

# REFINED (SUCCESSIVE) H-INDICES: AN APPLICATION TO ECONOMICS IN THE REPUBLIC OF IRELAND

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### Abstract

We rank economics departments in the Republic of Ireland according to the number of publications, number of citations, and (successive)  $h$ -index of research-active staff. We increase the discriminatory power of the  $h$ -index by introducing two ancillary indices. The first ( $h^+$ ) measures the excess over the actual  $h$ -index, while the second index ( $h^\Delta$ ) measures the distance to the next  $h$ -index. The latter index is readily used to make the  $h$ -index a rational number.

### Keywords

Ranking, economists,  $h$ -index

## 1. Introduction

Hirsch (2005) introduced the  $h$ -index to measure the quality of academics. A researcher has an  $h$ -index of  $h$  if she has  $h$  publications that are cited at least  $h$  times. Schubert (2007) proposed successive  $h$ -indices. A university department has an  $h_1$ -index of  $h_1$  if it has  $h_1$  members with an  $h$ -index of at least  $h_1$ . (This can be repeated for universities, countries, and so on.) Schubert (2007) applies this to journals and publishers. Here we present the  $h_1$ -index of economics departments in the Republic of Ireland.

One problem with (successive)  $h$ -indices is that they are natural numbers. This implies that the  $h$ -ranking lacks a finer structure. One can have two opinions on this. On the one hand, any ranking is arbitrary to a degree, and a finer structure is precision without accuracy. On the other hand, minor but real quality differences are omitted. We show below that it is possible to define a rational  $h$ -index.

In Section 2, we set out the data and methods. In Section 3, the results are presented. Section 4 concludes.

## 2. Data and Methods

The analysis is based on a total of 125 economic researchers in 9 institutions in the Republic of Ireland. The names of individuals were taken from the relevant institution's web site.<sup>1</sup> People without traceable publications were excluded.

Data are taken from Scopus ([www.scopus.com](http://www.scopus.com)), at the end of 2006. Unlike *EconLit*, *Scopus* includes citations. Compared to the *ISI Web of Science* and *IDEAS/REPEC*, *Scopus* has a better coverage of journals, particularly after 1996. *Scopus* excludes working papers, and has a limited coverage of books.

We can generate three rankings of individuals, based on the number of publications, the number of citations to those papers, and the  $h$ -index. See Table A1. Publication and citation numbers are not corrected for the journal quality, page length, or number of authors. These rankings are included for comparison only. The focus is here on  $h$ -indices. The rankings are not corrected for self-citations or age.

For institutions, we look at totals and averages of publications and citations. The “total”  $h$ -index is Schubert's  $h_1$ -index. The average  $h$ -index is also given – the difference between the total and average in an indicator of the variance within an institution.

An institution has an  $h_1$ -index of  $h_1$  if it has  $h_1$  members with an  $h$ -number of at least  $h_1$ . However, some institutions may have more than  $h_1$  members, say  $n$ , with an  $h$ -number of at least  $h_1$ . Let's define  $h_1^+ := n - h_1$ . Institutions can be ranked first on  $h_1$  and second on  $h_1^+$ . This captures the extent to which productivity within an institution is skewed at the upper end. Unfortunately, this cannot be made into a single index.

One may also consider the distance to  $h_1+1$ . For an institution to get a higher  $h_1$ -index, the  $h$ -index of at least one member has to increase by at least one point. But it may also be that  $h_1$  members have an  $h$ -index of exactly  $h_1$ , and the rest an  $h$ -index of 0. In that case,  $2h_1+1$  additional points are needed. The former institution should be ranked ahead of the latter. Let  $n$  denote the additional points needed. The fact that there is a maximum distance between  $h_1$  and  $h_1+1$  allows us to express the distance as a fraction,  $n/(2h_1+1)$ , and the  $h_1$ -index as a rational number:  $h_1^\Delta = h_1 + 1 - n/(2h_1+1)$ . It is easily seen that  $h_1^\Delta = h_1 + 1$  for  $n=0$  (i.e., no additional points are needed) and that  $h_1^\Delta = h_1$  for  $n=2h_1+1$  (i.e., the maximum number of additional points are needed).

The same holds for the  $h$ -index.<sup>2</sup> Note that  $h^+$  and  $h^\Delta$  can readily be generalized (Sidiropoulos *et al.*, 2007).

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<sup>1</sup> The names of the economists at the Central Bank of Ireland were kindly supplied by Mary Keeney.

<sup>2</sup> The second author has an  $h$ -index of 17. As soon as someone cites Fankhauser *et al.* (1999), his  $h$ -index will rise to 18, so his  $h^\Delta$ -index is  $18 - 1/(2 \cdot 17 + 1) = 17.97$ .

### 3. Results

Table 1 shows the results for the nine institutions, and Table 2 shows the corresponding rankings.<sup>3</sup> The rankings based on total and average number of publications, total and average number of citations, average  $h$ -index, and  $h_1$ -index roughly agree. There are three institutions (all in Dublin) that clearly outperform the other six institutions.

However, two institutions have an  $h_1$ -index of four, and five have one of two. Therefore, Table 1 also shows  $h_1^+$  and  $h_1^\Delta$ . The finer ranking suggested by these two indices roughly agree with one another on the ranking, and with the rankings based on publication and citation numbers. Table 3 shows the rank correlations.  $h_1^+$  and  $h_1^\Delta$  correlate well with citations and publications, as well as with  $h_1$  and average  $h$ . At the same time, the  $h_1$  index shows relatively poor correlations with citations and publications –  $h_1^+$  and  $h_1^\Delta$  thus serve as a bridge between  $h_1$  and citations and publications.

### 4. Conclusion

We present two extensions of the  $h_1$ -index,  $h_1^+$  and  $h_1^\Delta$ . The  $h_1^+$ -index allows for a secondary ranking for institutions with an equal  $h_1$ -index. The  $h_1^\Delta$ -index is a rational number with a finer discrimination than the  $h_1$ -index. An application to economics institutions in the Republic of Ireland shows that the new indices perform as desired. The same would apply to the original  $h$ -index.

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<sup>3</sup> Ruane and Tol (2007) discuss the results in more details, including the implications for research policy in Ireland. They also compare this ranking to the earlier ones by Barrett and Lucey (2003) and Coupe and Walsh (2003).

Sidiropoulos, A., D. Katsaros and Y. Manolopoulos (2007), 'Generalized Hirsch h-index for Disclosing Latent Facts in Citation Networks', *Scientometrics*, **72** (2).

Table 1. Scores of economics institutions in the Republic of Ireland.

	People		Publications		Citations		$h_1$		$h_1^+$	$h_1^\Delta$
			#	avg	#	avg	#	avg		
UCD	29	255	8.8	1020	35.2	5	2.9	3	5.6	
ESRI	16	180	11.3	1125	70.3	4	3.4	2	4.8	
TCD	17	164	9.6	912	53.6	4	2.7	1	4.9	
NUIM	14	67	4.8	135	9.6	2	1.6	4	2.8	
UCG	15	52	3.5	143	9.5	2	1.3	4	2.6	
UCC	12	35	2.9	57	4.8	2	1.1	1	2.6	
UoL	4	26	6.5	29	7.3	2	1.5	0	2.4	
DCU	8	26	3.3	40	5.0	2	0.8	0	2.4	
CBI	11	33	3.0	57	5.2	1	0.8	5	1.7	

Table 2. Ranks of economics institutions in the Republic of Ireland.

	People		Publications		Citations		$h_1$		$h_1^+$	$h_1^\Delta$
			#	avg	#	avg	#	avg		
UCD	1	1	3	2	3	1	2	1	1	
ESRI	3	2	2	1	1	2	1	2	3	
TCD	2	3	1	3	2	2	3	3	2	
NUIM	5	4	5	5	4	4	4	4	4	
UCG	4	5	6	4	5	4	6	5	5	
UCC	6	6	9	6	9	4	7	6	5	
UoL	9	8	4	9	6	4	5	7	7	
DCU	8	8	7	8	8	4	9	7	7	
CBI	7	7	8	6	7	9	8	9	9	

Table 3. Rank correlations (cf. Table 2).

	# publ	avg publ	# cit	avg cit	$h_1$	avg $h$	$h_1^+$	$h_1^\Delta$
people	0.96	0.60	0.94	0.77	0.58	0.75	0.89	0.90
# publ		0.71	0.95	0.84	0.65	0.88	0.95	0.93
avg publ			0.63	0.93	0.63	0.90	0.78	0.70
# cit				0.81	0.52	0.78	0.85	0.81
avg cit					0.54	0.92	0.83	0.75
$h_1$						0.64	0.80	0.83
avg $h$							0.89	0.83
$h_1^+$								0.98

Table A1. Rankings of economists in research institutions in the Republic of Ireland.

Rank	Name	Inst.	Score <sup>a</sup>	Publications		Citations		h-index	
				#	rank	#	rank	#	rank
1	Tol, R.S.J.	ESRI	3.00	89	1	750	1	17	1
2	Lane, P.R.	TCD	1.32	29	3	393	2	8	3
3	Nolan, B.	UCD	1.26	35	2	208	3	10	2
4	Barry, F.G.	TCD	0.86	27	5	150	4	6	5
5	Whelan, C.T.	ESRI	0.83	22	6	127	5	7	4
6	Honohan, P.	TCD	0.72	28	4	83	10	5	8
7	Kelly, M.	UCD	0.64	13	13	104	6	6	5
8	Clinch, J.P.	UCD	0.61	19	7	79	11	5	8
9	O'Rourke, K.H.	TCD	0.59	15	9	95	8	5	8
10	Ruane, F.	ESRI	0.54	11	20	44	19	6	5
11	Leahy, D.M.	UCD	0.53	11	20	87	9	5	8
12	O Grada, C.	UCD	0.53	14	10	57	16	5	8
13	Harmon, C.P.	UCD	0.53	9	28	99	7	5	8
14	Walsh, P.P.	UCD	0.51	13	13	51	18	5	8
15	Reynolds-Feighan, A.	UCD	0.48	10	22	52	17	5	8
16	Callan, T.	ESRI	0.43	10	22	63	14	4	16
17	Bergin, J.	UCD	0.42	9	28	64	13	4	16
18	Maitre, B.	ESRI	0.42	12	17	37	22	4	16
19	Whelan, K.T.	CBI	0.42	12	17	36	23	4	16
20	Keane, M.J.	UCG	0.41	12	17	32	26	4	16
21	Conniffe, D.	NUIM	0.41	19	7	15	38	3	25
22	Bradley, J.	TCD	0.41	6	40	78	12	4	16
23	O'Niell, D.	NUIM	0.39	7	34	58	15	4	16
24	Andreosso-O'Callaghan, B.	UoL	0.35	14	10	14	41	3	25
25	Devereux, P.J.	UCD	0.35	13	13	22	29	3	25
26	Walsh, B.	UCD	0.35	5	48	44	19	4	16
27	FitzGerald, J.D.	ESRI	0.35	7	34	26	27	4	16
28	Matthews, A.	TCD	0.32	10	22	21	30	3	25
29	Gallagher, L.A.	UCC	0.31	9	28	26	27	3	25
30	Farrell, L.	UCD	0.30	6	40	42	21	3	25
31	Cotter, J.	UCD	0.29	13	13	19	32	2	34
32	Lucey, B.M.	TCD	0.29	14	10	9	53	2	34
33	Morgenroth, E.L.W.	ESRI	0.27	4	54	34	24	3	25
34	Bargain, O.	UCD	0.26	7	34	1	95	3	25
35	Roche, M.J.	NUIM	0.25	10	22	16	33	2	34
36	Kearney, C.	TCD	0.25	10	22	14	41	2	34



37	Drudy, P.J.	TCD	0.24	4	54	12	45	3	25
38	Hutson, E.	UCD	0.23	9	28	7	58	2	34
39	Barrett, A.	ESRI	0.23	8	33	14	41	2	34
40	Madden, D.	UCD	0.22	7	34	16	33	2	34
41	Flavin, T.J.	NUIM	0.21	7	34	9	53	2	34
42	Whelan, C.	UCD	0.21	6	40	15	38	2	34
43	DeWit, G.	NUIM	0.20	6	40	11	47	2	34
44	Jacobson, D.S.	DCU	0.20	6	40	10	50	2	34
44	Lenihan, H.	UoL	0.20	6	40	10	50	2	34
46	Siddiqui, A.S.	UCD	0.20	6	40	8	57	2	34
47	Boylan, T.A.	UCG	0.19	5	48	13	44	2	34
48	O'Donoghue, C.	UCG	0.19	5	48	10	50	2	34
49	Whelan, B.J.	ESRI	0.18	4	54	16	33	2	34
50	Bredin, D.	UCD	0.18	10	22	5	65	1	60
51	Cuddy, M.P.	UCG	0.18	4	54	11	47	2	34
51	Murphy, A.	TCD	0.18	4	54	11	47	2	34
53	Kapur, K.	UCD	0.17	4	54	9	53	2	34
54	O'Shea, E.	UCG	0.17	3	68	16	33	2	34
55	Kennelly, B.	UCG	0.17	2	86	21	30	2	34
56	Pastine, T.	NUIM	0.17	4	54	4	69	2	34
57	Convery, F.J.	UCD	0.17	9	28	5	65	1	60
58	McElroy, B.	UCC	0.16	3	68	7	58	2	34
58	Sweetman, O.	NUIM	0.16	3	68	7	58	2	34
60	Doyle, E.	UCC	0.16	3	68	6	61	2	34
61	Newman, C.	TCD	0.16	3	68	5	65	2	34
62	McQuinn, K.	CBI	0.14	7	34	4	69	1	60
63	Harrison, M.J.	TCD	0.14	3	68	33	25	1	60
64	Walsh, F.	UCD	0.13	6	40	1	95	1	60
65	Deegan, J.	UoL	0.12	5	48	5	65	1	60
66	Pastine, I.	UCD	0.12	5	48	4	69	1	60
67	Ahearne, A.G.	UCG	0.11	3	68	15	38	1	60
68	Kawakatsu, H.	DCU	0.11	4	54	4	69	1	60
69	Thom, R.	UCD	0.11	3	68	12	45	1	60
70	Denny, K.	UCD	0.11	4	54	3	79	1	60
70	O'Reilly, G.	CBI	0.11	4	54	3	79	1	60
72	Broome, S.J.	NUIM	0.11	4	54	2	82	1	60
73	McDonough, T.	UCG	0.11	4	54	1	95	1	60
74	Garvey, E.	UCG	0.10	2	86	16	33	1	60
75	Ferreira, S.	UCD	0.10	3	68	4	69	1	60

75	Shinnick, E.	UCC	0.10	3	68	4	69	1	60
77	Gavin, C.	CBI	0.10	3	68	3	79	1	60
78	Delaney, L.	UCD	0.10	3	68	2	82	1	60
78	Gekker, R.	UCG	0.10	3	68	2	82	1	60
78	Kavanagh, E.	UCC	0.10	3	68	2	82	1	60
78	O'Toole, F.	TCD	0.10	3	68	2	82	1	60
78	Traistaru-Siedschlag, I.	ESRI	0.10	3	68	2	82	1	60
83	Duffy, D.	ESRI	0.09	3	68	1	95	1	60
84	Kearney, I.	ESRI	0.09	2	86	6	61	1	60
85	O'Hagan, J.	TCD	0.09	2	86	4	69	1	60
86	Eakins, J.	UCC	0.08	2	86	2	82	1	60
86	Kavanagh, C.	UCC	0.08	2	86	2	82	1	60
88	Nolan, A.	ESRI	0.08	2	86	1	95	1	60
88	Pantelidis, T.	NUIM	0.08	2	86	1	95	1	60
90	Kearns, A.	CBI	0.08	1	97	9	53	1	60
91	O'Leary, E.	UCC	0.08	1	97	6	61	1	60
91	van Rensburg, T.M.	UCG	0.08	1	97	6	61	1	60
93	Doris, A.	NUIM	0.08	1	97	4	69	1	60
93	O'Sullivan, P.	NUIM	0.08	1	97	4	69	1	60
93	Scott, S.	ESRI	0.08	1	97	4	69	1	60
96	Cassidy, M.	CBI	0.07	1	97	2	82	1	60
96	Hurley, M.J.	NUIM	0.07	1	97	2	82	1	60
96	Kirby, E.	UCC	0.07	1	97	2	82	1	60
96	Mariuzzo, F.	TCD	0.07	1	97	2	82	1	60
96	Rousseau, F.	NUIM	0.07	1	97	2	82	1	60
101	Considine, J.	UCC	0.06	5	48	0	101	0	101
102	Somerville, R.A.	TCD	0.04	4	54	0	101	0	101
102	Velupillai, K.V.	UCG	0.04	4	54	0	101	0	101
104	Hogan, T.	DCU	0.03	3	68	0	101	0	101
105	Parlane, S.	UCD	0.02	2	86	0	101	0	101
105	Piggins, A.	UCG	0.02	2	86	0	101	0	101
105	Sjostrom, W.	UCC	0.02	2	86	0	101	0	101
108	Bergin, A.	ESRI	0.01	1	97	0	101	0	101
108	Birmingham, C.	CBI	0.01	1	97	0	101	0	101
108	Browne, F.X.	CBI	0.01	1	97	0	101	0	101
108	d'Agostino, A.	CBI	0.01	1	97	0	101	0	101
108	Di Maria, C.	UCD	0.01	1	97	0	101	0	101
108	Doran, D.	CBI	0.01	1	97	0	101	0	101
108	Geary, P.T.	NUIM	0.01	1	97	0	101	0	101

108	Lally, B.	UCG	0.01	1	97	0	101	0	101
108	Largey, A.	DCU	0.01	1	97	0	101	0	101
108	Lyons, S.	ESRI	0.01	1	97	0	101	0	101
108	McDonnell, T.	DCU	0.01	1	97	0	101	0	101
108	McGovern, S.	DCU	0.01	1	97	0	101	0	101
108	Murphy, A.P.	CBI	0.01	1	97	0	101	0	101
108	O'Donnell, M.	UoL	0.01	1	97	0	101	0	101
108	Poti, V.	DCU	0.01	1	97	0	101	0	101
108	Power, B.	UCC	0.01	1	97	0	101	0	101
108	Raghavendra, S.	UCG	0.01	1	97	0	101	0	101
108	Tamura, Y.	TCD	0.01	1	97	0	101	0	101

<sup>a</sup> The overall score is the sum of number of publications, number of citations, and the *h*-index, each divided by the score of the highest ranked individual.

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