Writing Energy Economics Research for Impact

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ABSTRACT

We explore the drivers of impact for energy economics research based on an analysis of citations generated by *The Energy Journal* articles. The focus is on non-topic generators of impact. Our regression analysis shows that these non-topic measures can explain a substantial proportion (about 20%) of variation in future citations. We apply these findings, integrated with prior research on effective economics writing style, to recommend how energy economics articles should be written to increase their impact. These recommendations center particularly around the importance of initial article information provided to the reader and article structure.

Keywords: The Energy Journal, Impact, Citations, Readability, Scientometrics

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1. UNDERSTANDING ENERGY IMPACT

Energy economics researchers, like all researchers, are motivated to generate impact from their research. Impact can be defined both broadly in terms of the beneficial contribution of research to society (Penfield et al., 2014), as well as more narrowly in terms of the contribution the research makes to the development of knowledge within a discipline (Li, Liao and Yen, 2013). Our focus in this study is on the latter definition and we measure research impact, similar to Li, Liao and Yen (2013), through citations to a published article. We investigate the non-topic drivers that contribute to these future citations and interpret our findings to advise authors of energy economics articles on effective writing style and article structure.

Citations to an article generally demonstrate that the research has stimulated theoretical, empirical, or policy discussion in future research. As a result, citations to a researcher's body of work are important in career promotion processes as part of an assessment of research contribution (Reinstein et al., 2011). They also act as a form of intrinsic motivation by showing the researcher they are contributing to the development of knowledge in their field.

Researchers are, therefore, motivated to produce research that generates citations. Primarily this involves creating contributions that advance knowledge and understanding. But individual articles must also attract the attention of researchers who might build on their ideas. Consider a reasonable peer group of reputable sources for energy economics research comprising *The Energy Journal*, *Energy Economics*, and the *Journal of Environmental Economics and Management*. There were over 2,000 articles published by just these three journals in the last five years. There is a

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crowded marketplace of energy economics ideas, and new research somehow needs to attract the attention of researchers who will cite that research to build their research arguments. The working hypothesis of this study, therefore, argues that better written and structured energy economics articles will be more likely to be noticed and ultimately cited in a busy research environment characterized by limited researcher attention.

Having one's research accepted by journals with a high reputation is one means of generating attention and signaling the importance and relevance of the research. The case in point of this study is energy economics research published in *The Energy Journal*. Our study sample shows that articles in *The Energy Journal* generated an average of 11 citations in the five years after publication. The journal is ranked in the first quartile of economics journals in the *ISI Journal Citation Report*. It is one of the two joint-top field journals for energy and environmental economics from a list of 61 ranked journals in the 'Agricultural, Environmental and Energy Economics' category of the *Centre National de la Recherche Scientifique* (CNRS) in France. It holds similarly elevated rankings in other national research journal ranking systems. However, not every article published in the journal has an equal impact, a feature in common with all journals. The median number of citations is less than the average at 7 cites per article. Thirty percent of articles receive 3 or fewer citations, and the top 10 percent of the most cited articles account for 37 percent of all citations. A sizable minority of articles are therefore not particularly impactful, and a small number of articles deliver an out-sized influence.

In this study, we systematically analyze articles published in *The Energy Journal* to show how non-topic factors can influence future citations in energy economics. We show, using regressions of citations on non-topic factors in articles published in *The Energy Journal* between 1996 and 2013, that about 20 percent of the variation in future citations is related to these measures. Our findings, therefore, cover an important range of factors in determining research impact: writing style and article structure matters. To carry out our study, we build on the scientometrics literature to develop measures of writing and structural choices in research publications. Scientometrics is a research field that involves the analysis of scientific literature, including determining important factors in generating research impact. The initial focus is on the first information that a potential reader sees when considering whether to read an article (title, abstract, topic). A second focus is on the structural choices in framing and writing the article itself (writing style, presentation, and references). The final focus is on author characteristics. While our study has a statistical analysis as its foundation, we present the findings in the form of advice for future writers.

In designing this study, we are conscious that an important overall finding of the scientometrics literature is that there is no one size fits all approach that works in writing impactful research (Tahamtan, Afshar and Ahamdzadeh, 2016). For example, papers in sociology with short titles receive more citations than papers with long titles, while the opposite is true of medical research (van Wesel, Wyatt and ten Haaf, 2014). There also tend to be particular patterns of conformity that signal belonging to a research group (Walker, 2010), such as structuring research in a certain fashion or citing from an informally agreed set of sources. Thus, what works in broad scientometrics with its study of very large corpora of articles, does not necessarily work at the individual journal level. Our research, therefore, draws from the broad scientometrics perspective but allows a specific understanding of how writing decisions in energy economics research influences future citations.

Our study is related to popular guidance on the importance of good writing in economics, most notably by McCloskey (1985, 2019), and in energy science (Weiss and Newman, 2011). Our contribution is the integration of this guidance through a quantitative scientometrics investigation of the relationship between article features and future citations. This is the first study to carry out such a quantitative investigation in energy economics, and the most comprehensive study of its kind in the broader economics field. Doing so results in more qualified guidance based on empirics compared to prior wide-ranging economics writing guides, and richer guidance personalized to energy economics than the scientometric studies. Our methodological approach is quite close to Dowling, Hammami and Zreik (2018), who analyze the impact of article features on citations for *Economics Letters* articles, but we significantly expand on that study, which just examined three of the 19 article features that this study examines. As the ultimate aim of this study is to highlight the features of writing and structure that influence impact, we write up our results in the form of a writing guide, integrating the relevant findings in the justification for the advice. The next section describes the data and testing approach, and the following section presents the findings and guidance.

2. EMPIRICAL APPROACH

Using Scopus, we identify all articles published in The Energy Journal from 1996 to 2013. Information in Scopus was significantly incomplete before 1996 and 2013 is the latest publication year possible because citations up to five years after publication (up to the end of 2018) is our main dependent variable. We only include documents of type ‘articles,’ thus excluding other document types that the journal occasionally publishes such as ‘reviews’ and ‘editorials.’ Excluding also articles with incomplete information for at least one important variable, we are left with a final sample of 504 articles.

The main dependent variable (DV), *5-year Citations*, includes all *Scopus* citations to an article except self-citations, in the first five years following publication. On average, there are 10.6 citations per article, with a median of seven citations. There is also a notable skew in the citation distribution, with the top 10% of articles contributing 37% of total citations. We need to account for this skewed distribution in our testing, so we calculate the DV as the inverse hyperbolic sine (asinh) of citations (Card and DellaVigna, 2017; Dowling, Hammami and Zreik, 2018). We also construct some additional DVs. To test shorter time-period citations, we use *3-year Citations*, and for a longer time period, we construct *10-year Citations*. We also test, using a dummy variable construction, whether the top 25 percent of most cited articles have particular features that are related to citation success.

The testing approach is OLS regressions of the asinh-transformed counts of citations DVs and probit regressions of dummy DVs coded 1 if an article is among the top 25 percent most-cited articles and 0 otherwise. All independent variables (IVs), described below, are included in the regressions. As the range of IVs is quite large, we apply general-to-specific (GETS) modeling (Campos, Ericsson and Hendry, 2005; Hansen, 1996) to arrive at a more parsimonious model through implementing the Stata *genspec* package of Clarke (2014). Lastly, we calculate the elasticities of significant independent variables to determine practical importance.

Our IVs are generally measures of the non-topic features of an article, except for one control measure of the article topic. We formally define all variables in Table 1. We focus initially on the first decision point that a potential reader reaches; assessing the title, topic, and abstract of an article to decide if the article is worth reading. Readers can view this initial information on *The Energy Journal* website (or other similar websites) before accessing the article itself. We measure the topic based on the first JEL code of an article (*Topic_JEL*) as a dummy variable that equals 1 if the JEL code begins with ‘Q4’ (Energy economics topics) to divide articles into those that fit with the core focus of the journal and those a bit removed from the core objectives. For the title, we generate measures of title length (*Title_Length*) and whether there is a question mark (*Title_Question*) or colon (*Title_Colon*) in the title construction. In the abstract, we measure the length of the abstract (*Abs_Length*) and readability complexity (*Abs_Readability*) using the well-established Gunning Fog Index (Bailin and Grafstein, 2016) which we calculate as:

$$FOG = 0.4\left[\left(\frac{words}{sentences}\right) + 100\left(\frac{complex\_words}{words}\right)\right],$$

where a *complex word* is one with three or more syllables, excluding common endings.

We next explore the structural and readability features of the article itself. Similar to the measures for abstracts, we measure article length (*Paper_Length*) and readability complexity (*Paper_Readability*). Two further readability measures are a count of commas (*Paper_Commas*) in an article to proxy for sentence complexity and whether the article is written in an active voice as measured by use of *we* (*Paper_Active*). Both of these measures are scaled by page count as they are naturally highly correlated with the total number of words in an article. We proxy for whether a paper is theoretical or empirical by including a dummy variable that equals 1 if an article contains two or more tables (*Tables*) as theoretical articles will have low numbers of tables. We also count figures and charts (*Figures*) to examine the benefit of these visual interpretations in generating impact.

Three variables measure the references in an article. The first is a simple count of references scaled by the number of pages in the article (*Ref_Count*). The second variable is the proportion of references cited in an article that is from the previous five years (*Ref_Recent*). The third variable is the proportion of references from the ten most popular peer journals (including *The*

Table 1: Variable definitions

Variable	Description
5-year Citations	Dependent variable: citations to an *The Energy Journal* article in the five years following publication excluding self-citations. Two measures: (1) Inverse hyperbolic sine (asinh) transformation of all citations, and (2) Dummy variable equal to 1 for papers at/above top 25 percent of most cited articles
3-year Citations	Same as *5-year Citations* except three year citation window
10-year Citations	Same as *5-year Citations* except ten year citation window
Topic_JEL	Dummy variable equal to 1 if JEL code for article begins with ’Q4’—energy economics topics
Title_Length	Word count of article title
Title_Question	Dummy variable equal to 1 if title contains a question mark
Title_Colon	Dummy variable equal to 1 if title contains a colon
Abs_Length	Word count of article abstract
Abs_Readability	Gunning Fog Index of readability complexity of abstract as defined in Section 2
Paper_Length	Page count of article
Paper_Readability	Gunning Fog Index of readability complexity of article as defined in Section 2
Paper_Commas	Number of commas in article scaled by number of pages
Paper_Active	Number of uses of ’we’ active voice in article scaled by number of pages
Tables	Dummy variable equal to 1 if article contains two or more tables
Figures	Dummy variable equal to 1 if article contains two or more figures
Ref_Count	Count of references cited in an article scaled by number of pages
Ref_Recent	Percentage of references cited in an article that were published in the five years prior to the publication year of the article
Ref_Peer	Percentage of references in an article that cite papers from the ten most common journal citation sources for *The Energy Journal*. Journals are, in order from most popular: (1) The Energy Journal, (2) Energy Economics, (3) Energy Policy, (4) Econometrica, (5) American Economic Review, (6) Journal of Econometrics, (7) Journal of Political Economy, (8) Journal of Environmental Economics and Management, (9) Journal of Regulatory Economics, and (10) Review of Economics and Statistics
Author_Count	Count of number of authors of an article
Author_Cites	Average citations for all authors of an article up to the year before the year of article publication (with asinh transformation)
Author_RankInstit	Highest ranked author institution based on *Shanghai Academic Ranking of World Universities* (ARWU) at time of publication. Articles before 2003 ranked on 2003 ARWU. Categorical variable: 0 ’unranked’, 1 ’200-500 rank’, 2 ’50-199 rank’, 3 ’1-49 rank’
Periods	Dummy variable equal to 1 for articles published from 2004 onwards

Energy Journal; see Table 1 for the full list) cited as references in all journal articles over the sample period (*Ref_Peer*).

The last group of variables is related to the authors of articles. We include a count of authors (*Author_Count*), the average citations of an articles' authors up to the year before publishing their article (*Author_Cites*; this is asinh-transformed similar to the main DV), and the rank of the best-ranked institutional affiliation among the authors of the article (*Author_RankInstit*). We use the *Shanghai Academic Ranking of World Universities* (ARWU) ranking of the top 500 universities for this purpose. The ARWU ranking is updated each year, so we use the institutional ranking in the year of article publication except for articles published before 2003, where we use the 2003 ARWU ranking as this is the earliest available ranking. We divide the institutional rankings into four categories: institutions ranked 1-49th, ranked 50-199th, ranked 200-500th, and unranked. A significant number of authors in the last category are from outside of traditional academia. The top rank is chosen over the average author rank, as this is most visible to readers. We also include a period dummy to control for time effects, which is equal to 1 for the period 2004-2013 due to a clear visual break in citations after 2003 (see Figure 1 (top figure)). The period dummy is preferred to yearly dummies as there is no obvious rationale for using yearly dummies.

3. GUIDANCE ON WRITING WITH IMPACT IN ENERGY ECONOMICS

Table 2 provides descriptive statistics and pairwise correlations. We see from this table, and from Variance Inflation Factor inspection, that there is no problem with correlations. Figures 1, 2, and 3 provide a visual exploration of the descriptive features of the dataset. Table 3 reports the overall testing, and Table 4 contains additional testing using GETS modeling and analysis of elasticities. In the following guidance, we integrate the descriptive exploration, formal testing, and prior research findings to propose best practice on writing impactful energy economics research.

We first discuss some broad overall findings. From the descriptive statistics in Table 2, we see the average three-year citations per article are 5; for five years, it is 11; and for ten years, it is 24. In Figure 1 (top figure) we see a strong upward trend in citations per paper over time; a trend which has been incorporated in our testing. The tests reported in Table 3 contain the overall models for asinh-transformed citation counts in columns 1-3, and for the top 25% most-cited articles dummy variable in columns 4-6. The asinh models show explanatory power of about 20%, with the most-cited articles models reasonably comparable. From the significance levels of IVs, it is clear that just a few of the variables drive this explanatory power. We confirm this with the GETS modeling in Table 4 where just 5-7 variables are retained in the reduced form models.

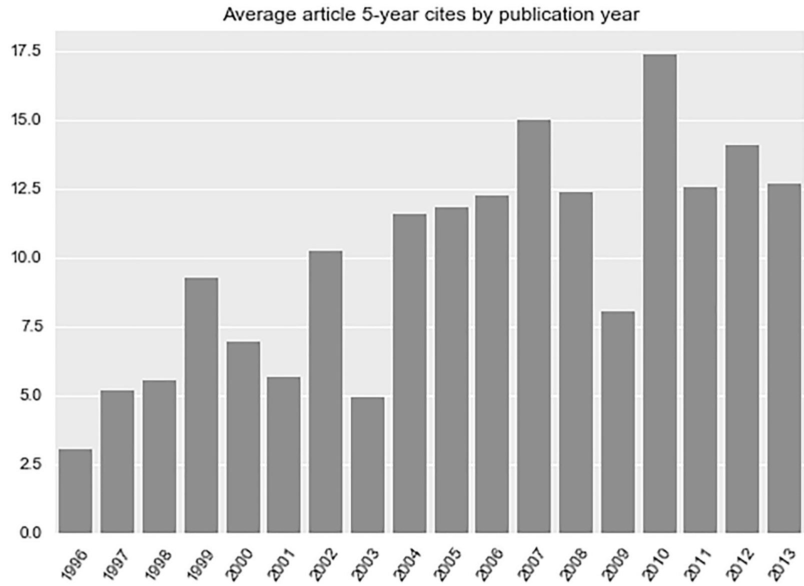
3.1 First impressions

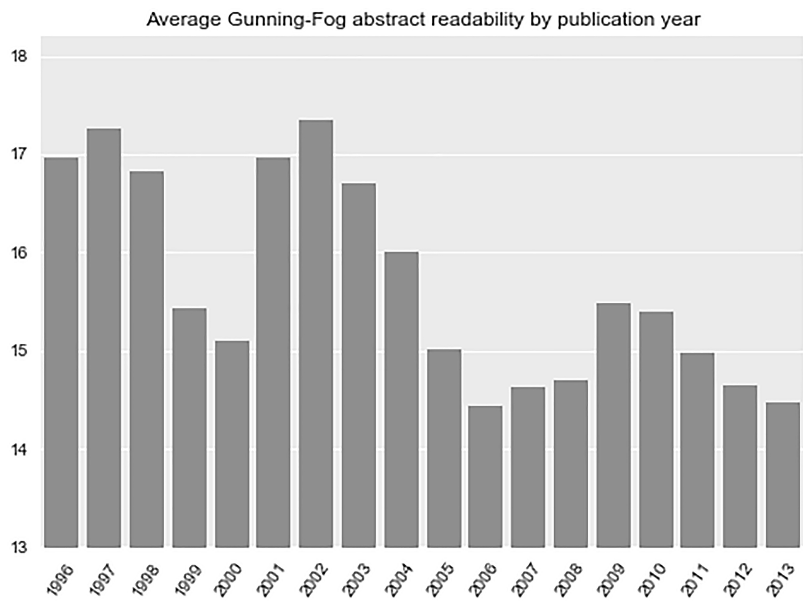
The first set of information that a potential reader of an article sees on *The Energy Journal* website (or when searching for an article through Google Scholar or other article databases) is the title, abstract, and topic of the article. We concentrate here on the title and abstract as the readability measures, but our findings in Table 3 show no impact of the topic dummy based on JEL codes. Other (unreported) variations of this variable also show no significance.

3.1.1 Titles

Titles of articles are (surprisingly) important for impact. Previous research on title length has shown higher citations for shorter titles (Hudson, 2016), although, as noted in the introduction, there can be discipline-specific differences. This is possibly related to articles with longer titles be-

Figure 1: Top figure: Average article 5-year citations by publication year. Citations are raw citation counts. Bottom figure: Average Gunning Fog Index abstract readability scores by publication year. Y-axis starts at 13 as the score measures readability based on schooling years and 13 is the first year of university.





ing less likely to be downloaded (Jamali and Nikzad, 2011). Posing the title as a question increases citations (Costello et al., 2019), while colons in a title can reduce citations, although often this is because the use of colons is a proxy for longer title length (Jamali and Nikzad, 2011).

In our sample, the average title is 11 words, 12% of titles contain a question mark, and 41% a colon. The results in Table 3 show a negative relationship with title length. Titles with a question mark have a short-to-medium term positive impact on citations. Different from the prior findings,

Table 2: Variable descriptive statistics

	Mean	Std.Dev	Min	Max	Pairwise.Corrs
5-year Citations	10.61	12.99	0.00	123.00	1.0000
3-year Citations	5.27	6.55	0.00	59.00	
10-year Citations	23.72	32.32	0.00	320.00	
Topic_JEL	0.57	0.50	0.00	1.00	0.0600
Title_Length	10.62	3.57	3.00	21.00	-0.0493
Title_Question	0.12	0.33	0.00	1.00	0.0897
Title_Colon	0.41	0.50	0.00	1.00	0.0557
Abs_Length	145.80	36.40	46.00	275.00	0.0925
Abs_Readability	15.44	2.71	9.07	35.62	-0.0896
Paper_Length	22.89	7.12	10.00	53.00	0.1800
Paper_Readability	12.57	1.42	8.07	18.02	0.0505
Paper_Commas	22.80	5.76	0.12	57.65	0.0482
Paper_Active	1.58	1.27	0.00	5.91	0.1062
Tables	0.85	0.35	0.00	1.00	0.0387
Figures	0.71	0.46	0.00	1.00	0.0530
Ref_Count	1.31	0.67	0.15	5.07	0.1091
Ref_Recent	0.47	0.23	0.00	1.00	0.1734
Ref_Peer	0.25	0.16	0.00	1.00	0.0518
Author_Count	2.18	1.25	1.00	16.00	0.1660
Author_Cites	164.30	477.10	0.00	9132.00	0.0262
Author_RankInstit:					
: Unranked	0.38	0.49	0.00	1.00	-0.0313
: 200-500th	0.17	0.38	0.00	1.00	-0.0963
: 50-<200th	0.19	0.40	0.00	1.00	-0.0182
: 1-<50th	0.26	0.44	0.00	1.00	0.1344

Descriptive statistics based on 504 regular articles published in *The Energy Journal* between 1996 and 2013. See Section 2 and Table 1 for further details on variable construction. Summary statistics of 3, 5, and 10 year citation DVs and Author_ cites are reported before inverse hyperbolic sine transformation for interpretation purposes. Pairwise correlations are on the main dependent variable of *5-year Citations*.

we see that including a colon in a title is also positively related to future citations. In the GETS modeling in Table 4 we find the presence of a question or colon in the title remains positive and significant in the reduced model. The elasticities analysis in the same table shows a 1.5% impact on citations from having a question mark and a 6.2% impact from using a colon.

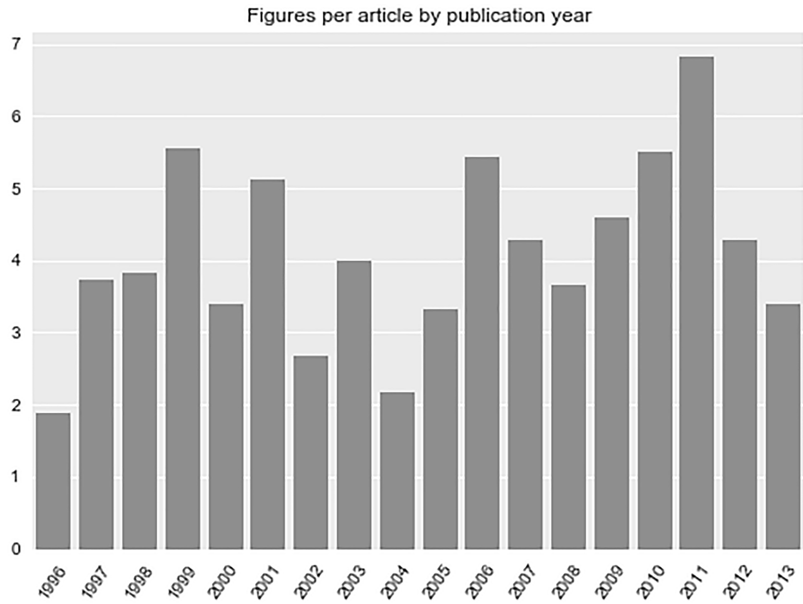
> ***Titles:*** *Titles should be short, and if not short, would benefit from a colon to improve readability. Posing a question as a title is usually related to higher future citations.*

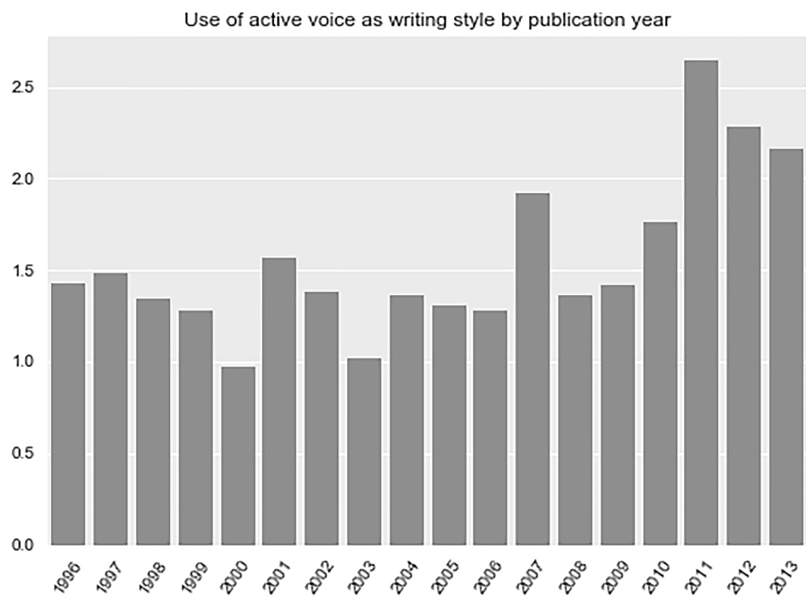
3.1.2 Abstracts

Abstracts should clearly and concisely discuss the purpose of a study, the main findings, and key implications (Zimmerman, 1989). Weiss and Newman (2011) go as far as to specify a sentence-by-sentence structure that elaborates in more detail on this idea. In terms of technical structure, prior research shows that longer abstracts are generally related to higher citations (vanWesel, Wyatt and ten Haaf, 2014), perhaps due to providing more filtering information to researchers. Dowling, Hammami and Zreik (2018) finds that better readability of abstracts for *Economics Letters* journal articles is positively related to future citations.

Abstracts in our study are about 150 words long, with the tests in Table 3 showing a mild positive relationship between length and future citations. Readability complexity for abstracts, measured by the Gunning-Fog Index, has an average score of 15.5, and we don't find any significance for readability in the testing. However, this might be due to an interesting readability pattern shown in Figure 1 (bottom figure). Here we see that readability of abstracts has fallen from requiring a college graduate education to a college sophomore level over the sample period. It might be that

Figure 2: Top figure: Average count of figures per article by publication year. Bottom figure: Occurrences of active voice per page of article (use of *we*) by publication year.

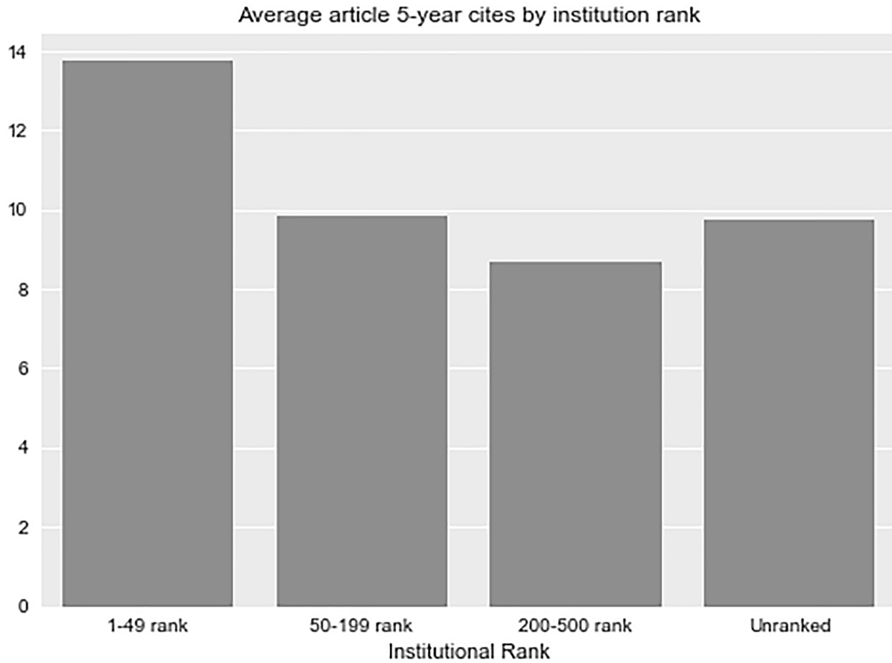




there has been greater emphasis placed on readability over time by journal editors, better training in appropriate writing style for authors, or perhaps that authors are more focused on reaching a wider audience in the presentation of their research. Good readability, therefore, does not particularly improve future citations but is instead a normal expectation.

> ***Abstracts:*** *Abstracts should be readable by a reasonably competent undergraduate student in energy economics. Length does not matter, but rather use the space needed, within the journal limitations, to clearly state the purpose, findings, and implications of your research.*

Figure 3: Top figure: Average article 5-year citations grouped by highest ranked author institution. Citations are raw citation counts. The unranked column includes both corresponding authors from universities not in ARWU Top 500 rank as well as industry authors. Bottom figure: regplot of researcher impact on 5-year citations. Researcher impact is average citations across all article authors' prior articles at time of publication. Both citation measures are after inverse hyperbolic sine (asinh) transformation.



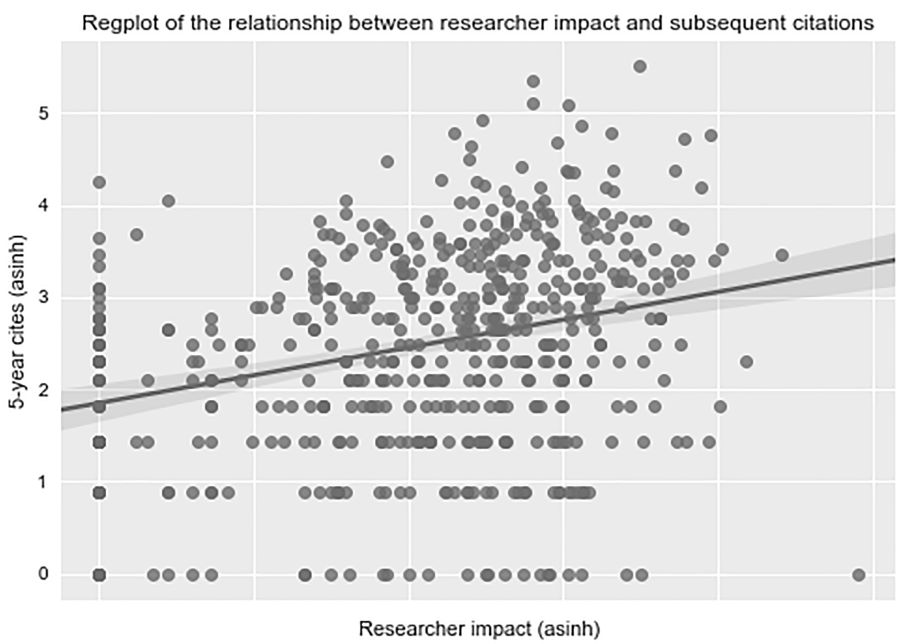


Table 3: Energy economics research impact: Main results

	Citations			Top 25% most-cited		
	3-year	5-year	10-year	3-year	5-year	10-year
Topic_JEL	0.086	0.082	–0.096	–0.041	–0.003	–0.329*
	(0.088)	(0.093)	(0.127)	(0.138)	(0.140)	(0.179)
Title_Length	–0.023*	–0.030**	–0.045**	–0.023	–0.014	–0.058**
	(0.013)	(0.014)	(0.019)	(0.021)	(0.022)	(0.028)
Title_Question	0.243*	0.304**	0.182	0.488**	0.277	0.163
	(0.132)	(0.140)	(0.186)	(0.199)	(0.201)	(0.256)
Title_Colon	0.289***	0.310***	0.322**	0.362**	0.358**	0.318*
	(0.095)	(0.100)	(0.136)	(0.146)	(0.149)	(0.191)
Abs_Length	0.001	0.002*	0.003*	0.001	–0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Abs_Readability	–0.011	–0.020	–0.010	0.019	0.010	0.026
	(0.017)	(0.018)	(0.023)	(0.027)	(0.028)	(0.032)
Paper_Length	0.022***	0.024***	0.050***	0.023**	0.019*	0.053***
	(0.007)	(0.007)	(0.011)	(0.011)	(0.011)	(0.015)
Paper_Readability	0.054	0.066*	0.018	–0.004	–0.046	–0.081
	(0.034)	(0.036)	(0.047)	(0.051)	(0.051)	(0.063)
Paper_Commas	–0.005	–0.002	0.001	0.001	0.009	0.005
	(0.008)	(0.008)	(0.011)	(0.012)	(0.012)	(0.015)
Paper_Active	0.047	0.036	0.058	0.071	0.088	0.133*
	(0.036)	(0.038)	(0.056)	(0.054)	(0.055)	(0.074)
Tables	0.061	0.092	0.095	–0.034	–0.110	0.133
	(0.122)	(0.129)	(0.166)	(0.195)	(0.195)	(0.240)
Figures	–0.008	–0.004	0.162	0.094	0.191	0.122
	(0.098)	(0.104)	(0.139)	(0.157)	(0.161)	(0.198)
Ref_Count	0.253***	0.263***	0.318***	0.140	0.001	0.182
	(0.081)	(0.085)	(0.120)	(0.125)	(0.130)	(0.174)
Ref_Recent	1.113***	1.053***	0.640**	1.376***	1.314***	0.773*
	(0.204)	(0.216)	(0.288)	(0.334)	(0.343)	(0.419)
Ref_Peer	0.290	0.573*	0.996**	0.518	0.851*	0.771
	(0.282)	(0.298)	(0.410)	(0.449)	(0.453)	(0.598)
Author_Count	0.073*	0.070*	0.066	0.073	0.099	0.077
	(0.037)	(0.039)	(0.066)	(0.061)	(0.063)	(0.086)
Author_Cites	0.056**	0.073***	0.083**	0.123***	0.156***	0.132**
	(0.024)	(0.025)	(0.035)	(0.039)	(0.041)	(0.051)
Author_RankInstit:						
: Unranked	–0.209*	–0.260*	–0.358*	–0.362*	–0.271	–0.757**
	(0.126)	(0.133)	(0.186)	(0.205)	(0.208)	(0.308)
: 50-<200th	–0.286**	–0.180	–0.269	–0.546***	–0.417**	–0.381
	(0.122)	(0.129)	(0.182)	(0.196)	(0.197)	(0.251)
: 1-<50th	–0.015	0.045	–0.023	–0.090	–0.017	–0.196
	(0.118)	(0.125)	(0.168)	(0.176)	(0.177)	(0.222)
Periods	0.502***	0.433***	0.446***	0.698***	0.741***	0.711***
	(0.112)	(0.118)	(0.153)	(0.194)	(0.201)	(0.222)
Constant	–0.824	–0.543	0.219	–3.681***	–3.255***	–2.925***
	(0.570)	(0.602)	(0.773)	(0.932)	(0.930)	(1.115)
Number of articles	504.000	504.000	328.000	504.000	504.000	328.000
F-stat / Chi-square	7.57***	7.50***	5.11***	94.58***	96.26***	74.85***
Adj / Pseudo R-square	0.215	0.213	0.209	0.162	0.169	0.201

Table reports findings from OLS regressions (Citations) and probit regressions (Top 25% most-cited) on three-, five-, and ten-year subsequent citations to articles published in *The Energy Journal* from 1996–2013 (1996–2008 for ten-year citations). For the main citations dependent variables citation counts have been transformed using an inverse hyperbolic sine function to account for skewness. See Section 2 and Table 1 for further details on variable construction and testing approach. Contrast *Author_RankInstit* category are articles where the top ranked institution of the authors is 200–500th. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, standard error in brackets.

Table 4: Energy economics research impact: GETS modeling and elasticities

	General-to-specific model			Elasticities		
	3-year	5-year	10-year	3-year	5-year	10-year
Title_Question		0.348**			0.015**	
		(0.135)			(0.007)	
Title_Colon	0.240***			0.062***		
	(0.086)			(0.020)		
Paper_Length	0.023***	0.027***	0.051***	0.266***	0.214***	0.340***
	(0.006)	(0.006)	(0.009)	(0.083)	(0.065)	(0.071)
Ref_Count	0.190***			0.181***		
	(0.070)			(0.058)		
Ref_Recent	1.145***	0.966***	0.549**	0.275***	0.192***	0.091**
	(0.194)	(0.200)	(0.257)	(0.051)	(0.040)	(0.041)
Ref_Peer		0.679**	0.910**		0.059*	0.078**
		(0.290)	(0.380)		(0.030)	(0.032)
Author_Count		0.081**			0.060*	
		(0.036)			(0.033)	
Author_Cites	0.056**	0.095***	0.110***	0.131**	0.127***	0.106**
	(0.022)	(0.023)	(0.031)	(0.056)	(0.044)	(0.045)
Periods	0.564***	0.576***	0.667***			
	(0.101)	(0.098)	(0.125)			
Constant	-0.290	0.250	0.811***			
	(0.227)	(0.225)	(0.289)			
Number of articles	514	539	362			
F-stat	18.92***	19.86***	18.92***			
Adj R-square	0.197	0.197	0.199			

Table reports findings from general-to-specific (GETS) modeling of full model reported in Table 3 on three-, five-, and ten-year subsequent citations to articles published in *The Energy Journal* from 1996-2013 (1996-2008 for ten-year citations). Also reported are elasticities for significant variables as identified by the GETS modeling. See Section 2 and Table 1 for further details on variable construction and testing approach. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, standard error in brackets.

3.2 Full article

For the full article, the most important characteristics include the length and readability complexity. Other writing style characteristics, such as the use of commas (an alternative proxy to the Gunning-Fog Index for sentence construction complexity), and the use of an active rather than a passive writing style, appear to have some weaker effects. We also include measures of the numbers of tables and figures and three assessments of the referencing used to justify arguments in the article.

3.2.1 Article structure

Longer articles generate more citations (Falagas et al., 2013), perhaps because of the greater information content of longer articles (Leimu and Koricheva, 2005). Articles with greater theoretical contributions tend to be more cited over time (Colquitt and Zapata-Phelan, 2007) compared to those with a stronger emphasis on empirics. A rationale for this is that theoretical research often leads to calls for empirical testing of the theory, with repeated empirical studies required to assess the validity of the theory. Other recommendations are that articles include figures or charts as an explanatory aid to comprehension. Clark and Divvala (2016) find a large upward trend in the use of figures over time, but only a weak correlation with citations.

Our testing shows the length of articles to be particularly important. Length is positively related to citations in all main tests and remains significant in the GETS reduced-form model. The elasticities analysis shows the practical significance of the measures. We don’t find a significant relationship for our proxy for empirical or theory articles: the presence of tables in a paper. This might be because nearly all articles (85%) have at least two tables and, therefore, nearly all articles are empirical based on this measure. Figures are also widely used in *The Energy Journal* articles, with about 70% of articles containing two or more figures. The testing finds these to be insignificantly related to citations. However, we do see a compelling upward trend in Figure 2 (top figure) when we chart the use of figures over time. There is approximately one extra figure per article in the second half of the sample compared to the first. About four figures per paper is the current average, albeit that this is driven, in part, by a relatively small number of articles with a large number of figures.

> ***Article structure:*** *Articles should aim to use all the space needed when writing articles (up to 9,500 words according to current journal policy). Although this does not preclude the important need to avoid irrelevant details and unnecessary verbosity. Nearly all articles have tables, and the use of visual guides in the form of figures, three to five figures normally, is an expectation rather than an advantage.*

3.2.2 Writing style

Improving writing style in economics is at the heart of the influential work of McCloskey (2019). The breadth of this advice is beyond the space available here but, in summary, says: write clearly, with the reader in mind. We should aim to tell the reader what they need to know in a way that they will understand. Some specific advice frequently proffered is to write in the active rather than the passive voice and reduce the use of commas, with commas being a proxy for sentence complexity. The modern recommendation to use personal pronouns ('I,' 'we') in writing is often linked to the recommendation to use the active voice, although not by definition (Banks, 2017).

We test the importance of these writing recommendations. Tests include overall readability and per page counts of the use of commas and the most common personal pronoun—'we'. The tests do not show a compelling, significant link between any of the measures and citations. One reason for this might be, similar to other variables already discussed, that there has been a trend over time in favor of reducing readability complexity and increasing the use of personal pronouns. We see that for the personal pronoun in Figure 2 (bottom figure) where the most recent years have seen a large rise in usage.

> ***Writing style:*** *Our technical tests are no substitute for the excellent writing advice in McCloskey (2019). We do however note that personal pronouns are now the expectation in writing, as is aiming article writing complexity at "the least sophisticated rather than the most sophisticated reader" of a journal (Zimmerman, 1989) (p. 460).*

3.2.3 References

References in an article are used to support arguments, justify choices, and compare findings (Swales, 1986). Leydesdorff, Bornmann and Wagner (2017) provides comprehensive charts showing this clustering at the journal level. Articles can, therefore, indicate membership of a field by selecting references from among clustered journals. Roth, Wu and Lozano (2012) shows the importance of peer journal referencing in their cross-disciplinary study on drivers of article citation. They also show the importance of references being recent in terms of publication time proximity to the article.

Our testing includes a count of references (scaled by article length), the proportion of references from the last five years, and the proportion of references that belong to a cluster of peer journals. On average, the articles in the sample cite 30 references, with about half from the most recent five years, and a quarter drawn from peer journals. Both the measures of recency and peer journal citation are quite stable over time, albeit with a small uptrend in citing from among peer journals. The (unreported) proportion of citations to prior *The Energy Journal* articles is rising over time, from around 1.5 citations per article in the early sample period to above two citations per article in recent times. The results from the main testing and the GETS modeling shows a strong positive significance for articles with more references, and articles citing a higher proportion of recent articles. We also see some significance for the proportion of peer journal citations in longer citation windows.

References: *It is better to have more than fewer references in support of article argumentation, but without running the risk of 'argument by citation' (Sparrowe and Mayer, 2011) as it weakens researcher authority and affects readability. References should come from the most recent five years, with a reasonable proportion from peer journals to build relevant arguments of interest to target readers.*

3.3 Author characteristics

The last group of factors is related to the authors themselves. Prior research shows higher author past citations and institutional affiliation to be linked to higher article citation (Hurley, Ogier and Torvik, 2013; Amara, Landry and Halilem, 2015). This is quite intuitive as both measures speak to the *a priori* ability of authors to generate impact from their research. The measures are, at a broad level, related to each other in that institutional rankings often incorporate combined citations to their faculty in the ranking process (Lin, Huang and Chen, 2013). Articles with more authors are also linked to higher citations (Thelwall and Sud, 2016), perhaps due to the benefits of collaboration in producing quality research.

The average article in our sample has two authors, of which the averaged prior citations per author is 164 but with a large standard deviation of three times the mean. Twenty-six percent of best-ranked authors come from an institution ranked in the global top 50, perhaps reflective of the high ranking of the journal. Thirty-eight percent of best-ranked authors are from outside the global top 500 academic institutions, including a large proportion of industry and policymaker researchers. Exploratory analysis in Figure 3 (top figure) shows that most citations are to articles where the best-ranked author is from a top 50 institution. However there is also a strong citation impact from articles in the unranked group suggesting the benefit of the diverse author backgrounds encouraged by the journal. We also see in Figure 3 (bottom figure) a positive relationship between prior author citations and article citations. The formal tests in Table 3 show some statistical significance for the number of authors and strong significance for author prior citations. Institutional rank provides mixed results.

Author characteristics: *Multiple author articles are the norm, perhaps because of the research benefits of collaboration. The depth of research experience of the author group is important; a group that includes an author who has strong prior citations tends to benefit significantly from their experience.*

4. DISCUSSION

We have explored, for the first time, determinants of energy economics research impact. We concentrate on how non-topic writing and structural features of articles influence subsequent citations. Our findings are perhaps surprising, in that about 20% of the variation in future citations to *The Energy Journal* articles can be explained by these factors. By blending our statistical analysis with existing advice on good writing in economics and energy science, we can offer a condensed set of guidelines for creating impact.

This study thus propounds the strong benefits of paying attention not just to the topic of an article, but also to how it is written, presented, and structured. It is, however, worth bearing in mind when interpreting these findings that we have, by necessity, only measured impact by future citations. Future research, when feasible, could explore influences on a wider meaning of impact. Perhaps a viable approach to this could be through qualitative analysis of impact reports submitted by researchers to national research evaluation frameworks (such as the UK REF).

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