

Determinants of citations in *Ecological Economics*, 2005-2018

M. Ballandonne¹, I. Cersosimo² and C. Fouillet³

¹ESSCA School of Management
1 rue Joseph Lakanal. 49003 Angers, FRANCE
Email: matthieu.ballandonne@essca.fr

²ESSCA School of Management
1 rue Joseph Lakanal. 49003 Angers, FRANCE
Email: igor.cersosimo@essca.fr

³ESSCA School of Management
1 rue Joseph Lakanal. 49003 Angers, FRANCE
Email: cyril.fouillet@essca.fr

ABSTRACT

We contribute to the literature studying ecological economics through the lens of bibliometrics by examining the determinants of citations to contributions published in the journal Ecological Economics from 2005 to 2018. We use a negative binomial regression model to examine the influence of theoretically chosen explanatory variables on the documents' cumulative citation counts. Results show that the cumulative number of citations received is positively related to publishing in a special issue, with an increase in the number of authors, the number of author-provided keywords, the length of the abstract, the number of cited references, publishing with an open access option, and the length of the contribution. Cumulative citations are nevertheless negatively correlated with title length and with the publication of "other" contents (book reviews, corrections, letters, news items, and reprints) as compared to regular articles.

Keywords: Bibliometrics, citations analysis, ecological economics, negative binomial regression, scientometrics

JEL Classification: B4, Q0

Mathematics Subject Classification: 62

1. INTRODUCTION

That scholars live in a "publish or perish" era is widely acknowledged (e.g., Moosa, 2018). The number of publications achieved by an author is a crucial indicator in research evaluation. Besides the number of publications, the number of citations to those publications has also had a tremendous influence. One of the most well-known indicators in research evaluation combining these two aspects is the *h*-index (Hirsch, 2005). This number indicates that an author (or research group or institution) has *h* publications

each cited at least h times. In other words, getting cited has become as important for scholars – for career progress, institutional and peer recognitions, etc. – as publishing.

The aim of this article is to examine a classic question in bibliometrics – what the determinants of citations are – for ecological economics, which can be broadly defined as “an interdisciplinary field of research focused on the interactions between the economy and the environment” (Shmelev, 2012, p.3). Answering this question is important for scholars in the field and for editorial policies. It also sheds a broader light on the determinants of citations in economics.

Ecological economics has already been the object of several bibliometrics studies (Ballandonne, 2019; Castro e Silva and Teixeira, 2011; Costanza et al., 2004; 2016; Hoepner et al., 2012; Ma and Stern, 2006; Teixeira and Castro e Silva, 2015). Polyakov et al. (2017) have examined the determinants of citations of nineteen journals (including *Ecological Economics*, hereafter *EE*) belonging to the Q category of the *Journal of Economics Literature* classification, i.e., agricultural, resource, environmental, and ecological economics (AREE). Their broad scope assumes that we could talk about “the field of AREE economics” (Polyakov et al., 2017, p.1387). This is, nevertheless, a controversial assumption. As summarized, for instance, in Ballandonne (2019), one of the issues is the different methodological grounds and approaches between ecological economics and environmental economics. For instance, van den Bergh (2001, p.13) notes that “On the one hand, ecological economics offers criticism of the [environmental and resource economics] approach, and, on the other, it tries to develop and apply alternative methods and approaches.” Ecological and environmental (and also resource) economics have thus been considered distinct fields. As Hoepner et al. (2013) also put it: “We do not suggest that ecological economics is the same as agricultural, resource or environmental economics. It is not...Nor is it a subfield of resource and environmental economics, just like environmental economics is not a subfield of ecological economics” (p.174). Consequently, as in Ballandonne (2019) and Castro e Silva and Teixeira (2011), we focus on the journal *EE* to represent the field of ecological economics. Indeed, Castro e Silva and Teixeira (2011, p.850) characterize *EE* as the “area’s [ecological economics] ‘seed’ journal.” We believe this methodological choice is also more useful for authors’ publishing strategies and for editorial policies, considering that these are made at a journal, rather than at a field, level.

Table 1a and 1b: Literature review of citations' determinants (NS: natural sciences, SS: social science, Mix: natural and social sciences)

Independent Variable	Positive effect	Negative effect	No significant effect
Open Access ¹	Timsit et al. (2019) (NS)		Craig et al. (2007) (literature review); Kurtz et al. (2005) (NS)
Special Issue	Conlon et al. (2006) (SS); Olk and Griffith (2004) (SS); Varela (2013) (SS)		
Type of document	Adusumilli et al. (2005) (NS) for conference; Annalingam et al. (2014) (NS) for reviews and research studies; Biscaro and Giupponi (2014) (Mix) for reviews; Peters and van Raan (1994) (NS) for reviews; Timsit et al. (2019) (NS)	Bormann and Williams (2013) for proceedings (NS)	Adusumilli et al. (2005) (NS) for conference
Number of authors	Annalingam et al. (2014) (NS); Biscaro and Giupponi (2014) (Mix); Bormann and Williams (2013) (NS); Borsuk et al. (2009) (NS); Didegah and Thelwall (2013a) (Mix) (2013b) (NS); Fox et al. (2016) (NS); Kostoff (2007) (NS); Leimu and Koricheva (2005a) (NS), (2005b) (NS); Peters and van Raan (1994) (NS); Polyakov et al. (2017) (SS); Rigby (2013) (NS); Sooryamoorthy (2009) (NS); Uddin and Khan (2016) (Mix); Timsit et al. (2019) (NS); Vieira and Gomes (2010) (NS); Wojciechowski et al. (2017) (NS)	Conlon et al. (2006) (SS); Didegah and Thelwall (2013b) (NS); So et al. (2015) (NS); Stremersch et al. (2007) (SS)	Bormann et al. (2012) (NS); Didegah and Thelwall (2013b) (NS); Falagas et al. (2013) (NS); Stremersch et al. (2007) (SS)
Number of keywords	So et al. (2015) (NS); Stremersch et al. (2007) (SS); Uddin and Khan (2016) (Mix)	Didegah and Thelwall (2013a) (Mix)	Stremersch et al. (2007) (SS)

¹ For definitions of the open access categories used by Clarivate Analytics, see: https://images.webofknowledge.com/WOK48B3/help/WOK/hp_results.html (accessed May 5th, 2021).

Independent Variable	Positive effect	Negative effect	No significant effect
Length of the Title	Annalingam et al. (2014) (NS); Jacques and Sebire (2010) (NS)	Ayres and Vars (2000) (SS); Didegah and Thelwall (2013a) (Mix); Letchford et al. (2015) (Mix); Stremersch et al. (2007) (SS); Subotic and Mukherjee (2014) (SS)	Annalingam et al. (2014) (NS); Falagas et al. (2013) (NS); Jamali and Nikzad (2011) (NS); Rostami et al. (2014) (Mix); Stremersch et al. (2007) (SS); Uddin and Khan (2016) (Mix)
Length of the contribution	Ayres and Vars (2000) (SS); Bormmann and Williams (2013) (NS); Conlon et al. (2006) (SS); Didegah and Thelwall (2013a) (Mix); Falagas et al. (2013) (NS); Fox et al. (2016) (NS); Judge et al. (2007) (SS); Kostoff (2007) (NS); Leimu and Koricheva (2005b) (Mix); Polyakov et al. (2017) (SS); Stremersch et al. (2007) (SS); Uddin and Khan (2016) (Mix); Vieira and Gomes (2010) (NS); Xie et al. (2019) (Meta-analysis)	So et al. (2015) (NS)	Didegah and Thelwall (2013a) (Mix); Judge et al. (2007) (SS); Peters and van Raan (1994) (NS); Rigby (2013) (NS)
Length of the abstract	Didegah and Thelwall (2013a) (Mix); Kostoff (2007) (NS); Weinberger et al. (2015) (Mix)		Falagas et al. (2013) (NS)
Number of references	Didegah and Thelwall (2013a) (Mix); (2013b) (NS); Fox et al. (2016) (NS); Judge et al. (2007) (SS); Kostoff (2007) (NS); Peters and van Raan (1994) (NS); Polyakov et al. (2017) (SS); Rigby (2013) (NS); So et al. (2015) (NS); Vieira and Gomes (2010) (NS)		Falagas et al. (2013) (NS)
Number of countries²	Didegah and Thelwall (2013a) (Mix); Glänzel (2001) (NS); Glänzel and de Lange (2002) (NS); Narin et al. (1991) (NS); Polyakov et al. (2017) (SS); Sooryamoorthy (2009) (NS); Wojciechowski et al. (2017) (NS)	Didegah and Thelwall (2013b) (NS)	Didegah and Thelwall (2013a) (Mix) (2013b) (NS); Glänzel and de Lange (2002) (NS); Leimu and Koricheva (2005a) (NS); Rigby (2013) (NS)

² Some contributions in our dataset have authors indicating several countries, because of multiple institutional affiliations. We kept these as a sign not of international collaboration but of international research. In other words, the number of countries represents the international character of the research conducted, which is not necessarily the same as international collaboration. Also, we are grateful to Web of Science (Clarivate Analytics) for providing us a list of the abbreviations of the names of countries they use. We complemented that list with the information provided by Web of Science Core Collection Help at: https://images.webofknowledge.com/images/help/WOS/hs_country_abbreviations.html (accessed May 5th, 2021).

2. DATA COLLECTION

EE is indexed in the Clarivate Analytics Web of Science (WoS) Core Collection database. We collected, in September 2021, the information about documents published in *EE* from 2005 to 2018³. We chose 2018 as the end year to guarantee a two-year minimum “citation window” to each publication, enabling all documents we study to be cited (see Waltman, 2016). As we will see below, this citation window is important for some of our modeling choices. We will also consider the effect of time on cumulative citations by including a time variable in our regression model. The start year is, in turn, motivated by the wish to obtain a reasonable amount of data while studying relatively recent publications.

The dataset is initially of 4,032 documents. To convert the WoS text files into a format enabling data processing, we used the *R* (R Core team, 2020) package *bibliometrix* developed by Aria and Cuccurullo (2017). The dataset is then reduced to 3,962 documents after removing one duplicate, three untitled contributions, and 66 documents with no information on authors' affiliation.

3. REGRESSION MODEL

3.1. Dependent variable

The dependent variable is the number of cumulative citations achieved by the documents from their date of publication to the date of data collection. This information is stored in WoS Z9 tag.⁴ We provide summary statistics and the histogram of the dependent variable in Table 2 and Figure 1, respectively. The dependent variable is a count variable, that is discrete and non-negative. It exhibits classic characteristics for citations counts data (Mingers and Burell, 2006; Seglen, 1992). Specifically, a large share of documents (5.58%) received zero citations, and the variable is overdispersed (its variance is larger than its mean, see Table 2). We shall see below how these elements, combined with theoretical reasons, influence the choice of the regression model we use.

³ Our WoS query was: “*Date of data collection*: September 07, 2021; *Database*: WoS Core Collection; *Query*: SO = “ECOLOGICAL ECONOMICS”; *Time-span*: 2005-2018; *File output*: Plain text”.

⁴ The Z9 tag is defined as the total times cited count in Web of Science Core Collection, BIOSIS Citation Index, Chinese Science Citation Database, Data Citation Index, Russian Science Citation Index, SciELO Citation Index (see https://images.webofknowledge.com/images/help/WOS/hs_wos_fieldtags.html, accessed May 5th, 2021).

Table 2: Summary statistics of independent variables

Variables	Description	Min	Max	Mean	Std. Dev.
citations	Cumulative citations count (Z9 tag)	0	2913	46.55	96.42
nb_authors	Number of authors	1	36	2.69	1.88
nb_keywords	Number of author-provided keywords	0	18	4.60	2.05
nb_char_title	Number of characters in the title	8	230	91.50	30.17
nb_char_ab	Number of characters in the abstract	0	3959	1106.79	484.79
nb_refs	Number of cited references	0	331	49.88	28.94
nb_pages	Number of pages	1	49	10.13	4.01
nb_countries	Number of different countries mentioned in the address field	1	13	1.42	0.77
diff_time	Difference (in days) between the date of publication (1st day of the month considered if the day is missing) and the date of data collection	1011	6089	3471.23	1486.14
ln_diff_time	Natural logarithm of diff_time	6.92	8.71	8.04	0.50
		Count of 0	Count of 1		
OA_DUMMY	Open-Access dummy (1 if any open-access option is mentioned; 0 otherwise)	3089	873		
SI_DUMMY	Special Issue dummy (1 if published in special issue; 0 otherwise)	3925	37		
doc_type	Document type (can take the five values below)	Count			
ARTICLE	Includes contributions tagged "ARTICLE"	3420			
EDITORIAL MATERIAL	Includes contributions tagged "EDITORIAL MATERIAL"	161			
PROCEEDINGS PAPER	Includes contributions tagged "ARTICLE; PROCEEDINGS PAPER"	81			
REVIEW	Includes contributions tagged "REVIEW"	57			
OTHER	Includes contributions tagged "BOOK REVIEW", "CORRECTION", "LETTER", "NEWS ITEM" and "REPRINT"	243			

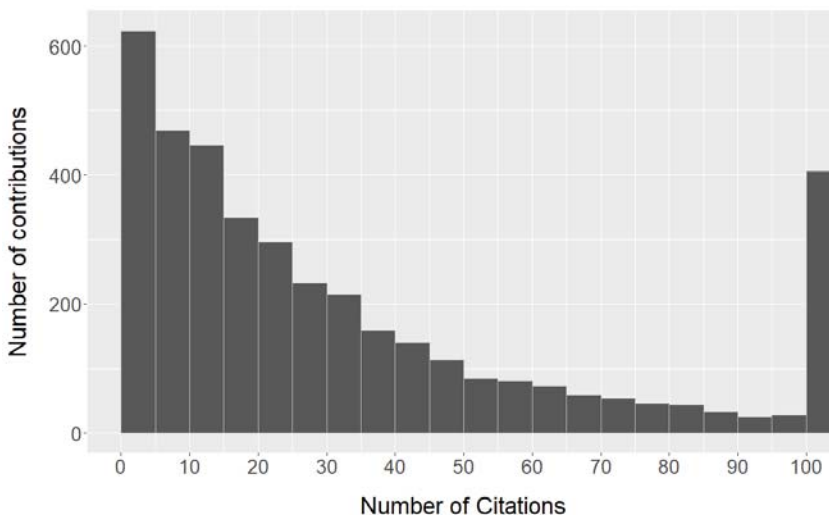


Figure 1. Histogram of the number of cumulative citations (the final category on the right tail of the distribution aggregates all papers with a citation count greater than 100)

3.2. Explanatory variables

To determine the explanatory variables, we use the literature reviews by Bornmann et al. (2012), Didegah and Thelwall (2013a; 2013b), Mingers and Xu (2010), Onodera and Yoshikane (2015), Tahamtan et al. (2016), and Waltman (2016). Table 1a and Table 1b show the independent variables we chose, with a *non-exhaustive* list of the contributions that have investigated them before. Contributions are organized according to the direction of the relationship found and the disciplines studied (which we broadly classify as natural sciences, social sciences, or both). Tracking all possible combinations of research fields and modeling choices is beyond the scope of our study. Therefore, we use Table 1a and Table 1b only to inform our choice of explanatory variables and, later in the article, to position our results in the literature. Some contributions appear in more than one column of Table 1a and Table 1b for the same variable. This happens because some papers investigate more than one field of research, use different modeling options with different results or study different periods. For instance, Glänzel and de Lange (2002) show a positive effect of multinational research on citations for papers in biomedical research, but no effect for chemistry. In addition, Stremersch et al. (2007) use nested models and find, for instance, that the effect of the number of keywords is positive and significant in one nested model, while it is non-significant in the full model. Finally, Didegah and Thelwall (2013b) use the same model on contributions published in different years and find that the effect of some variables is not constant over time. We provide summary statistics of the independent variables in Table 2.

We account for the different types of contributions by creating a categorical variable *doc_type* that can take five different values, corresponding to traditional articles, proceedings papers, review papers, editorial contents, and other contributions (where we include book reviews, corrections, letters, news items, and reprints). The type of document is obtained by transforming the information contained in WoS DT tag – details are given in Table 2. The document type “PROCEEDINGS PAPERS” (“ARTICLE; PROCEEDINGS PAPERS” in WoS) represents contributions for which a conference is mentioned and can thus also be used as a proxy for examining the effect of conferences on citations.

Finally, as in most other studies on the determinants of citations, we do not consider variables representing the reputation of the authors or the quality of the contributions. Concerning the dynamic impact of the reputation of the authors on citations, a well-known effect in bibliometrics is the so-called Matthew effect, according to which advantages (or disadvantages) beget further advantages (or disadvantages). In other words, famous authors are more cited, becoming even more famous and attracting further citations (see Wang, 2014). Concerning the quality of the contributions, Mingers and Xu (2010) emphasize the difficulties of accounting for it in quantitative citations analysis: “We might hope that it is the quality of the paper that determines how often it is cited, but how can one measure quality except through circular factors such as the journal it is published in or the number of citations?” (p.423). Focusing on one journal, as we do, also has the advantage that we can reasonably assume that the quality of the contributions published in *EE* was consistent during the period studied.

Table 1a and Table 1b show that the literature studying the influence of a document’s characteristics on the citations it received often offers conflicting results. This suggests that the results obtained are field-specific and that micro studies, like ours, are important for understanding the factors affecting citations in specific fields of research.

3.3. Negative binomial model

As we noted, our dependent variable is an overdispersed count variable. We chose a negative binomial (NB) model for theoretical and statistical reasons.

We first discarded the use of ordinary least square models. As Long and Freese (2014, p.481) note: “Although the linear regression model has often been applied to count outcomes, these estimates can be inconsistent or inefficient...it is much safer to use models specifically designed for count outcomes.” The main candidates in our case are usually Poisson, Negative Binomial, and their Zero-Inflated variants. We chose a NB regression model over a Poisson model because the former accounts for overdispersion, while the latter does not (the Poisson regression model assumes equality of mean and variance for the dependent variable).

We then chose the NB model over its Zero-Inflated variant (ZINB). Long and Freese (2014) describe a ZINB model as follows: “A zero-inflated model assumes that there are two latent (that is, unobserved) groups. An individual in the ‘always 0’ group...has outcome 0 with a probability of 1, whereas an individual in the ‘not always 0’ group...might have outcome 0, but there is a nonzero probability that the individual has a positive count” (p.535). In other words, adopting a ZINB model would mean that we have a theoretical reason to believe that some documents would never receive any citation, which is not always realistic. For instance, Long and Freese (2014) study the number of publications by scholars. To justify the choice of a ZINB model, they assume that some individuals in their sample did not publish because they never get the opportunity to do so, for instance because they work in places “where publishing is not allowed” (p.535). As Biscaro and Giupponi (2014) also summarize: “Nonetheless the large number of articles in the dataset whose *citation count* takes value 0, we still prefer the negative binomial model to a zero-inflated Poisson, because the latter model assumes that many of the observations that take value zero are drawn from a different distribution in which articles will never be cited. In our case, there is no theoretical reason to assume that non-cited articles come from a different distribution” (p.7). Indeed, as soon as they are published, documents get a chance to be cited, even if they end up not being cited. The only theoretical possibilities that could explain that a contribution has a null probability of getting cited is that the contribution is never published or that the time-window for collecting citations counts is extremely short. We ruled out both possibilities by analyzing only published contributions and by granting a two-year minimum citation window to each document.

Furthermore, the response variable does not represent the citations received per unit of time, but the cumulative number of citations received from the date of publication to the date of data collection – the difference between the two dates being represented by the variable *diff_time*. It is common practice in counts regression models to correct for the time effect by adding the logarithm of the time variable and to constrain its coefficient to 1 (what is called an offset). Nevertheless, constraining the coefficient of the offset to 1 means that the chances of being cited are constant over time, which is also not the case, considering that the relationship between time and citations usually follow life-cycle patterns (e.g., Anauati et al., 2016; Bouabid, 2011). We, therefore, reject the use of a constrained offset and – as suggested by Long and Freese (2014, p. 506) – we consider the logarithm of time as an explanatory variable which coefficient is estimated as are the other coefficients in the model.

Our negative binomial regression model is the following (see also Long and Freese 2014, p.507):

$$E(y_i | x_i) = \tilde{\mu}_i = \exp[\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki} + \beta_t \ln(t_i) + \varepsilon_i]$$

Where $x_1, \dots, x_n$ are the explanatory variables, y_i is the dependent variable, $\ln(t_i)$ is the logarithm of our time variable and ε_i is an error term assumed to be uncorrelated with the explanatory variables. Also, $\exp(\varepsilon)$ is assumed to have a gamma distribution and a parameter α is used to determine the degree of

(over)dispersion of predictions, by specifying the variance function of the dependent variable given the explanatory ones. We used Stata's default variance function (Long and Freese 2014, p.509):

$$Var(y_i|x) = \mu_i + \alpha\mu_i^2$$

When $\alpha = 0$, the conditional variance is equal to the conditional mean (there is no overdispersion) and we get the Poisson regression model. When $\alpha > 0$, the conditional variance is higher than the conditional mean (overdispersion). Stata *nbg* estimation procedure "forces the estimate of α to be positive as required for the gamma distribution" (Long and Freese 2014, p.510).

4. RESULTS

The estimation procedure was carried out using Stata 15.1 *nbg* function (StataCorp, 2017). The coefficients are calculated via maximum likelihood estimation. Following the recommendation of Long and Freese (2014, p.512-514), we use robust standard errors to account for heteroskedasticity. Results are provided in Table 3. To interpret the results, we follow Tu (2019) in commenting only on the significance (at the 5% level) and signs of coefficients, other things being equal. Similarly to a linear model, a positive coefficient indicates a positive relationship between the dependent and the explanatory variable (an increase in the explanatory variable corresponds to an increase in the dependent one); a negative coefficient means a negative relationship, and a null coefficient indicates no relationship. To interpret the magnitude of the effects, however, we need to consider the exponential nature of the model. More precisely: "For a unit change in x_k , the expected count changes by a factor of $\exp(\beta_k)$, holding other variables constant" (Long and Freese, 2014, p.491) where β_k is the coefficient estimated for the variable x_k . To put it differently, for a unit change in x_k , the expected count is multiplied by $\exp(\beta_k)$ or, as in Long and Freese (2014, p.490):

$$\frac{E(y|x, x_k + 1)}{E(y|x, x_k)} = e^{\beta_k}$$

In Table 3, we only show the raw coefficients since, for our purposes, they make for an easier qualitative interpretation. We place our results in relation to the literature review presented in Table 1a and Table 1b and, when applicable, to Polyakov et al. (2017).

We find that the number of citations received is significantly positively related to the number of authors. This is in line with most studies in our review and with Polyakov et al. (2017). Other studies, however, find a negative or no effect.

Table 3: Results of the negative binomial regression

	Coefficient	Std. Err.	p-value
OA_DUMMY	0.1295	0.0637	0.042
SI_DUMMY	0.4769	0.1774	0.007
nb_authors	0.0575	0.0129	0.000
nb_keywords	0.0420	0.0134	0.002
nb_char_title	-0.0027	0.0008	0.000
nb_char_ab	0.0003	0.0001	0.000
nb_refs	0.0118	0.0011	0.000
nb_pages	0.0139	0.0067	0.037
nb_countries	0.0620	0.0320	0.053
ln_diff_time	1.2619	0.0519	0.000
doc_type			
EDITORIAL MATERIAL	-0.1568	0.1055	0.137
OTHER	-3.5264	0.2384	0.000
PROCEEDINGS PAPER	0.1742	0.2528	0.491
REVIEW	0.1413	0.1742	0.417
_cons	-7.7434	0.4429	0.000
/lnalpha	-0.1021	0.0305	
alpha	0.9030	0.0275	

We find a positive and significant effect for the number of authors-provided keywords, in agreement with most of the literature. This adds to the results of Polyakov et al. (2017) – who did not investigate the effect of the number of keywords but instead used keywords as part of their topic modeling analysis.

The coefficient for the number of characters in the title is negative and significant, showing that longer titles are associated with fewer citations. This finding adds to the mixed results in other studies where positive, negative, and no effects have been found. In contrast, we find that the length of the abstract has a positive and significant effect on citations, a result in line with most other studies. Our findings about the effect of title and abstract lengths add to Polyakov et al. 2017, who did not consider these variables. The number of cited references has a significant and positive effect on citations, an expected result widely found in the literature. In addition, we also find that the length of the contributions (that we measured in number of pages) has a positive and significant effect, as in most of the literature we reviewed and as in Polyakov et al. 2017.

For the number of countries, the results in the literature are mixed but mostly show a positive effect on citations. We find no significant effect on citations counts in *EE*. Our result is also different from Polyakov et al. (2017) who find a positive effect for this variable, showing a difference between *EE* and the broader AREE research field.

Publishing with an open access option has a positive and significant effect.

We also find that publishing in a special issue is associated with an increase in the number of citations, a result in line with other studies.

Regarding the document type, an important result is that contributions in the “other” category are cited significantly less than articles (the reference category). This shows that the document type is important to consider in the field of ecological economics. However, in contrast to other contributions, we do not find a significant effect for publishing a review. Similarly, there is no significant difference in the number of citations received by editorial contents or proceedings papers compared to regular articles. That there is no significant effect of publishing proceedings papers also suggests that conferences have no significant effect on citations counts, contributing to the mixed results of the literature.

Finally, the logarithm of time since publication has an expected significant and positive effect on the dependent variable.

Stata *nbg* command provides estimates for the overdispersion parameter α and its logarithm. The estimate for our model is $\alpha = 0.9$ (Table 3), with a 95% confidence interval equal to $[0.85; 0.96]$. This confirms the overdispersion we observed in our exploratory analysis and supports our modeling choice.

5. CONCLUSION

We have examined the determinants of cumulative citations for the documents published in *EE* from 2005 to 2018, using a negative binomial regression model. Our results show that several variables are significantly related to citations counts.

Variables that measure different aspects of the length of the contributions, such as the number of pages, the number of characters in the abstract, and the number of cited references, are positively related to citations counts. In contrast, the length of the title is negatively related to the number of citations received. In addition, the number of authors is positively related to citations counts. We also considered the international dimension of a contribution, measured by counting the number of countries listed in authors' affiliations. We do not find any significant effect for this variable. Concerning the variables that reflect different aspects of publishing, we find a positive relationship between citations and publishing in a special issue or publishing with an open access option. We also find that the number of keywords provided by authors is positively related to the number of citations received.

Our results show that all types of contributions received a similar number of citations, except for “other” contributions (book reviews, corrections, letters, news items, and reprints), which are cited significantly less. This is especially interesting for two types of documents: review papers and proceedings papers. In contrast to results for other research areas, we do not find that review papers are cited significantly more in *EE*.

Moreover, publishing proceedings papers, which we also used as a proxy for participation in conferences, is not significantly related to citations counts.

As we noticed in section 3.2, the literature studying the relationship between a document's characteristics and its citations often found conflicting results. We add to the literature by showing that, in some cases, our results for EE are different from those found in other studies and from those found by Polyakov et al. (2017) for the broader AREE field.

Without claiming any causal relationship, these results can be helpful for ecological economists who want to develop and test new strategies to increase their academic impact. Journals in the field of ecological economics could also consider our results to adjust their policies concerning the number of keywords or the length of titles and abstracts.

Concerning the limitations of our research, we decided to focus only on a limited set of characteristics of academic contributions, specifically those that could be quantified. The literature review by Tahamtan et al. (2016) offers suggestions about other possible explanatory variables that can be used when studying determinants of citations. Additionally, it could be interesting to explore the relationship between citations counts and authors' presence or influence on social media (see Ye and Na, 2018). Finally, we only considered documents published between 2005 and 2018. A longer time frame could be examined to see if there was an evolution in the determinants of citations in *EE* over time.

6. REFERENCES

- Adusumilli, P.S., Chan, M.-K., Ben-Porat, L., Mullerad, M., Stiles, B.M., Tuorto, S. and Fong, Y., 2005, Citation characteristics of basic science research publications in general surgical journals. *Journal of Surgical Research*, **128**, No. 2, 168-173.
- Anauati, V., Galiani, S. and Gálvez, R. H., 2016, Quantifying the life cycle of scholarly articles across fields of economic research. *Economic Inquiry*, **54**, No. 2, 1339-1355.
- Annalingam, A., Damayanthi, H., Jayawardena, R. and Ranasinghe, P., 2014, Determinants of the citation rate of medical research publications from a developing country. *SpringerPlus*, **3**, No. 140.
- Aria, M. and Cuccurullo, C., 2017, bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, **11**, No. 4, 959-975.
- Ayres, I. and Vars, F. E., 2000, Determinants of citations to articles in elite law reviews. *The Journal of Legal Studies*, **29**, No. S1, 427-450.
- Ballandonne, M., 2019, The historical roots (1880-1950, of recent contributions (2000-2017, to ecological economics: Insights from reference publication year spectroscopy. *Journal of Economic Methodology*, **26**, No. 4, 307-326.
- Biscaro, C. and Giupponi, C., 2014, Co-authorship and bibliographic coupling network effects on citations. *PLoS ONE*, **9**, No. 6, e99502.

Bornmann, L., Schier, H., Marx, W. and Daniel, H.-D., 2012, What factors determine citation counts of publications in chemistry besides their quality? *Journal of Informetrics*, **6**, No. 1, 11-18.

Bornmann, L. and Williams, R., 2013, How to calculate the practical significance of citation impact differences? An empirical example from evaluative institutional bibliometrics using adjusted predictions and marginal effects. *Journal of Informetrics*, **7**, No. 2, 562-574.

Borsuk, R. M., Budden, A.E., Leimu, R., Aarssen, L.W. and Lortie, C.J., 2009, The influence of author gender, national language and number of authors on citation rate in ecology. *The Open Ecology Journal*, **2**, No. 1, 25-28.

Bouabid, H., 2011, Revisiting citation aging: A model for citation distribution and life-cycle prediction. *Scientometrics*, **88**, No. 1, 199-211.

Castro e Silva, M. and Teixeira, A. A. C., 2011, A bibliometric account of the evolution of EE in the last two decades. *Ecological Economics*, **70**, No. 5, 849-862.

Conlon, D. E., Morgeson, F.P., McNamara, G., Wiseman, R.M. and Skilton, P.F., 2006, From the editors: Examining the impact and role of special issue and regular journal articles in the field of management. *Academy of Management Journal*, **49**, No. 5, 857-872.

Costanza, R., Stern, D., Fisher, B., He, L. and Ma, C., 2004, Influential publications in ecological economics: A citation analysis. *Ecological Economics*, **50**, No. 3-4, 261-292.

Costanza, R., Howarth, R.B., Kubiszewski, I., Liu, S., Ma, C., Plumecocq, G. and Stern, D.I., 2016, Influential publications in ecological economics revisited. *Ecological Economics*, **123**, 68-76.

Craig, I., Plume, A., Mcveigh, M., Pringle, J. and Amin, M., 2007, Do open access articles have greater citation impact? A critical review of the literature. *Journal of Informetrics*, **1**, No. 3, 239-248.

Didegah, F. and Thelwall, M., 2013a, Which factors help authors produce the highest impact research? Collaboration, journal and document properties. *Journal of Informetrics*, **7**, No. 4, 861-873.

Didegah, F. and Thelwall, M., 2013b, Determinants of research citation impact in nanoscience and nanotechnology. *Journal of the American Society for Information Science and Technology*, **64**, No. 5, 1055-1064.

Falagas, M.E., Zarkali, A., Karageorgopoulos, D.E., Bardakas, V. and Mavros, M.N., 2013, The impact of article length on the number of future citations: A bibliometric analysis of general medicine journals. *PLoS ONE*, **8**, No. 2, e49476.

Fox, C. W., Paine, C. E. T. and Sauterey, B., 2016, Citations increase with manuscript length, author number, and references cited in ecology journals. *Ecology and Evolution*, **6**, No. 21, 7717-7726.

Glänzel, W., 2001, National characteristics in international scientific co-authorship relations. *Scientometrics*, **51**, No. 1, 69-115.

Glänzel, W. and de Lange, C., 2002, A distributional approach to multinationality measures of international scientific collaboration. *Scientometrics*, **54**, No. 1, 75-89.

Hirsch, J. E., 2005, An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, **102**, No. 46, 16569-16572.

Hoepner, A.G.F., Kant, B., Scholtens, B. and Yu, P.-S., 2012, Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions. *Ecological Economics*, **77**, 193-206.

Hoepner, A.G.F., Kant, B., Scholtens, B. and Yu, P.-S., 2013, Is the journal Ecological Economics really in itself a poor and misleading guide to what ecological economics is about? A reply to "Influencing the perception of what and who is important in ecological economics". *Ecological Economics*, **89**, 174-176.

Jacques, T. S. and Sebire, N. J., 2010, The impact of article titles on citation hits: An analysis of general and specialist medical journals. *JRSM Short Reports*, **1**, No. 1, 1-5.

Jamali, H. R. and Nikzad, M., 2011, Article title type and its relation with the number of downloads and citations. *Scientometrics*, **88**, No. 2, 653-661.

Judge, T. A., Cable, D.M., Colbert, A.E. and Rynes, S.L., 2007, What causes a management article to be cited—Article, author, or journal? *Academy of Management Journal*, **50**, No. 3, 491-506.

Kostoff, R. N., 2007, The difference between highly and poorly cited medical articles in the journal *Lancet*. *Scientometrics*, **72**, No. 3, 513-520.

Kurtz, M.J., Eichhorn, G., Accomazzi, A., Grant, C., Demleitner, M., Henneken, E. and Murray, S.S., 2005, The effect of use and access on citations. *Information Processing & Management*, **41**, No. 6, 1395-1402.

Leimu, R. and Koricheva, J., 2005a, Does scientific collaboration increase the impact of ecological articles? *BioScience*, **55**, No. 5, 438-443.

Leimu, R. and Koricheva, J., 2005b, What determines the citation frequency of ecological papers? *Trends in Ecology & Evolution*, **20**, No. 1, 28-32.

Letchford, A., Moat, H.S. and Preis, T., 2015, The advantage of short paper titles. *Royal Society Open Science*, **2**, No. 8, 150266.

Long, J.S. and Freese, J., 2014, *Regression models for categorical dependent variables using Stata*. 3rd ed., Stata Press Publication, StataCorp LP: College Station, Texas.

Ma, C. and Stern, D.I., 2006, Environmental and ecological economics: A citation analysis. *Ecological Economics*, **58**, No. 3, 491-506.

Mingers, J. and Burrell, Q.L., 2006, Modeling citation behavior in Management Science journals. *Information Processing & Management*, **42**, No. 6, 1451-1464.

Mingers, J. and Xu, F., 2010, The drivers of citations in management science journals. *European Journal of Operational Research*, **205**, No. 2, 422-430.

Moosa, I.A., 2018, *Publish or perish: perceived benefits versus unintended consequences*. Edward Elgar Publishing: Cheltenham.

Narin, F., Stevens, K. and Whitlow, E.S., 1991, Scientific co-operation in Europe and the citation of multinationally authored papers. *Scientometrics*, **21**, No. 3, 313-323.

Olk, P. and Griffith, T.L., 2004, Creating and disseminating knowledge among organizational scholars: The role of special issues. *Organization Science*, **15**, No. 1, 120-129.

Onodera, N. and Yoshikane, F., 2015, Factors affecting citation rates of research articles. *Journal of the Association for Information Science and Technology*, **66**, No. 4, 739-764.

Peters, H.P.F. and Raan, A.F.J. van, 1994, On determinants of citation scores: A case study in chemical engineering. *Journal of the American Society for Information Science*, **45**, No. 1, 39-49.

Polyakov, M., Polyakov, S. and Iftekhar, M.S., 2017, Does academic collaboration equally benefit impact of research across topics? The case of agricultural, resource, environmental and ecological economics. *Scientometrics*, **113**, No. 3, 1385-1405.

R Core Team, 2020, R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from <https://www.R-project.org/>

Rigby, J., 2013, Looking for the impact of peer review: Does count of funding acknowledgements really predict research impact? *Scientometrics*, **94**, No. 1, 57-73.

Rostami, F., Mohammadpoorasl, A. and Hajizadeh, M., 2014, The effect of characteristics of title on citation rates of articles. *Scientometrics*, **98**, No. 3, 2007-2010.

Seglen, P.O., 1992, The skewness of science. *Journal of the American Society for Information Science*, **43**, No. 9, 628-638.

Shmelev, S.E., 2012, *Ecological economics, sustainability in practice*, Springer Netherlands: Dordrecht.

So, M., Kim, J., Choi, S. and Park, H.W., 2015, Factors affecting citation networks in science and technology: Focused on non-quality factors. *Quality & Quantity*, **49**, No. 4, 1513-1530.

Sooryamoorthy, R., 2009, Do types of collaboration change citation? Collaboration and citation patterns of South African science publications. *Scientometrics*, **81**, No. 1, 177-193.

StataCorp, 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC.

Stremersch, S., Verniers, I. and Verhoef, P. C., 2007, The quest for citations: Drivers of article impact. *Journal of Marketing*, **71**, No. 3, 171-193.

Subotic, S. and Mukherjee, B., 2014, Short and amusing: The relationship between title characteristics, downloads, and citations in psychology articles. *Journal of Information Science*, **40**, No. 1, 115-124.

Tahamtan, I., Safipour Afshar, A. and Ahamdzadeh, K., 2016, Factors affecting number of citations: A comprehensive review of the literature. *Scientometrics*, **107**, No. 3, 1195-1225.

Teixeira, A.A.C. and Castro e Silva, M., 2015, Relational environment and intellectual roots of "Ecological Economics": An orthodox or heterodox field of research? *Economics Discussion Papers*, No. **2015-52**, Kiel Institute for the World Economy, <http://www.economics-ejournal.org/economics/discussionpapers/2015-52>

Timsit, J. F., Citerio, G., Lavilloniere, M., Perner, A., Ruckly, S., Bakker, J., Bassetti, M., Benoit, D., Curtis, J.R., Doig, G.S., Herridge, M., Jaber, S., Papazian, L., Peters, M.J., Singer, P., Smith, M., Soares, M., Torres, A., Vieillard-Baron, A. and Azoulay, E., 2019, Determinants of downloads and citations for articles published in Intensive Care Medicine. *Intensive Care Medicine*, **45**, No. 7, 1058-1060.

Tu, J., 2019, What connections lead to good scientific performance? *Scientometrics*, **118**, No. 2, 587-604.

Uddin, S. and Khan, A., 2016, The impact of author-selected keywords on citation counts. *Journal of Informetrics*, **10**, No. 4, 1166-1177.

van den Bergh, J. C. J. M., 2001, Ecological economics: Themes, approaches, and differences with environmental economics. *Regional Environmental Change*, **2**, No. 1, 13-23.

Varela, D., 2013, The contribution of ISI indexing to a paper's citations: Results of a natural experiment. *European Political Science*, **12**, No. 2, 245-253.

Vieira, E. S. and Gomes, J. A. N. F., 2010, Citations to scientific articles: Its distribution and dependence on the article features. *Journal of Informetrics*, **4**, No. 1, 1-13.

Waltman, L., 2016, A review of the literature on citation impact indicators. *Journal of Informetrics*, **10**, No. 2, 365-391.

Wang, J., 2014, Unpacking the Matthew effect in citations. *Journal of Informetrics*, **8**, No. 2, 329-339.

Weinberger, C. J., Evans, J. A. and Allesina, S., 2015, Ten simple (empirical, rules for writing science. *PLOS Computational Biology*, **11**, No. 4, e1004205.

Wojciechowski, J., Ceschin, F., Pereto, S.C.A.S., Ribas, L.G.S., Bezerra, L.A.V., Dittrich, J., Siqueira, T. and Padial, A.A., 2017, Latin American scientific contribution to ecology. *Anais da Academia Brasileira de Ciências*, **89**, No. 4, 2663-2674.

Xie, J., Gong, K., Cheng, Y. and Ke, Q., 2019, The correlation between paper length and citations: A meta-analysis. *Scientometrics*, **118**, No. 3, 763-786.

Ye, Y. E. and Na, J.-C., 2018, To get cited or get tweeted: A study of psychological academic articles. *Online Information Review*, **42**, No. 7, 1065-1081.