

DISCUSSION PAPER SERIES

IZA DP No. 16916

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at Its End?**

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*RWTH Aachen University and IZA*

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## ABSTRACT

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# Is the Scholarly Field of Entrepreneurship at Its End?

This paper presents tentative evidence from 68,792 papers published between 1961 and 2020 that progress in the scholarly field of entrepreneurship is declining. It is found that the annual number of papers published in entrepreneurship has increased exponentially since the Second World War, growing on average by 17% annually since 1961; the average disruption score of papers have declined by a factor of 36 between the 1960s and the 2010s; and that the average team size per paper has increased from 1,6 between 1960-1980 to 2,4 between 2000 and 2020. Estimates from an ideas production function suggest that the field is getting fished out and that researchers are stepping on one another's toes. A Wald-test indicates that a structural break in the disruptiveness of entrepreneurship and business papers occurred around 1999. These results should not be taken as a negative evaluation: it may be a mark of the success of its scholars that the field is mature and degenerating. The remaining task facing the field of entrepreneurship may be how to confront its end.

**JEL Classification:** L26, O30, B40, J24

**Keywords:** entrepreneurship, business, science, disruption, innovation

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# 1 Introduction

Suggesting that the scholarly field of entrepreneurship is at an end, or stagnating, may cause indignation, derision, or, most likely, pushback. To ensure that this is not based on misunderstanding, the meaning of the *ending* of a scholarly field, akin to Lakatos (1978)'s notion of a degenerative research program,<sup>1</sup> will be explained at the outset. Facing its end does not mean that the field of entrepreneurship has failed or that research is dwindling. On the contrary, it may be a mark of the recognised success of the field (Landström et al., 2019, 2012; Teixeira, 2011) - although pathologies may also be a cause. Due to the diligence of its scholars it is becoming “fished-out” and swamped by a deluge of new papers every year, each making less and less of a mark. This is a feature of successful science: as Cauwels and Sornette (2020, p.22) remarked, “as a consequence of its past successes, scientific discovery follows a process of diminishing returns [leading to] the end of science.”

The message of this paper is that largely as a consequence of its success, the field of entrepreneurship may be facing its end - it may have become a degenerative field to the extent that it produces diminishing returns, that its progress is declining. Recently, García-Lillo et al. (2023, p.1) claimed that entrepreneurship is “a highly dynamic” field. This paper shows that in terms of disruption and novelty, it is not a dynamic field. Again, it has to be stressed that this is not necessarily a negative evaluation of the field or its scientists - on the contrary. For science to continue to be a vibrant activity and expand the frontiers of human knowledge, scholarly fields must be successful, reach their goals, and then wrap up, freeing attention and resources for new scholarly quests (King and Rudy, 2023b). As King and Rudy (2023a) explain,

“many forms of knowledge production seem to be facing their end. [...] Many

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<sup>1</sup>Lakatos (1978) introduced the distinction between a research program that is progressive or degenerative. As explained by Nanay (2017, p.1204) if the changes in a research program over time have increased its “predictive/explanatory power” it is progressive, but “if it has not, it is degenerative.” A degenerative research program “produces diminishing returns” and sees “declining progress” (Editor, 2010).

of our systems for producing and certifying knowledge have ended or are ending [...] We want to offer a new perspective by arguing that it is salutary – or even desirable – for knowledge projects to confront their ends.”

This paper presents tentative evidence for the end of entrepreneurship as field based on the disruption index, team size and citations of 68,792 papers published in business and entrepreneurship between 1961 and 2020. This evidence suggests that entrepreneurship has become a mature and degenerating scholarly field marked by a) a rapid increase in the number of new papers published in the field per year, b) a decrease in the disruptiveness of publications in the field despite the increase in the number of publications, and c) research teams becoming larger over time.

While this evidence is tentative, mainly because of the current limitations of disruption indices (see Leibel and Bornmann (2024)), it is nevertheless consistent with the diagnosis of Landström et al. (2019, p.1) that “entrepreneurship has matured as a research field” where research now “often fails to challenge our take-for-granted assumptions.” The matured field of entrepreneurship has become less innovative and less disruptive, with the growing number of scholars working in heavily institutionalized settings producing incremental advances to the existing canon. It is also consistent with the warning sounded by Kraus et al. (2023, p.1095) that “an unplanned growth in literature can impede advancement [...] The exponential growth of literature in small business and entrepreneurship research in recent years has made salient just such risk.”

Anecdotally, one may also observe that entrepreneurship research is increasingly going around in circles, revisiting topics dealt with in the past, often only introducing new labels and casting old wine in new bottles. Kuratko and Audretsch (2022, p.275) expressed concern that the “vitality of the academic field of entrepreneurship is not at all guaranteed” because it may be in danger of losing touch “with the real-world phenomenon it is trying to explain

and understand. Kraus et al. (2023, p.1096) are alarmed by more and more publications with “trivial findings” and “little novelty.”

If it has indeed become a mature, degenerating field, entrepreneurship will be no exception, implying that field-specific factors are not the cause of the degeneration. Recent studies, e.g. Bloom et al. (2020), Chu and Evans (2021), Klüppel and Knott (2023), Park et al. (2023), Singh et al. (2022) and Wu et al. (2019) documented declines in R&D productivity and the disruptiveness of new papers and patents across a broad range of fields. The present paper contributes to this research agenda by focusing on the field of entrepreneurship and business, which has so far not been a central concern in any of the studies cited.

The rest of the paper will proceed as follows. Section 2 provides a synopsis of the relevant literature on the declines in innovation and science that have been a corollary of the “Great Stagnation” that has beset advanced economies in recent decades. It also provides a summary of the evolution of the field of entrepreneurship to mark its success, noting the various phases through which the field successfully took off and developed since the Second World War.

Section 3 describes the methods subsequently used to test the hypothesis that the entrepreneurship and business fields are maturing and degenerating, as measured by outputs, team sizes and papers becoming less disruptive over time.

Section 4 contains the empirical findings, from which it is concluded that a) the annual number of papers published in entrepreneurship has increased exponentially since the Second World War - growing on average by 17% per year since 1961; b) the average disruption score of papers have declined over time - by a factor of 36 between the 1960s and the 2010s; c) the average team size per paper has continued to increase over the period - from 1,6 between 1960-1980 to 2,4 between 2000 and 2020; between the 1960s and the 2010's the share of all papers by solo authors declined from 68% to 19%. A Wald test indicated that the structural break in the disruptiveness of entrepreneurship and business papers occurred around 1999.

These findings are consistent with the hypothesis that the entrepreneurship and business field is maturing and degenerating. Section 5 concludes.

## 2 Related Literature

This section first discusses the ossification of the economy and science, a feature of advanced economies that has been of increasing concern (see, e.g. Naudé (2022)). Then, it discusses the take-off and development of entrepreneurship as a scientific field after the Second World War, arguing that the impact of research fields may resemble an S-curve trajectory as diminishing returns set in.

### 2.1 The Ossification of Economy and Science

Over the past decades, evidence has accumulated that overall rates of innovation, business dynamics and entrepreneurship, in at least advanced economies, have declined since the 1970s. Studies that have documented and analyzed this “Great Stagnation” include Akcigit and Ates (2019), Arora et al. (2019), Bloom et al. (2020), Cauwels and Sornette (2020), Cowen (2010), Calvino et al. (2020), Cooke (2019), Decker et al. (2014, 2016, 2017), Gordon (2012, 2015, 2018), Hall (2016), Haltiwanger (2022), Hopenhayn et al. (2022), Miranda et al. (2016), Naudé (2016, 2022), and Thiel (2011). As Bhaskar (2021) puts it, the current age is characterised by its “small thinking.”

Two related reasons for the decline in innovation and business dynamics, reflected in declining economic and productivity growth rates, are the decline of science (Bloom et al., 2020; Iaria et al., 2018) and the decline in the discovery of highly impactful, disruptive knowledge (Chu and Evans, 2021; Horgan, 1996; Jones, 2009; Huebner, 2005; Wang et al., 2013). These two reasons are discussed in sub-sections 2.1.1 and 2.1.2.

### 2.1.1 The decline of science

As far as the decline of science, specifically the decline in the productivity of researchers, is concerned, evidence is accumulating that it takes ever more research inputs to maintain the rate of R&D productivity. Jones (2009) ascribed this to a “burden of knowledge,” positing that as the body of knowledge grows, it takes human researchers longer to absorb this to be able to add new knowledge, and that this is reflected in the age when scientists make discoveries as well as the sizes of research teams, increasing over time. He predicted that this would lead to a decline in the productivity of R&D (and eventually economic growth) over time. Bloom et al. (2020) found evidence from USA data that R&D productivity is declining. Specifically, “just to sustain constant growth in GDP per person, the U.S. must double the amount of research effort searching for new ideas every 18 years to offset the difficulty of finding new ideas” (Bloom et al., 2020, p.1138).

Bhattacharya and Packalen (2020, p.1-2) stress the ever-greater effort that scientific progress demands, also noting that science is becoming less impactful. They conclude that “while there are many times more scientists today than in the past, today’s advances do not compare favourably to past breakthroughs [...] today’s discoveries take many times more research effort than past discoveries. The cost of developing new drugs, for example, now doubles every nine years.”

It is not only a burden of knowledge effect that leads to a decline in research productivity: Klüppel and Knott (2023), confirming that scientific productivity in the US is declining, ascribed it to “pathologies in how R&D is organized,” which results in “excess research;” and “deterioration” of R&D practices on the firm level, amongst others. The fact that research productivity is declining across several scholarly fields suggests that the pathologies in how science is conducted are not field-specific (Park et al., 2023), but rather due to common underlying factors, which may include the burden of knowledge effect, but also

other, perhaps more avoidable headwinds, such as rot in the institutions of science.

One form of rot in the institutions of science, according to Archer (2020), is that scientific institutions are increasingly incentivizing “shoddy research.” For instance, he writes, “training in science is now tantamount to grant-writing and learning how to obtain funding.” The shoddy research that he mentions is reflected in the retraction rate of papers in scientific journals, which has more than trebled over the past decade (van Noorden, 2023). It is also reflected in the replication crisis in science (Baker, 2016) which is also affecting the entrepreneurship field (van Witteloostuijn et al., 2021; Crawford et al., 2022).

A second source of rot in the institutions of science is the rise of self-appointed gatekeepers, who through “defensive” barricades around a field attempt to keep new scholars and their ideas out. In the process, scepticism towards the established order becomes unwelcome, which is a sign of unscientific behaviour, given Lakatos (1978, p.1)’s remark that “the hallmark of scientific behaviour is a certain scepticism even towards one’s most cherished theories.” Indeed, when scepticism and criticism becomes less appreciated in a field, it starts to resemble belief systems. Thus, Eintalu (2021, p.117) compared scholars in modern day university departments to a “*caste of priests*” with vested interests who “*are interested in keeping others back from the pie [...] Instead of searching for the truth, one starts to think about the rivals. Negative competition appears — envy, slandering ...*”. Hence, King and Rudy (2023a) conclude that “for many, academic organisations appear moribund and continuing improvement requires new institutional arrangements.”

### **2.1.2 The decline in disruptive new knowledge**

The decline of science, specifically the decline in the productivity of researchers, contributes to the decline of disruptive new knowledge. The challenge is how to measure whether a new paper or patent is disruptive or not. Typically, measures have included patent or

paper citations and (one-dimensional) citation indexes (Bornmann and Tekles, 2019). More recently, multi-dimensional citation indices have been proposed. Influential in this has been Funk and Owen-Smith (2016) who proposed a CD index, which measures the impact of a paper or patent to the extent that it consolidates (C) or disrupts (D) a field. The CD index ranges from a “maximally disruptive value” of 1 to a “maximally consolidating value” of  $-1$ .

Relatedly, Wu et al. (2019) proposed a Disruption Score (or Index) (D, or  $D_1$ ), which they used this measure to “analyze more than 65 million papers, patents and software products that span the period 1954–2014” and found from this that “smaller teams have tended to disrupt science and technology with new ideas and opportunities, whereas larger teams have tended to develop existing ones” (Wu et al., 2019, p.378). In section 3 below, their dataset, which is made available by Wu et al. (2021) is used to analyze the disruption of papers in the field of business and entrepreneurship, and to show that teams working on papers in the entrepreneurship and business field has been getting larger over time.

Park et al. (2023) calculated a CD index using data from 45 million papers and 3.9 million patents between 1945 and 2010 and 1980 and 2010, respectively. The fields they analyzed were life sciences and biomedicine, physical sciences, social sciences, technology, chemicals, computers and communications, drugs and medical, electrical and electronic, and mechanical. They found that “papers and patents are increasingly less likely to break with the past in ways that push science and technology in new directions. This pattern holds universally across fields and is robust across multiple citation-and text-based metrics. Moreover, they also conclude that “the observed declines are unlikely to be driven by changes in the quality of published science, citation practices or field-specific factors. Overall, our results suggest that slowing disruption rates may reflect a fundamental shift in the nature of science and technology ” (Park et al., 2023, p.138).

Another relevant study for understanding the decline in disruptive new knowledge is the paper by Chu and Evans (2021). The authors analyzed 1.8 billion citations from 90 million

papers from the Web of Science between 1960 and 2014 and found similar evidence of scientific output’s disruptiveness declining. They found that when the output in a scientific field grows large newly published papers “become unlikely to disrupt existing work” and “tend to develop existing ideas more than disrupt them, and rarely launch disruptive new streams of research” (p.2). As they explain (p.1):

“When the number of papers published per year in a scientific field grows large, citations flow disproportionately to already well-cited papers; the list of most cited papers ossifies; new papers are unlikely ever to become highly cited, and when they do, it is not through a gradual, cumulative process of attention gathering; and newly published papers become unlikely to disrupt existing work. These findings suggest that the progress of large scientific fields may be slowed, trapped in existing canon.”

From subsections 2.1.1 and 2.1.2, one may conclude that the decline in science and the decline in the discovery of disruptive new knowledge will be reflected in a field with rapidly increasing output, done by ever-increasing teams and accompanied by decreasing impacts/disruptiveness. In the following subsection, subsection 2.2, the rise of entrepreneurship as a field is discussed, after which, in sections 3 and 4, empirical evidence will be presented to show that the field of entrepreneurship reflects such features of a declining field.

## **2.2 The Rise of Entrepreneurship as Field**

The history of entrepreneurship as a scientific field has been extensively documented, for example, by Aldrich (2012), Busenitz et al. (2003, 2014), Chandra (2018), Landström et al. (2012, 2019), Sánchez (2011), Souza et al. (2021) and Veciana (2007). These authors describe a field that arose and developed quite rapidly after the Second World War, with the first

courses and conferences taking place in the late 1940s and the first specific entrepreneurship scientific journals, such as the *Journal of Small Business Management* and *American Journal of Small Business*, later *Entrepreneurship Theory and Practice*, founded in the 1960s and 1970s (Sánchez, 2011).

The 1990s were the growth age of entrepreneurship studies when the field took off (Landström et al., 2019). By 1990 Gartner (1990, p.28) described entrepreneurship as a robust new field “budding with new ideas and thoughts.” By the 2010s, “research in entrepreneurship ‘exploded’ in terms of the number of journal publications as well as the range of topics published” and that “entrepreneurship research has developed a stable range of topics, an identifiable community of researchers, and increase in specialization in the field (Chandra, 2018, p.17,19). The field had been so successful that by 2019, McMullen (2019, p.413) had no doubt that “entrepreneurship journals should be considered on par with other, premier management journals, which are widely considered to be unequivocal A journals.”

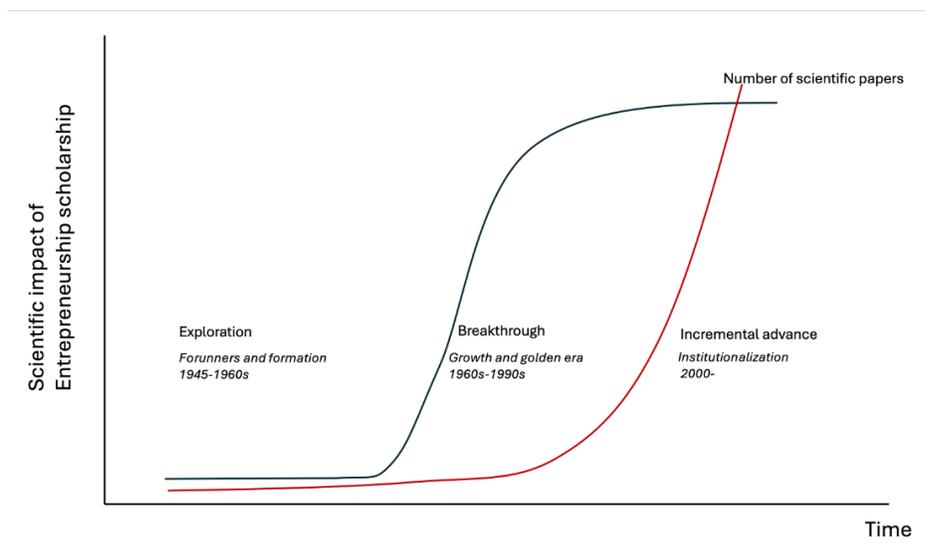
As in most scientific fields, the entrepreneurship field’s success has followed a S-curve trajectory. This can be depicted with the help of Figure 1. Landström et al. (2019, p.7) relates how entrepreneurship research has evolved over five phases since World War Two, namely “(1) forerunners in mainstream disciplines(1945–1980), the formation period during the 1980s, (3) the growth of the field in the 1990s, (4) the “Golden Era” in the 2000s, and (5) the establishment of a scholarly field in its own right in the 2010s.”

In Figure 1, based on the data from Wu et al. (2021) these five phases have been consolidated into three phases: the exploration phase, roughly from the 1940s to the 1960s, the breakthrough era from the 1960s to the 1990s and the era of incremental advance, from around 2000 (in section 3.2 it will be shown that a structural break in the data on the disruptiveness of publications in the field occurs in **1999**).

Landström et al. (2019) recognize the latest era of incremental advancement, stating that

“Entrepreneurship has matured as a research field” and that this has had the consequence of an institutionalization<sup>2</sup> of the field, resulting in less disruptive research. As they put it, “current research within the field often fails to challenge our take-for-granted assumptions ” (Landström et al., 2019, p.1). In this, entrepreneurship as a scientific field is like other fields, where “as a consequence of its past successes [it] follows a process of diminishing returns” (Cauwels and Sornette, 2020, p.22).

Figure 1: Trajectory of Entrepreneurship Research, 1940s- present



Source: Author’s compilation based on Bhattacharya and Packalen (2020, p.12) and adjusted evolution of entrepreneurship research periods from ?, p.7.

With diminishing returns thus likely relevant also for the field of entrepreneurship, it may very well be the case that the field today is characterized, as in other fields, by a “culture of deference to authority,” a fixation with publishing in a relatively few high-impact journals which “incentivizes careerism over creativity” (Bhattacharya and Packalen, 2020, p.2). Bhattacharya and Packalen (2020, p.2) refer to Frey (2003) who lamented that in the adjacent field of economics “new ideas are rejected for lack of rigour as they are by necessity less well formulated than well-established ideas, and that this has inundated economics with boring and irrelevant papers.” It is for the reader to decide whether, browsing through a

<sup>2</sup>Aldrich (2012) identifies and discusses six interrelated forces that have driven the institutionalization of entrepreneurship research.

leading recent entrepreneurship journal, they are not more and more confronted with boring and irrelevant papers. It seems likely in any case, as the tentative evidence in section 4 suggests, that papers have become less disruptive.

### 3 Methodology

This paper uses descriptive and regression analyses to determine whether progress in entrepreneurship research is declining.

First, the average Disruption Score or Index (D, also referred to as  $D_1$ ) and the share of disruptive papers annually from 1960 to 2018 for the field of entrepreneurship and business studies are calculated, and it is evaluated whether average disruption by papers in the field has been declining or increasing over time.

Second, a knowledge production function for the field of entrepreneurship is estimated using OLS regression analyses and measuring new knowledge creation by the proxy of a paper's disruptiveness. From this, estimates are obtained, from which inferences can be made about whether the field of entrepreneurship is being fished out and whether research in the field is hampered by organizational pathologies.

The hypothesis is that, given the success of entrepreneurship as a field, it has reached maturity and that it is a degenerating field in the sense that new knowledge is getting harder to find. This would be reflected in a) a rapid increase in the number of new papers published in the field per year, b) a decrease in the disruptiveness of publications in the field accompanying the increase in the number of publications, and c) research teams becoming larger over time.

### 3.1 Data

Data on the Disruption Score (D), team size and citations of 68,792 papers published in the field of business and entrepreneurship studies between 1961 and 2020 are used. This data was obtained from Wu et al. (2021) who makes data available for 19 million Microsoft Academic Graph (MAG) field-of-study (FOS) papers over the period 1830 to 2021 on *Harvard's Dataverse* website.<sup>3</sup> The broad field of “business,” which encompasses entrepreneurship, is a MAG “top-level field of study” with a level 0 label of 8 assigned to it (Wu et al., 2021).

The disruptiveness of a paper is measured by the disruption score (D) (or  $D_1$ ), which has been calculated for each paper by Wu et al. (2019) using citation network analysis, which is “based on the dynamic network measure of technological change introduced by Funk and Owen-Smith (2016)” (Bornmann and Tekles, 2019, p.331).

Wu et al. (2019) define disruption (D) of a focal paper (FP)  $i$  with respect to papers that reference it (papers  $j$ ) and papers that do not (papers  $k$ ) by calculating “the difference between the proportion of type  $i$  and type  $j$  papers ( $p_i - p_j$ ) which equals the difference between the observed number of these papers ( $n_i - n_j$ ) divided by the number of subsequent works ( $n_i + n_j + n_k$ )” (Wu et al., 2019, p.379). Note that  $n_k$  “is the number of papers citing at least one of the FP’s cited references without citing FP itself” (Bornmann et al., 2020b, p.1150). Formally,

$$D = p_i - p_j = \frac{n_i - n_j}{n_i + n_j + n_k} \quad (1)$$

In other words, if an FP is cited as well as a significant number of its references, then the article is more consolidating of the field rather than disruptive Bornmann and Tekles (2019). The value of D ranges between 1 (most disruptive) to 0 (neutral) and -1 (least disruptive or

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<sup>3</sup>See <https://doi.org/10.7910/DVN/JPWNNK>

“developing”).

According to Bornmann and Tekles (2019, p.332) and Wu et al. (2019), “the disruption index does, in fact, measure what it intends to measure: new insights, ideas or methods that disrupt the cumulative nature in a scientific field.” Other studies that tested the validity of the disruption (D)-index include Li and Chen (2022) and Chen et al. (2021).

Discussions of the strengths and limitations of the Disruption (D) score of Wu et al. (2019) - and an overview of its uses - are contained in Leibel and Bornmann (2024) and Bornmann et al. (2020a). The latter point out that the most significant weakness of the D-score is that it “detects only a few papers as disruptive due to the term  $N_k$ , which is often very large compared to the other terms in the formula [...] A large  $N_k$  produces disruption values of small magnitude, as  $N_k$  only occurs in the denominator of the formula. As a result, the disruption index is very similar for many papers, and only a few papers get high disruption values” (Bornmann et al., 2020a, P.1245). The former makes the point that “More research on the validity of disruption scores as well as a more precise understanding of disruption as a theoretical construct is needed before the indices can be used in the research evaluation practice” (Leibel and Bornmann, 2024, p.1). Hence, the results in this paper are tentative and a call for further research is warranted.

## 3.2 Regression model

To examine the hypothesis that the field of entrepreneurship has reached maturity and that it is a degenerating field, an ideas production function will be estimated based on data on Disruption Scores (D), team size and citations of 68,792 papers published in the field of business and entrepreneurship studies between 1961 and 2020, obtained from Wu et al. (2021).

A standard ideas production function is:

$$\Delta A_t = (R)^\lambda A_t^\phi \tag{2}$$

According to (2), new knowledge in the field comes from the total number of entrepreneurship and business researchers/ scholars ( $R$ ) working to discover new knowledge, as well as from the existing stock of knowledge, which inspires new ideas and can be recombined into new combination (Almeida et al., 2024).

The sizes and signs parameters  $\lambda$  and  $\phi$  are essential for the eventual growth of new knowledge ( $\Delta A$ ). If  $\phi > 0$  then intertemporal spillovers of knowledge are positive, and we have what has been termed the “standing-on-shoulders” effect, after Sir Isaac Newton who is reported to have said “If I have seen further, it is by standing on the shoulders of giants.” If, on the other hand,  $\phi < 1$ , there is what has been termed a “fishing-out” effect, after the case of a pond with only a limited number of fish, which diminishes over time. In such a case, just like it will be harder to catch new fish in a pond with dwindling supplies, if  $\phi < 1$  then knowledge may be getting “fished out.”

As for the parameter  $\lambda$ , it measures the productivity of the researchers seeking new knowledge. If  $\lambda > 1$  there are complimentary effects between the efforts of the researchers – the more there are the better everyone will function. However, if  $\lambda < 1$ , the productivity of a researcher will decline the more other researchers there are. It is a “stepping-on-toes” effect.

What do empirical evidence suggest about the signs and sizes of  $\phi$  and  $\lambda$ ?

There are no estimates so far for entrepreneurship and business studies—this paper provides the first tentative estimates. However, two sets of estimates have been provided for knowledge creation in the USA as a whole. The first, by Bloom et al. (2020) found  $\phi = -2, 1$ . This means that ideas are getting fished out.

A second set of empirical estimates of  $\phi$  and  $\lambda$  have been provided by Klüppel and Knott (2023) who found an estimate of  $\phi = 1,02$  to  $1,24$ . This means ideas are not getting fished out. However, they found that research productivity in the USA has been declining because of a significant stepping-on-toes effect. Their estimate of  $\lambda$  is  $-0.1$ , reflecting, as they put it, “pathologies in how R&D is organized.”

In sub-section 4.2, the OLS regression results for estimating (2) in logarithmic form are reported.

## 4 Empirical Findings

This section reports on the empirical findings on the disruptiveness of research in the broad business field, which encompasses research on entrepreneurship. Section 4.1 presents descriptive statistics, and section 4.2 the regression analyses.

### 4.1 Descriptive Results

The summary statistics of the variables obtained from Wu et al. (2021) are contained in Table 1. Table 1 shows that across the 68,792 papers of interest, the average paper had around 43 citations and 2,3 authors, and its disruption score was 0,012. The largest team size was 49 authors per paper (a 2020 paper), and whereas the average citations per paper was 43, the most citations were 29,538 (for a paper published in 1981).

Finer analysis of this data allows one to document the growth and development of the field, including the disruptiveness of research and the sizes of research teams over time. First, as far as the growth and development of entrepreneurship as a scientific field are concerned, Figure 2 shows that the field emerged in the 1960s and accelerated with exponential growth

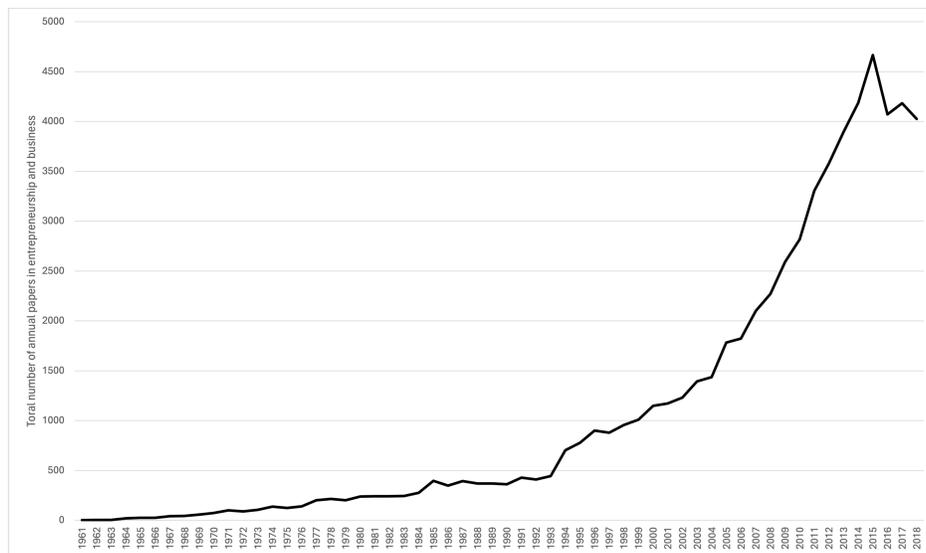
Table 1: Summary statistics, 68,792 papers in entrepreneurship and business studies, 1961-2020

Variable	Mean	Standard Deviation
Disruption	0,012	0,074
Team size per paper	2,3	1,30
Citations per paper	42,7	208,4

Source: Authors' own compilation.

in publications in the 1990s - the average growth rate of new papers has average 17% since 1961.

Figure 2: Total annual publications in the field of entrepreneurship and business, 1961 - 2018



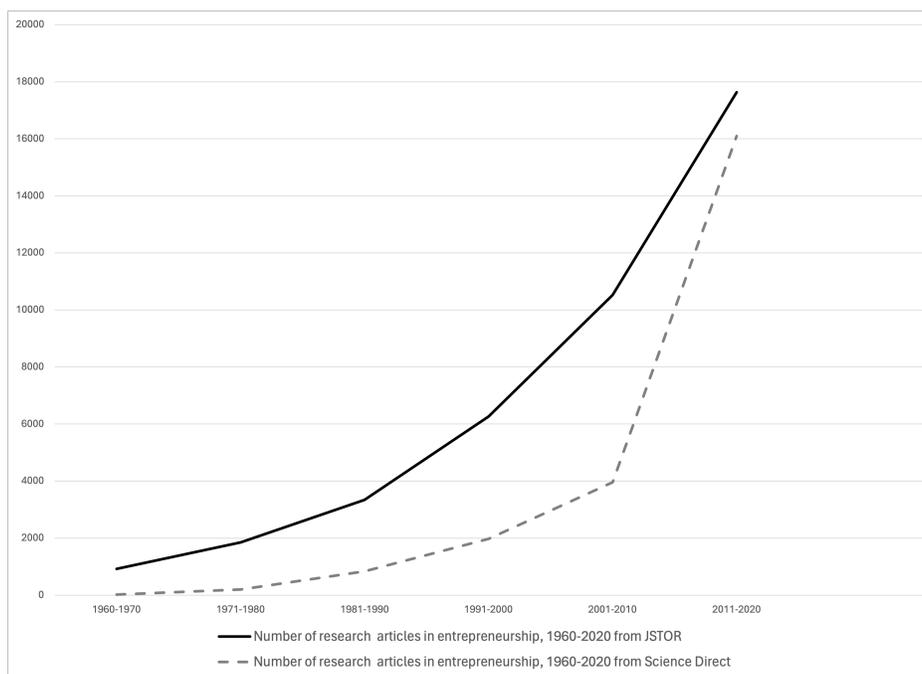
Source: Author's compilation based on data from Wu et al. (2021).

The data in Figure 2, from Wu et al. (2021) encompasses all publications in the broad MAG top-field of business, which is thus strictly speaker somewhat broader than entrepreneurship alone. However, when a search term was performed on the term “entrep” on Science Direct and JSTOR, this confirmed the rapid exponential rise in publications - see Figure 3. This shows that the Science Direct database shows a 502-fold increase in annual publications in entrepreneurship, and the JSTOR database a 19-fold increase.

This exponential rise in publication output is a feature that entrepreneurship as a field shares with many other fields. While it reflects success in mobilizing resources and getting results,

Chu and Evans (2021, p.4) have warned that “If too many papers are published in short order, new ideas cannot be carefully considered against old, and processes of cumulative advantage cannot work to select valuable innovations. The more-is-better, quantity metric-driven nature of today’s scientific enterprise may ironically retard fundamental progress.” This is the case in entrepreneurship research, too, as Kraus et al. (2023) has warned.

Figure 3: Number of entrepreneurship publications as per JSTOR and Science Direct, 1960-2020

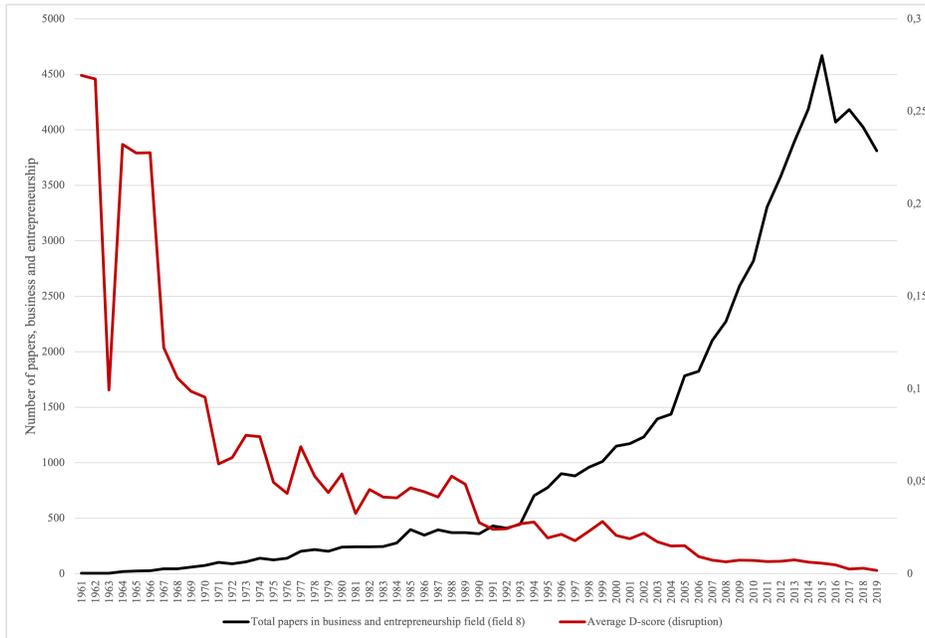


Source: Author’s compilation based on searching the term ”entrep” in Science Direct and JSTOR

Second, as far as the disruptiveness of papers in the field is concerned, the data of Wu et al. (2021) consistently point out that the disruptiveness of papers in the field has declined in spite of the rapid growth in publications (and the increase in research team size). The D-score value has declined from an average of 0,183 in the 1960s, to 0,005 in the 2010s. This is a 36-fold decrease.

Figure 4 depicts the decline in disruptive papers as measured by the D-score proposed by Wu et al. (2019) against the increase in average team size.

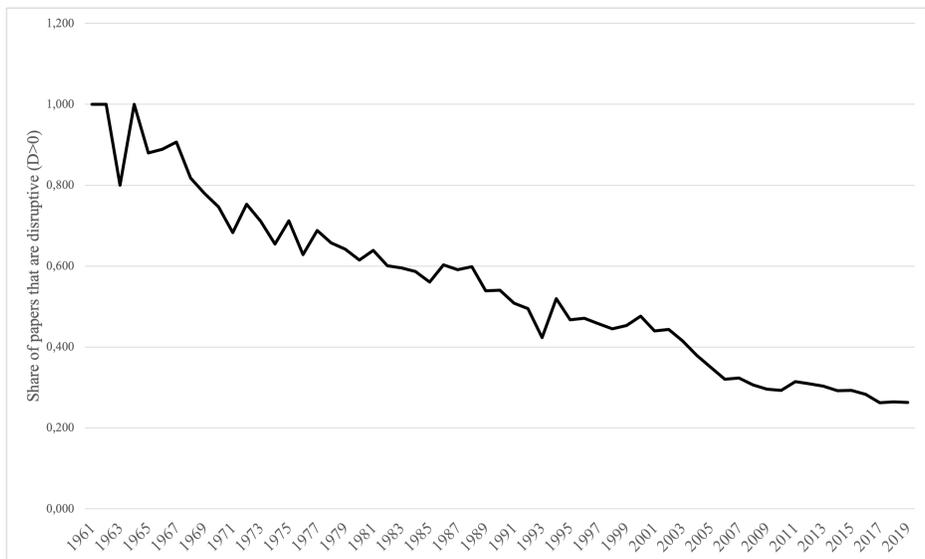
Figure 4: Disruption scores and total papers, 1961-2019



Source: Author's compilation based on data from Wu et al. (2021)

One can also calculate the share of papers annually that had a D-score  $> 0$ , i.e. which were somewhat disruptive. Figure 5 shows that, as with the average D-score, the share of papers with a  $D > 0$  has consistently declined over time.

Figure 5: Share of Papers with a  $D > 0$ , 1961-2019



Source: Author's compilation based on data from Wu et al. 2019

Third, regarding the size of research teams per paper, the data shows that the average team size involved in a paper increased over time. Table 4 below shows that the average team size per paper increased from 1,6 between 1960-1980 to 2,4 between 2000 and 2020.

Around 27% of all papers published between 1961 and 2020 were solo-authored papers, which is very similar to the share of 24% found by Wu et al. (2019) in a sample of 43,661,387 papers across all fields from 1900 to 2014. Notably, between the 1960s and the 2010, the share of all papers by solo authors declined from 68% to 19%. The finding here of growth in team size over time in the publication of papers in the entrepreneurship and business field is consistent with findings from other fields, such as those of Wuchty et al. (2007), Wu et al. (2019) and Jones (2021).

The simultaneous decline in the disruptiveness of papers and the increase in research team sizes over time in the field of entrepreneurship and business, is consistent with the dynamics of the rise and fall of scientific fields as documented by Singh et al. (2022). The latter, “using 1.5 million preprints from the arXiv repository covering 175 research field” found that “the early phase of a field is characterized by disruptive works mixing of cognitively distant fields written by small teams of interdisciplinary authors, while late phases exhibit the role of specialized, large teams building on the previous works in the field” (Singh et al., 2022, p.1). This seems to be an apt characterisation of the data patterns reported in this section.

Thus, from the descriptive statistics in this sub-section, it can be concluded that a) the number of papers in entrepreneurship has increased exponentially, b) the average disruption score of papers and share of disruptive papers have declined over time, c) the average team size per paper has continued to increase over the period. These findings are consistent with the hypothesis that the entrepreneurship and business fields are maturing and degenerating.

## 4.2 Regression Results

Using OLS, the ideas knowledge production function (equation 2) is estimated in log format, i.e.:

$$\Delta \log A_t = a_0 + \lambda \log R + \phi \log A \quad (3)$$

Where  $\Delta \log A$  is the change in the log of the total disruption score in a year;  $\log R$  the log of the number of researchers publishing in the field in a year, and  $\log A$  the log of the cumulative knowledge in the field as proxied by the cumulative D-score. The perhaps heroic assumption here is that the D-score reflects the production of new knowledge.

The regression results are contained in Table 2. The overall results are highly significant, with a  $R^2$  of 0,74. All the parameters are statistically significant at the 1% and 5% levels.

Table 2: OLS regression results, ideas production function for the field of entrepreneurship and business, 1961-2018, dependent variable  $\Delta A$

Variable	Coefficient	t-value
constant	0,61	5,80***
logR	0,11	2,60**
logA	-0,23	-3,33***
<i>Diagnostics:</i>		
$R^2 = 0,74$		
F (2,53) = 26,77***		
N = 56		

\*\*\* indicates significance at the 1% level and \*\* at the 5% level (calculated using robust standard errors)

The *Supremum Wald test* (see Andrews (1993)) for an unknown structural break in the time series was performed following the regression. The null hypothesis of no structural break was rejected (test statistic value was 20,06 with an associated p-value of 0,003), and the break date was estimated as 1999.

The sizes and signs on the  $\phi$  and  $\lambda$  are respectively -0,23 and 0,11. Given that  $\phi < 1$  there is a fishing-out effect. Also, given that  $\lambda < 1$  the implication is that the impact of a researcher in entrepreneurship and business is declining given the more other researchers there are. It is a stepping-on-toes effect. That the fishing out of ideas are driving team size increases is confirmed by the result that if the total number of researchers publishing in the field in a particular year is substituted with the average size of the teams that produce a single paper, then further support for the fishing out of ideas is found- see Table 3.

Table 3: OLS regression results, ideas production function for the field of entrepreneurship and business, 1961-2018, dependent variable  $\Delta A$ , with the average size of publication teams

Variable	Coefficient	t-value
constant	-1,58	-1,41
logR	0,32	1,78**
logA	-0,13	-3,29***
<i>Diagnostics:</i>		
$R^2 = 0,69$		
$F(2,53) = 19,10***$		
$N = 56$		

\*\*\* indicates significance at the 1% level and \*\* at the 5% level (calculated using robust standard errors)

The results in Table 3 suggest that, controlling for fishing-out effects, larger team sizes are driving disruptive papers. With  $\lambda < 1$ , this is not, however, leading to increasing returns but rather decreasing returns, confirming a stepping-on-toes effect.

To further investigate how the nature of teams and disruptions in the field of entrepreneurship had changed between the 1960s-1970s and 2000-2020, the sample was split into these two bookend periods, the summary statistics for each calculated, and a regression performed of the D-score on the team size for both periods. This enables one to compare the disruptiveness of papers at the beginning and the end of the period and examine how the relationship between team size and disruption has changed over time.

The summary statistics for the two periods are contained in Table 4.

Table 4: Summary Statistics for Start and End of the Sample Period

<b>Variable</b>	<b>Mean, 1961-1980</b>	<b>Mean, 2000-2020</b>
Disruption	0,070	0,0070
Team size per paper	1,59	2,42
Citations per paper	62,95	29,4
N	1865	57164

*Source:* Authors' own compilation.

Table 4 shows that papers in the later period (2000-2020) were on average 10 times less disruptive than in the later period (2000-2020), had only 46% of the citations of earlier papers, and required on average a team of authors that were 52% larger.

Table 5: OLS regression results, dependent variable D-scores

<b>Variable</b>	<b>Coefficient (1961-1980)</b>	<b>Coefficient (2000-2020)</b>
constant	0,10 (10,26)***	0,01 (24,81)***
Team size per paper	-0,02 (-3,47)***	-0,00 (-11,68)***
adj $R^2$	0,01	0,00
N	1865	57164

*Source:* Authors' own compilation.

Table 5's results confirm a negative relationship between team size and the disruptive nature of papers - smaller teams produce more disruptive papers. However, the negative relationship between team size and disruption has become smaller over time. This suggests that although small teams produce more disruptive papers in entrepreneurship and business, these smaller teams have become less effective over time.

## 5 Concluding Remarks

This paper used data on disruption scores, team size, and citations of 68,792 papers published in business and entrepreneurship studies between 1961 and 2020 to conclude that entrepreneurship has become a mature and degenerating scholarly field.

Using descriptive analysis, it was found that a) the annual number of papers published in

entrepreneurship has increased exponentially since the Second World War; b) the average disruption score of papers and share of disruptive papers have declined over time - by a factor of 36 between the 1960s and the 2010s; c) the average team size per paper has continued to increase - from 1,6 between 1960-1980 to 2,4 between 2000 and 2020. A Wald test indicated that the structural break in the disruptiveness of entrepreneurship and business papers occurred around 1999.

Regression analysis—estimating a rough ideas production function—suggests that the field may be trapped in an existing canon where ideas are getting “fished out” and researchers are “stepping on one another’s toes.” These findings are consistent with findings from many other scientific fields, and with expectations and warnings from several scholars in entrepreneurship.

These results and the conclusion are tentative. Further research is indicated to address weaknesses in the method of measuring disruption through the D-score or index. This index is a recent additions to the metrics of scientific impact and is subject to limitations, as was discussed. Furthermore, research is needed to estimate the ideas production function for the field using better and diverse measures of knowledge creation. Further research is also indicated to understand better how teamwork has evolved in the field, and whether different organization of research teams, for example, in terms of hierarchy, results in more or less disruptive papers.

The likely degeneration of the field of entrepreneurship that the tentative findings in this paper suggest should not necessarily be taken as a negative evaluation of the field. Despite being a relatively young field, entrepreneurship scholarship has been remarkably successful in providing an understanding of entrepreneurship and converging on a set of explanations for the questions it sought to answer. As a result of this scholarly success, the field of entrepreneurship has achieved a rather broad scientific agreement on the central questions it has set out to answer. For instance, there is little fundamental disagreement on what

entrepreneurship and entrepreneurial ability are, how to measure it, the institutional context in which it is more likely to thrive, the relationship between the allocation of entrepreneurial talent and the reward structure of societies, the process and steps of new venture creation, and the elements of entrepreneurial ecosystems. Scholars all agree that the phenomenon they study has both upsides and downsides.

Hardly any scholars today disagree that entrepreneurship is a ubiquitous and impactful feature of society, with impacts that can be both good and bad, and that entrepreneurial ability determines the extent and nature of entrepreneurship and who becomes an entrepreneur or not. There is also hardly any disagreement about whether the cultural, historical, and institutional context shapes the decisions people make to become entrepreneurial or not and the decisions they make when active as entrepreneurs. Most entrepreneurship research today concerns duplication, refinement, confirmation, application to new trends, and new technologies and techniques. There are no new grand narratives or challenges. Entrepreneurship is a field that has been fished out and which is not “budding with new ideas and thoughts” anymore.

Entrepreneurship is in this fate not unique in the “age of small thinking” that has come to characterize modern science, which seems to labour under a “burden of knowledge.” The fact that the field of entrepreneurship is not uniquely degenerating suggests that it is unlikely to be field-specific factors driving the decline in the disruptiveness of entrepreneurship research. As such, entrepreneurship scholars can benefit from a better understanding of the obstacles and constraints hampering the broader scientific enterprise and how the adoption of these in the field is affecting its research productivity.

Finally, if the field of entrepreneurship is indeed facing diminishing returns to research, which the tentative findings in this paper suggest, it may imply, appropriately for a field studying entrepreneurship, an opportunity since, as King and Rudy (2023a) advises, *“it is not only necessary but also beneficial for disciplines to confront their ends. Instead of rejecting the*

*concept of ending, scholars across disciplines should use this moment to ask: why do we do what we do, and when (if ever) could we be done?"*

When would the field of entrepreneurship be done?

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