Understanding relative trends in research use by policymakers: comparative analysis of three small advanced economies

Bastian Rake, Olga Ryazanova, Peter McNamara

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Research Question and Literature

The idea that sharing robust scientific insights with policymakers leads to the creation of better public policies has been one of the fundamental assumptions of evidence-informed policymaking approach. In its simplistic linear form, this idea has been challenged by those who correctly point out that evidence from academic research is just one of the types of evidence that can be used by policymakers, and that having robust evidence is often insufficient for making policy change (Kuchenmüller et al., 2022; Smith et al., 2024). Nonetheless, academic research can be an important input into decision-making, influencing both how policy-makers think about a particular issue and what specific steps they take to address it (de Sandes-Guimarães et al., 2022; Newson et al., 2018).

The visible 'footprint' of this influence can be seen by analysing the citations of academic publications in policy documents (e.g., De Filippo & Sastrón-Toledo, 2023; Xu & Zong, 2023). This analytical approach has its limitations. It can deliver false negatives (incorrectly assuming that specific research has not influenced policy), because not every piece of research that policymakers use is actually cited in final drafts of policy documents. It can also deliver false positives (incorrectly assuming that specific research has influenced policy), because policymakers can use research to justify and legitimise decisions which they already made before research has been produced (Smith et al., 2024).

Cross-country comparisons of citations in policy documents can partly alleviate these methodological concerns. Large international samples better reflect the global nature of science and its impact. With careful controls for disciplinary differences, relative trends in policy citations can point to differences in the quantity and quality of academia-policy interactions across countries, setting the scene for further in-depth exploration using qualitative methods.

For this purpose, there is no need for the method to deliver accurate absolute estimates of research use, as long as the limitations are the same across all countries.

Our study looks at all academic publications produced in three small advanced economies (Ireland, Finland and Israel) over 12 years and explores the national and global footprint these outputs left in policy documents and in media. We connect data from three leading databases – Scopus, Overton and Altmetrics, - to deliver a nuanced comparative picture of research translation into policy and into global discourse. In addition to providing insights on relative research use trends, we investigate whether a visibility of research publication in mass media has any influence on its subsequent use in policy documents.

Data

The three countries, Finland, Ireland, and Israel, have been chosen due to their similarities in terms of population size, structure of higher education sector, and technological development. We collected bibliometric data for each of the three countries from the Scopus database. Scopus is a comprehensive database covering more than 90 million research publications such as journal articles, books, book series, and conference papers from more than 7,000 publishers worldwide across virtually all disciplines, including the sciences, technology, medicine, social sciences, as well as arts and humanities.

Our data contains all research outputs published between 2012 and 2023 by researchers with affiliations in at least one of the three countries. Our data includes 745,511 unique research publications of which 268,850 list at least one author from Finland, 196,544 list at least one author from Ireland, and 278,908 list at least one author from Israel.[1]. Scopus provides bibliometric information on each of these publications, including authors' names, author affiliations, publication year, publication outlet, and the number of forward citations.

While the latter is a frequently used indicator for impact within the academic community, it does not capture impact in policy making. Therefore, we use the unique identifiers (DOIs) associated with each publication to conduct a follow up search of mentions in policy documents through the Overton database. Overton is currently the largest existing database of policy documents covering approx. 18 million documents globally. Using the Overton database allows us to match each research publication in our dataset with mentions/ citations in different types of policy-related documents.

[1] The sum of articles originating each country is slightly higher than the number of unique articles in the dataset due to cross-country collaborations.

To capture the additional types of data which can be used to understand the ways in which research becomes known to policymakers, and the extent to which public attention to research influences the probability of it being used in policy formation, we collected data on news mentions of research and its social media visibility from the Altmetric database. This database is one of the most comprehensive sources for capturing the attention of public to research outputs (e.g., Lemke et al., 2022; Repiso et al., 2019).

Finally, we supplement the bibliometric information we obtained from Scopus with CWTS Journal Indicators (https://www.journalindicators.com/) provided by the University of Leiden. We have chosen these journal metrics for several reasons. Firstly, they are based on Scopus data, which aligns with our bibliometric dataset. Secondly, they offer broad journal coverage, which was important due to multidisciplinary nature of our dataset. Thirdly, these indicators are available in Open Access, which improves the replicability of our methodology.

Methodology

In addition to descriptive analyses, we employ negative binomial regressions with robust standard errors. This model has been chosen as our dependent variables are count variables, i.e., variables which can take only non-negative integer values including zero. Negative binomial regressions are the standard regression model for analysing count data. All regressions include several publication-related variables to explore linkages between publication characteristics and the number of citations in different type of policy documents.

Table 1 presents explanations for all variables used in the regression analysis. All independent variables were coded from the Scopus data, with the exception of the *top journal* variable, which was coded using CWTS journal metrics. The source normalized impact per paper (SNIP) was matched longitudinally to the year of publication, so that, for example, a paper published in 2018 would be assigned $SNIP_{2018}$ journal metric.

The variable *share of female authors* was generated using gender prediction algorithm in R, similarly to the method used by Anzia and Bernhard (2022). The algorithm used first names of authors in Scopus data to predict the gender of an author with a defined probability threshold (80%). While this approach has its limitations, it, nonetheless, offers an opportunity to add an important gender dimension to large-scale datasets that are unsuitable for more precise manual coding.

Dependent variables:	
Number of citations by policy documents	Number of forward citations by policy documents, including e.g., government documents, European Union documents, documents authored by international organisations, or legal documents.
Number of citations by government documents	Number of forward citations by government documents.
Number of citations by EU documents	Number of forward citations by European Union documents.
Independent variables:	
Number of media mentions	Number of mentions in mass media outlets.
Number of Twitter mentions	Number of mentions in Twitter/X posts.
Government funded	Binary indicator equal to 1 if a publication acknowledges funding from government sources.
Number affiliations	Number of different affiliations (i.e., organisations) reported in author affiliations
Number countries	Number of different countries reported in author affiliations.
Top journal (top 10% SNIP)	Binary indicator equal to 1 if a publication appeared in one of the top 10% of journals according to the SNIP indicator.
Academic citations per year	Number of forward citations from academic sources per year since publication.
Share of female authors	Share of female authors in %.
Ireland	Binary indicator equal to 1 if at least one author reports and Irish affiliation.
Finland	Binary indicator equal to 1 if at least one author reports and Finnish affiliation.
Life Science	Binary indicator equal to 1 if the research publication appeared in life science-focused outlets.
Health Science	Binary indicator equal to 1 if the research publication appeared in health science-focused outlets.
Social Science	Binary indicator equal to 1 if the research publication appeared in social science-focused outlets.
Physical Science	Binary indicator equal to 1 if the research publication appeared in physical science-focused outlets.

Table 1: Description of variables

Preliminary Descriptive Results

Visibility of research in policy documents

Our preliminary descriptive results presented in Table 2 indicate that around 10.9% of the research outputs produced in Ireland and Finland are mentioned in any type of policy-related document. In contrast, only approx. 5.8% of research outputs originating in Israel are being used in policy-related documents. Out of those policy citations, the majority comes from documents published by national governments (circa 76% for research produced in Ireland and Finland, and 69% for research produced in Israel). A sizable minority of citations comes from European Union-related documents (circa 15% for research produced in Ireland and Finland, and 10% for research produced in Israel). As seen in Figure 1, in all three countries the rates of policy citations drop after 2018, suggesting that it takes a relatively long period of time, i.e., often more than five years, before research publications are used by policy makers and policy practitioners and are mentioned in policy documents.

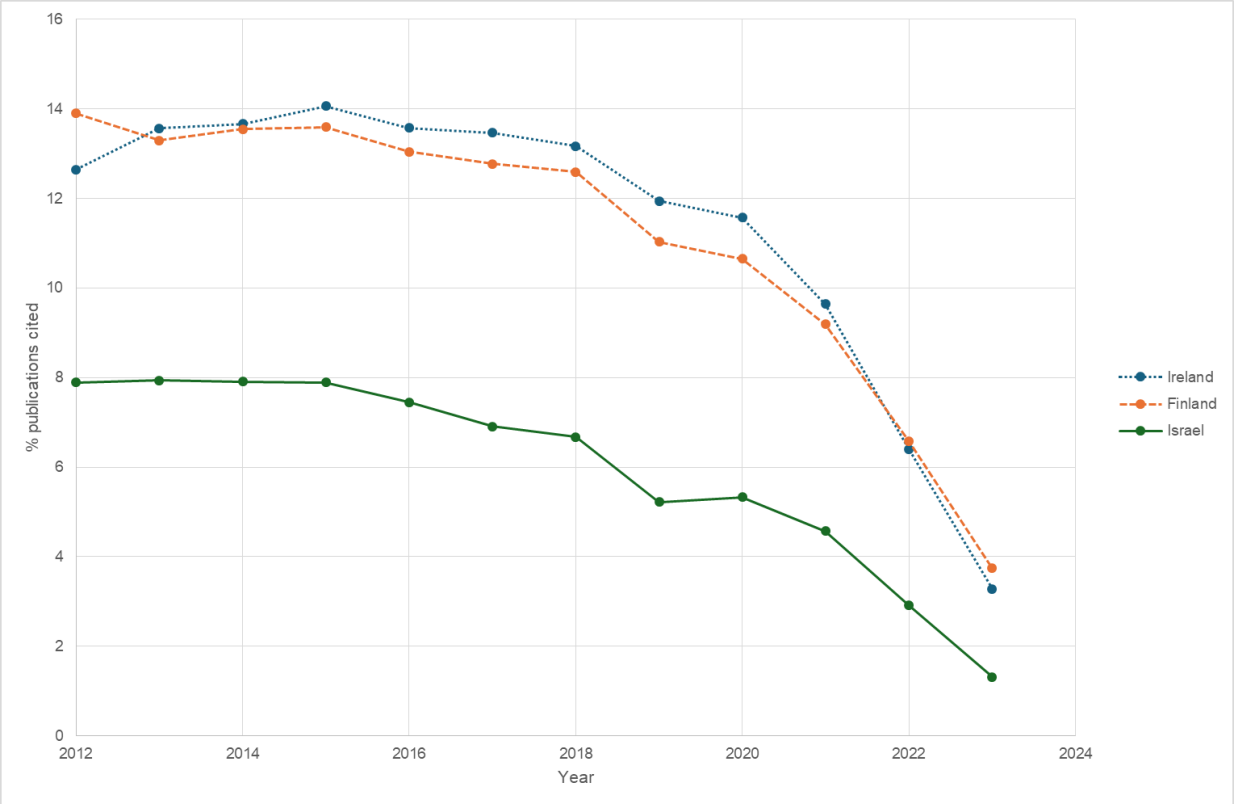

Figure 1. Citations in all types of policy documents

	Ireland			Finland			Israel		
	% Publications cited by policy documents	% Publications cited by government documents	% Publications cited by EU policy documents	% Publications cited by policy documents	% Publications cited by government documents	% Publications cited by EU policy documents	% Publications cited by policy documents	% Publications cited by government documents	% Publications cited by EU policy documents
2012	12.65	10.15	2.13	13.90	10.92	2.11	7.89	5.35	0.70
2013	13.57	10.78	2.19	13.30	10.53	2.14	7.94	5.27	0.69
2014	13.67	10.77	2.34	13.55	10.51	2.03	7.91	5.45	0.77
2015	14.06	10.97	2.04	13.59	10.55	2.18	7.89	5.41	0.76
2016	13.58	10.63	2.04	13.04	9.92	2.02	7.45	5.24	0.86
2017	13.47	10.34	1.81	12.77	9.77	1.95	6.91	4.76	0.62
2018	13.17	10.17	1.86	12.59	9.49	1.95	6.67	4.66	0.68
2019	11.94	8.80	1.81	11.03	8.48	1.77	5.22	3.56	0.50
2020	11.57	8.41	1.59	10.65	8.14	1.62	5.33	3.76	0.64
2021	9.64	7.11	1.52	9.19	7.04	1.54	4.57	3.27	0.49
2022	6.39	4.65	0.87	6.57	5.07	1.08	2.91	2.05	0.33
2023	3.28	2.14	0.49	3.74	2.69	0.57	1.31	0.93	0.14
Overall	10.90	8.30	1.64	10.85	8.35	1.70	5.77	3.99	0.58

Table 2: Citations rates of published research output in policy documents per publication year

Visibility of research in media

One might argue that getting research cited in policy documents is difficult due to a highly political nature of development and approval process for these documents (e.g., Newson et al., 2021). Following this logic, it should be easier for researchers to get their work mentioned in mass media, which is open to a broader range of perspectives. Mentions in traditional (mass) media is an indicator of which research is seen as being of interest for a broader non-academic audience by those who curate media contents (Credit et al., 2024). Surprisingly, Table 3 indicates that only a relatively small fraction of research publications receives mentions in the media. Moreover, across the three countries in our dataset, the share of research publications mentioned in the media is below the share of research publications in the more broadly defined categories of policy documents. Presumably, the media report on recently published research which is why the rates of media mentions only slightly decline for more recent years.

	Ireland		**Finland**		**Israel**	
	% Publications with media mentions	% Publications with X (Twitter) mentions	% Publications with media mentions	% Publications with X (Twitter) mentions	% Publications with media mentions	% Publications with X (Twitter) mentions
2012	2.89	21.76	3.24	20.14	3.15	20.99
2013	4.21	27.01	4.27	23.89	4.87	26.11
2014	5.08	33.03	5.36	30.74	5.49	31.99
2015	6.63	39.21	6.48	35.50	6.92	37.99
2016	7.33	42.93	7.29	39.08	8.21	41.28
2017	7.82	46.53	7.76	42.28	7.76	42.10
2018	7.25	50.21	8.08	46.39	7.13	43.72
2019	7.79	51.40	8.25	46.85	7.62	44.14
2020	9.19	56.41	8.63	50.68	8.74	47.06
2021	9.69	58.22	9.39	54.10	9.73	49.92
2022	9.06	57.29	8.84	53.84	8.93	50.38
2023	7.71	52.40	7.85	49.33	7.63	45.96
Overall	7.35	46.58	7.31	42.28	7.36	41.08

Table 3: Citations rates of published research output in media / social media per publication year

In contrast to this relatively low citation rates of research in policy documents and mass media, we find that more than 40% of research outputs across all three countries have been mentioned on X (formerly Twitter). In addition to the overall higher rate of mentions/citations on X, trend of citations goes in the direction opposite to policy documents, as seen in Figure 2. About 50% of more recent research publications are more frequently mentioned on X while only about 20% of 10-year-old publications mentioned. The general trends and patterns are

remarkably stable across the three countries with Ireland having slightly higher rates of research publications mention on X compared to the other two countries. It is notable that, unlike citations in policy documents, there are no significant cross-country differences in the research mentions in media (especially in mass media – see lower part of Figure 2).

Figure 2. Citations in mass and social media

The difference in mentions may be due to the nature of the communication. Policy documents and media require that a third party engages with a research publication. In contrast, X had been increasingly used by researchers themselves to communicate their work (Guenther et al., 2023). While social media like X provide opportunities for interactions with individuals from outside academia, it has been found that most research communication on X is based on sharing information without further debate and that bots play a considerable role in disseminating research information on X (Didegah et al., 2018). Based on our dataset, we cannot rule out that the rather high share of research being mentioned on X is influenced by researcher sharing their own and their colleagues work as well as by bots re-sharing the corresponding posts.

Disciplinary differences in visibility of research in policy documents

One may expect differences among academic disciplines regarding the use of the corresponding research in policy making (Li & Hu, 2024). As indicated in Table 4, social science research publications originating in Ireland have the highest share of mentions in policy documents compared to other disciplines with multidisciplinary research publications having

a very similar share. The overall pattern is slightly different for Finland, with little difference between the share of research publications mentioned in policy documents for health science and social science research. Health science publications from Israel have the highest share of mentions in policy documents across all disciplines. Similar to the results presented in Table 2, research originating in Israel is, across disciplines, less frequently cited in policy documents compared to the other countries. Figure 3 below visualises the average policy citation rates across disciplines for each country in our dataset.

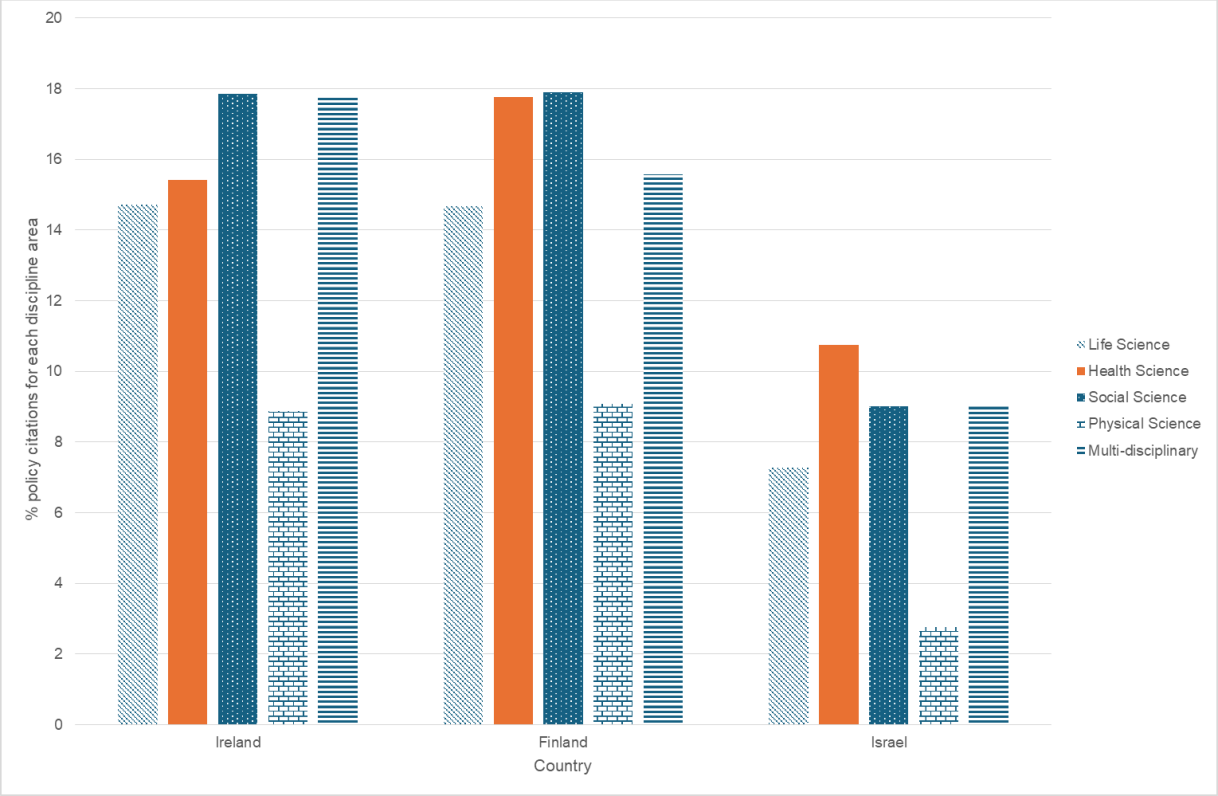

Figure 3. Policy citations across disciplines (average for 2012-2023)

Our results suggest that there are some differences with respect to citations in policy documents across disciplines and countries. These differences may be driven by countries' research profiles and specialisations, differences in the policy making with respect to science-policy interactions as well as with respect to areas policy makers are focussing on, and the nature of the underlying research. With respect to the latter, it seems that research in the physical sciences may be of more fundamental nature and, therefore, less immediately applicable in policy contexts. It is also possible that research in physical sciences is particularly relevant for specific areas of policy, such as policy on alternative energy, which might be less prominent in some countries.

	Ireland					Finland					Israel				
	% Publications cited by policy documents					% Publications cited by policy documents					% Publications cited by policy documents				
	Life Science	**Health Science**	**Social Science**	**Physical Science**	**Multi-disciplinary**	**Life Science**	**Health Science**	**Social Science**	**Physical Science**	**Multi-disciplinary**	**Life Science**	**Health Science**	**Social Science**	**Physical Science**	**Multi-disciplinary**
2012	18.26	20.69	25.57	9.88	23.56	20.81	27.35	27.33	10.48	20.75	9.77	16.58	15.90	3.93	11.56
2013	20.38	23.89	23.84	9.54	25.78	19.63	26.39	23.25	9.74	22.75	10.22	15.75	15.06	3.76	12.83
2014	19.83	21.48	23.92	10.79	21.79	18.64	24.69	24.66	10.72	23.22	9.82	15.12	14.00	3.78	12.77
2015	20.13	23.62	23.30	8.92	29.17	19.59	25.20	22.89	10.49	20.89	10.03	16.08	12.59	3.44	13.44
2016	19.66	21.41	22.20	10.56	20.07	18.60	23.03	21.23	11.12	18.54	9.87	14.60	11.34	3.32	11.96
2017	19.25	20.69	21.20	10.40	21.41	17.60	22.36	21.03	10.73	15.26	9.43	14.29	10.16	3.19	7.90
2018	18.61	19.17	21.72	10.96	21.60	17.01	20.75	20.83	11.15	13.15	8.22	13.15	9.84	3.33	9.20
2019	16.71	16.44	19.30	10.52	18.24	14.63	16.70	18.77	9.27	14.89	6.44	9.90	7.63	2.82	7.26
2020	13.66	14.85	19.65	10.07	17.62	13.88	15.31	18.12	9.73	14.73	6.69	9.64	8.15	2.77	7.79
2021	10.89	11.98	16.16	8.97	13.37	10.49	11.80	15.69	8.98	13.49	5.22	7.98	6.47	2.21	8.58
2022	7.03	7.42	11.41	5.98	9.84	7.06	9.28	11.56	5.68	9.04	0.00	4.99	4.41	1.38	5.23
2023	3.18	3.87	6.27	3.08	5.05	4.39	4.54	6.53	3.49	6.06	1.63	2.01	2.28	0.62	4.07
Overall	14.73	15.42	17.86	8.87	17.74	14.67	17.77	17.91	9.09	15.57	7.28	10.76	9.00	2.77	9.02

Table 4: Citations rates of published research output per publication year across academic disciplines

Preliminary Regression Results

Our preliminary regression results, presented in Table 5, indicate that research publications that are more frequently mentioned in the media or on X/Twitter tend to receive more citations in policy documents. This finding holds for citations in policy documents more broadly as well as for citations in government documents and European Union documents. This finding indicated that research that is more visible outside of academy is more frequently used in the work of policy makers and policy practitioners.

Government funding seems to be only relevant for citations by policy documents and from government sources but not for European Union documents. Our results reveal interesting patterns with respect to collaboration. The international diversity (number of countries) within co-authorship teams is positively related to policy citations, but the same is not true for organisational diversity (number of affiliations) within co-authorship teams which is negatively linked to the number of citations by different types of policy documents.

The same applies to academic publications that appear in top journals and those that receive more academic citations. One interpretation of this might be that research of higher quality which appears in more prestigious journals is more frequently used in different types of policy documents. Similarly, research that is more impactful within the academic community as indicated by the number of citations per year, is also used more frequently in different types of policy documents.

A higher share of female authors is positively linked to the number of citations in different types of policy documents. Research publications originating in Ireland and Finland are linked to higher number of policy citations, relative to publications originating in Israel. Life science and social science publications are linked to a higher number of citations in all types of policy documents, but health science publications are only positively linked to the number of citations in policy documents more broadly and citations in government documents. Physical science publications receive fewer citations in policy documents more generally but are positively linked to the number of citations in government and EU citations relative to multidisciplinary publications.

	(1)	(2)	(3)
Dependent variable:	Number of citations by policy documents	Number of citations by government documents	Number of citations by EU documents
Number of media mentions	0.0162***	0.0137***	0.0111***
	(0.0015)	(0.0014)	(0.0030)
Number of Twitter mentions	0.0035***	0.0025***	0.0018***
	(0.0004)	(0.0003)	(0.0006)
Government funded	0.3300***	0.3711***	-0.0545
	(0.0456)	(0.0456)	(0.1260)
Number affiliations	-0.0165***	-0.0075***	-0.0717***
	(0.0018)	(0.0017)	(0.0055)
Number countries	0.1121***	0.0796***	0.2438***
	(0.0047)	(0.0045)	(0.0121)
Top journal (top 10% SNIP)	0.3972***	0.3587***	0.2797***
	(0.0156)	(0.0164)	(0.0362)
Academic citations per year	0.0716***	0.0618***	0.0689***
	(0.0017)	(0.0014)	(0.0024)
Share of female authors	0.0020***	0.0019***	0.0023***
	(0.0002)	(0.0002)	(0.0006)
Ireland	0.8968***	0.9764***	1.1269***
	(0.0185)	(0.0177)	(0.0493)
Finland	0.9103***	1.0322***	1.0423***
	(0.0160)	(0.0164)	(0.0448)
Life Science	0.4381***	0.5987***	0.5409***
	(0.0160)	(0.0160)	(0.0373)
Health Science	0.8313***	0.9779***	0.0672
	(0.0172)	(0.0159)	(0.0475)
Social Science	1.3986***	1.1314***	1.3714***
	(0.0179)	(0.0174)	(0.0381)
Physical Science	-0.0309*	0.0752***	0.1348***
	(0.0178)	(0.0168)	(0.0339)
Year dummies	yes	yes	yes
Constant	-5.4955***	-5.9321***	-7.6674***
	(0.0384)	(0.0417)	(0.0929)
lnalpha	2.3772***	2.4351***	3.9661***
	(0.0086)	(0.0095)	(0.0241)
N	745502	745502	745502
AIC	625415.7030	469543.8609	116239.6261
BIC	625726.7920	469854.9499	116550.7150

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 5: Negative binomial regressions

Discussion and directions for future research

Our study offers comparative insights into the visible 'footprint' that research produced in Ireland, Finland and Israel over 12 years left in policy documents and media. The comparison of metrics provides information on different knowledge processes (Ryazanova et al., 2024) behind the translation of research into political and public realm. The mentions of research on social media (X/Twitter in our study) reflect the unidirectional process of knowledge sharing, largely driven by academia. As seen in the data, this type of communication has grown substantially, with more than 50% of published research now being shared through social media. While social media is sometimes dismissed as academics talking to other academics, our study shows that this type of communication has a small but significant relationship with the probability of research being used by policymakers. This confirms that knowledge sharing by academics is a necessary (albeit not sufficient) condition of creating policy impact.

The mentions of research in mass media articles, assuming that those articles are initiated by journalists, reflect the process of knowledge transfer, where there is evidence that academic research has been noticed by non-academic audiences. While there is a consistent growing trend here, the absolute percentages of cited publications remain very low, in single digits. This, however, might be an artefact of the metric rather than a genuine lack of researchers' representation in public discourse. Altmetrics database, from which our data is drawn, identifies mentions by using scholarly identifiers, such as DOIs. Traditional style of mass media journalism does not normally provide formal references to sources, which renders linkages between research and mass media invisible. What we see in the data is, most likely, largely based on specialised media outlets, rather than regular news outlets. We, therefore, would advise caution in interpreting the findings of our analysis, which probably underestimate the real footprint of academics in mass media.

Finally, the citations of research in policy documents reflect the process of knowledge reuse, with non-academic audiences applying the result of academic research to the practice of policymaking[2]. It is remarkable how stable this percentage is across the years of our dataset and also how similar the trends are for Ireland and Finland. Our findings raise practical questions for science policy and research evaluation. For example, if 90% of research never gets cited in policy documents, can we reasonably expect the majority of researchers to aim for having some form of policy impact? If it takes at least five years for research to get cited in

[2] If academics are involved in the process of drafting policy documents, this would categorise this process as knowledge application.

policy documents, is it reasonable to expect early career researchers to have visible policy impact? It is also unclear, whether policymakers have a consistent culture of citing sources of evidence that is used in policy development process. Recent research indicates that multiple 'evidence cultures' exist in policymaking (Bandola-Gill et al., 2024), so it is likely that, to some extent, the policy citations indicator mirrors mass media mentions in under-representing the extent of research use in policymaking. The fact that health sciences are consistently higher cited across all three countries confirms this assumption, because the health policy space has one of the strongest culture of scientific evidence use (Bandola-Gill et al., 2024) and likely is better at acknowledging academic sources.

Our regression analysis delivered two noteworthy results, one of which is in line with the literature, and another seems to be rather counterintuitive. The fact that highly cited research and research published in top journals is more likely to be cited in policy documents supports the idea that traditional scholarly legitimacy lends credibility to research evidence when policymakers are seeking inputs into their decision-making (Smith et al., 2024; Xu & Zong, 2024).

What we found surprising is the positive relationship between the percentage of female authors and research citations in policy documents. Existing literature indicates that traditional forms of academic legitimacy, based on outputs, seniority and network centrality, tend to be less available to female academics. Consequently, one would expect that female academics have poorer access to situations where they can translate their research into policymaking (such as being a member of advisory boards or think tanks). This finding would merit further investigation, perhaps with a deeper exploration of the types of policies that tend to cite research produced by female academics.

Finally, disciplinary differences in research 'footprint' in policy documents clearly indicate the need for a nuanced approach to science polity and research evaluation that takes those differences into account. We also acknowledge that our grouping of discipline areas can be refined substantially. Firstly, the broad groupings into health sciences, social sciences, life sciences, physical sciences and multidisciplinary research masks differences between disciplines within each group, which can be quite substantial. Secondly, the grouping is based on classification of the journals rather than the topic of each publication. This also can be improved in future research.

Conclusion

Our preliminary results indicate that academic publications originating in Ireland or Finland are more frequently cited in policy documents than publications originating in Israel.

This observation holds across different types of policy documents and academic disciplines. However, we do not find major difference between the three countries with respect to the share of publications that is mentioned in the media or on social media (Twitter/X). There are some differences regarding the citations rates of research publications across disciplines and countries. Our results point towards links between academic legitimacy, traditional research impact, (social) media impact, and citations in policy documents. Hence, there seem to be multiple pathways through which research publications are disseminated and taken up by policy makers and policy practitioners.

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