

Not the Last Word: The Academic Inflation Reduction Act

Joseph Bernstein MD¹ 

In 1992, the *New York Times* reported that transplant surgeon Thomas Starzel had published more than 500 papers over the previous decade [1]—more than any other author. This prompted my supervisor at the time to remark, “Geez, I don’t think I’ve read 500 papers in the last decade.” (He nonetheless went on to serve as a chair at another school.)

Fast-forward to the modern era (Fig. 1), and Starzel’s pace of about 50 papers a year seems paltry. An article in *Nature* circa 2018 [8] reported that thousands of scientists publish more

than 70 papers per year. Medline, the database of scientific publications maintained by the National Library of Medicine, added more than 1.3 million papers in calendar year 2022, compared to 765,850 added in 2014 [12]. Orthopaedic surgery residency applicants have likewise shown a corresponding bump in that time interval, boasting, on average, 15 abstracts, presentations, and publications in 2022 versus 6 in 2014 [13, 14].

Unless you believe that there has been a corresponding explosion in scientific knowledge, this proliferation of manuscripts is really a form of inflation. Accordingly, just as the value of money goes down when the money supply goes up, the expansion of Medline devalues the worth of any one publication. Further, to make up for that, scholars are encouraged to publish more and more, which of course only exacerbates the inflationary trend.

Economics typically offers two responses to monetary inflation, both of which might also apply to academic inflation. One approach, especially in smaller countries, is that the government will issue a new currency. There may be a “new Lira” or “new Shekel” that serves as a direct revaluation. For instance, one New Shekel might be pegged to 10 of the old.

For academic inflation, a similar strategy can be employed, though

a log-transformation might be more suitable. That is, we should no longer say that “Dr. Smith has X number of publications,” but rather categorize Dr. Smith’s output by the natural logarithm of X. This not only makes the numbers more manageable (as in the case with the New Shekel) but more broadly matches our intuition of what the number means (Table 1). Also, by using a log scale, the incentive to publish one more paper when one has already published many is accordingly markedly reduced. This itself may help limit further inflation.

Another response, particularly to severe inflation, involves placing less value on the currency and more on actual commodities (up to the point of bartering). A similar process can be implemented in the realm of academic inflation. Scholars should consider listing only a select few of their most pivotal works on their resumes, complete with descriptions of these papers and their contributions to them.


This approach dovetails nicely with modern information systems, which offer many easy ways to list one’s complete bibliography online. People might include a link to their “Open Researcher and Contributor ID” [10], though my preference is Google Scholar [<https://scholar.google.com/>]. Google Scholar allows users to curate personal pages, with links provided not only to the manuscript itself but to the cited and citing works, as well. (I may also prefer it because Google is a bit more generous as to what counts as a citation...)

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J. Bernstein , University of Pennsylvania, 424 Stemmler Hall, Philadelphia, PA 19104, USA, Email: orthodoc@uphs.upenn.edu

¹Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA, USA

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Fig. 1 In 1993, Peter Steiner published a classic cartoon in *The New Yorker* showing two dogs near a computer, one typing, with the caption: “On the Internet, nobody knows you’re a dog” [6]. These days, there are more than 300 orthopaedic journals, many pay-for-play internet-based volumes only. Thus, a person reading just a bibliography may not know that a given journal is dog-like. In this figure, an homage to that cartoon representing this problem has been generated courtesy of ChatGPT.

In contrast to the situation of monetary inflation, the first response cannot be mandated in the case of academic inflation. Moving to a log-scale will only happen if the trend catches on. On the other hand, the second response—the movement from currency to commodity—can be mandated somewhat in the academic world.

Specifically, in the case of residency applications, I propose a standard whereby applicants submit a resume limited to one page (Fig. 2). That resume can list contact information and educational credentials. The bibliography section, in a break with the past, would include a link to an online version of the full list of publications, coupled with descriptions of no more

than three of the applicants’ most meaningful projects.

One may criticize this proposal as simply another round in a game of whack-a-mole [9]. Orthopaedic residency positions are highly desirable, and applicants are going to do whatever they perceive they can do to enhance their application. If they are no longer able to show off high scores on Step 1 of the United States Medical Licensing Exam (USMLE), for instance, they might try to show off extensive bibliographies; and if the chance to show off extensive bibliographies is taken away, some other meretricious metric will take its place.

Such criticism is not unreasonable, but would apply only if the discarded criterion is not replaced by something

better. Step 1 reform fell short because the advice to substitute the USMLE with a “more on-point examination” [3] was not headed. The test was simply discarded. Similarly, if applicants were to be barred outright from sharing their research output without a replacement, things will be made worse here too. Applicants will be prompted to pursue wheel-spinning substitute activities in ever greater numbers. (Six away rotations, here we come!)

Replacing the conventional publication list with detailed descriptions of selected impactful projects would motivate applicants to pursue meaningful work. Selection committees will have more robust signals about the applicants’ academic potential. Ultimately, this ensures that academic effort retains its value.

Alan H. Daniels MD

Department of Orthopedics, Warren Alpert Medical School, Brown University

Scientific knowledge has grown exponentially over the last 200 years. In this thought-provoking column, Dr. Bernstein laments that entries in Medline have doubled from 2014 to 2022. However, over the same time period, a similar trend has occurred in financial markets, where the Dow Jones Industrial Average has doubled and the Nasdaq has tripled! A small amount of inflation (academic or financial) represents natural progression, yet hyperinflation is not good for anyone. With the explosion of artificial intelligence (AI) in medical practice and medical research [2], our orthopaedic publications are at risk of becoming as worthless as a Zimbabwe 100 Trillion Dollar Note (Fig. 3).

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Table 1. The “E-index”^a

E-index	Range	Length of Bibliography	Colloquial Interpretation
1	e ⁰ (1)	1 paper	A new member of the “published scholar” club.
2	e ¹ (2.71) to e ² (7.4)	~3 papers	Is it a spinoff from the first, or the start of a career? Completely unknown.
3	e ² (7.4) to e ³ (20.1)	5 to 20 papers	Publishing enough to get a sense that research matters; themes may emerge, especially if first or senior author.
4	e ³ (20.1) to e ⁴ (54.6)	21 to 50 papers	A true researcher, with a collection large enough to assess quality.
5	e ⁴ (54.6) to e ⁵ (148.4)	51 to 150 papers	Productive scholar. Can assess not only quality, but trends.
6	e ⁵ (148.4) to e ⁶ (403.4)	151 to 400 papers	Exceptionally productive scholar—but historically worthy only if there are some landmark papers here.
7	e ⁶ (403.4) to e ⁷ (1096.6)	401 to 1000 papers	Needs hobbies.

^aThe E-index categorizes scholarly output by the natural logarithm of bibliography length.

Additional historical context is helpful to understand our current situation. My grandfather, Edward W. Daniels PhD, was a scientist at Argonne National Laboratories and a full professor at the University of Chicago who spent his life studying the effects of radiation and gravity on single-celled organisms. He was part of the team that sent the first amoeba to space [4]. He finished his prolific academic career with 160 publications, which is paltry compared to the hoard of scientists who publish more than 70 papers per year [8]. The world has rapidly evolved over the last two generations, however, and we should remember that when he began his career in 1958, a gallon of gas was 30 cents and we hadn’t yet sent a huge array of plants, animals, and humans to space. Although academic inflation is real, so too is the inflation of human knowledge and achievement.

Although we may lament that the value of each individual research publication decreases over time, this

process represents the natural evolution of scientific discovery as we delve deeper into nuanced topics. Sir Isaac Newton discovered gravity in 1666 in a landmark discovery, paving the way for Albert Einstein to refine our collective knowledge in 1915 by proposing that gravity is the result of distortions in space-time created by mass and energy. Now, more than a century later, publications about gravity have become increasingly nuanced, and there is more than one journal solely dedicated to *microgravity*! The same inflationary process has occurred in medicine and orthopaedics as more discoveries become more numerous, yet more nuanced and subspecialized over time. For example, in 1944 there was one paper in Medline using the term “spine surgery.” In 2024, there are 10,524. At first glance, this rate of inflation may seem excessive; however, we must consider the incredible explosion of operative techniques and technologies that require continuous assessments of safety and efficacy.

The next generation of surgeons who are applying to residency have had no choice but to increase the number of publications on their applications to compete successfully with their fellow applicants. This is problematic because the time spent writing papers takes away from what these students should be doing: learning the foundations of medicine and surgery. However, the arms race is real for those who wish to match into our highly competitive specialty [11]. They have no choice but to cultivate research experiences if they hope to maximize their chances of a successful match.

There is one aspect of academic inflation that Dr. Bernstein and I strongly disagree on: the E-index. Although publishing more than 400 papers may seem excessive, it doesn’t seem right to shame productive scientists by suggesting they “need hobbies.” Similarly, utilizing a logarithmic scale is unnecessary and unhelpful. Examining the merits of the research with indices such as the author’s H-Index [7] or journal’s Eigenfactor

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Albert Einstein, PhD
mc-squared@gmail.com

Education

- Diploma in mathematics and physics, Swiss Federal Polytechnic, 1900
- Ph.D. in Physics, University of Zurich, 1905

Professional Experience

- Professor of Theoretical Physics. Princeton University, 1933-1955
- Director, Kaiser Wilhelm Institute for Physics, 1914-1932
- Patent Examiner Swiss Patent Office, Bern, 1902-1909

Google Scholar Page: <https://scholar.google.com/citations?user=qc6CjYAAAAJ&hl=en&oi=ao>

Key Publications

1. Einstein, A. (1905). Über die von der molekularkinetischen Theorie der Wärme geforderte Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen. *Annalen der Physik*, 322(8), 549–560. <https://doi.org/10.1002/andp.19053220806>
 - This paper explained Brownian motion, providing empirical evidence for the existence of atoms and molecules.
2. Einstein, A. (1905). Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, 322(10), 891–921. <https://doi.org/10.1002/andp.19053221004>
 - This paper introduced the special theory of relativity, fundamentally changing our concepts of space, time, and simultaneity.
3. Einstein, A. (1905). "Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig?" *Annalen der Physik*, 323(13), 639–641. <https://doi.org/10.1002/andp.19053231314>
 - This paper introduced the equation $E=mc^2$, showing that mass and energy are equivalent.

Awards and Honors: Nobel Prize in Physics, 1921; Copley Medal of the Royal Society, 1925; Gold Medal of the Royal Astronomical Society, 1926

Languages: German (native); English (fluent); Italian (conversational); Yiddish (beginner)

Interests: Violin playing; Sailing; Fashion.

Fig. 2 A sample one-page resume I (JB) created for Albert Einstein. As shown, limiting “key publications” to three may force the omission of important works. “Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt,” for which the Nobel Prize was awarded, was omitted here.

[5] are well established, and I believe those are superior to the E-index for measuring researcher impact.

Clearly, the current pace of academic inflation is not sustainable. Since we do not have a Federal Reserve Bank for orthopaedic publications, Dr. Bernstein and I do agree on one potential solution: returning to

the one-page resume. Highlighting the accomplishments we are most proud of forces us to place value upon each component of our work. For those of us that review countless applications for academic positions, expansive CVs—which currently are the norm—are an impossibly vast wasteland; too much to try to explore and

discuss. The one-page resume would focus the applicant to highlight his or her core values and most-impressive accomplishments. This is certainly a solution I can live with and implement.

I commend Dr. Bernstein for highlighting an important problem. Limiting scientific productivity is not

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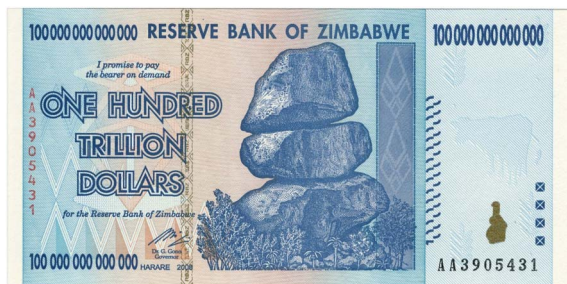


Fig. 3 No longer valued as real currency, the Zimbabwe 100 Trillion Dollar Note was issued during a time of hyperinflation in Zimbabwe. © Reserve Bank of Zimbabwe / Wikimedia Commons / Public domain image.

the right solution, but changing the way we highlight our accomplishments would certainly help. Science is rapidly advancing, inflation is relentless, and the arms race continues. I nonetheless believe we should cherish the process. Many of us are enjoying the ride.

Matthew L. Webb MD, MHS

St. Tammany Parish Hospital

Do you remember the time when a real person would have to pay the Postal Service 30 cents of his or her own earnest money if he or she wanted to waste a moment of your time? Now, anyone can waste your time for free, and “they” don’t even have to be real people.

We all know that the future is artificial intelligence (AI). By my best estimation, all AI does is gobble up every informational source that is not paywalled and regurgitate that so-called “information” in a slightly less comprehensible form. It doesn’t matter if that information is correct, useful, or anything close to what you were looking for. This artificial “intelligence” has suddenly added more “information” to the information heap.

And so it goes with the internet. The old internet is gone, and the new internet has become a self-refilling landfill. And it’s overflowing: There is more and more similar-appearing information to sort through until, maybe, you find something resembling what you were looking for, but it probably lacks any useful insight. It might even be complete nonsense, but it is almost certainly hoping to sell you something.

And so it goes with peer-reviewed scientific manuscripts. It has never been easier to publish scientific research. Once upon a time, if you wanted to include a figure with your manuscript, you had to use your own earnest money to create a 35-mm slide in triplicate and mail those in (with stamps and envelopes), along with several physical copies of your manuscript. The editor would then mail a copy on to each reviewer. And that was just the barrier to submitting the manuscript for consideration—it could be years before completed work appeared on any journal’s page.

The publishing landscape is different now, with author-pays open access journals and predatory never-heard-of journals soliciting naive assistant professors, feeding on their incentive to publish or perish. Perhaps not

surprisingly, we now also have rampant plagiarism and problems with the fabrication of fraudulent results, which have resulted in numerous recent high-profile retractions and publishing scandals.

So while it has never been easier to publish than it is today, the average value of each published work has also never been less. In this regard, I agree with Dr. Bernstein: There is some inflation going on.

But unlike currency, the value of scientific manuscripts is not fungible, and published research should not be regarded as though it is. A paper that wins an Aufranc award or Charnley award, for example, might be 10 or even 100 times as valuable as another paper on the same topic in a similar journal. Papers published in journals with high standards for editorial and peer review seem, to me, more impressive than papers published in other journals. And papers published in author-pays journals seem to be 10 or 100 times less valuable—and I hope that resident selection committees feel the same way.

All of this should force us to ask, What is the value of a potential trainee’s involvement in topic-specific scientific research? What is more valuable: substance or volume? Does volume matter at all? Is a potential trainee who coauthored 70 papers somehow more prepared for the trials of orthopaedic residency than a trainee who completed 7 away rotations? Or are both of these hypothetical candidates perhaps overprepared?

These questions should invite more-important discussions. The effort, time, and cost involved in padding one’s resume, visiting various potential training sites, and even the essential act of submitting multiple residency applications are great. Do our traditional means of evaluating orthopaedic training

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candidates further disadvantage those who are already disadvantaged? To what extent do our traditional means of evaluating candidates exclude those candidates with fewer resources or nontraditional backgrounds? Are we excluding those who may in fact be better prepared, and who may bring more to the table, especially with regard to diversity, equity, and inclusion? These bigger questions and discussions need to be discussed at greater length and with more seriousness than has been applied to them to this point.

In one of the few instances since I've known him, I agree with Dr. Bernstein: Perhaps limiting each applicant to listing three scholarly works is the best means. From a practical standpoint, enough is enough. Can we all agree that just *some* is *enough*? Let's end this rat race, and instead encourage applicants to show us their best stuff.

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