economics.

Journal		Impact factor 2009		ISI coverage		Country of affiliations (as of September 2010)	
Title	Abbreviation	2 year	5 year	Years	# of publications	Editor (s)	Associate editor(s)
Agricultural Economics	AE	0.673	0.983	2000–2009	492	USA (2×)	AUS, BFA, CHL, CHN, ETH, GBR, GER, IND, JPN, MEX, PHL, TWN, USA (6×), ZAF
American Journal of Agricultural Economics	AJAE	1.047	1.642	2000–2009	800	USA (4×)	AUS, CAN, DNK, GER, USA (26×)
Ecological Economics	EcE	2.422	2.858	2000–2009	1,582	USA (2×)	AUS, GER, IND, PRT, USA
Energy Economics	EnE	2.333	2.673	2000–2009	599	IRL, SGP, USA	AUS, AUT, BEL, BRA, CAN (2×), CHN (2×), CYP, GBR (2×), GER (2×), IND, JPN (2×), KOR, RUS, SAU, TUR, TWN (2×), USA (12×), ZAF
Energy Journal	EJ	1.857	2.186	2000–2009	305	CAN, GBR, USA	CAN
Environment and Development Economics	EDE	0.861	1.211	2001–2009	276	GRC	BRA, CHE, CHN, GBR, GRC (2×), IND, USA, ZAF
Environmental & Resource Economics	ERE	1.314	1.718	2000–2009	687	GBR (2×)	AUS, GBR (2×), GER, JPN, NLD (4×), POL, USA (6×)
Journal of Agricultural and Resource Economics	JARE	0.474	0.827	2000–2009	325	USA	USA (3×)
Journal of Agricultural Economics	JAE	1.155	1.493	2000–2009	257	GBR	GBR (7×)
Journal of Environmental Economics and Management	JEEM	2.581	2.967	2000–2009	453	USA	Canada, USA (5×)
Land Economics	LE	1.558	1.883	2000–2009	385	USA (2×)	DNK, GBR, NOR, USA (19×),
Marine Resource Economics	MRE	0.492	*NA*	2007–2009	67	USA	CAN, ISL, NOR, USA (8×)
Resource and Energy Economics	REE	1.333	1.963	2000–2009	188	NLD, USA	*-Not Assigned (NA)-*
Resources Policy	RP	0.902	1.101	2000–2009	181	AUS	CHL, GHA
Total of 14 journals:					6597		

Explanation: This table displays descriptive statistics for the journals in the field of environmental and ecological economics as defined in the text above. The journal names and their abbreviations are shown in the first two columns. The third and fourth column display a journal's 2 and 5 year Institute of Scientific Information (ISI) impact factor, respectively. Column five and six present the range of WoK's annual coverage of a journal within our sample period (2000–2009) and the number of publications in the respective journal during this period, respectively. The final two columns provide information on the degree of international collaboration among the editorial boards of the journals as of September 29th 2010. The column 'Editor(s)' refers to the nationality of the Editor(s), Editor(s) in Chief or Managing Editor(s) of the journal. The final column provides information on the nationality of the remaining members of the overall editorial team, which carry the title of Associate Editor(s) or Co-Editor(s). The country abbreviations represent the 3-letter codes of the International Organization for Standardization (ISO) and refer to the following countries: Australia (AUS), Austria (AUT), Belgium (BEL), Brazil (BRA), Burkina Faso (BFA), Canada (CND), Chile (CHL), China (CHN), Cyprus (CYP), Denmark (DNK), Ethiopia (ETH), German (GER), Ghana (GHA), Great Britain (GBR), Greece (GRC), India (IND), Iceland (ISL), Japan (JPN), Mexico (MEX), Netherlands (NLD), Norway (NOR), Philippines (PHL), Poland (POL), Portugal (PRT), Republic of Korea (KOR), Russia (RUS), Saudi Arabia (SAU), Singapore (SGP), South Africa (ZAF), Switzerland (CHE), Taiwan (TWN), Turkey (TUR) and United States (USA).

Lee's (2005) paper on energy consumption and GDP in EnE is the highest rank 'focused paper' with 16 citations per year. The Turner et al. (2003) paper on valuing nature also has 16 citations. From the Lee and Chang paper in REE onwards, the differences between the *Cites p.a.* become much smaller. Therefore, we think it is correct to regard the first four articles in Table 2 as the most prominent articles in the field. The adjustment for the age effect is crucial as we find that the (Pearson) correlation coefficient between publication year (starting from year 2000 is 1) and Citations is −0.80. The correlation coefficient between year and *Cites p.a.* is 0.01. This, again, shows the importance of accounting for age in citation analysis.

Table 2 also shows that papers from EcE dominate the top 10 list (7 out of 10 are published in EcE), EnE has two papers in this top 10, and REE has one. Irwin (2002) is the most cited paper from LE (place 12), Aufhammer and Carson (2008) is the highest ranked JEEM paper (15), and List and Gallet (2001) is the highest ranked paper from ERE (#20). The articles with the most *Cites p.a.* for the other journals are as follows: AE on position 45, AJAE on 51, EJ on 55, EDE on 124, JAE on 135, RP on 160, and JARE on 175. There was no publication from the MRE in the top 265.

To analyse journal influence, we use *Cites p.a.* and *Citations* but also calculate a third metric, which represents the percentage of all articles published in a journal that are included in our influential studies list (*% Top Papers*).

The journals' performance regarding this top 265 is shown in Table 3. EcE is by far the top-performer with 41% of the publications in this top 265, whereas it has 24% of total publications. It also has the largest number of total citations (405) and most citations per year. If we relate the number of publications in the top 265 to the number of publications in a journal, we receive the percentage of journal papers which passes our five *Cites p.a.* threshold and makes our top 265 list *(% of Top Papers)*. Here, it shows that EnE ranks first with 9.4% and JEEM ranks second with 8.4%. EcE is in third place here with 6.5%. This reflects the differences in format of the journals (e.g. annual publication volume). Table 3 shows that EcE, EnE and JEEM really are outstanding in the field of environmental and ecological economics compared to the other journals; the journals ranked 4–6 in this table have less than half the number of papers and citations than journal number 3.

We use Spearman's rank correlation coefficient to find out about the relationship between the orderings. The Spearman rank correlation coefficient between the rank of*% of Top Papers* and the rank of *Citations* is 95%. That between the rank of the*% of Top Papers* and the rank of the *Cites p.a.* is 96%. The Spearman correlation between the rank of *Citations* and the rank of *Cites p.a.* is 99%. This shows that the three ranking criteria are very closely related. Therefore, we conclude that Ecological Economics, Energy Economics and the Journal of Environmental Economics and Management are to be regarded as the most influential journals focused on publishing articles in environmental and ecological economics.

When comparing our top article based journal rating with the journals' impact factors displayed in Table 1, an interesting observation emerges. It seems as if the degree of internationalization of editorial boards explains shifts in movement at least for the upper half of our ranking. In this upper half, JEEM and EJ are the only journals whose editorial boards are based in only two or three countries, respectively, whereas the editorial boards of AJAE EcE, EnE, and ERE originate from five to twenty countries. In terms of 2 year and 5 year impact factor, JEEM ranks 1st and EJ ranks 4th. In all three of our assessments, however, these two journals lose ranks (e.g. JEEM being ranked 2nd, 2nd and 3rd, and EJ consistently 7th). Hence, it seems as if less international editorial boards are less effective in globally spreading the word about their very best papers. This observation seems further supported by the fact that while AJAE EcE, EnE, and ERE all improve in our top article based assessment compared to their impact factors, LE with an editorial board originating from four countries, remains ranked similarly.

Table 2
Most influential studies in the field of environmental and ecological economics (2000-2009).

Rank	Authors	Year	Title	Journal	Cites	Cites p.a.
1	de Groot; Wilson; Boumans	2002	A typology for the classification, description and valuation of ecosystem functions, goods and services	EcE	209	25.44
2	Engel; Pagiola; Wunder	2008	Designing payments for environmental services in theory and practice: An overview of the issues	EcE	39	16.97
3	Lee, CC	2005	Energy consumption and GDP in developing countries: A cointegrated panel analysis	EnE	85	16.04
4	Turner et al.	2003	Valuing nature: lessons learned and future research directions	EcE	110	15.98
5	Lee, CC; Chang, CP	2008	Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data	REE	38	14.44
6	Boyd, J; Banzhaf, S	2007	What are ecosystem services? The need for standardized environmental accounting units	EcE	44	14.43
7	Clarke et al.	2009	International climate policy architectures: Overview of the EMF 22 International Scenarios	EnE	10	13.98
8	Wunder, S; Engel, S; Pagiola, S	2008	Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries	EcE	31	13.49
9	Gallai, N; Salles, JM; Settele, J; Vaissiere, BE	2009	Economic valuation of the vulnerability of world agriculture confronted with pollinator decline	EcE	22	13.48
10	Farber, SC; Costanza, R; Wilson, MA	2002	Economic and ecological concepts for valuing ecosystem services	EcE	108	13.15
11	Apergis, N; Payne, JE	2009	Energy consumption and economic growth in Central America: Evidence from a panel cointegration and error correction model	EnE	19	12.97
12	Irwin, EG	2002	The effects of open space on residential property values	LE	99	12.69
13	Pagiola, S	2008	Payments for environmental services in Costa Rica	EcE	29	12.62
14	Narayan, PK; Smyth, R	2008	Energy consumption and real GDP in G7 countries: New evidence from panel cointegration with structural breaks	EnE	24	12.21
15	Auffhammer, M; Carson, RT	2008	Forecasting the path of China's CO2 emissions using province-level information	JEEM	28	12.18
16	Smith, MD; Wilen, JE	2003	Economic impacts of marine reserves: the importance of spatial behavior	JEEM	84	12.06
17	Gibson; Ostrom; Ahn	2000	The concept of scale and the human dimensions of global change: a survey	EcE	122	11.57
18	Crompton, P; Wu, YR	2005	Energy consumption in China: past trends and future directions	EnE	65	11.54
19	Soytas, U; Sari, R	2003	Energy consumption and GDP: causality relationship in G-7 countries and emerging markets	EnE	86	11.27
20	List, JA; Gallet, CA	2001	What experimental protocol influence disparities between actual and hypothetical stated values?	ERE	98	11.11
21	Yuan; Zhao; Yu; Hu	2007	Electricity consumption and economic growth in China: Cointegration and co-feature analysis	EnE	31	11.08
22	DeShazo, JR; Fermo, G	2002	Designing choice sets for stated preference methods: The effects of complexity on choice consistency	JEEM	89	10.94
23	Murphy; Allen; Stevens; Weatherhead	2005	A meta-analysis of hypothetical bias in stated preference valuation	ERE	60	10.94
24	Weber, CL; Matthews, HS	2008	Quantifying the global and distributional aspects of American household carbon footprint	EcE	24	10.83
25	Narayan, PK; Singh, B	2007	The electricity consumption and GDP nexus for the Fiji Islands	EnE	30	10.72
26	Hein, L; van Koppen, K; de Groot, RS; van Ierland, EC	2006	Spatial scales, stakeholders and the valuation of ecosystem services	EcE	46	10.70
27	Peters, GP	2008	From production-based to consumption-based national emission inventories	EcE	26	10.55
28	Munoz-Pina, C; Guevara, A; Torres, JM; Brana, J	2008	Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results	EcE	24	10.44
29	Apergis, N; Payne, JE	2009	Energy consumption and economic growth: Evidence from the Commonwealth of Independent States	EnE	10	10.36
30	Ferrini, S; Scarpa, R	2007	Designs with a priori information for nonmarket valuation with choice experiments: A Monte Carlo study	JEEM	34	10.31
31	Anton; Deltas; Khanna	2004	Incentives for environmental self-regulation and implications for environmental performance	JEEM	63	10.27
32	Boxall, PC; Adamowicz, WL	2002	Understanding heterogeneous preferences in random utility models: A latent class approach	ERE	79	10.21
33	Polasky, S; Camm, JD; Garber-Yonts, B	2001	Selecting biological reserves cost-effectively: An application to terrestrial vertebrate conservation in Oregon	LE	97	10.16
34	Reed; Fraser; Dougill	2006	An adaptive learning process for developing and applying sustainability indicators with local communities	EcE	39	10.05
35	Lenzen, M; Murray, J; Sack, F; Wiedmann, T	2007	Shared producer and consumer responsibility — Theory and practice	EcE	35	9.86
36	Popp, D	2004	ENTICE: Endogenous technological change in the DICE model of global warming	JEEM	60	9.79
37	Goulder, LH; Mathai, K	2000	Optimal CO_2 abatement in the presence of induced technological change	JEEM	104	9.78
38	Fischer, C; Newell, RG	2008	Environmental and technology policies for climate mitigation	JEEM	24	9.74
39	Lee; Chang; Chen	2008	Energy-income causality in OECD countries revisited: The key role of capital stock	EnE	19	9.67
40	Robinson, J	2004	Squaring the circle? Some thoughts on the idea of sustainable development	EcE	61	9.56
41	Wolde-Rufael, Y	2009	Energy consumption and economic growth: The experience of African countries revisited	EnE	14	9.56
42	Sanchirico, JN; Wilen, JE	2001	A bioeconomic model of marine reserve creation	JEEM	84	9.55
43	Wiedmann, T; Minx, J; Barrett, J; Wackernagel, M	2006	Allocating ecological footprints to final consumption categories with input–output analysis	EcE	44	9.50
44	Tol, RSJ	2002	Estimates of the damage costs of climate change — Part II. Dynamic estimates	ERE	81	9.45
45	Ivanic, M; Martin, W	2008	Implications of higher global food prices for poverty in low-income countries	AE	17	9.45
46	Kahneman, D; Sugden, R	2005	Experienced utility as a standard of policy evaluation	ERE	47	9.43
47	Troy, A; Wilson, MA	2006	Mapping ecosystem services: Practical challenges and opportunities in linking GIS and value transfer	EcE	34	9.15
48	Ma, C; Stern, DI	2008	China's changing energy intensity trend: A decomposition analysis	EnE	21	9.14
48	Turpie, JK; Marais, C; Blignaut, JN	2008	The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa	EcE	21	9.14
50	Tyrvainen, L; Miettinen, A	2000	Property prices and urban forest amenities	JEEM	95	9.08
51	Lusk, JL; Roosen, J; Fox, JA	2003	Demand for beef from cattle administered growth hormones or fed genetically modified corn: A comparison of consumers in France, Germany, the United Kingdom and the United States	AJAE	68	9.01
52	Turner et al.	2000	Ecological–economic analysis of wetlands: Scientific integration for management and policy	EcE	89	9.01
53	Jaffe, AB; Newell, RG; Stavins, RN	2005	A tale of two market failures: Technology and environmental policy	EcE	45	8.91
54	Costello, C; Polasky, S	2008	Optimal harvesting of stochastic spatial resources	JEEM	19	8.91
55	Bower, J; Bunn, DW	2000	Model-based comparisons of pool and bilateral markets for electricity	EJ	90	8.88
56	Deller; Tsai; Marcouiller; English	2001	The role of amenities and quality of life in rural economic growth	AJAE	82	8.82
57	Weisz et al.	2006	The physical economy of the European Union: Cross-country comparison and determinants of material consumption	EcE	36	8.71
58	Lenzen, M; Murray, SA	2001	A modified ecological footprint method and its application to Australia	EcE	81	8.71

(continued on next page)

Table 2 (*continued*)

Rank	Authors	Year	Title	Journal	Cites	Cites p.a.
59	Chapagain; Hoekstra; Savenije; Gautam	2006	The water footprint of cotton consumption: An assessment of the impact of worldwide consumption of cotton products on the water resources in the cotton producing countries	EcE	33	8.69
60	Soytas, U; Sari, R	2009	Energy consumption, economic growth, and carbon emissions: Challenges faced by an EU candidate member	EcE	12	8.68
61	Fisher-Vanden, K; Jefferson, GH; Liu, HM; Tao, Q	2004	What is driving China's decline in energy intensity?	REE	56	8.66
62	Squalli, J	2007	Electricity consumption and economic growth: Bounds and causality analyses of OPEC members	EnE	24	8.58
63	Ness, B; Urbel-Piirsalu, E; Anderberg, S; Olsson, L	2007	Categorising tools for sustainability assessment	EcE	31	8.54
64	Stern, DI	2000	A multivariate cointegration analysis of the role of energy in the US macroeconomy	EnE	88	8.48
65	Zhang et al.	2007	Ecosystem services and dis-services to agriculture	EcE	23	8.47
66	Bosetti; Carraro; Tavoni	2009	Climate change mitigation strategies in fast-growing countries: The benefits of early action	EnE	6	8.39
66	Calvin et al.	2009	2.6: Limiting, climate change to 450 ppm CO_2 equivalent in the 21st century	EnE	6	8.39
68	Woodward, RT; Wui, YS	2001	The economic value of wetland services: A meta-analysis	EcE	78	8.39
69	Brander; Florax; Vermaat	2006	The empirics of wetland valuation: A comprehensive summary and a meta-analysis of the literature	ERE	38	8.32
70	Brunnschweiler; Bulte	2008	The resource curse revisited and revised: A tale of paradoxes and red herrings	JEEM	19	8.27
70	Ferraro, PJ	2008	Asymmetric information and contract design for payments for environmental services	EcE	19	8.27
72	Small, KA; Van Dender, K	2007	Fuel efficiency and motor vehicle travel: The declining rebound effect	EJ	30	8.26
73	Kim; Phipps; Anselin	2003	Measuring the benefits of air quality improvement: A spatial hedonic approach	JEEM	62	8.12
74	Benz, E; Truck, S	2009	Modeling the price dynamics of CO_2 emission allowances	EnE	13	7.97
75	Basset-Mens, C; Ledgard, S; Boyes, M	2009	Eco-efficiency of intensification scenarios for milk production in New Zealand	EcE	11	7.96
76	Cameron, TA; Poe, GL; Ethier, RG; Schulze, WD	2002	Alternative non-market value-elicitation methods: Are the underlying preferences the same?	JEEM	62	7.95
77	Dalhuisen et al.	2003	Price and income elasticities of residential water demand: A meta-analysis	LE	58	7.95
78	Lusk, JL	2003	Effects of cheap talk on consumer willingness-to-pay for golden rice	AJAE	54	7.94
79	Yang, HY	2000	A note on the causal relationship between energy and GDP in Taiwan	EnE	81	7.93
80	Lee, CC; Chang, CP	2007	Energy consumption and GDP revisited: A panel analysis of developed and developing countries	EnE	22	7.86
81	Carlsson, F; Martinsson, P	2001	Do hypothetical and actual marginal willingness to pay differ in choice experiments? Application to the valuation of the environment	JEEM	74	7.82
82	Huang, BN; Hwang, MJ; Yang, CW	2008	Causal relationship between energy consumption and GDP growth revisited: A dynamic panel data approach	EcE	16	7.81
83	Leggett, CG; Bockstael, NE	2000	Evidence of the effects of water quality on residential land prices	JEEM	81	7.74
84	Joskow, PL; Kahn, E	2002	A quantitative analysis of pricing behavior in California's wholesale electricity market during Summer 2000	EJ	61	7.74
85	Neuhoff et al.	2005	Network-constrained Cournot models of liberalized electricity markets: the devil is in the details	EnE	41	7.74
86	Dasgupta; Hettige; Wheeler	2000	What improves environmental compliance? Evidence from Mexican industry	JEEM	82	7.71
87	Altinay, G; Karagol, E	2005	Electricity consumption and economic growth: Evidence from Turkey	EnE	37	7.71
88	Loomis, J; Kent, P; Strange, L; Fausch, K; Covich, A	2000	Measuring the total economic value of restoring ecosystem services in an impaired river basin: Results from a contingent valuation survey	EcE	80	7.71
89	Suh, S	2004	Functions, commodities and environmental impacts in an ecological–economic model	EcE	49	7.68
90	Sumaila, UR; Walters, C	2005	Intergenerational discounting: A new intuitive approach	EcE	43	7.64
91	Altinay, G; Karagol, E	2004	Structural break, unit root, and the causality between energy consumption and GDP in Turkey	EnE	44	7.59
92	Jumbe, CBL	2004	Cointegration and causality between electricity consumption and GDP: Empirical evidence from Malawi	EnE	50	7.54
93	van der Zwaan; Gerlagh; Klaassen; Schrattenholzer	2002	Endogenous technological change in climate change modelling	EnE	65	7.53
94	Stern, DI; Common, MS	2001	Is there an environmental Kuznets curve for sulfur?	JEEM	71	7.50
95	Teisl, MF; Roe, B; Hicks, RL	2002	Can eco-labels tune a market? Evidence from dolphin-safe labeling	JEEM	62	7.47
96	Nalle et al.	2004	Modeling joint production of wildlife and timber	JEEM	43	7.42
97	Bennett, MT	2008	China's sloping land conversion program: Institutional innovation or business as usual?	EcE	17	7.40
97	Narayan; Narayan; Smyth	2008	Are oil shocks permanent or temporary? Panel data evidence from crude oil and NGL production in 60 countries	EnE	17	7.40
97	Wunder, S; Alban, M	2008	Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Ecuador	EcE	17	7.40
100	Birol, E; Karousakis, K; Koundouri, P	2006	Using a choice experiment to account for preference heterogeneity in wetland attributes: The case of Cheimaditida wetland in Greece	EcE	28	7.37
101	Lusk, JL; Schroeder, TC	2004	Are choice experiments incentive compatible? A test with quality differentiated beef steaks	AJAE	46	7.30
102	Max-Neef, MA	2005	Foundations of transdisciplinarity	EcE	39	7.25
103	Oh, W; Lee, K	2004	Causal relationship between energy consumption and GDP revisited: the case of Korea 1970–1999	EnE	48	7.24
104	Jones, DW; Leiby, PN; Paik, IK	2004	Oil price shocks and the macroeconomy: What has been learned since 1996	EJ	46	7.21
105	Turner, RK; Daily, GC	2008	The ecosystem services framework and natural capital conservation	ERE	19	7.17
106	Lise, W; Van Montfort, K	2007	Energy consumption and GDP in Turkey: Is there a co-integration relationship?	EnE	20	7.15
107	Turner, K; Lenzen, M; Wiedmann, T; Barrett, J	2007	Examining the global environmental impact of regional consumption activities — Part 1: A technical note on combining input–output and ecological footprint analysis	EcE	24	7.10
108	Paavola, J; Adger, WN	2006	Fair adaptation to climate change	EcE	31	7.07
109	Bayer; Keohane; Timmins	2009	Migration and hedonic valuation: The case of air quality	JEEM	8	7.07
110	McDonald; Patterson	2004	Ecological footprints and interdependencies of New Zealand regions	EcE	42	7.04
111	Mahan; Polasky; Adams	2000	Valuing urban wetlands: A property price approach	LE	74	7.02
112	Keller; Bolker; Bradford	2004	Uncertain climate thresholds and optimal economic growth	JEEM	43	7.01
113	Newell, RG; Pizer, WA	2003	Discounting the distant future: How much do uncertain rates increase valuations?	JEEM	50	7.01
114	Andrew, R; Forgie, V	2008	A three-perspective view of greenhouse gas emission responsibilities in New Zealand	EcE	12	7.00
115	Blanford; Richels; Rutherford	2009	Feasible climate targets: The roles of economic growth, coalition development and expectations	EnE	5	6.99
116	de Gorter, H; Just, DR	2009	The welfare economics of a biofuel tax credit and the interaction effects with price contingent farm subsidies	AJAE	9	6.93
116	Druckman, A; Jackson, T	2009	The carbon footprint of UK households 1990–2004: A socio-economically disaggregated, quasi-multi-regional input–output model	EcE	9	6.93
116	Tukker et al.	2009	Towards a global multi-regional environmentally extended input–output database	EcE	9	6.93
119	Martinez et al.	2007	The coasts of our world: Ecological, economic and social importance	EcE	21	6.89
120	Alberini, A; Cropper, M; Krupnick, A; Simon, NB	2004	Does the value of a statistical life vary with age and health status? Evidence from the US and Canada	JEEM	42	6.85

Table 2 (*continued*)

Rank	Authors	Year	Title	Journal	Cites	Cites p.a.
121	Sanchinco, JN; Wilen, JE	2005	Optimal spatial management of renewable resources: Matching policy scope to ecosystem scale	JEEM	35	6.82
121	Spatari,	2005	Twentieth century copper stocks and flows in North America: A dynamic analysis	EcE	35	6.82
123	Key; Sadoulet; de Janvry	2000	Transactions costs and agricultural household supply response	AJAE	70	6.80
124	Wunder, S	2008	Payments for environmental services and the poor: concepts and preliminary evidence	EDE	15	6.77
125	Seto, KC; Kaufmann, RK	2003	Modeling the drivers of urban land use change in the Pearl River Delta, China: Integrating remote sensing with socioeconomic data	LE	51	6.76
126	Brown et al.	2001	Trade-off analysis for marine protected area management	EcE	62	6.73
127	Joskow, PL	2006	Markets for power in the United States: An interim assessment	EJ	31	6.69
128	Soytas; Sari; Ewing	2007	Energy consumption, income, and carbon emissions in the United States	EcE	22	6.67
128	Wiser, RH	2007	Using contingent valuation to explore willingness to pay for renewable energy: A comparison of collective and voluntary payment vehicles	EcE	22	6.67
130	Perfecto, I; Vandermeer, J; Mas, A; Pinto, LS	2005	Biodiversity, yield, and shade coffee certification	EcE	33	6.65
131	Akinlo, AE	2008	Energy consumption and economic growth: Evidence from 11 Sub-Sahara African countries	EnE	13	6.62
131	Park, J; Ratti, RA	2008	Oil price shocks and stock markets in the US and 13 European countries	EnE	13	6.62
133	Poe; Giraud; Loomis	2005	Computational methods for measuring the difference of empirical distributions	AJAE	35	6.61
133	Uchida; Xu; Rozelle	2005	Grain for green: Cost-effectiveness and sustainability of China's conservation set-aside program	LE	35	6.61
135	Dougill et al.	2006	Learning from doing participatory rural research: Lessons from the Peak District National Park	JAE	27	6.53
135	Sadorsky, P	2006	Modeling and forecasting petroleum futures volatility	EnE	27	6.53
137	Wunscher; Engel; Wunder	2008	Spatial targeting of payments for environmental services: A tool for boosting conservation benefits	EcE	15	6.53
138	Ghali, KH; El-Sakka, MIT	2004	Energy use and output growth in Canada: A multivariate cointegration analysis	EnE	42	6.50
139	Lee, CC; Chang, CP	2005	Structural breaks, energy consumption, and economic growth revisited: Evidence from Taiwan	EnE	31	6.46
140	Gerbens-Leenes; Hoekstra; van der Meer	2009	The water footprint of energy from biomass: A quantitative assessment and consequences of an increasing share of bio-energy in energy supply	EcE	10	6.46
141	Knittel, CR; Roberts, MR	2005	An empirical examination of restructured electricity prices	EnE	32	6.45
142	Sohngen, B; Mendelsohn, R	2003	An optimal control model of forest carbon sequestration	AJAE	47	6.44
143	Arnold, JEM; Perez, MR	2001	Can non-timber forest products match tropical forest conservation and development objectives?	EcE	56	6.43
144	Christie et al.	2006	Valuing the diversity of biodiversity	EcE	27	6.41
145	Huisman, R; Huurman, C; Mahieu, R	2007	Hourly electricity prices in day-ahead markets	EnE	22	6.35
146	Machado, G; Schaeffer, R; Worrell, E	2001	Energy and carbon embodied in the international trade of Brazil: An input–output approach	EcE	55	6.31
147	Krausmann et al.	2008	Global patterns of socioeconomic biomass flows in the year 2000: A comprehensive assessment of supply, consumption and constraints	EcE	15	6.30
148	Hoekstra; van der Bergh	2003	Comparing structural and index decomposition analysis	EnE	48	6.29
149	Demont et al.	2008	Regulating coexistence in Europe: Beware of the domino-effect!	EcE	16	6.28
149	Kumar, M; Kumar, P	2008	Valuation of the ecosystem services: A psycho-cultural perspective	EcE	16	6.28
151	Maxim, L; Spangenberg, JH; O'Connor, M	2009	An analysis of risks for biodiversity under the DPSIR framework	EcE	5	6.26
152	Pagiola et al.	2007	Paying for the environmental services of silvopastoral practices in Nicaragua	EcE	17	6.26
153	van Vuuren, DP; Weyant, J; de la Chesnaye, F	2006	Multi-gas scenarios to stabilize radiative forcing	EnE	29	6.26
154	Harrison, GW	2006	Experimental evidence on alternative environmental valuation methods	ERE	27	6.25
155	Binswanger, M	2001	Technological progress and sustainable development: what about the rebound effect?	EcE	60	6.23
156	Wilson, C; Tisdell, C	2001	Why farmers continue to use pesticides despite environmental, health and sustainability costs	EcE	53	6.08
157	Zhou, P; Ang, BW; Poh, KL	2008	Measuring environmental performance under different environmental DEA technologies	EnE	16	6.08
158	Kosoy; Martinez-Tuna; Muradian; Martinez-Alier	2007	Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America	EcE	21	6.06
159	Kotchen, MJ; Moore, MR	2007	Private provision of environmental public goods: Household participation in green-electricity programs	JEEM	22	6.06
160	Banchirigah, SM	2006	How have reforms fuelled the expansion of artisanal mining? Evidence from sub-Saharan Africa	RP	24	6.05
161	Welsch, H	2006	Environment and happiness: Valuation of air pollution using life satisfaction data	EcE	25	6.05
162	Sethi et al.	2005	Fishery management under multiple uncertainty	JEEM	30	6.04
163	Bertram, M; Graedel, TE; Rechberger, H; Spatari, S	2002	The contemporary European copper cycle: Waste management subsystem	EcE	48	5.96
164	Hubacek, K; Giljum, S	2003	Applying physical input–output analysis to estimate land appropriation (ecological footprints) of international trade activities	EcE	45	5.96
165	Figge, F; Hahn, T	2004	Sustainable value added — Measuring corporate contributions to sustainability beyond eco-efficiency	EcE	39	5.96
166	Spash, CL; Vatn, A	2006	Transferring environmental value estimates: Issues and alternatives	EcE	22	5.92
167	Paavola, J	2007	Institutions and environmental governance: A reconceptualization	EcE	19	5.91
168	Ekins et al.	2003	A framework for the practical application of the concepts of critical natural capital and strong sustainability	EcE	44	5.89
169	Cole, MA	2004	Trade, the pollution haven hypothesis and the environmental kuznets curve: Examining the linkages	EcE	39	5.88
170	Gintis, H	2000	Beyond Homo economicus: Evidence from experimental economics	EcE	57	5.87
171	Phillis; Andriantiatsaholiniaina	2001	Sustainability: an ill-defined concept and its assessment using fuzzy logic	EcE	54	5.86
172	Palmer, K; Burtraw, D	2005	Cost-effectiveness of renewable electricity policies	EnE	28	5.84
173	Morey, E; Thacher, J; Breffle, W	2006	Using angler characteristics and attitudinal data to identify environmental preference classes: A latent-class model	ERE	25	5.79
174	Alberini, A; Boyle, K; Welsh, M	2003	Analysis of contingent valuation data with multiple bids and response options allowing respondents to express uncertainty	JEEM	44	5.77
175	Lusk et al.	2005	A meta-analysis of genetically modified food valuation studies	JARE	31	5.76
176	Newell, RG; Pizer, WA	2003	Regulating stock externalities under uncertainty	JEEM	43	5.76
177	Brouwer, R	2000	Environmental value transfer: State of the art and future prospects	EcE	61	5.74
178	Muniz, I; Galindo, A	2005	Urban form and the ecological footprint of commuting. The case of Barcelona	EcE	27	5.73
179	Zhang, XP; Cheng, XM	2009	Energy consumption, carbon emissions, and economic growth in China	EcE	6	5.72
180	Scarpa, R; Campbell, D; Hutchinson, WG	2007	Benefit estimates for landscape improvements: Sequential Bayesian design and respondents' rationality in a choice experiment	LE	16	5.72

(*continued on next page*)

Table 2 (*continued*)

Rank	Authors	Year	Title	Journal	Cites	Cites p.a.
180	Soytas, U; Sari, R	2007	The relationship between energy and production: Evidence from Turkish manufacturing industry	EnE	16	5.72
182	Galeotti; Lanza; Pauli	2006	Reassessing the environmental Kuznets curve for CO_2 emissions: A robustness exercise	EcE	25	5.71
183	Bateman; Burgess; Hutchinson; Matthews	2008	Learning design contingent valuation (LDCV): NOAA guidelines, preference learning and coherent arbitrariness	JEEM	14	5.68
184	Cologni, A; Manera, M	2008	Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries	EnE	13	5.66
184	Darby; Batte; Ernst; Roe	2008	Decomposing local: A conjoint analysis of locally produced foods	AJAE	13	5.66
186	Rehfeld; Rennings; Ziegler	2007	Integrated product policy and environmental product innovations: An empirical analysis	EcE	20	5.64
187	Rigby, D; Woodhouse, P; Young, T; Burton, M	2001	Constructing a farm level indicator of sustainable agricultural practice	EcE	49	5.62
188	Van Passel; Nevens; Mathijs; Van Huylenbroeck	2007	Measuring farm sustainability and explaining differences in sustainable efficiency	EcE	19	5.62
189	Limburg, KE; O'Neill, RV; Costanza, R; Farber, S	2002	Complex systems and valuation	EcE	46	5.60
190	Wu, JJ; Plantinga, AJ	2003	The influence of public open space on urban spatial structure	JEEM	39	5.60
191	Lubowski, RN; Plantinga, AJ; Stavins, RN	2006	Land-use change and carbon sinks: Econometric estimation of the carbon sequestration supply function	JEEM	25	5.60
192	Bohringer, C; Jochem, PEP	2007	Measuring the immeasurable — A survey of sustainability indices	EcE	18	5.60
193	Brons, M; Nijkamp, P; Pels, E; Rietveld, P	2008	A meta-analysis of the price elasticity of gasoline demand. A SUR approach	EnE	11	5.60
193	Seifert, J; Uhrig-Homburg, M; Wagner, M	2008	Dynamic behavior of CO_2 spot prices	JEEM	11	5.60
195	Bosetti, V; Tavoni, M	2009	Uncertain R&D, backstop technology and GHGs stabilization	EnE	4	5.59
195	Erb, KH; Krausmann, F; Lucht, W; Haberl, H	2009	Embodied HANPP: Mapping the spatial disconnect between global biomass production and consumption	EcE	4	5.59
195	Schwarzlmuller, E	2009	Human appropriation of aboveground net primary production in Spain, 1955–2003: An empirical analysis of the industrialization of land use	EcE	4	5.59
195	van Vliet, J; den Elzen, MGJ; van Vuuren, DP	2009	Meeting radiative forcing targets under delayed participation	EnE	4	5.59
199	Azar, C; Schneider, SH	2002	Are the economic costs of stabilising the atmosphere prohibitive?	EcE	45	5.59
200	Cole, MA; Elliott, RJR	2003	Determining the trade-environment composition effect: The role of capital, labor and environmental regulations	JEEM	38	5.59
201	Scarpa, R; Thiene, M; Train, K	2008	Utility in willingness to pay space: A tool to address confounding random scale effects in destination choice to the Alps	AJAE	10	5.56
202	McFarland, JR; Reilly, JM; Herzog, HJ	2004	Representing energy technologies in top-down economic models using bottom-up information	EnE	34	5.54
203	Lusk et al.	2001	In-store valuation of steak tenderness	AJAE	50	5.53
204	Rehdanz, K; Maddison, D	2005	Climate and happiness	EcE	31	5.50
205	Piggott, NE; Marsh, TL	2004	Does food safety information impact US meat demand?	AJAE	36	5.50
206	Goodwin, BK; Mishra, AK	2006	Are “decoupled” farm program payments really decoupled? An empirical evaluation	AJAE	25	5.50
207	Brunnermeier; Cohen	2003	Determinants of environmental innovation in US manufacturing industries	JEEM	41	5.49
208	Simianer; Marti; Gibson; Hanotte; Rege	2003	An approach to the optimal allocation of conservation funds to minimize loss of genetic diversity between livestock breeds	EcE	39	5.47
209	Raymond et al.	2009	Mapping community values for natural capital and ecosystem services	EcE	8	5.46
210	Hilson, G; Pardie, S	2006	Mercury: An agent of poverty in Ghana's small-scale gold-mining sector?	RP	23	5.46
211	Heberlein, TA; Wilson, MA; Bishop, RC; Schaeffer, NC	2005	Rethinking the scope test as a criterion for validity in contingent valuation	JEEM	28	5.46
212	Springer, U	2003	The market for tradable GHG permits under the Kyoto Protocol: A survey of model studies	EnE	38	5.46
213	Wolde-Rufael, Y	2004	Disaggregated industrial energy consumption and GDP: the case of Shanghai, 1952–1999	EnE	36	5.43
214	Born, W; Rauschmayer, F; Brauer, I	2005	Economic evaluation of biological invasions — A survey	EcE	26	5.42
215	Lusk, JL; Norwood, FB	2005	Effect of experimental design on choice-based conjoint valuation estimates	AJAE	27	5.35
216	Bin, O; Polasky, S	2004	Effects of flood hazards on property values: Evidence before and after Hurricane Floyd	LE	31	5.35
217	Gundersen, C; Oliveira, V	2001	The Food Stamp Program and food insufficiency	AJAE	47	5.34
218	Bateman et al.	2006	Analysing the agricultural costs and non-market benefits of implementing the Water Framework Directive	JAE	22	5.32
219	Carson et al.	2003	Contingent valuation and lost passive use: Damages from the Exxon Valdez oil spill	ERE	38	5.31
220	Cleveland; Kaufman; Stern	2000	Aggregation and the role of energy in the economy	EcE	56	5.31
221	Krajnc, D; Glavic, P	2005	How to compare companies on relevant dimensions of sustainability	EcE	25	5.30
222	Gregory, R; Wellman, K	2001	Bringing stakeholder values into environmental policy choices: A community-based estuary case study	EcE	47	5.29
223	Ostman, O; Ekbom, B; Bengtsson, J	2003	Yield increase attributable to aphid predation by ground-living polyphagous natural enemies in spring barley in Sweden	EcE	39	5.28
224	Banchirigah, SM	2008	Challenges with eradicating illegal mining in Ghana: A perspective from the grassroots	RP	13	5.27
224	Kara et al.	2008	The impacts of EU CO_2 emissions trading on electricity markets and electricity consumers in Finland	EnE	13	5.27
226	Kotchen, MJ; Reiling, SD	2000	Environmental attitudes, motivations, and contingent valuation of nonuse values: A case study involving endangered species	EcE	56	5.27
227	Mitsch, WJ; Gosselink, JG	2000	The value of wetlands: importance of scale and landscape setting	EcE	52	5.26
228	Macmillan, DC; Philip, L; Hanley, N; Alvarez-Farizo, B	2002	Valuing the non-market benefits of wild goose conservation: A comparison of interview and group-based approaches	EcE	41	5.26
229	Asquith, NM; Vargas, MT; Wunder, S	2008	Selling two environmental services: In-kind payments for bird habitat and watershed protection in Los Negros, Bolivia	EcE	12	5.22
229	Claassen, R; Cattaneo, A; Johansson, R	2008	Cost-effective design of agri-environmental payment programs: US experience in theory and practice	EcE	12	5.22
229	Nandha, M; Faff, R	2008	Does oil move equity prices? A global view	EnE	12	5.22
229	Pannell, DJ	2008	Public benefits, private benefits, and policy mechanism choice for land-use change for environmental benefits	LE	12	5.22
233	Xu, JT; Yin, RS; Li, Z; Liu, C	2006	China's ecological rehabilitation: Unprecedented efforts, dramatic impacts, and requisite policies	EcE	22	5.22
234	Bastianoni; Pulselli; Tiezzi	2004	The problem of assigning responsibility for greenhouse gas emissions	EcE	32	5.22

Table 2 (*continued*)

Rank	Authors	Year	Title	Journal	Cites	Cites p.a.
235	Ferraro, PJ; Simpson, RD	2002	The cost-effectiveness of conservation payments	LE	42	5.22
235	Gerbens-Leenes; Nonhebel	2002	Consumption patterns and their effects on land required for food	EcE	42	5.22
237	Halicioglu, F	2007	Residential electricity demand dynamics in Turkey	EnE	18	5.19
237	Zachariadis; Pashourtidou	2007	An empirical analysis of electricity consumption in Cyprus	EnE	18	5.19
239	Gossling, S; Hansson, CB; Horstmeier, O; Saggel, S	2002	Ecological footprint analysis as a tool to assess tourism sustainability	EcE	40	5.18
240	Champ, PA; Bishop, RC	2001	Donation payment mechanisms and contingent valuation: An empirical study of hypothetical bias	ERE	47	5.18
241	Odhiambo, NM	2009	Electricity consumption and economic growth in South Africa: A trivariate causality test	EnE	5	5.18
242	Coomes, OT; Grimard, F; Burt, GJ	2000	Tropical forests and shifting cultivation: Secondary forest fallow dynamics among traditional farmers of the Peruvian Amazon	EcE	55	5.17
243	Sneeringer, S	2009	Does animal feeding operation pollution hurt public health? A national longitudinal study of health externalities identified by geographic shifts in livestock production	AJAE	8	5.17
244	Yang et al.	2008	Evaluating the power investment options with uncertainty in climate policy	EnE	11	5.16
245	Lewis, DJ; Plantinga, AJ	2007	Policies for habitat fragmentation: Combining econometrics with GIS-based landscape simulations	LE	17	5.15
245	Regnier, E	2007	Oil and energy price volatility	EnE	17	5.15
247	Rosegrant et al.	2000	Integrated economic–hydrologic water modeling at the basin scale: The Maipo river basin	AE	50	5.15
248	Pearce, D	2007	Do we really care about biodiversity?	ERE	17	5.12
249	Sandhu, HS; Wratten, SD; Cullen, R; Case, B	2008	The future of farming: The value of ecosystem services in conventional and organic arable land. An experimental approach	EcE	13	5.10
250	Sari, R; Ewing, BT; Soytas, U	2008	The relationship between disaggregate energy consumption and industrial production in the United States: An ARDL approach	EnE	10	5.09
251	Plummer, R; Armitage, D	2007	A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world	EcE	18	5.07
252	Hamilton, JD	2009	Understanding crude oil prices	EJ	7	5.07
253	Olmstead; Hanemann; Stavins	2007	Water demand under alternative price structures	JEEM	15	5.06
254	Huang et al.	2003	Biotechnology as an alternative to chemical pesticides: A case study of Bt cotton in China	AE	36	5.05
255	Nakamura, M; Takahashi, T; Vertinsky, I	2001	Why Japanese firms choose to certify: A study of managerial responses to environmental issues	JEEM	46	5.04
256	Mendelsohn; Dinar; Williams	2006	The distributional impact of climate change on rich and poor countries	EDE	22	5.02
257	Braga, J; Starmer, C	2005	Preference anomalies, preference elicitation and the discovered preference hypothesis	ERE	25	5.02
258	Poe, GL; Clark, JE; Rondeau, D; Schulze, WD	2002	Provision point mechanisms and field validity tests of contingent valuation	ERE	40	5.01
259	Elobeid, A; Tokgoz, S	2008	Removing distortions in the US ethanol market: What does it imply for the United States and Brazil?	AJAE	9	5.00
259	Headey, D; Fan, SG	2008	Anatomy of a crisis: The causes and consequences of surging food prices	AE	9	5.00
261	Zamani, M	2007	Energy consumption and economic activities in Iran	EnE	14	5.00
262	Alfnes, F; Guttormsen, AG; Steine, G; Kolstad, K	2006	Consumers' willingness to pay for the color of salmon: A choice experiment with real economic incentives	AJAE	19	5.00
262	Hadorn et al.	2006	Implications of transdisciplinarity for sustainability research	EcE	19	5.00
262	MacMillan; Hanley; Lienhoop	2006	Contingent valuation: Environmental polling or preference engine?	EcE	19	5.00
265	Carlsson, F; Frykblom, P; Liljenstolpe, C	2003	Valuing wetland attributes: An application of choice experiments	EcE	34	5.00

Explanation: This table displays the most influential studies in the area of environmental and ecological economics published between 2000 and 2009, whereby influence is conceptualised as citations per year since publication (Cites p.a.) and 5 or more Cites p.a. are considered as indication of high influence. The first four columns show the rank of a study, a study's author(s), its publication year and its title. The fifth column states the abbreviated title of the journal, in which a study was published. Abbreviations are based on Table 1. Column sixth displays the total number of citations to a paper as recorded by ISI. The last column presents the number of citations, which a study received per year since its publication. This figure is calculated on a monthly basis as described in the main text. The values in the last column are rounded to two digits after the point, while the ranks in the first column are based on the precise values.

In analysing author influence, we follow Gauffriau and Larsen (2005), who make the case for fractional rather than full author counting (e.g. a credit of 1/3 for one of three authors rather than a credit of 1 for each of them).[2] Hence, in investigating author influence, our main metric becomes *fractional Cites p.a.* and our sub-metrics are fractional total citations and fractional publications listed among our most influential studies list. Fractional publications or fractional citations divide a publication or the citations it receives by the number of authors contributing.

However, fractional counting has the caveat that it ignores the order in which authors appear. This is unfortunate in interdisciplinary research areas such as environmental and ecological economics, in which the meaning of author ordering might vary considerably. Some papers might have a few alphabetically listed authors, whereby each author is assumed to have made an equivalent contribution to the paper. Other studies have a few authors ordered non-alphabetically but without any indication of the degree to which each author contributed. Huge author lists can occur in interdisciplinary research. In some cases, the first and last authors are seen as the most important contributors. In other cases, it is the first author who is regarded as the most important, then the second, etc. In summary, we are not able to understand the exact relationships between the co-authors and are not aware of any bibliographic dataset or method, which would enhance our understanding. Hence, we can only rely on our fractional metrics and add an alternative metric based on full author counting. As full author counting metric, we also report the total number of publications of an individual author that received sufficient citations to be included in our list. Table 4 gives influential authors in the field of environmental and ecological economics who have at least five fractional cites per year. This is a list of 91 authors.

If we use fractional citations per year as the criterion, we find that Chien-Chang Lee from National Chung Hsing University in Taiwan is in the first place with more than 33 citations. Sven Wunder from the Brazilian Center for International Forestry Research and Stefano Pagiola from the World Bank are in second and third position and they have 24 citations. As to the number of publications, we find that Wunder and Jayson Lusk from Oklahoma State both have 6

[2] Gauffriau and Larsen's (2005) case is supported by Hilmer and Hilmer (2005), who find that agricultural economists receive career returns to sole authorship but not to lead authorship of a multi author paper.

Table 3
Influence of journals in the field of environmental and ecological economics.

Journal	Characteristics of influential studies			Total publications (2000–2009)	% of papers in top 265		Total citations		Citations per annum	
	Publications	Average # of pages per article	Publication period		Value	Rank	Value	Rank	Value	Rank
Ecological Economics	108	13.46	2000–2009	1,582	6.83%	3	3957	1	803.3	1
Energy Economics	56	14.70	2000–2009	599	9.35%	1	1556	3	424.1	2
Journal of Environmental Economics and Management	38	21.00	2000–2009	453	8.39%	2	1814	2	290.1	3
American Journal of Agricultural Economics	18	14.33	2000–2009	800	2.25%	5	655	4	113.4	4
Environmental & Resource Economics	14	23.93	2001–2008	687	2.04%	6	641	5	104.3	5
Land Economics	11	15.55	2000–2008	385	2.86%	4	532	6	77.8	6
Energy Journal	6	31.17	2000–2009	305	1.97%	7	265	7	43.9	7
Agricultural Economics	4	14.00	2000–2008	492	0.81%	10	112	8	24.7	8
Resource and Energy Economics	2	18.50	2004–2008	188	1.06%	9	94	9	23.1	9
Resource Policy	3	9.33	2006–2008	181	1.66%	8	60	10	16.8	10
Journal of Agricultural Economics	2	17.00	2006	257	0.78%	11	49	11	11.9	11
Environment and Development Economics	2	19.50	2006–2008	276	0.72%	12	37	12	11.8	12
Journal of Agricultural and Resource Economics	1	17.00	2005	325	0.31%	13	31	13	5.8	13
Marine Resource Economics	0			67	0.00%	14	0	14	0.0	14
Total	*265*	*15.99*	*2000-2009*	*6,597*			*9803*		*1950.9*	

Explanation: This table displays the influence of journals focusing on the field of environmental and ecological economics, whereby influence is conceptualized as a journal's contribution to all studies in the field, which receive more than five citations on average per year. Columns one and two present the journal's name and the number of influential publications. The third column exhibits the average number of pages of an influential articles published in the respective journal, while the fourth column displays the range of years, over which the journal published influential articles. Column five presents the total publications of a journal in our sample period (2000–2009). The last six columns display the values and respective ranks of three alternative ranking criteria for journal influence: a journal's percentage of influential publications, a journal's total citations of influential publications and a journal's total citations per annum of influential articles. The journals are ordered in this table according citations per annum.

papers and share the pole position. Lee, Stephen Polasky, Ramazan Sari and Ugur Soytas all have 5 publications. Kerry Turner from East Anglia has 4 publications and ranks 7th, together with Chun-Ping Chang from National Chung Hsing University in Taiwan, David Stern from Australian National and Matthew Wilson from the University of Maryland. Lee and Wunder share the number one position if we rank along the fractional number of publications. Sadia Banchirigah from Manchester ranks 21st with fractional citations per year but is in rank 7 as to the fractional number of publications. On the basis of the fractional citations, we find that Stern is in the first place. Please note that the ordering along this criterion deviates most from that of the other three measures. For example, Wunder and Pagiola – being number 2 and 3 with fractional citations per annum – are now in places 23 and 25 respectively. In contrast, Richard Tol from Dublin and Hao-Yen Yang from Taipei – numbers 26 and 35 with fractional citations per annum – are in place 9 with overall fractional citations.

We give the Spearman rank correlation coefficients regarding Table 4 in Appendix A. It shows that the rank correlations are far from perfect. Therefore, it does substantially matter for author influence what criterion is used. Especially the rank correlation between the fractional publications and the fractional number of citations is very low (4%). Thus, it has to be defined very clearly what is meant by influence if one wants to discuss author influence. We do not want to provide and encompassing assessment of author influence as there is no objective framework to decide about the weights of the different issues involved; it is inevitably subjective to decide about the most influential author. However, we do want to point out that it is particularly necessary to account for the age effect when assessing disaggregated concepts such as authors or articles, which do not experience a mitigation of age effects due to the aggregation such as journals. The low correlations between fractional citations and both, fractional citations p.a. and number of publications are a good illustration of this aspect. The quality of fractional cites p.a. as a measure of author influence is highlighted by it correlating better with all of the three measures than any of these with each other. Therefore, we regard this measure, from a statistical perspective, as the one that is most relevant for the assessment of author influence although this statistical observation is insufficient to justify an objective framework. However, there is the issue of interdisciplinary research with a large number of co-authors which may have a different contribution to their paper. Hence, while we recommend *Cites p.a.* as most suitable measure of author influence, we would also recommend considering additional measures in any analysis of author influence to enhance the overall information value of the investigation.

The last part of the citation analysis is the investigation of the most influential institutions in the field of environmental and ecological economics. Our measures of institutional influence are equivalent to our measures of author influence with the exception that we call the total number of publications total number of affiliations, whereby a paper with two authors from the same affiliation would count twice for the institution (in a number of publication case, the paper would count only once).

Table 5 presents the influential institutions. Here, the University of Maryland and Resources for the Future lead the pack and the UK based University of East Anglia and the World Bank are the main runners up. In the top 10 of institutions, five are located in the US and two in the UK. We find that University of Maryland, Resources for the Future and University of East Anglia are always in the top 3 whether we rank along number of affiliations, fractional citations or fractional number of publications. This reveals that they have both broad and deep quality. As such, they can truly be regarded as the most influential institutions in environmental and ecological economics. We give the Spearman rank correlation coefficients regarding Table 5 in Appendix B. It shows that the rank correlations are substantial but not perfect. Therefore, to some extent, it does matter for institutional influence what criterion is used. However, compared to author influence, it appears that there is a much higher correlation and that the assessment of institution influence is not very sensitive to the criterion used.

We want to put forward, once again, the importance of adjusting for the age effect. This age effect especially seems to matter for non-aggregated units of analysis with structural differences in age such as authors and articles whose age differs virtually by definition (Tables 2 and 4 respectively). However, for more aggregated units of analysis without a necessarily material age difference such as journals and institutions (Tables 3 and 5 respectively) it has a less substantial impact. Articles that have been published take time to

Table 4
Influential authors in the field of environmental and ecological economics (2000-2009).

Rank	Name	Initials	Fractional citations	Number of publications		Fractional number of publications		Fractional citations	
			p. a.	Value	Rank	Value	Rank	Value	Rank
1	Lee	CC	33.65	5	3	2.83	1	136.83	2
2	Wunder	S	24.54	6	1	2.83	1	55.83	23
3	Pagiola	S	23.66	4	7	1.81	12	54.76	25
4	Lusk	JL	19.53	6	1	2.73	3	129.37	4
5	Wilson	MA	18.80	4	7	1.42	18	129.67	3
6	Stern	DI	18.57	4	7	2.33	4	152.67	1
7	Chang	CP	17.60	4	7	1.83	10	51.83	29
8	Sari	R	16.76	5	3	2.17	5	67.67	13
8	Soytas	U	16.76	5	3	2.17	5	67.67	13
10	Wolde-Rufael	Y	14.98	2	29	2.00	7	50.00	30
11	Polasky	S	14.34	5	3	1.87	9	90.60	7
12	Newell	RG	14.22	4	7	1.83	10	73.50	11
13	Wilen	JE	14.21	3	13	1.50	14	101.50	5
14	Narayan	PK	13.93	3	13	1.33	19	32.67	71
15	Irwin	EG	12.69	1	85	1.00	23	99.00	6
16	de Groot	RS	12.33	3	13	0.78	69	89.97	8
17	Engel	S	12.33	3	13	1.00	23	28.33	81
18	Paavola	J	12.11	3	13	1.67	13	52.83	26
19	Apergis	N	11.67	2	29	1.00	23	14.50	226
19	Payne	JE	11.67	2	29	1.00	23	14.50	226
21	Banchirigah	SM	11.33	2	29	2.00	7	37.00	65
22	Ferraro	PJ	10.88	2	29	1.50	14	40.00	56
23	Joskow	PL	10.56	2	29	1.50	14	61.50	17
24	Peters	GP	10.55	1	85	1.00	23	26.00	97
25	Popp	D	9.79	1	85	1.00	23	60.00	19
26	Robinson	J	9.56	1	85	1.00	23	61.00	18
27	Tol	RSJ	9.45	1	85	1.00	23	81.00	9
28	Scarpa	R	8.91	3	13	1.17	21	25.67	102
29	Cole	MA	8.68	2	29	1.50	14	58.00	21
30	Lenzen	M	8.60	3	13	1.00	23	55.25	24
31	Squalli	J	8.58	1	85	1.00	23	24.00	111
32	Smyth	R	8.57	2	29	0.83	62	17.67	179
33	Boumans	RMJ	8.48	1	85	0.33	244	69.67	12
34	Farber	S	8.44	3	13	0.75	71	65.83	15
35	Yang	HY	7.93	1	85	1.00	23	81.00	9
36	Tavoni	M	7.92	3	13	1.00	23	5.67	440
37	Turner	RK	7.83	4	7	0.87	61	41.77	47
38	Suh	S	7.68	1	85	1.00	23	49.00	32
39	Altinay	G	7.65	2	29	1.00	23	40.50	51
39	Karagol	E	7.65	2	29	1.00	23	40.50	51
41	Jumbe	CBL	7.54	1	85	1.00	23	50.00	30
42	Bennett	MT	7.40	1	85	1.00	23	17.00	184
43	Max-Neef	MA	7.25	1	85	1.00	23	39.00	59
44	Plantinga	AJ	7.24	3	13	1.33	19	36.33	68
45	Banzhaf	S	7.22	1	85	0.50	98	22.00	131
45	Boyd	J	7.22	1	85	0.50	98	22.00	131
47	Carson	RT	6.98	2	29	0.67	78	20.33	157
48	Wiser	RH	6.67	1	85	1.00	23	22.00	131
49	Wiedmann	T	6.62	2	29	0.75	71	25.75	101
50	Akinlo	AE	6.62	1	85	1.00	23	13.00	245
51	Sadorsky	P	6.53	1	85	1.00	23	27.00	91
52	Stavins	RN	6.52	3	13	1.00	23	28.33	81
53	Pizer	WA	6.39	2	29	1.00	23	46.50	40
54	Harrison	GW	6.25	1	85	1.00	23	27.00	91
55	Binswanger	M	6.23	1	85	1.00	23	60.00	19
56	Auffhammer	M	6.09	1	85	0.50	98	14.00	233
57	Welsch	H	6.05	1	85	1.00	23	25.00	106
58	Brouwer	R	6.03	2	29	1.06	22	62.22	16
59	Smith	MD	6.03	1	85	0.50	98	42.00	45
60	Gintis	H	5.87	1	85	1.00	23	57.00	22
61	Costanza	R	5.78	2	29	0.58	87	47.50	36
62	Crompton	P	5.77	1	85	0.50	98	32.50	73
62	Wu	YR	5.77	1	85	0.50	98	32.50	73
64	Costello	C	5.66	2	29	0.70	75	15.50	204
65	Kotchen	MJ	5.66	2	29	1.00	23	39.00	59
66	Bosetti	V	5.59	2	29	0.83	62	4.00	493
66	Schwarzlmuller	E	5.59	1	85	1.00	23	4.00	493
68	Carlsson	F	5.58	2	29	0.83	62	48.33	35
69	Gallet	CA	5.56	1	85	0.50	98	49.00	32
69	List	JA	5.56	1	85	0.50	98	49.00	32
71	DeShazo	JR	5.47	1	85	0.50	98	44.50	42
71	Fermo	G	5.47	1	85	0.50	98	44.50	42

(continued on next page)

Table 4 (*continued*)

Rank	Name	Initials	Fractional citations	Number of publications		Fractional number of publications		Fractional citations	
			p. a.	Value	Rank	Value	Rank	Value	Rank
73	Springer	U	5.46	1	85	1.00	23	38.00	63
74	Poe	GL	5.44	2	29	0.83	67	37.17	64
75	Matthews	HS	5.42	1	85	0.50	98	12.00	264
76	Weber	CL	5.42	1	85	0.50	98	12.00	264
77	Singh	B	5.36	1	85	0.50	98	15.00	216
78	Bunn	DW	5.30	2	29	0.67	78	46.83	39
79	Pannell	DJ	5.22	1	85	1.00	23	12.00	264
80	Halicioglu	F	5.19	1	85	1.00	23	18.00	176
81	Odhiambo	NM	5.18	1	85	1.00	23	5.00	464
82	Sneeringer	S	5.17	1	85	1.00	23	8.00	368
83	Ferrini	S	5.15	1	85	0.50	98	17.00	184
83	Regnier	E	5.15	1	85	1.00	23	17.00	184
85	Kaufmann	RK	5.15	2	29	0.83	62	44.17	44
86	Pearce	D	5.12	1	85	1.00	23	17.00	184
87	Adamowicz	WL	5.11	1	85	0.50	98	39.50	57
87	Boxall	PC	5.11	1	85	0.50	98	39.50	57
89	Hamilton	JD	5.07	1	85	1.00	23	7.00	394
90	Hubacek	K	5.04	3	13	0.77	70	31.02	77
91	Zamani	M	5.00	1	85	1.00	23	14.00	233

Explanation: This table displays influential authors in the field of environmental and ecological, whereby influence is conceptualized as an author's contribution to all studies in the field, which receive more than five citations on average per year. Authors are ranked is this table based on fractional citations per annum. To calculate this measure, each study's citation per annum values are equally shared between its authors. For instance, if a study with three authors received 15 citations p.a., each author is assigned a value of 5 fractional citations p.a. Subsequently, multiple fractional citations per annum values of an individual author are summed up. An author's rank is presented in the first column, his/her name and initials in the subsequent two columns and the author's fractional citations per annum value in the fourth column. The last six columns display the values and respective ranks of three alternative ranking criteria for author influence: an author's number of influential publications, an author's fractional number of influential studies and an author's fractional citations of influential publication.

become cited and this means that more recent papers are disadvantaged. We control for this and, as such, are able to arrive at a more precise way to determine author and article influence. With journals, the age effect is less severe at least in fixed samples like ours (If we did not impose an earlier publication year limit on our sample, age effects would likely matter more for journals too.). This may be due to specialization by the journals in the field, to their adherence to a particular quality standard and to publication volume. This specialization, quality standard and publication volume do not appear to change a lot over time. As to institutions, the age effect also is not that important because there usually will be a group of researchers and PhDs working in the field which allows for continuity in the production of articles.

4. Conclusion

We investigate the influence of articles, authors, journals and institutions in the field of environmental and ecological economics. The main measure in our age adjusted analysis of the influence of articles, journals, authors and institutions is *citations per year since publication* (*Cites p.a.*) (Costanza et al., 2004; Keloharju, 2008; Schwert, 2007). Conceptually, *Cites p.a.* represent the ratio of the total citations received by an article divided by the decimal years passed since the article's publication. We depart from studies that investigated the literature until 2001 and include a time period that has witnessed an enormous increase of the academic and societal importance in the field. We adjust for age given the huge impact of the year of an article's publication on its influence. We analyse 6597 studies on environmental and ecological economics published between 2000 and 2009.

On the basis of our analysis, we can come up with a clear perspective of what the most influential articles are, journals, and institutions. With respect to the influence of authors, we find it is much more complex and subjective. Hence, we are hesitant to conclude that one most influential author exists. Instead, we consider our results to indicate many influential authors, whose precise ranking depends considerably on the metric employed.

As to the most influential articles, we find that De Groot et al. (2002) on classifying ecosystem attributes has 25 *Cites p.a.* and is to be regarded as the most influential paper in environmental and ecological economics published in the 21st century. Second is the review paper by Engel et al. (2008) with almost 17 citations per year. Lee's (2005) paper on energy consumption and GDP ranks third with 16 citations per year. The Turner et al. (2003) paper on valuing nature has almost 16 citations and is in the fourth place. We establish that Ecological Economics, Energy Economics and the Journal of Environmental Economics and Management have the most influential articles, publish very influential authors and are cited most. These three journals have to be regarded as the most influential. At the author level, we establish that the criterion used to assess author influence greatly matters. On the basis of (fractional) citations per year (see Gauffriau and Larsen, 2005), we find that Chien-Chang Lee, Sven Wunder and Stefano Pagiola rank first, second and third respectively. With the number of publications, Sven Wunder and Jayson Lusk rank first with six publications, before Chien-Chang Lee, Stephen Polasky, Ramazan Sari, and Ugur Soytas with five publications. On the basis of the fractional number of publications, we rank Lee first, Wunder second, and Lusk third. With regard to the overall fractional citations, David Stern is in the first place, before Chien-Chang Lee and Matthew Wilson. The University of Maryland, Resources for the Future, the University of East Anglia and the World Bank appear to be the most influential institutions in the field of environmental and ecological economics in the 21st century.

These results build on previous citation analyses regarding environmental and ecological economics which predominantly focused on the 20th century (Costanza et al., 2004; Kohlstad, 2000; Ma and Stern, 2006; Smith, 2000). We investigate the influential articles, authors and journals in the field on the basis of articles published in the 21st century when the field gained increasing academic and societal importance. Our analysis of the most influential institutions in the field has not been done before over any sample period. Our citation

Table 5
Most influential institutions in the field of environmental and ecological economics (2000–2009).

Rank	Institution	Country	Fractional cites p.a.	Number of affiliations		Fractional cites		Fractional number publications	
				Value	Rank	Value	Rank	Value	Rank
1	University of Maryland	USA	57.99	22.00	2	393.67	1	5.17	3
2	*Resources for the Future*	USA	52.75	16.00	3	287.50	3	7.00	1
3	University of East Anglia	UK	47.72	25.50	1	290.77	2	5.90	2
4	*World Bank*	USA	46.00	13.00	5	176.45	7	4.68	4
5	National Chung Hsing University	Taiwan	33.65	5.00	28	136.83	12	2.83	14
6	Vrije University Amsterdam	Netherlands	33.19	14.67	4	205.81	5	4.53	5
7	*Centre for International Forestry Research (CIFOR)*	Indonesia	29.36	7.50	13	97.83	22	3.58	9
8	Ohio State University	USA	29.32	9.00	10	208.17	4	3.83	8
9	University of California at Berkeley	USA	27.92	12.00	6	126.27	13	3.97	6
10	University of Leeds	UK	25.75	11.50	7	110.77	15	3.52	10
11	University of California, Davis	USA	22.25	7.50	13	147.23	10	2.82	15
12	University of British Columbia	Canada	22.23	6.00	21	150.00	8	3.00	12
13	University of Manchester	UK	22.18	9.00	10	108.85	16	3.93	7
14	Middle East Technical University	Turkey	21.95	6.50	18	75.33	32	2.83	13
15	Stanford University	USA	21.25	6.50	18	193.13	6	2.79	16
16	*US Department of Agriculture*	USA	19.98	9.00	10	149.67	9	3.28	11
17	Wageningen University	Netherlands	18.88	6.50	18	102.70	20	1.66	37
18	University of Western Australia	Australia	18.17	4.00	41	89.25	28	2.25	21
19	Georgia State University	USA	18.09	3.00	59	62.00	42	2.00	23
20	Purdue University	USA	17.35	7.00	15	108.00	17	2.50	19
21	Yale University	USA	17.10	10.50	9	105.67	18	2.78	17
22	Massachusetts Institute of Technology	USA	16.11	5.00	28	95.50	24	2.50	19
23	Abant Izzet Baysal University	Turkey	15.91	4.50	38	66.00	35	2.00	23
24	ETH Zurich	Switzerland	15.89	5.50	24	38.87	76	1.80	30
25	University of Sydney	Australia	15.42	5.00	28	104.50	19	1.75	31
26	Oregon State University	USA	15.35	7.00	15	97.70	23	2.57	18
27	Shih Chien University	Taiwan	14.37	3.00	59	36.33	80	1.33	47
28	University of Minnesota	USA	14.34	5.00	28	90.60	27	1.87	26
29	University of Massachusetts	USA	14.07	4.00	41	102.00	21	1.75	31
30	North China Electric Power University	China	14.03	5.00	28	29.25	97	1.75	31
31	Australian National University	Australia	14.00	3.00	59	142.17	11	1.83	28
32	Carnegie Mellon University	USA	13.99	2.33	85	51.00	51	1.33	47
33	Monash University	Australia	13.79	4.00	41	29.67	96	1.83	28
34	Klagenfurt University	Austria	13.77	11.00	8	45.86	61	1.86	27
35	*Fondazione Eni Enrico Mattei*	Italy	13.43	5.33	27	22.31	118	2.14	22
36	Duke University	USA	13.18	3.50	57	53.33	49	1.42	46
37	University of York	UK	13.14	6.00	21	53.75	48	1.50	40
38	Kansas State University	USA	12.72	6.00	21	93.67	25	1.93	25
39	University of California at San Diego	USA	12.04	3.00	59	27.33	100	1.67	36
40	Illinois State University	USA	11.67	2.00	86	14.50	159	1.00	70
40	University of Piraeus	Greece	11.67	2.00	86	14.50	159	1.00	70
42	Indiana University	USA	11.57	3.00	59	122.00	14	1.00	70
43	Norwegian University of Science and Technology	Norway	11.24	2.00	86	26.90	104	1.10	67
44	University of Michigan	USA	10.65	5.00	28	63.75	39	1.75	31
45	University of Illinois at Urbana-Champaign	USA	10.55	3.50	57	69.92	33	1.13	66
46	Cornell University	USA	10.53	5.00	28	54.42	46	1.58	38
47	University of Alberta	Canada	10.21	2.00	86	79.00	30	1.00	70
48	Lund University	Sweden	10.18	4.33	40	65.08	37	1.33	47
49	Princeton University	USA	9.90	3.00	59	42.81	65	1.19	57
50	Deakin University	Australia	9.80	2.50	80	20.50	124	1.00	70

Explanation: This table displays the most influential institutions in field of environmental and ecological economics, whereby influence is conceptualized as an institution's contribution to all studies in the field, which receive more than five citations on average per year. Institutions are ranked is this Table based on fractional citations per annum. To calculate this measure, each study's citation per annum value is equally shared between its authors. For instance, if a study with three authors received 15 citations p.a., each author is assigned a value of 5 fractional citations p.a. Subsequently, the fractional citations per annum values of each individual author affiliated with an institution are summed up. (If an author is affiliated with multiple institutions, each institution receives an equal share of the author's fractional citations.) An institution's rank is presented in the first column, its name and country of origin in the subsequent two columns and the institution's fractional citations per annum value in the fourth column. The last six columns display the values and respective ranks of three alternative ranking criteria for institutions influence: an institution's total number of author affiliations within the group of influential studies, (which represents the sum of the publications of authors solely affiliated with the institution plus the sum of the institution's share of each publication by authors affiliated with multiple institutions); an institution's fractional citations of influential studies; and an institution's fractional number of publications among the most influential studies in the field of environmental and ecological economics. (This last criterion shares the credit for a publication equally among its authors and allocates the credit for an author equally among its affiliated institutions.)

analysis is free from the age effect and our results highlight the relevance of an age adjustment especially for disaggregated units of analysis with structural age differences such as articles and authors. We furthermore find that more international editorial boards appear to be better in promoting their best journal articles than editorial boards originating from a small number of countries. As such, we think we have added value to the existing literature.

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Appendix A. Spearman rank correlation coefficients between ranking criteria used in for author influence in Table 4.

	Fractional citations per annum	Number of publications	Fractional number of publications	Fractional citations
Fractional citations per annum	1	0.57	0.44	0.45
Number of publications		1	0.34	0.29
Fractional number of publications			1	0.04
Fractional citations				1

Explanation: This appendix displays the Spearman rank correlations between the ranking criteria used in Table 4: Fractional citations per annum; number of publications; fractional number of publications; and fractional citations. The calculations are based on the data points presented in Table 4.

Appendix B. Spearman rank correlation coefficients between ranking criteria used for institution influence in Table 5.

	Fractional citations per annum	Number of affiliations	Fractional citations	Fractional number of publications
Fractional citations per annum	1	0.72	0.65	0.64
Number of affiliations		1	0.61	0.88
Fractional citations			1	0.86
Fractional number of publications				1

Explanation: This appendix displays the Spearman rank correlations between the ranking criteria used in Table 5: Fractional citations per annum; number of affiliations; fractional citations; and fractional number of publications. The calculations are based on the data points presented in Table 5.

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