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Which Leading Journal Leads?

Idea Diffusion in Economics Research Journals

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Abstract

How do ideas flow through economics research journals? Do the general interest journals set the trends in research attention to particular topics, or is it the field journals that have greater initial influence? In this paper we focus on the subfield of environmental economics and attempt to empirically identify whether it has been the leading general interest journals or the top environmental economics field journal that has set the research trends on climate change, air pollution, water pollution, and other topics. Results indicate that leadership depends on the topic, however, there is some evidence that the top field journal in environmental economics generally took the lead in more controversial topics.

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Introduction

How do research ideas spread amongst academic journals? Do leading general interest journals set the trends that field journals then pick up and expand upon? Or, are field journals more cutting edge, and it is the general interest journals that publish in an area only after it has already been indicated as a subject of interest in a focused subfield? A third possibility is that academic journals simply do not pay much attention to each other and publish according to other primary influences. In this paper we investigate the topic of "idea diffusion" and attempt to empirically identify evidence for academic research journals in economics influencing one another on specific subjects.

There has been a lot of research done on publishing trends in economics, particularly on the publishing output of top general interest journals in the field. A number of studies have tried to determine which academics are the most cited (Hamermesh, 2014; Kim et al., 2006), which departments are the most prolific (Whaples, 1991), and which subfields garner the greatest research attention (Kosnik, 2015; Card and DellaVigna, 2013; Kelly and Bruestle, 2011; Kim et al., 2006). Analyzing the publication outputs of top general interest academic journals in economics is important; indeed, the top general interest journals are investigated so thoroughly presumably because they are perceived to have an influence on the field and in public policy discourse that is significant and greater than other, less highly ranked or less broadly defined journals.

Few studies, however, investigate whether it is the top general interest journals that actually set the trends over top field journals in economics, or vice versa. Would a young environmental economist seeking prestige and recognition have a greater impact on the field publishing a novel paper on climate change in the *American Economic Review* or in the *Journal*

of Environmental Economics and Management, the number one environmental economics field journal for the last thirty-five years? In this paper we concentrate on one subfield, environmental economics, and investigate whether it is the general interest journals that seem to set the research trends on climate change, air pollution, water pollution, and other topics, and the top field journal that then follows, or whether it is the field journal that leads the general interest journals on topics of academic interest. How does knowledge and idea diffusion flow through economics research journals?

Literature Review

The study of ideas and how they spread (alternatively called "idea diffusion" or "knowledge diffusion") has a history in the innovation and entrepreneurship literature (Rosell and Agrawal, 2009; Weterings and Ponds, 2009), where the question of how novel ideas arise and how they gain traction has long held a fascination. Theories in this literature (on things like the importance of geographical proximity, or the importance of universities and basic research) have primarily been empirically tested with patent data, and focus almost exclusively on innovative ideas as represented through patent applications. The econometrics in these papers often parallels, therefore, the citation analysis literature of academic research journals and the efforts of some researchers to determine research influence through most cited articles, or most cited academic departments and people (Hamermesh, 2013; Card and DellaVigna, 2013), as represented by the direction and degree of citation counts.

But focusing on citation counts in order to determine influence in academic research has many noted problems (Posner, 1999; Lange and Frensch, 1999; Wright, 1989). While many citations are legitimate, and could be used to lead to a correct determination of which papers

from which journals are leading idea flows into other journals, there are many other motivations for citing work that have nothing to do with idea influence, for example, strategic self-citation, collusive reciprocal citation, citation of the editors of the journal of submission, and "celebratory" citing, in which an author hopes to increase the perceived importance of his or her work by tying it to an especially well-known, influential publication. The results of citation analysis presume that the majority of citations faithfully reflect the origin of some piece of information or acknowledgement of priority, but this may not always be the case. Therefore, this paper focuses on a different methodological tool for investigating idea diffusion through academic research: textual analysis.

Textual analysis doesn't use the proxy of citation (or patent) counts, but focuses on actual *ideas* themselves, and their usage in the literature (as represented through word choices), to analyze knowledge flows and idea diffusion. Our empirical strategy, therefore, is more direct than has been used in the past when studying journal influence. Rather than focusing indirectly on prolific people, departments, or journals, this research focuses on important ideas themselves and how they have been used in the literature over time.

Data

The output of five top-tier general-interest academic journals was studied: *American Economic Review (AER), Econometrica (E), Journal of Political Economy (JPE), Quarterly Journal of Economics (QJE),* and *Review of Economic Studies (RES).* This list was chosen after considering a number of different rankings, including Engemann and Wall (2009), Kalaitzidakis et al. (2001), and a variety of online listings. In addition, these journals are the most common ones used in published research that investigates trends in the discipline of economics

(Hamermesh, 2013; Card and DellaVigna, 2013; Laband et al., 2002; Laband and Tollison, 2000). The journals utilized in this work are inclusive of the journals most often used in work of the kind that attempts to determine trends, patterns, and influence of academic economics research more broadly.

The field journal utilized in this study is the *Journal of Environmental Economics and Management (JEEM),* the most widely recognized leading field journal in environmental economics over the past thirty five years. Indeed, the time period studied in this paper is from 1974-2014, from the time of *JEEM*'s founding, until the year the *Journal of the Association of Environmental and Resources Economists (JAERE)* was founded, the new field journal of the *Association of Environmental and Resource Economists (AERE),* that is now in direct competition with *JEEM.*

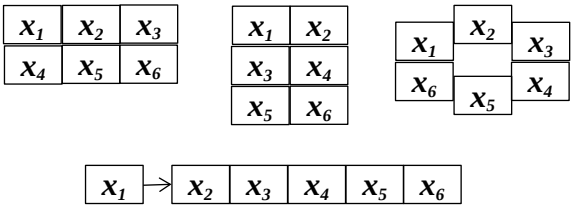
All of the abstracts published in all six of these journals for the years 1974-2014 are in the database. Special symposium articles, if they include abstracts, are also included.[1] Given these criteria the corpus includes 15,531 abstracts, some descriptive information for which can be found in Table 1.

Model

We assume a population of agents, X_i, on a landscape (of indeterminate form) which forms a research network - see Figure 1.

[1] It is worth noting, however, that the *American Economic Review*'s annual *Papers and Proceedings* issue is not included, whether or not any of its published articles have abstracts.

Figure 1: Potential Landscapes of Agents



Each agent (in this context, each academic journal) has output, Y_i (in this case their corpus of published research articles) which is affected by a number of factors, Z_{ij} (including, for example, preferences of the editor, type and number of articles submitted, institutional and political environment in which the journal publishes, and more.). The goal of this paper is not to focus on understanding how Y_i is determined by Z_{ij} – though that is certainly a worthy research agenda in itself (Kosnik, 2015) – the focus instead is on the landscape and how the ideas in a given journal's output, Y_1, flows through the rest of the agent's outputs, $Y_{2...N}$. Is there a clear direction of progress (from Y_1 to Y_5, say)? If so, how strong is it? And, has it been consistent over time?

Methodology – Textual Analysis & Econometrics

This paper combines textual analysis with regression methods for its primary empirical results. [2] The raw data from text analytic counts of keywords are used as variable inputs in

[2] Textual analysis is the accumulation of large amounts of textual data, the cleaning and parsing of the text with unique algorithms, and then the turning of the text into a database where the words themselves are statistically analyzed for trends and correlative patterns. Textual analysis as a methodological tool has taken off in the last decade in many social science disciplines (most notably political science and psychology), and it has begun to be utilized in the economics literature as well (Kosnik 2015, 2014a, 2014b; Baker et al., 2014; Gentzkow and Shapiro, 2010; Tetlock, 2007; Antweiler and Frank, 2004).

regression methods that seek to determine Granger causality of key terms and concepts between the journals under study.

The unstructured text utilized in this paper comes from the research abstracts included in the database. The text is organized within a vector-space model (VSM). In the VSM each element of the vector indicates the occurrence of a word within an abstract. A collection of abstracts results in a collection of vectors; 15,531 to be exact in this study.

There is some debate as to whether the elements of the vectors should be transformed in any way, perhaps turned into logs of frequency of use in order to tamp down the raw frequencies. Another option is to weight the elements in some way, such as through an inverse-document frequency transformation.[3] In this paper we have chosen to leave the elements as raw, unweighted counts of frequency of use. This is because we want single occurrences of terms (for example, "climate change") to count, and we want multiple occurrences of terms to count for relatively more, as a representation of greater attention and focus. All of the following keyword counts, therefore, are based on raw term frequency analysis.

The focus of this paper is on the subfield of environmental economics. Within environmental economics, the following six topics were chosen for analysis: air pollution, water pollution, climate change, sustainability, recycling, and surveys. These topics were chosen after consulting a number of textbooks in the field, with special attention to chapter headings and themes which appeared to be of consistent importance across the academic textbooks.[4] In addition, topics were chosen according to the number and uniqueness of keywords available to

[3] An inverse-document frequency transformation (idf) reflects the frequency of a term within a document, but also across all the documents within a corpus. It often works to lower the frequency weight of a word if it is common across the entire corpus, under the assumption that it is thus not a very unique or informationaly important word, such as "the."

[4] Textbooks consulted include: *Environmental & Natural Resource Economics, 9th Ed.* (Tietenberg and Lewis 2012); *Natural Resource and Environmental Economics, 4th Ed.* (Perman et al., 2012); *Environmental Economics, 2nd Ed.* (Kolstad 2010).

represent them.[5] Table 2 provides the keywords and phrases used in the analysis of each of the topics.

The combined frequency counts of the keywords associated with each topic were used as variables in estimating vector autoregressive (VAR) models. VAR models fit a multivariate time-series regression of each dependent or endogenous variable on lagged values of itself and on lagged values of all the other dependent or endogenous variables (Tsay, 2002; Kennedy, 2003). We estimated reduced form VAR models in which the frequency of the keywords comprising a topic from a journal is a function of the lagged frequencies of that topic in the journal in question and the lagged frequencies of that topic in all of the other journals. All keyword frequencies were assumed to be endogenous, so the frequency of a keyword in a specific journal might be dependent on a preceding frequency of that keyword in the same journal or in another journal.

To test for leadership we apply the Granger causality test (Granger, 1969) to the VAR results. The general two variable case of the Granger model is:

$$\boldsymbol{X_t + b_o Y_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon'_t}$$

$$\boldsymbol{Y_t + c_o X_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \varepsilon''_t}$$

where X and Y are stationary time series. If $b_o = c_o = 0$ then this is a simple causal model, otherwise it is a model with either instantaneous causality or, alternatively, representative of a situation in which the sampling period of the data is inappropriately long for examining the

[5] Certain environmental economics topics, such as renewable energy and benefit-cost analysis, were not chosen for study as the keywords that might be used to represent them were often too broad to be assured of a primarily environmental economics research focus.

process of interest, making it appear as if the causal relationship is instantaneous. In determining causality or leadership in this two variable model the coefficients of interest are b_j and c_j which represent the effect of lagged values of *Y* on *X* and of lagged values of *X* on *Y*, respectively. If one or more of the estimated values of b_j is significantly different from zero then it is said that *Y* Granger causes *X*. Granger causality has been applied in a myriad of contexts including the macroeconomic (Nelson, 1979), the regional (Cromwell, 1992), the historic (Becker and Woessmann, 2013) and the whimsical (Thurman and Fisher, 1988).

Rejecting the possibility of instantaneous causality across journals, the models estimated were the once lagged version:

$$\boldsymbol{X_{i,k,t} = \beta_0 + \alpha_{i,k} X_{i,k,t-1} + \sum_{k^c} \beta_{i,k^c} X_{i,k^c,t-1} + \varepsilon_{i,k,t}} \quad (1)$$

and the once and twice lagged version:

$$\boldsymbol{X_{i,k,t} = \beta_0 + \alpha_{1,i,k} X_{i,k,t-1} + \alpha_{2,i,k} X_{i,k,t-2} + \sum_{k^c} \beta_{1,i,k^c} X_{i,k^c,t-1} + \sum_{k^c} \beta_{2,i,k^c} X_{i,k^c,t-2} + \varepsilon_{i,k,t}} \quad (2)$$

where

$\boldsymbol{X_{i,k,t}}$ = the frequency of keyword i in journal k in year t
$\boldsymbol{k^c}$ = the set of journals complementary to journal k in which keyword i appears, $k \notin k^c$

Each of these models was estimated simultaneously for all journals. Results from these regressions were used to conduct Granger causality tests. For each topic category, causality was tested between every pair of journals in which the keywords appeared so that causality could be

identified between each pair. For equation (1) the null hypothesis was that each $\boldsymbol{\beta}_{i,k^c}$ was zero. For equation (2) the null hypothesis was that each pair of $\boldsymbol{\beta}_{1,i,k^c}$ and $\boldsymbol{\beta}_{2,i,k^c}$ was jointly zero.

Because this is a time-series analysis, the issue of publication lags may be a concern. If two journals have significantly different lags from initial submission to publication, it may be that articles submitted simultaneously could appear to have an intertemporal causal relationship if one journal has, for example, a publication lag that is a year or more longer than the other's. Results from Björk and Solomon (2013) show that receipt to publication lags are longer for journals related to business and economics than for other disciplines, making the issue potentially important here. Unfortunately, discerning these lags for a journal is difficult. While most journals offer some analysis of the lag from submission to decision, the information varies in form, making direct comparisons impossible.[6] While direct comparisons may be impossible, a careful reading of the journals' reports suggests that delays for the journals in this sample all tend to be less than a year, alleviating concerns that any results observed might be purely the result of differential lags. Further, the existence of any publication lag would support the rejection of instantaneous causality.

Results

We begin our investigation into causality of ideas between the journals first with simple tests of individual keywords from the list in Table 2. This resulted in 590 once-lagged causality tests, and 489 once and twice-lagged causality tests. Results are available from the authors upon

[6] *JEEM* reports at http://journalinsights.elsevier.com/journals/0095-0696/review_speed present time from submission to first and final decision. *AER* reports at http://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.15000011 give median time to first decision and average number of week from acceptance to publication. *JPE* reports at http://www.press.uchicago.edu/journals/jpe/instruct.html?journal=jpe describe the number of submissions without a decision after nine months. *RES* reports at http://www.restud.com/editors-report/ the mean delay from submission to decision.

request, but the main take-away is that there does appear to be significant causality in the frequency of at least some individual keywords between the journals. Of the 590 and 489 tests, 64 and 112, respectively, yielded results that were significant at the 5% level. These numbers are greater than the number of significant results that would be expected in the absence of causality (29.50 and 24.45 respectively), suggesting that the frequency of many environmental keywords is Granger-caused by the frequency of the same keywords in other journals under study. In particular, *JEEM* and *AER* turned out to be the journals that, at the individual keyword level, most frequently influenced the other journals under study. At the same time, *JPE* showed remarkable independence of keyword use.

But testing individual keywords does not tell us much conceptually. What is of greater interest is the results of Granger causality tests from aggregated keyword counts of all the terms in Table 2 under a particular topic, for example climate change, across all the journals under study. Table 3 provides an aggregated numerical count of all the keywords in each topic for all the journals under the time span of this study, 1974-2014.

We estimated once and twice lagged VAR models of the relationships between the topic frequencies in each of the journals, examining each journal as the potential follower against each of the others as the potential leader. In total there were 180 Granger causality tests associated with these VAR models. The results reveal that of these 180 tests, 33 yielded results that were significant at the 5% level or better, suggesting that significant leadership in topics exists between the journals. As shown in Table 4, *JEEM*, *AER* and *E* were significant leaders in five topics and *JPE, QJE* and *RES* were significant leaders in six topics. *JEEM*'s leadership was primarily in the controversial areas of surveys (related to contingent valuation) and climate change. *JEEM* was a significant follower in eight cases, although four of these were for water

pollution. *AER* was a leader primarily in water pollution and sustainability, and it followed only in climate change and surveys. *E* led primarily in water pollution and surveys and primarily followed in climate change. *JPE* led in recycling, surveys and climate change and followed in recycling, surveys and sustainability, emphasizing, perhaps, the reciprocal nature of environmental topics among these journals. *QJE* led in surveys and air pollution and followed in surveys and sustainability, further emphasizing this cyclic nature. *RES* led in climate change and sustainability while following primarily in surveys. Indeed, leadership seems to vary and be dependent on the topic in question.

We estimated VAR models of the relationships between the aggregated topic frequencies in *JEEM* and in the combined general interest journals (GENERALS) and tested for Granger causality, with six tests of whether the GENERALS led *JEEM* and six tests of whether *JEEM* led the GENERALS. The results, presented in Table 5, suggest a low level of causality. Out of the six topics studied, only two – climate change and surveys - showed significant causality. In both of those *JEEM* led the GENERALS, although with climate change, the GENERALS also led *JEEM*. The significance of both *JEEM* and the GENERALS in the topic of climate change reflects variations by keyword; for some keywords *JEEM* led, while for others the GENERALS led.[7] Overall, there seems to be some (although not a lot of) statistically significant shared causality between the leading environmental field journal and the top generalist journals.

We next investigate the intertemporal nature of the relationships described in Table 5, in an attempt to discern any changes in the degree of leadership over time. The analysis was repeated for moving ten year segments of the data, looking first at the period from 1976 through 1985, then 1977 through 1986, and so on, estimating VAR models with once and twice-lagged

[7] Statistical evidence for this is available from the authors upon request.

explanatory variables, and then conducting Granger causality tests for both the GENERALS and *JEEM* leadership or causality.

Figure 2 presents these results graphically. The vertical axis measures one minus the Granger causality p-value, so higher levels of the curves represent more significant causality.

The graphs suggest several patterns. First, it is not surprising that both air pollution and water pollution demonstrate insignificant causality in either direction in Table 5, as it appears that over time both the GENERALS and *JEEM* showed leadership covering these two topics. Air and water pollution may have been such broadly important topics in the policy arena that nobody needed to be led here– it was clear that these policy issues were of national interest already.

Climate change, however, shows *JEEM* leading steadily since the 1980s, whereas the GENERALS have only demonstrated leadership on this topic sporadically. Climate change has been a more controversial policy topic historically, and so it is interesting to discover that *JEEM* primarily led the coverage of research into this area. It may be that a field journal has more latitude in covering controversial areas than might a general interest journal.

JEEM also appears to be showing some leadership on the topic of recycling. Throughout the 1980s *JEEM* leads on this, and through the 2000s as well, although in the 1990s there is evidence of leadership by both *JEEM* and the GENERALS.

With regards to the topic of surveys, neither *JEEM* nor the GENERALS leads in the early years, but after 1990 *JEEM* clearly takes the lead on this. It is this latter effect which is likely leading to the significant leadership coefficient for *JEEM* in Table 5. Before the 1990s there was some controversy in economics as to whether surveys constituted reputable evidence or not, however, after the Blue Ribbon Panel decision in 1993, surveys and contingent valuation gained

respectability as empirical evidence, and so use of survey evidence took off in environmental economic publications, although it appears less so still in the general interest journals.

Finally, the figure on sustainability appears to show the GENERALS leading in the 1980s, but then neither the GENERALS nor *JEEM* showing much consistent leadership after that. Sustainability may be one topic where the journals really didn't take their cues regarding idea importance from each other, but from, perhaps, outside unseen influences unrelated to each of the journals.

Conclusions

We began this paper by asking the question, in order to have the greatest impact on the field, should a young environmental economist seek to publish in a top general interest journal, or a top field journal? Our results indicate that it depends on the topic. For well publicized, widely recognized policy topics (i.e. air pollution and water pollution), there does not appear to be a clear advantage for future influence in the field whether the young researcher published in the *American Economic Review* or in the *Journal of Environmental Economics and Management*. However, there is some evidence that for more controversial topics (such as climate change or surveys), publishing in a top field journal may lead to greater impact on the top general interest journals later on.[8]

The results presented here are based on the subfield of environmental economics. Useful future research would investigate idea diffusion in other subfields (labor, finance, macroeconomics, etc.) as well, in order to discover if similar trends regarding influence hold more consistently across the profession.

[8] A colleague commented that this may be less because the top field journal is "leading," than because it is the ultimate repository of ideas with nowhere else to go. To us, the distinction is unimportant. Whether by choice or by default, *JEEM* published articles on climate change and surveys before the general interest journals.

Understanding idea diffusion in the economics literature is important for several reasons. It tells researchers looking to impact their field that, apart from the pure prestige that might accompany a top level generalist publication, thought leadership can perhaps be established either through a top generalist publication or through a leading field publication. It tells academics and policy makers with scarce reading time that new ideas and research in nascent sub-fields are as likely to appear first in either the leading generalist journals or in top level field journals.

Table 1 - Abstract Counts per Decade

Journal	1970s	1980s	1990s	2000s	2010s	Totals
American Economic Review	693	1,194	888	988	626	4,389
Econometrica	628	840	569	605	319	2,961
Journal of Political Economy	656	813	563	430	154	2,616
Quarterly Journal of Economics	316	564	462	413	211	1,966
Review of Economic Studies	340	524	394	430	256	1,944
Journal of Environmental Economics and Management	154	328	461	486	226	1,655
Totals	2,787	4,263	3,337	3,352	1,792	15,531

Table 2 – Topics & Associated Keywords and Phrases

Topic Keywords	**Air Pollution**	**Water Pollution**	**Climate Change**	**Sustainability**	**Recycling**	**Surveys**
	clean air act*	clean water act*	climate change	sustainability	recycling	survey
	particulate matter	water pollution control act	climate	weak sustainability	recycling return deposits	contingent valuation
	ozone	water quality act	global warming	strong sustainability	extraction cost	blue ribbon panel
	carbon monoxide*	safe drinking water act	greenhouse gas	environmental sustainability	disposal cost	NOAA panel
	nitrogen oxides*	water transfer	greenhouse gas emission*	sustainable development	newspapers	stated preference
	sulfur dioxide*	surface water	carbon dioxide*	biodiversity	glass	saliency bias
	lead	riparian doctrine	carbon dioxide emissions	future generations	bottles	strategic bias
	smog trading	prior appropriation	carbon sequestration	ecosystem services	bottle bill legislation	information bias
	regional clean air incentives market*	groundwater contamination	carbon sequestration credit	intergenerational fairness	recycling programs	hypothetical bias
	acid rain	water market	pigouvian tax	two-period model	landfill	response bias
	acidification	instream use	cap-and-trade	kuznets curve	solid waste	selectivity bias
	state implementation plan*	instream flow protection	regional greenhouse gas initiative*	wildlife protection	copper	Nonresponse bias
	national ambient air quality standards*	national effluent standards	reducing emissions from deforestation and forest degradation*	growth-development relationship	iron ore	starting point bias
	air quality index	water pricing	kyoto	population growth	scrap market	nonmarket valuation
	uniformly mixed pollutant	total maximum daily load*	tradeable permits	natural resource curse	pricing trash	choice experiment
	pigouvian tax	nonpoint source	geoengineering		e-waste	conjoint model
	cap-and-trade	point source	clean coal			conjoint analysis
	nonuniformly mixed pollutant	oil spill	emissions trading			contingent ranking
	emissions trading	ocean dumping	international agreement on climate change			
	corporate average fuel eonomy*	marine protection research and sanctuaries act	european union emissions trading system*			
		beneficial use				
		effluent charge				
		watershed				
		municipal wastewater				
		sewage				

* Acronym of key term was also included in the frequency counts.

Table 3 – Aggregated Topical Keyword Counts

	American Economic Review	Econometrica	Journal of Political Economy	Quarterly Journal of Economics	Review of Economic Studies	Journal of Environmental Economics & Management
Air Pollution	128	84	91	80	74	238
Water Pollution	8	3	4	1	5	100
Climate Change	31	5	7	8	1	268
Sustainability	37	7	16	21	22	102
Recycling	37	5	20	10	15	135
Surveys	137	64	66	69	44	272

Table 4 - Significant Granger Causality Tests of Topics on Specific Journal Pairings, with P-values

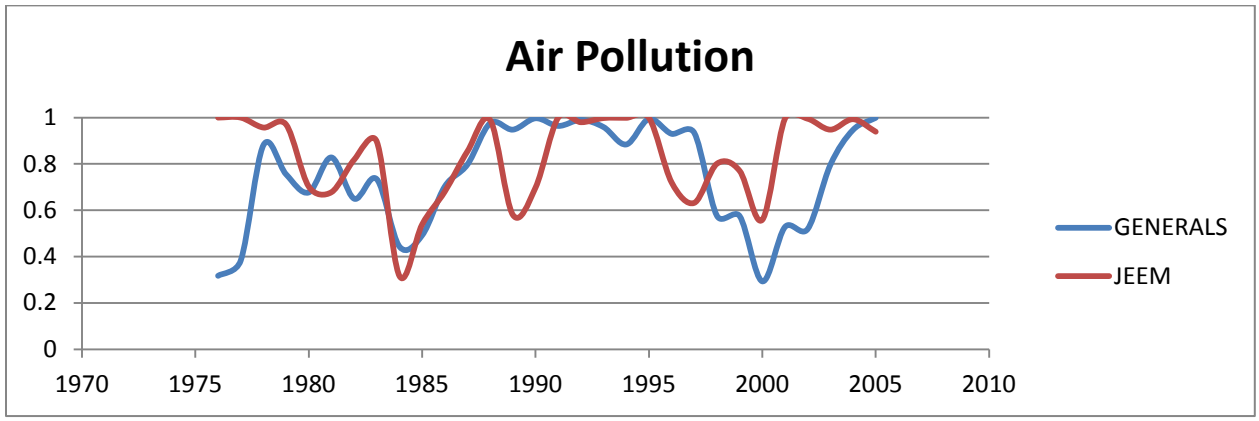
	Leader					
Follower	***JEEM***	***AER***	***E***	***JPE***	***QJE***	***RES***
JEEM		WaterPollution <0.001	WaterPollution <0.001	Recycling 0.024 ClimateChange 0.022	WaterPollution <0.001 AirPollution 0.040	ClimateChange <0.001 WaterPollution 0.040
AER	ClimateChange 0.030			Surveys 0.040		
E	Surveys 0.001	WaterPollution 0.029	Surveys 0.005	ClimateChange 0.014	AirPollution 0.004 Surveys 0.039	ClimateChange <0.001 Recycling 0.012
JPE	Recycling <0.001	Sustainability <0.001	Sustainability 0.002		Sustainability 0.019	Sustainability 0.006
QJE	Surveys 0.002	Sustainability 0.029	Surveys 0.023	Recycling 0.037		Sustainability 0.020
RES	ClimateChange 0.014	Recycling 0.015	WaterPollution <0.001	Surveys 0.023	Surveys 0.042	

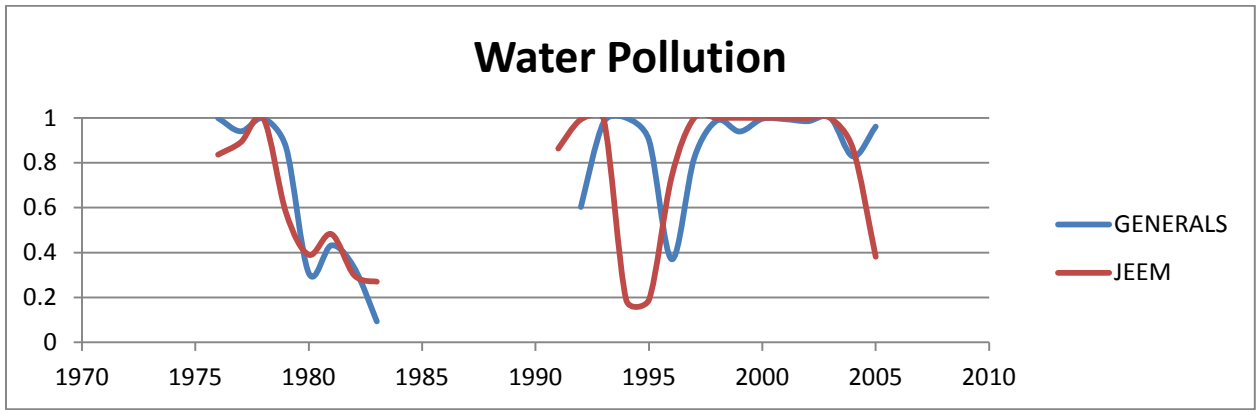
Table 5 – p-Values for Granger Causality Tests of Topics Level Leadership

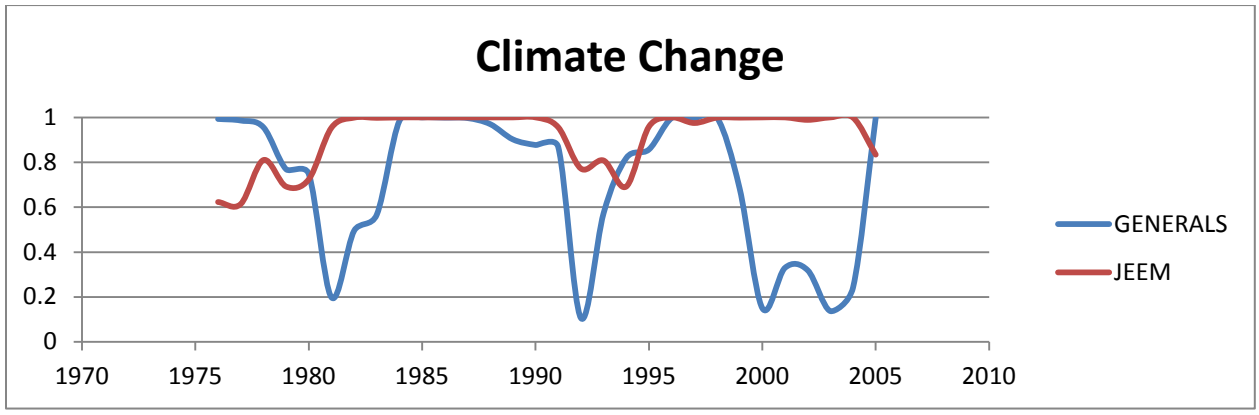
	GENERALS Lead	*JEEM* Leads
Surveys	0.118	0.053*
Recycling	0.253	0.605
Sustainability	0.701	0.642
Climate Change	< 0.001***	0.048**
Water Pollution	0.754	0.598
Air Pollution	0.271	0.563

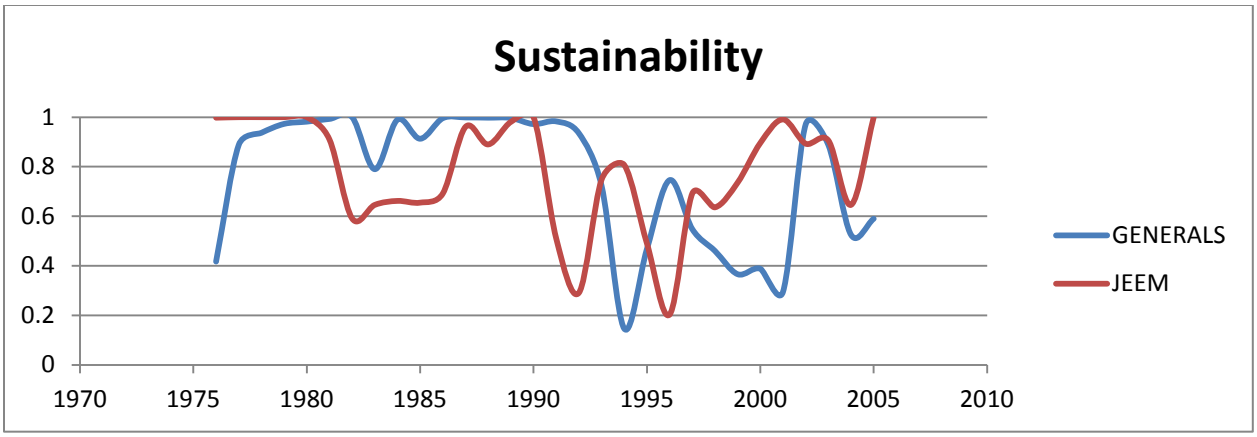
*** 1% level of significance
** 5% level of significance
* 10% level of significance

Figure 2 – One Minus p-Value for Ten Year Moving Window Tests of Topic Level Leadership








Sustainability
1
0.8
0.6
0.4
0.2
0
1970
1975
1980
1985
1990
1995
2000
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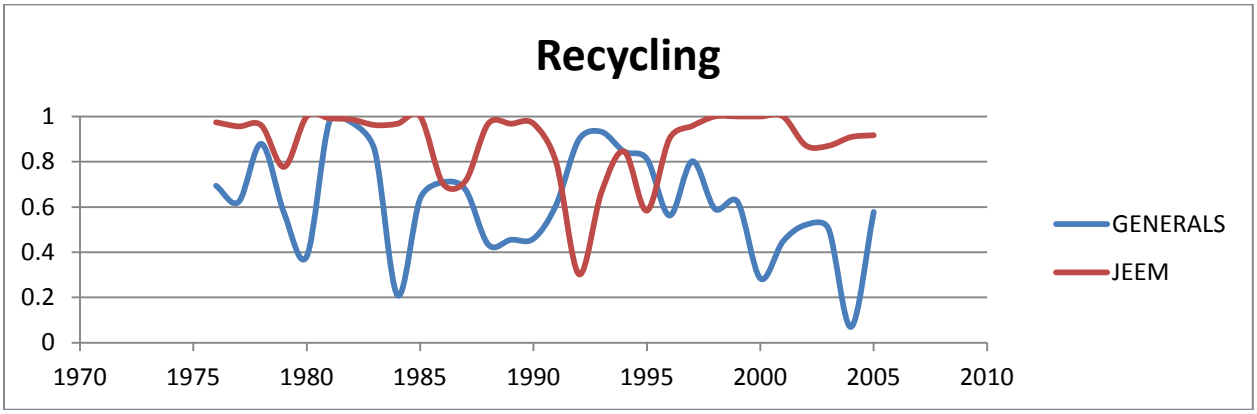
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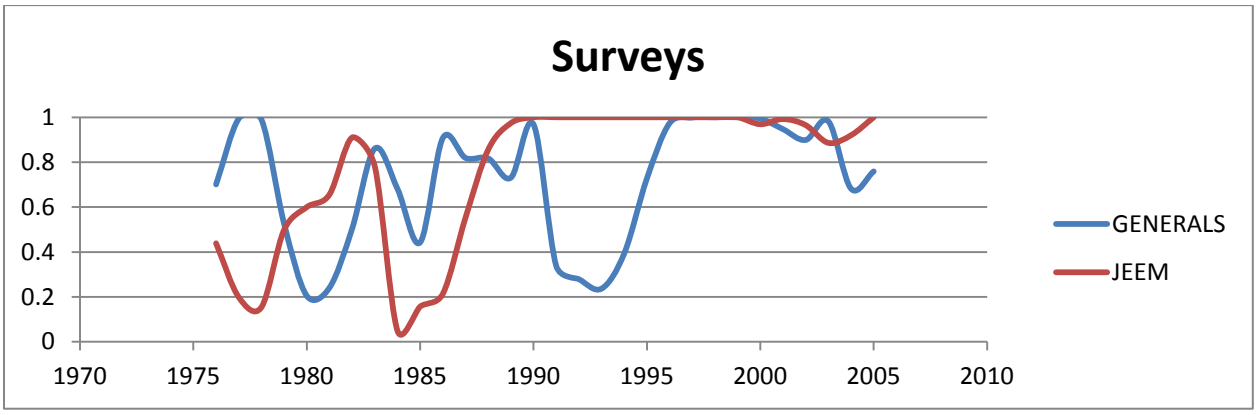
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