The Rise of Behavioral Economics: A Quantitative Assessment

Niels Geiger

This article is devoted to the issue of operationalizing and empirically measuring the development of behavioral economics, focusing on trends in the academic literature. The main research goal is to provide a quantitative, bibliometric assessment to answer the question of whether the relative importance of behavioral economics has increased over the past decades. After an introduction and a short summary of the history of behavioral economics, several studies are laid out and evaluated. The results generally provide a quantitative confirmation of the story of a rise of behavioral economics that can be found in the literature, and add some notable additional insights.

Introduction

Over the past years, the observation that behavioral economics (BE) has ascended toward the mainstream in economics—not only in theory, but also in teaching and practical applications, especially policy advice—has been frequently stated in literature on recent history of economic thought as well as in reviews on the development of BE. For example, at the outset of her valuable survey, Esther-Mirjam Sent (2004: 735) notes that BE "is attracting increasing attention and recognition," and in her paper on rationality for the *New Palgrave*, Sent (2008) concludes that "more and more economists are embracing one form or another" of bounded rationality (BR). Heukelom (2011: 27) summarizes the past two decades by stating that "behavioral economists gradually built their program into a stable and well-defined mainstream economic program." Similarly, Wilkinson and Klaes (2012: 14) remark that "the field has now become a more respectable one, with a variety of journals publishing relevant research." Indeed, not only could it be observed that BE was gaining popularity, but even that, although remaining controversial, it was moving toward the mainstream. This trend is reflected by university hirings, conferences, and so forth (see Rabin 2002: 657 f.). In 2001, George Akerlof was awarded the Nobel Prize, and titled his Lecture "Behavioral Macroeconomics and Macroeconomic Behavior" (Akerlof 2002). Only one year later, Daniel Kahneman, a psychologist, became one of the next laureates—and most recently, in 2013, Robert Shiller, one of the key figures in behavioral finance, received the honor. At the outset of the 2008–9 financial and economic crisis, Akerlof

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and Shiller noted in the preface to *Animal Spirits* (2009: xi) that the book "draws on an emerging field called behavioral economics."

More such examples from the past one or two decades can be found, for example, in Rabin (2002: 657), Sent (2004: 735 ff.), and Angner and Loewenstein (2012: 641). The problem, however, is that even these examples together amount to little more than a series of anecdotal evidence. They provide an impression of the tip of the iceberg but do not allow for inferences about the general picture underneath. This is also true of those instances providing specific numbers: For example, when Heukelom (2012b: 797, 814) mentions the frequent citations of work by Kahneman and Tversky, he refers to data by Laibson and Zeckhauser (1998) that were, already at that point, almost 15 years old. To get a proper impression of broad trends, this approach needs to be extended, both to include the time that has passed since then and to consider additional work in BE, and by putting the numbers in perspective. This is precisely what this article aims to do through a bibliometric analysis.

The article focuses on developments in academia and theory, that is, of which content publications and discussions in the literature were over the past decades. The question of trends in practice, that is especially economic policy (advice), will be left open for subsequent research. This article considers theoretical developments only because both questions vindicate an elaborate treatment they could not be given if they were concentrated into just one article.

The analysis in this article is organized as follows: "A Short History of Behavioral Economics" provides a short overview of the history of BE and its related concepts in the academic literature. The core of the article lies in "Quantitative Assessment of the Development of Behavioral Economics," which first sketches the research question and its operationalization in more detail before it describes the data used for the evaluation. It subsequently provides and finally discusses the empirical results of the bibliometric analysis. The "Conclusion" shortly summarizes the findings and draws a way to further research, especially the subsequent research question of developments in policy.

A Short History of Behavioral Economics

BE is a subfield of economics that, to varying degrees, integrates insights from psychology and analyzes what happens in markets when agents do not conform to standard criteria of rationality (see Camerer 1999: 10575; Mullainathan and Thaler 2000). An important characteristic is that assumptions about individual behavior are empirically tested, with the aim to increase, and frequently connected to claiming increased empirical realism (see Berg 2010: 861). Its roots lie in the pioneering works of especially Herbert Simon in the 1950s, and its scope and influence have widened since the research by Daniel Kahneman and Amos Tversky in the 1970s. It has become a broad field with a unifying idea (to combine psychology and economics), but different approaches, for example with respect to the definition of *rationality*. While it is not the aim of this article to provide a detailed overview of the development and history of BE

(the interested reader is referred to Sent 2004 or Heukelom 2014 for a comprehensive overview, as well as the critical evaluation by Berg and Gigerenzer 2010), some notes are required to frame the context of this article and to embed its research question.

Using "psychological" arguments within economic theory was common practice for a long time, namely throughout most of the nineteenth century, after economics had established itself as a scientific discipline of its own (see, e.g., Geiger 2016). Not only were casual observations included but also actual insights were borrowed from psychologists (see Sent 2004: 738). It often was, however, not state-of-the-art knowledge integrated in a comprehensive manner. Some authors consider Adam Smith's *Theory of Moral Sentiments* (1759) as an early example of BE, in which he sketched a view of individual judgment and decision making reminiscent of modern approaches to the subject (see Ashraf et al. 2005). Irving Fisher's (1930: 312) interest rate theory, similar to Böhm-Bawerk's (1889) theory of capital that he built on, rests on both "economic" (e.g., productivity) and "psychological" (e.g., fads and fashion) factors (see Loewenstein 1992: 17 f.; Thaler 1997: 439 f.). In John Maynard Keynes's *General Theory* (1936) economic fluctuations depend on demand-side factors that crucially include both the "fundamental psychological law" (96) underlying the marginal propensity to consume and investment outlays that, in turn, are sensitive to both "animal spirits" (161) and "beauty-contest"-like speculation (157).

However, around the turn of the twentieth century, this connection began to weaken, with economists actively venturing to break loose from psychology: What had been started prominently by Vilfredo Pareto and others was completed by John Hicks, Paul Samuelson, and others in the 1930s and 1940s (see Bruni and Sugden 2007: 146; for a divergent argument, see Hands 2010). Since then, mainstream as well as much of heterodox economics has not paid much attention to the peculiarities of individual behavior, and models were subsequently populated by ever more "intelligent" actors (see Thaler 2000: 134). Today's standard agent is not just a representative one, it is also still one that forms Rational Expectations and, in doing so, conforms to the axioms of Rational Choice (RC).

Outside of the mainstream, though, it would not take long for alternative approaches to develop. With his 1955 paper "A Behavioral Model of Rational Choice," Herbert Simon investigated the question of whether and how rational decisions are possible with limited information and scarce cognitive capacities. Simon's critique of the standard model of RC is comprehensive and rejects the approach entirely, but at the same time it suggests an alternative route: Because an individual's rationality is bounded, the whole concept of optimization should be abandoned in favor of what Simon labeled "satisficing." In contrast to the agent who (1) takes all available information into account, (2) values each possible option through a consistent set of preferences, and (3) ultimately makes an optimal choice (i.e., maximizes utility), Simon's boundedly rational actors satisfice: They first must search for options and subsequently make a choice as soon as they find an alternative that satisfies their aspiration levels to a sufficient degree. The search is then aborted, even though the set of alternatives considered until that point is likely incomplete. This mode of behavior is fundamentally different from optimizing over all alternatives using all available information. Consequently,

Simon (e.g., 1978, 1986) coined the notion of "procedural" rationality to distinguish his concept from the "substantive" used in economics. The latter evaluates a choice by only looking at the outcome whereas Simon's concept also takes account of the process of decision making.

Although Simon was awarded the Nobel Prize in 1978, he hardly left an identifiable mark on contemporary developments. On the contrary, while he wrote on BR, Rational Expectations grew to become the standard in economic models. By the time he received the award, a disillusioned Simon had already left the economics-related department of industrial organization at Carnegie Mellon for psychology (see Simon 1991: 319 ff., 385). However, new critics raised their voices from the early 1970s onward, namely Daniel Kahneman and Amos Tversky.

Kahneman and Tversky introduced three pillars, on which much of today's BE rests, into the discussion on human rationality, judgment, and choice. First, with the "heuristics and biases" research program (Gilovich et al. 2002; Kahneman et al. 1982; Tversky and Kahneman 1974), Kahneman and Tversky investigated how judgments are conducted under uncertainty, and severely challenged the notion of agents incorporating all available information and drawing Bayesian inferences. With framing effects, Tversky and Kahneman (1981) showed that decisions depend on the context and at times even on the wording of a problem. They thus further challenged the normative tenets of neoclassical rationality, demonstrating that each of the underlying axioms—even invariance, that is the independence of choice from how a problem is presented—are violated in simple everyday situations (see Tversky and Kahneman 1986).

On the one hand, Kahneman and Tversky presented empirically founded criticism that demonstrated that RC was, at best, an inaccurate description of actual human behavior. On the other hand, in a third step, they combined some of these insights into a model of choice under risk, Prospect Theory (PT; Kahneman and Tversky 1979; later refined by Tversky and Kahneman 1992), which was proposed as an alternative to the standard model of Subjective Expected Utility (SEU). In PT, decision makers respond to changes, not levels, in wealth (with diminishing sensitivity on both sides); they are loss averse, that is a loss of a certain magnitude looms larger than a corresponding gain; and they do not weigh outcomes by their subjective probabilities, but based on decision weights instead, which are derived from subjective probabilities using a nonlinear function. PT, specifically developed with this intention in mind, could explain many of the shortcomings of SEU that Kahneman and Tversky had identified, and serves as *the* standard behavioral model for many different approaches in BE.

Strictly speaking though, neither Simon's groundwork nor that of Kahneman and Tversky was already BE. They laid the foundations, but it was not until their insights were actually applied (partly by the authors) that BE truly became a subject of its own.[1] Kahneman (2011: 292) specifically sees the beginnings of BE in the 1970s with the work of Richard Thaler, who picked up what Kahneman and Tversky had worked

1. In his Nobel Lecture, Kahneman (2003a) may imply this with his title "Psychology for Behavioral Economics."

out and incorporated it into standard economic models to analyze the implications, of, for example, the endowment effect that can be related to loss aversion (see Kahneman et al. 1991). A landmark contribution in this respect is probably Thaler's "Toward a Positive Theory of Consumer Choice" (1980). While this was an important step and early example of BE, it is not entirely accurate to state that this was the origin of BE in general. It was the origin of what is now sometimes referred to as "new" BE in the literature, but even before that, there was work that is nowadays respectively labeled "old" BE (see Sent 2004: 737 for the distinction that stresses different understandings of BR and corresponding adherence to optimization).

A prominent early representative of "old" BE is George Katona. He primarily labeled his research "psychological economics" (see Katona 1951, 1975) but also employed the term *behavioral economics* (see Heukelom 2011: 19 and Sent 2004: 740 ff.). Katona, who had developed the Michigan Consumer Sentiment Index in the 1940s, used survey data to understand and explain aggregate macroeconomic behavior, especially consumption outlays. His method was inductive and completely independent from RC models, hardly bearing any reference to them at all. Indeed, this is characteristic of other representatives of "old" BE as well: The established mainstream economic theory was not taken as a point of departure. Instead, an alternative theory was constructed from scratch by collecting empirical evidence of all sorts (see, e.g., Cyert and March 1963). Just like Simon's original work, none of these early efforts in "old" BE ever caught on with the mainstream. However, the branch is by no means dead, although it is still far from being standard or mainstream. Today, researchers around psychologist Gerd Gigerenzer (including Nobel Laureate Reinhard Selten in some publications) emphasize Simon's ideas and the implications they bear for economics. Indeed, they turn out to be greater critics than the current mainstream in standard economics when it comes to dealing with "new" BE today. Within BE, however, they are in the minority and clearly not the dominant force.[2]

This position is instead held by "new" BE, which developed as the results of Kahneman and Tversky were picked up in the late 1970s and early 1980s, and which evolved further in the subsequent decades. Even though Kahneman and Tversky opposed RC, PT is remarkably similar to SEU. Both theories value outcomes and weigh them to get a definite composite value—and individuals are assumed to pick the option with the highest value. Of course, the underlying assumptions are very different, and PT is frequently more successful in describing and predicting actual behavior than SEU (see Barberis 2013; Brandstätter et al. 2006: 416 ff.; Camerer

2. An impression of the different backgrounds may be gained from a casual look at the references or indexes of contributions in either school. Representatives of "new" BE hardly refer to Simon: If they do so, it is mostly to provide credit for introducing the notion—not the concept, which they do not apply, strictly speaking—of BR. E.g., Akerlof's Nobel Lecture (2002) as well as his joint work with Shiller (Akerlof and Shiller 2009) contain no reference, neither in their bibliographies nor in their indexes. Most of the work refers only to Kahneman and Tversky—the constituting groundwork—and consequently, there is no link to Simon, even within comprehensive volumes such as *Advances in Behavioral Economics* (Camerer et al. 2003, only some mentions) or *Advances in Behavioral Finance* (Thaler 2005, no reference at all). At the other end, the work of Kahneman and Tversky is frequently referred to in "old" BE, often in connection with a critical evaluation.

2000) although critics argue that this is also due to the many free parameters in PT (see Berg and Gigerenzer 2010: 143 f.; Brandstätter et al. 2008: 284 f.). Still, the general framework is rather similar in both PT and SEU, and it is fundamentally different from Simon's satisficing.[3]

"New" BE would subsequently follow in this vein, its usual method of introducing "alternative" models being the implementation of one alteration for explaining a specific observation into the standard model of the economic agent who remains "rational" in all other respects (see Camerer and Loewenstein 2003: 3; Kahneman 2003a: 1469; 2003c: 163; Rabin 1998: 12 f.; 2002: 658; 2013: 617 f.). The standard neoclassical approach still serves as the overarching benchmark (see Altman 2004: 8). In fact, for Rabin (2002: 659), BE is the logical next step from neoclassical economics, a position that is utterly alien to representatives of "old" BE. Correspondingly, "new" BE uses the notion of BR in a different manner, namely relative to the neoclassical rationality standard, whereas for representatives of "old" BE it implies something completely different, even an entirely different normative framework. In response, representatives of "old" BE have recently employed the term *ecological rationality* (see Rieskamp and Reimer 2007 for a definition). Concerning their (normative) understanding of BR, the two major strands of BE can therefore also be categorized as following a "consistency" ("new" BE) and "ecological rationality" ("old" BE) approach (see Berg 2014). The much less severe critique of Kahneman and Tversky and especially subsequent "new" BE certainly contributed to their relative popularity within economics (see Heukelom 2012b: 814 ff.), and it may even be argued that representatives of "new" BE intentionally followed this road to get the recognition from mainstream economics that Simon had never attained (see Berg and Gigerenzer 2010: 148 f.).

The development of BE was accompanied and reinforced by a phase of "institutionalization" in the 1980s and early 1990s that properly established it as a subdiscipline of economics. In 1982, the Society for the Advancement of Behavioral Economics was founded: It unites and discusses many different strands of research under the label of BE nowadays (e.g., see the various themes discussed in Altman 2006). Between 1984 and 1992 on initiative of Eric Wanner both the Alfred P. Sloan Foundation and later the Russell Sage Foundation came to play important roles in financing research, especially in bringing together and facilitating collaborations between Kahneman and Tversky, on the one hand, and interested economists, on the other, which led to the still active Behavioral Economics Roundtable (see Sent 2004: 744 and especially Heukelom 2012a: 263 f., 281). This period of the rise of primarily "new" BE also saw Herbert Simon, originally invited to and part of this circle, turn his back on the program in 1985/early 1986 (see Heukelom 2011: 25; 2012a: 275 f.).

Just like BE in general, "new" BE is a broad field unified mostly by its core idea of combining insights from psychology with economics, but using many different approaches in doing so; tackling a vast array of problems; and adhering to the

3. However, it should be added that in their original *Econometrica* article, Kahneman and Tversky (1979: 274 ff.) described an editing phase in which problems were simplified. This point was hardly taken up in subsequent work of "new" BE, but it is surely an element of BR in Simon's sense.

neoclassical standard of RC to different degrees of conformity. Furthermore, in their standard definition of the field, Mullainathan and Thaler (2000) point out that BE, while primarily concerned with BR (which consequently also features most prominently in the present analysis), also takes "bounded willpower" (BW) and "bounded self-interest" (BSI) into account. As a consequence of these broad perspectives, both supply side and demand side, producer and especially consumer theory are topics of interest in BE. In financial market theory, observations such as the equity premium puzzle or excessive stock rate movements are discussed. BE provides answers to questions of intertemporal choice (related to BW in particular), individual inclinations to trade (i.e., differences in buying and selling behavior) and how markets develop when agents deviate from the standard model, risk aversion and optimism in firms' project planning, altruism and fairness, as well as many more. An impression of the vast variety of topics discussed can be gained from the compilation of Thaler's "Anomalies" series (Thaler 1992) and from the four volumes that appeared in the *Roundtable Series in Behavioral Economics* (Bowles 2003; Camerer 2003; Camerer et al. 2003; Thaler 2005). The various forms of advice "new" BE derives for economic policy may be summarized under the term of *libertarian paternalism* (Thaler and Sunstein 2003, 2008), that is an active policy which, however, leaves the available options unchanged and only, if it does so at all, influences choices indirectly by using, for example, framing effects. Here, too, representatives of "old" BE remain sceptical of the arguments' validity (see, e.g., Berg and Gigerenzer 2007).

Quantitative Assessment of the Development of Behavioral Economics

The discussion in the following subsections presents the main results of this article. First, the method and the data tackled with it are described. Subsequently, the bibliometric results are outlined by providing numbers and corresponding figures. These are analyzed in the light of the qualitative-theoretical discussion of the history of economic thought in BE.

Data Investigated and Methods Used

The underlying research question of this article is to investigate whether BE has experienced a rise in popularity within economics (as reflected by the academic literature), especially within its mainstream, that is its most influential journals, in recent years. To quantitatively assess this question, it first must be operationalized. To do so, an analysis of absolute and relative frequencies of central BE terms and citations of seminal papers is conducted. Working with metadata and full-text searches, the analysis therefore employs methods from bibliometrics and scientometrics that were originally proposed and employed by pioneering contributors such as Garfield (1955) and De Solla Price (1963).

A systematic look at publications in major history of economic thought journals (particularly *The European Journal of the History of Economic Thought, History of*

Political Economy, and *The Journal of the History of Economic Thought*) shows that bibliometric data have already been used in a few contributions occasionally. Sometimes they appear as a single case and are used to illustrate one particular point, for example when Düppe (2012: 509) refers to citation counts once and in passing. However, there are also examples of more comprehensive bibliometric efforts, for example Oehler's (1990) analysis of the fields referring to fundamental articles on general equilibrium theory, Diamond's (2009) comparison of citation frequencies of Keynes and Schumpeter, or Hoover's (2014) analysis of the reception of Haavelmo's contributions. Examples from other journals include Kim et al. (2006) in *The Journal of Economic Perspectives* and Cardoso et al. (2010) in *Kyklos*. The most prominent journal to feature bibliometric research in general is probably *Scientometrics*. Over the journal's history, there are also several pertinent contributions concerning bibliometrics of economics (e.g., Cahlik 2000; Kufenko and Geiger 2016; McCain 2014). However, even when these contributions are considered, the conclusion that bibliometric methods have not yet entered research in the history of economic thought on a broad scale still emerges. For BE in particular, there is no comprehensive bibliometric analysis yet.

Bibliometric research frequently uses two general methods: content analysis and citation analysis. The combination of both methods, which is employed in this article, also allows for some correction of potential biases in citation analysis, such as "obliteration by incorporation" (see Merton 1988: 622). In economics, primary sources for content analysis are EconLit (http://www.aeaweb.org/econlit/), the American Economic Association's digital database that indexes international economic writings in more than 600 journals from more than a century, and JSTOR (http:// www.jstor.org). Citation counts are frequently tracked with data from the Social Sciences Citation Index (SSCI; http://thomson-reuters.com/social-sciences-citation-index/). This article uses data from the SSCI and additionally from JSTOR. JSTOR listed 235 entries in the group "Journals" of the category "Economics" at the time the data for this study were last updated (January 25, 2016). As possibly the closest match to EconLit's archive, the overarching JSTOR subject group "Business and Economics" (which includes the subjects "Business," "Development Studies," "Economics," "Finance," "Labor & Employment Relations," "Management & Organizational Behavior," and "Marketing & Advertising") lists 381 titles. These include all those from the Economics category, as well as many additional ones that are also indexed on EconLit. Overall, JSTOR is less comprehensive than EconLit although it also contains not just the top, but most of the major journals. What is more, the comparative advantage of JSTOR especially lies with its handily usable "Data For Research" (DFR; http://dfr.jstor.org/) tool that allows for text searches of key terms, grouped by categories, and provides time series for the number of items for each year in which the particular term appeared. Due to the limited accessibility of comparable data relevant for this research, EconLit is therefore not included.

To put the developments in economics into perspective of trends in neighboring fields, the analysis in this article is conducted for JSTOR's subject categories "Economics," "Finance," and the subject group "Business & Economics." Only research articles in journals, that is no (book) reviews and other entries (editorials, news, and

miscellaneous), are considered to focus on the actual research and achieve higher comparability with the SSCI data.

When looking at key terms in papers to evaluate how broadly BE has been discussed in the literature, it appears to be a straightforward and intuitive next step to also look at frequencies of particular *Journal of Economic Literature* (*JEL*) codes that are used to provide standard subject classifications within economics. Indeed, this could allow for a more accurate estimate of actual developments because not every paper in Business & Economics necessarily mentions all the various key terms or cites a particular set of references.[4] EconLit, unlike JSTOR, provides these codes, and it would therefore seem to be the better database once more. Three codes appear to be natural candidates for an investigation: D03 (Behavioral Microeconomics: Underlying Principles), E03 (Behavioral Macroeconomics), and G02 (Behavioral Finance: Underlying Principles). The problem, however, is that those codes were introduced very recently, and not applied retrospectively for older vintages. Consequently, when searching EconLit for the codes, the first item tagged with D03 appears in 2007, and G02 in 2009. E03 does not appear before 2013. Due to this short time frame, comparisons and an analysis of trends are hardly possible. Promising as this road might have appeared at first, it unfortunately cannot be expected to provide useful results and is therefore left out of this study. This is disappointing in particular because a combination of EconLit and SSCI would have allowed for an analysis of how often *all* papers in BE were cited over the years.

At the SSCI database, several indices relating to social sciences are available. The present study only uses citations from within the SSCI proper, that is it does not include conference proceedings (unless they appear in journals) and books. Therefore, the study analyzes numbers of citations in research articles from journals within the social sciences.[5] Even so, papers from a broader field of subjects than just economics would be considered, notably including psychology, which would tend to inflate the citation count of papers by Kahneman and Tversky relative to economics papers. However, results from the SSCI can also be narrowed down to the category Economics. When the data were last updated, they included 235 journals. The list is not identical with that of JSTOR, but there is a large intersection, and all prominent as well as most major journals are included. Also, as is the case with JSTOR, further journals indexed in EconLit can be found in other categories such as Business, so there is a high overall coverage indeed.

The time frame observed for all studies conducted in this article begins in 1950, starting with the decade when Herbert Simon published his first seminal works. The last year included is 2012 for JSTOR data,[6] and 2013 when the SSCI is used. Overall,

4. However, as pointed out by a referee, it could be argued that there is considerable variance in the number of *JEL* codes authors provide with their papers, and that they may be used strategically as well. Therefore, some of the same caveats as concern the key term analysis would apply.

5. Notably, this excludes, e.g., medicine, where Kahneman and Tversky's work was also directed at (i.e., on clinical studies).

6. This is because observations in later years are highly sensitive to, e.g., journals for which JSTOR does not provide full text coverage of the most recent three years, etc. (the number of articles per year listed in the database sharply decreases after 2012).

from 1950 to 2012, JSTOR contains 102,073 research articles in the Economics category, 184,476 in Finance, and a total of 526,692 in Business & Economics. Over the same period, there are just about 350,000 articles listed in the SSCI's Economics category.

For the term and citation frequencies, both absolute and relative numbers are featured, with a focus on the latter, that is the rate of papers mentioning a term or citing a particular paper relative to the whole set of papers (of the respective subject/subject group). The latter is important because the total annual number of papers fluctuates every year and has generally increased over the past decades, so that a rising absolute number of occurrences does not necessarily imply that the item was featured relatively more often.

Because this research looks at the JSTOR and SSCI databases that index not all, but the large majority of important English economic journals, and as the *lingua franca* of economics has been English since at least Simon's and especially Kahneman and Tversky's early contributions, it may well be said that the analysis thus builds on a sample approximating the total population of economics literature in journals. Therefore, to assess certain observed developments, no sophisticated inferential statistical methods are necessary. The data presented in the following and their descriptive statistics depict what has happened, and it is up to a more informed theoretical look to make sense of, or more generally, interpret these. It should still be noted though that throughout these six decades, the composition of journals listed in both databases did not remain unchanged: some ceased to exist, and others, for example, the *Journal of Economic Perspectives* in 1987, entered as new projects. Therefore, the present work is clearly not a panel study.

To narrow down this problem and at the same time get an impression of not just broad developments but also those in the mainstream and most influential research especially, this article performs all its analyses for a separate set of premier journals in economics as well. These "premier" or "top" journals are the top five most influential economics journals according to the RePEc Aggregate Ranking (http://ideas.repec.org/top/top.journals.all.html) on January 25, 2016, that is *The Quarterly Journal of Economics* (*QJE*), *The American Economic Review* (*AER*), *Econometrica, The Journal of Political Economy* (*JPE*), and *JEL*.[7] All discussions of problems related to impact factors notwithstanding (see, e.g., Alberts 2013), this list, which is based on various metrics of journal relevance, should provide at least for a decent proxy of mainstream developments. The reference numbers for these journals (i.e., total item counts) are research articles in JSTOR.

The following subsections present the individual notions and papers that are investigated here, sorted into three groups of overarching studies.

7. Note that the first issue of the *JEL* is from 1969, and 2012 issues were not yet covered on JSTOR when data for this study were last updated. However, due to the low overall number of research articles in the *JEL*, this does not skew the results.

Study 1: Key Terms in Behavioral Economics. For a general impression of empirical trends, the frequencies of five key terms that are central to BE and representative of major ideas discussed within the field are investigated. For BE, the choice of these terms is straightforward because its core notions are mostly quite specific to the subject. The search at DFR is case insensitive and is performed for full, not partial, matches of the composite terms. Text searches are performed anywhere (i.e., including titles, abstracts, the full text, and references). Numbers provided in the results are items that feature the respective term at least once.

- [1a]: The obvious first pick is *behavioral economics*, the name of the field. Numbers provided are the aggregate of papers mentioning one or both of "behavioural economics" and "behavioral economics," that is, the British and American spellings.
- [1b]: The next term is equally obvious: *bounded rationality*, the concept that encapsulates the underlying idea of all of BE that something about the neoclassical standard model of RC is amiss, and the overarching category of alternative approaches to describing and modeling behavior. The numbers also include instances of "boundedly rational". Additionally, frequencies for the related notions of *bounded willpower* and *bounded self-interest* are reported on (and for both terms, alternative spellings are included in the search).
- [1c]: Because BR is used in both "old" and "new," and even outside of, BE, *ecological rationality* is considered to provide a rough estimate of discussions of ideas of "old" relative to "new" BE.
- [1d]: *Satisficing* is another "old" BE term, already coined early on by Simon, which only rarely features in "new" BE work (which instead uses optimization).
- [1e]: The final term is *libertarian paternalism*. Given the data used here, the results are no direct measure of the influence these ideas had on actual policy, but of how broadly they are discussed—whether affirmatively or controversially—in the academic literature instead.

Study 2: Seminal Work in "Old" Behavioral Economics. BE, of course, is more than just a few key terms. Concerning the ideas behind these, some seminal papers have exerted significant influence on later contributions. While it is often easy to identify these linkages within particular papers, assessing the overall dissemination of individual contributions is more complicated. A quantitative impression can be gained from a citation analysis. The results of this exercise may be a proxy for how often core contributions, and thus possibly their ideas, have been discussed within the literature. The selection of these papers based on theoretical considerations necessarily requires some discretion, and it is inevitable to try to satisfice: There are obvious candidates but also examples where it is less clear whether they are to be considered among the most notable contributions to BE.[8]

8. The quantitative approach used in this paper can also be expanded to double-check whether a contribution, identified to be relevant by a theoretician, was truly that influential in actual developments, not

The following lists are therefore an attempt to include, in as little different publications as possible, the major branches within BE. Arguably, some other references could have been considered additionally, but there should be little doubt as to whether the listed publications are important groundwork to, or prominent examples of, BE. For the scholar who is not as familiar with BE, each item is commented with a short explanation of its selection. First, three sets of important contributions related to "old" BE are looked at:

- [2a]: Major works by Herbert Simon. The early papers "A Behavioral Model of Rational Choice" (1955) and "Rational Choice and the Structure of the Environment" (1956), in which Simon introduced the concepts of BR and satisficing, as well as the 1979 Nobel Lecture are considered (because it may be argued that, if anything, Nobel Lectures represent an author's general ideas well). Numbers for the 1955 and 1956 papers also include citations of republished versions, for example from Simon (1957).
- [2b]: Major works by George Katona. There are a few representatives of "old" BE already around the middle of the twentieth century, and Katona stands out among these. His most important contributions are summarized in two books (1951 and 1975). Because these are not indexed on the SSCI, a different, somewhat less accurate method must be employed to create the citation time series here, namely through the "cited reference search", using an author search for "Katona G*" and cited work search for "Psych* Ana*," respectively "Psych* Econ*." Search results are then manually checked for false positives (i.e., wrongly identified citations).
- [2c]: As an important and representative example of more recent "old" BE, Gigerenzer and Goldstein's "Reasoning the Fast and Frugal Way: Models of Bounded Rationality" (1996) is included in the study. This paper outlines Gigerenzer's critique of Kahneman and Tversky, where and why they differ, and illustrates examples and underlying premises of Gigerenzer's alternative approach, too. To feature another Nobel Laureate, Reinhard Selten's "Bounded Rationality" (1990) is considered as well.

Study 3: Seminal Work in "New" Behavioral Economics. As argued in the previous section, "new" BE is a very large and wide field, but there are some contributions of particular interest that may be regarded as crucial for further developments of the subdiscipline. The following are included in the study as representative of the groundwork underlying many other contributions:

- [3a]: Kahneman's Nobel Lecture, which was published in two highly similar versions: one in the AER (2003a) and another from the *American Psychologist*

just in BE: E.g., one could look at the most frequently cited papers with certain key words or *JEL* tags and then compare the top of this list with what theoreticians have perceived to be seminal. While such results may be interesting, they are not the concern of this article but a topic for further research. Applying the method to the question asked here would indeed amount to somewhat of a tautology.

(2003b). Citation numbers used are for the aggregate of both papers, whereby articles citing both versions are still counted as only one citation.

- [3b]: Papers by Kahneman and Tversky on PT, that is the original from 1979, and its 1992 refinement by Tversky and Kahneman.
- [3c]: Kahneman and Tversky's groundwork on the Heurstics-and-Biases-Programme, especially Tversky and Kahneman's seminal 1974 *Science* article.
- [3d]: Fundamental papers on framing, that is the seminal Tversky and Kahneman 1981 *Science* article and the discussion of the implications framing bears for the axioms of RC by Tversky and Kahneman in 1986. Based on a cited reference search and individual selection of the results, citation counts for the latter also include references to republished versions, particularly the one from 1987.

Citation frequencies in the three groundwork studies [3b]–[3d] are also compared to a "decision theory" category, which is constructed based on all Economics articles returned from a SSCI search for "decision theory," "decision making," and "choice theory" in the fields "Topic," "Title," and "Publication Name" (i.e., which contain at least one of the terms at least once in either one or more of these fields, which also encompass abstracts and key words). Study [3] includes more than just the groundwork, though:

- [3e]: Major work in "new" BE proper:
  - Regarding consumer theory, Thaler's 1980 paper "Toward a Positive Theory of Consumer Choice" is a straightforward candidate, for it marks the first example of an application of the underlying principles of PT to consumer theory. The ideas were presented more elaborately later by Thaler (1999).[9]
  - An important model within "new" BE is Laibson's (1997) "hyperbolic discounting," which claims to capture individuals' BW. Also notable in this context of intertemporal choice is Benartzi and Thaler's (1995) BE explanation of the equity premium puzzle (Mehra and Prescott 1985).
  - The third deviation of individual decision makers from a standard RC model, namely BSI, is captured by a fundamental article that discusses the effect of fairness and provides for a comparatively long time line: Kahneman et al. (1986).
  - To take account of the wide variety of representatives of, and topics discussed in, "new" BE, another Nobel Lecture, namely Akerlof's "Behavioral Macroeconomics and Macroeconomic Behavior" (2002), is included.
  - Behavioral finance is represented by Shiller's (1981) fundamental contribution on the volatility of stock prices.
- [3f]: Contributions by important economists (not necessarily positively) related to BE. This list is probably the most assorted and may well be considered random;

9. Another noteworthy paper, namely Thaler (1985), is only listed on the SSCI as the republished version (Thaler 2008b) with consequently too short a time frame and too few citations to derive any additional insights. Interestingly, Thaler (2008a: 12) states that the paper was often cited, but he still considers it a failure because of its lack of actual impact.

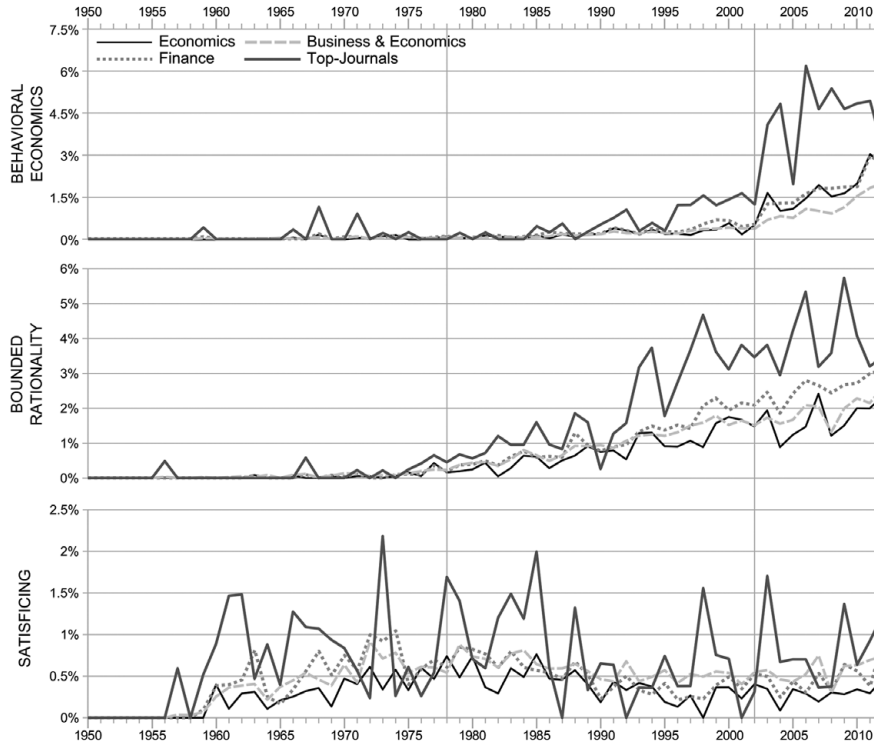

FIGURE 1. *Relative frequency of papers mentioning key BE terms, by category and in top journals, 1950–2012 (see online supplementary material for larger format). Vertical lines mark the years of Nobel Prize awards to Herbert Simon (1978) and Daniel Kahneman (2002).*

it is just intended to serve for a very rough comparison. It includes the supportive Kenneth Arrow (1982), Gary Becker (1993) as an antipole and radical proponent of the standard neoclassical approach, and Vernon Smith (aggregates for three papers: 1962, 1976, and 1991; and separate numbers for the 2003 Nobel Lecture) as a critic.

Empirical Results

Study 1. Figure 1 displays the time lines for the relative frequencies of items using key BE terms (as outlined in the previous subsection), sorted by categories and top journals, from 1950 to 2012. Those for "ecological rationality" and "libertarian paternalism" have been neglected for the figure, because the two terms are new and—correspondingly—only appear in the last few years of the observed period. In addition, both terms are still relatively rare, with the figures not allowing for any proper

inferences: "Ecological rationality" appears in 76 Business & Economics articles between 1988 and 2012 and only once in Economics. "Libertarian paternalism" was mentioned in 97 Business & Economics articles between the year of the publication of Thaler and Sunstein (2003) and 2012, and in 10 Economics articles of the same period. Overall frequencies are even lower for BW and BSI, which featured only 10 respectively 15 times in Business & Economics, twice respectively once in Economics, and seven respectively nine times in Finance.

The top panel in figure 1 shows that BE was a term not used quite frequently until the mid-1990s, with only rare instances of the notion appearing until then. Then, however, a rapid development took place, with a clearly upward sloping trend in all four lines. In 2010, more than 1.5 percent of all papers in the Business & Economics subject group contained the term, and in the subsets Economics and Finance, the frequency rose even more, to almost 2 percent in both. Most notable, however, is the sharp increase in relative frequency in top journals: Between 1995 and 2012, the relative number of items in all top journals that contained the term BE was more than 4 percent in eight years, and continuously higher than in all the years before. With only few exceptions, papers in top journals were more likely to use or refer to the term over the whole period observed (namely 1.03 percent or 231 items, 1950–2012), and in the past two decades this has increased to a substantial number even. In the 2000s, an economics paper in a top journal was about two to three times as likely to use the term than any paper in the whole sample: In general, about every 25th paper in a top journal published then had it included.

The second graph, the one showing the time series for BR, is very similar in one respect—the term is relatively more often used in top journals (1.51 percent, respectively 337 items). There is also another similarity, namely that all four lines show an upward trend, already beginning in the mid-1970s. It is also interesting to see that the relative frequency of BR in top journals was already at an earlier peak in the 1990s, when BE was still mentioned rather infrequently, and has been fluctuating around this level ever since. The other three lines reached their highest values in the late 1990s and 2000s, at frequency levels similar to those of BE. In contrast to this term, though, the trend growth of these lines that started to rise before the 1990s flattened out over the last 10 years. Overall, BR still features more frequently than BE in articles of both Business & Economics and Finance, but over the past decade, BE has caught up rapidly to, and sometimes even surpassed, BR within the Economics category and top journals.

When comparing the frequency of "satisficing" with the other two terms, the very different scale must be considered. In general, the term is much less used than the other two, and the difference between top journals and the general literature is less pronounced than in the other cases, although it still appears more frequently in top journals (0.6 percent, respectively 134 items). Discussion of the term begins with Simon's seminal contributions in the 1950s and reaches peaks in the late 1970s and 1980s. Afterward, the frequency returned to levels similar to the 1950s. The relative prevalence of the term has thus decreased, but it did not vanish from the discussion. While absolute frequencies of "satisficing" in the Economics category have slowly

TABLE 1. *Aggregate citation counts in journal articles for the central papers in study [2], 1950–2013*

Study	*Paper*	*Total Citations*	*Economics Citations*	*In Top Journals*
2a	Simon (1955)	2,321	522	38
	Simon (1956)	600	70	2
	Simon (1979)	444	145	6
2b	Katona (1951)	208	106	12
	Katona (1975)	246	136	1
2c	Gigerenzer and Goldstein (1996)	579	36	0
	Selten (1990)	34	20	3

decreased on average since the 1980s, those in the Business & Economics and Finance categories have been stable since the 1970s. This contrasts with BE and BR, where rising relative frequencies were also a result of increased absolute numbers.

It is also worthwhile to summarize the evolution of co-occurrences of terms (not depicted due to frequently missing data points and volatile time series). Overall, 24 percent of articles in Business & Economics containing BE also contained BR, and the series has mostly moved around this level historically (19.06 percent in Economics; 24.8 percent in Finance). However, BE appeared in 9.95 percent of all Business & Economics articles containing BR, 11.36 percent of those in the Economics and 13.62 percent in the Finance categories. Here, too, a substantially rising trend over the last decade of the observation period is evident. In the 1990s, around 5 percent of all BR articles contained the term BE on average, whereas in the 2000s, this number was well more than 10 percent, even getting close to and more than 20 percent in most recent years. In contrast, the trend for co-occurrences of "satisficing" within all BE items shows downward since the 1980s over all categories, with less than 5 percent of all BE papers in the 2000s also containing the term "satisficing." Within all items featuring "satisficing," the frequency of BE has followed a steady trend but fluctuated greatly throughout all categories, around about 5 percent overall. Finally, the occurrence of "satisficing" within all BR papers shows a declining trend over all categories until 1990, and a steady one around 10 percent in Business & Economics and Economics (about 2 percent in Finance) afterward. With all "satisficing" articles as a denominator, the picture is quite different: About one in five "satisficing" articles features BR, and after an earlier rise, the trend has been around 25 percent to 30 percent since the early 1990s throughout all categories.

Study 2. Table 1 summarizes the aggregate numbers for the "old" BE papers in study [2]. The third column displays the number of journal articles citing the paper in the SSCI, that is including all other categories, while the fourth column only displays citations from the Economics category, and the fifth column those from top journals. Simon's groundwork garnered plenty of citations, both within and outside of

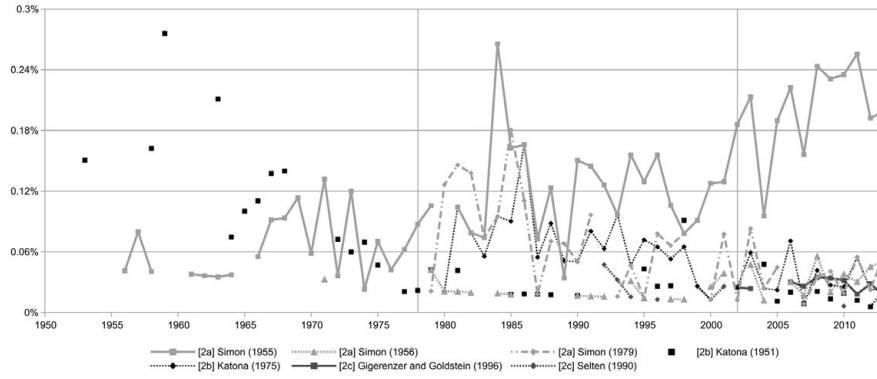

FIGURE 2. *Relative numbers of yearly economics citations for the central items in study [2], 1950–2013 (see online supplementary material for larger format). Vertical lines mark the years of Nobel Prize awards to Herbert Simon (1978) and Daniel Kahneman (2002).*

economics, but the difference between the two 1950s papers is striking ([2a]): The earlier one is cited almost three times as often, a great deal more frequently in economics overall and especially in top economics journals. In fact, the 1956 paper was first cited in economics in 1971. The 1955 paper has also a higher ratio of citations from top journals than Simon's Nobel Lecture did, which was cited 444 times over the more than three decades since its publication. George Katona's major monographs both gathered more than a hundred economics citations each ([2b]). Interestingly, however, this does not hold true for his major papers, such as Katona (1946, 1953, 1968): None of these made even 10 economics citations in all the years since their publication, even though they appeared in high-ranking journals. Concerning more recent "old" BE ([2c]), Gigerenzer and Goldstein's (1996) fundamental paper from the *Psychological Review* (*PR*) is similar to Simon (1956): It boasts a fair amount of citations, but only very few in economics journals overall, and none in premier economics journals. Selten's article, although relatively often cited in top journals, was referenced only very rarely overall.

Figure 2 plots these contributions' time series of relative citations in the SSCI's Economics category from 1950 to 2013. One interesting observation about this graph is that Simon's Nobel Lecture originally became the relatively most frequently cited of his works, but then fell behind the 1955 and to a similar level as the more rarely cited 1956 paper. Overall, the absolute yearly citation counts for the Nobel Lecture remained stable while those for the other two contributions have grown especially since the 1990s. For the 1955 paper, this growth was faster than the absolute number of items in the Economics category so, therefore, an upward trend in relative citation frequencies is observable from the early 1980s onward: Between 2008 and 2013, around 0.25 percent of all papers in the SSCI's Economics category cited Simon's groundwork. Similar to this development,

TABLE 2. *Aggregate citation counts in journal articles for the central papers in study [3], 1962–2013*

Study	*Paper*	*Total Citations*	*Economics Citations*	*In Top Journals*
3a	Kahneman (2003a, 2003b)	1,003	150	10
3b	Kahneman and Tversky (1979)	7,280	1,991	89
	Tversky and Kahneman (1992)	1,740	674	29
3c	Tversky and Kahneman (1974)	5,623	562	31
3d	Tversky and Kahneman (1981)	3,091	402	28
	Tversky and Kahneman (1986)	916	219	11
3e	Thaler (1980)	929	292	30
	Thaler (1999)	354	119	13
	Laibson (1997)	699	478	66
	Benartzi and Thaler (1995)	344	194	19
	Kahneman et al. (1986)	890	356	42
	Akerlof (2002)	63	47	0
	Shiller (1981)	700	499	42
3f	Arrow (1982)	151	73	7
	Becker (1993)	190	77	5
	Smith (1962, 1976, 1991)	473	291	33
	Smith (2003)	79	46	3

25 of the 38 citations in top journals are from the most recent two decades (1994–2013).[10] All the other "old" BE papers, however, do not show a comparable development: There is, at best, a steady trend and a low absolute citation count overall. Both of Katona's monographs, for example, were originally quoted quite frequently for several years after their publication.[11] However, despite relatively stable absolute numbers, the relative frequencies soon diminished. This trend is even more pronounced for top journals, in which Katona (1951) was last cited in 1970.

Study 3. For study [3], table 2 shows absolute citation counts: overall, in the SSCI's Economics category, and in premier journals. The very high numbers of items referencing Kahneman and Tversky's work ([3a]–[3d]) is striking. Obviously, their papers were widely acknowledged: The original PT article from 1979 is also the most frequently cited economics article on the SSCI.[12] This impression is further confirmed when looking at the miscellanies they coedited (not in table 2): The volume on *Heuristics and Biases*, first published in 1982 (Kahneman et al. 1982), was reprinted 16 times, and its updated rerelease (Gilovich et al. 2002) made it to six editions within six years after its publication. Similarly, *Choices, Values and Frames* (Kahneman and Tversky 2000) was already on its tenth edition in 2009. Citations from economics

10. Relative citations from top journals are not displayed in a separate figure here because, due to the low absolute numbers, the time lines are frequently interrupted and hardly provide for a steady development (this applies similarly, albeit to a much smaller degree, to the papers in study [3]).

11. In fact, the observations for three years of Katona (1951) are not displayed in figure 2 to allow for a better scale: 0.64 percent in 1952 (4 citations), 0.43 percent in 1954 (3), and 0.42 percent in 1955 (3).

12. This implies a change in ranking over the past few years: Based on the SSCI, Kim et al. (2006: 191) had previously reported rank 2 for Kahneman and Tversky's paper.

articles amount to only a fraction of the total count (many references to Kahneman and Tversky's groundwork come from psychology, etc.), but except for Tversky and Kahneman (1986), all papers were still at least cited 12 times a year on average since their respective publications.

For the BE papers from [3e], both total citations and references in premier journals are very high, with five out of six getting at least 20 citations per year on average (in all categories, mostly from Economics, Business, etc.). The only exception, interestingly, is Akerlof (2002), who is on a low overall count and zero citations from top journals. Benartzi and Thaler's (1995) behavioral explanation of the equity premium puzzle gets about one-third as many economics citations per year as the original (Mehra and Prescott 1985, not in the table), at a slightly higher ratio of premier references. Regarding the work "surrounding" BE, that is [3f], citation counts are lower on average, but quite many of these come from top journals. Becker (1993) and Smith (2003) score the lowest ratio in this respect, also notably below all the BE papers from [3e] (except for Akerlof 2002). Smith's Nobel Lecture has a similar top journal citations ratio to Kahneman's, but only under a third of the absolute citation count from economics articles.

Figure 3 plots the time series for the yearly relative citation counts of all these papers, with [3a]–[3d] on top and [3e]–[3f] in the bottom panel. In the first graph, all lines (except for the Tversky and Kahneman 1986 paper) show a clear upward trend after 2002 (marked by a vertical line), the year when Kahneman was awarded the Nobel Prize. Before this date, the trends were mostly flat for all papers except for Kahneman and Tversky (1979), which had been on a rise ever since its publication. The picture for the BE papers from [3e] is more complicated: Except for Shiller (1981), all papers were on or (in the case of Kahneman et al. 1986) very close to their highest relative counts in the decade after Kahneman's Nobel, but also on a flat trend, the only exceptions being Laibson (1997) and possibly Thaler (1999). Even for Shiller (1981), though, after a decline in absolute citations over the 1990s, this number was rising again after 2002. The papers from [3f] also lack a clear trend and mostly follow a flat line. References to Smith's groundwork (1962, 1976, 1991) increased slightly after his Nobel, but the trend is far less pronounced than that for Laibson (1997). Because there are years for all papers that display no citations in top journals at all and the lines of which are therefore broken relatively frequently, the charts for these relative citation amounts are not shown as they are not particularly graphic. However, it should be noted that the broad movements are quite similar for most of the papers, albeit on a higher relative level: Compared with an average economics article, those in top journals are more likely to cite the papers in study [3], especially in the past 10 years.

Next, the citation counts are set into perspective of another comparison group, namely economics articles on decision theory. Between 1950 and 2013, there were 5,589 such items (96 in top journals), which equals 1.51 percent of all economics articles (0.41 percent in top journals). Considering the groundwork articles from studies [3b]–[3d], it is worthwhile to point out that every single paper has been cited relatively more frequently among decision theory papers than among all economics papers. However, when looking at the evolution of citation frequencies over time,

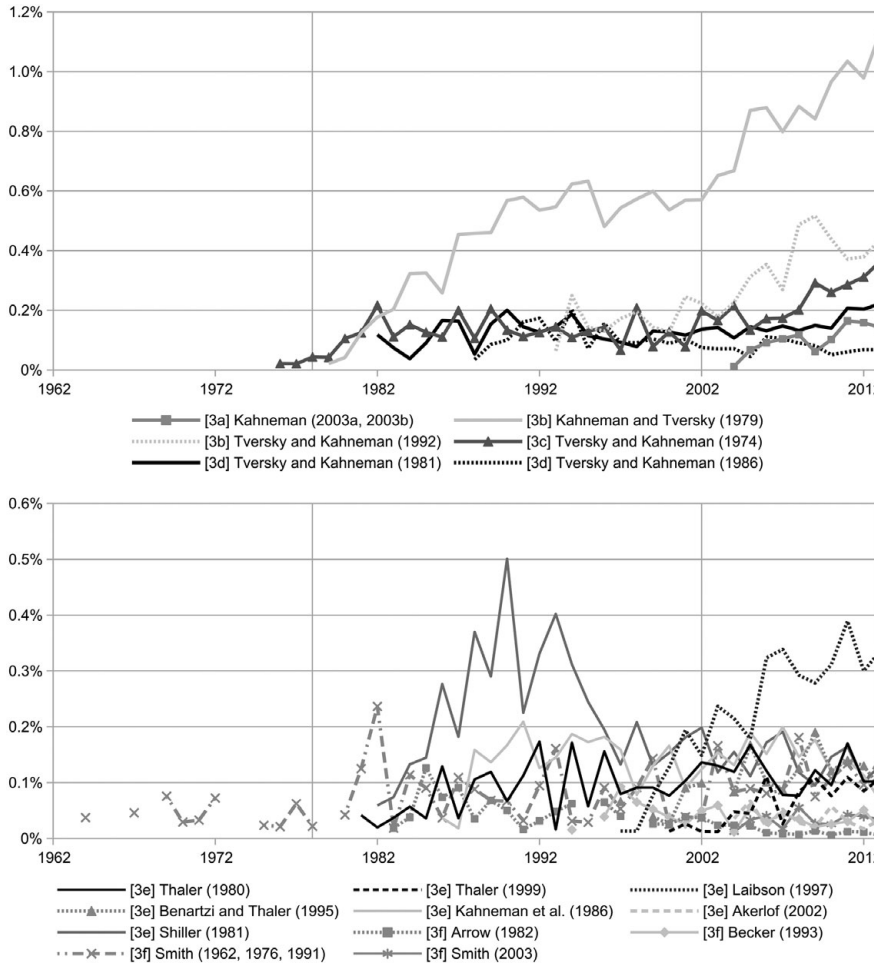

FIGURE 3. *Relative numbers of yearly economics citations for the papers in study [3], 1962–2013 (see online supplementary material for larger format). Vertical lines mark the years of Nobel Prize awards to Herbert Simon (1978) and Daniel Kahneman (2002).*

as depicted in table 3, a striking difference is evident: Both PT papers show rising trends overall, though not within the last two decades, and all the other papers do not have a rising trend at all but instead even a falling one sometimes. The overall level is therefore higher, but the maximum was already attained earlier than within all economics papers (see figure 3). The overall number of decision theory articles in top journals, and especially those quoting one of the articles from [3b]–[3d], is so low that they are not reported on in detail or depicted in a figure, for it is impossible

TABLE 3. *Absolute and relative citation frequencies in decision theory journal articles for the groundwork papers in study [3], 1974–2013*

Study	*3b*	*3b*	*3c*	*3d*	*3d*
Paper	*Kahneman and Tversky (1979)*	*Tversky and Kahneman (1992)*	*Tversky and Kahneman (1974)*	*Tversky and Kahneman (1981)*	*Tversky and Kahneman (1986)*
Total citations	356 (6.59%)	195 (3.83%)	101 (1.84%)	85 (1.59%)	55 (1.05%)
1974–78	0	0	1 (1.09%)	0	0
1979–83	1 (1.08%)	0	4 (4.3%)	3 (3.23%)	0
1984–88	7 (7.29%)	0	0	1 (1.04%)	0
1989–93	19 (6.86%)	1 (0.36%)	2 (0.72%)	6 (2.17%)	3 (1.08%)
1994–98	37 (6.07%)	16 (2.62%)	12 (1.97%)	7 (1.15%)	6 (0.98%)
1999–2003	51 (6.63%)	20 (2.6%)	5 (0.65%)	15 (1.95%)	11 (1.43%)
2004–8	80 (6.7%)	48 (4.02%)	18 (1.51%)	15 (1.26%)	16 (1.34%)
2009–13	161 (6.85%)	110 (4.68%)	59 (2.51%)	38 (1.62%)	19 (0.81%)

to derive any trends from these (12 of 84, 11 of 77, 2 of 86, 5 of 80, and 3 of 78 citing articles since the respective work's publication, in the order of their listing in table 2).

Discussion

Study [1], the most general of the three, provided some straightforward, yet also interesting results. All four time lines for BE in figure 1 showed a clear upward trend since the mid-1990s, and items in top journals were much more likely to contain a BE reference. The overall numbers are still far below those of central economics terms such as "monetary policy" or "business cycle", but especially the relative annual figures have been catching up rapidly more recently. Between 1950 and 2012, the terms BE and BR appeared in 320 respectively 597 of the 102,037 journal articles in JSTOR's Economics category. This is a great deal less frequent than, for example, "monetary policy" (12,503), "general equilibrium" (10,191), "business cycle" (8,857), "macroeconomics" (8,788), or "rational expectations" (4,211), but in a comparable order of magnitude as, for example, "evolutionary economics" (740), "growth accounting" (734), "creative destruction" (676), or "efficient market" (643). Apart from that, "fairness", a term associated with BSI but often also used outside of BE, appears in 4,398 articles over that time frame. Furthermore, when looking at the period 2000–2012 only, that is when BE and BR were rising, respectively had already risen to higher levels, the terms' relative frequencies are a great deal closer to those of, for example, "rational expectations" as in earlier decades. Concerning citation counts, those for Simon (1955) have been on levels similar to those of major works by Milton Friedman over the past decade, and Kahneman and Tversky (1979) alone was cited in about two-thirds as many articles as any work by John Maynard Keynes—more frequently than the *General Theory* individually—after 2000. Clearly, BR and BE are not the most prominent topics within economics, but they are on a rising trend and have recently surpassed some other notable themes.

It should be noted, of course, that the frequencies of papers mentioning a term are not a perfectly accurate estimate for all papers discussing BE or BR because not every BE or BR paper necessarily uses the respective term. The only papers included in studies [3a]–[3e] that feature BE in the text are Akerlof's (2002) and Kahneman's (2003a) Nobel Lectures. It could therefore be argued that the numbers from study [1] are likely to understate the extent of discussions of BE themes. As long as these discrepancies do not systematically shift over time, they should not affect the observed trends, though.

Furthermore, within all the items identified through the key term analysis, there is no semantic distinction made between how (and to which intent) the respective article employs the term. This is especially relevant with regard to different understandings of BR, particularly between "old" and "new" BE, as outlined in the previous section.[13] From the term frequencies of BR alone, it is not possible to discern, for example, which branch of BE contributed to the rise in relative frequencies. However, broadening the analysis by other terms such as *satisficing* and by including citation series for papers from different strands in the literature provides an impression of that. Both points—the potential undercounting and different meanings—highlight the relevance of conducting citation alongside content analysis. They also demonstrate that the purely quantitative analysis can only ever be complementary to, and not fully replace, informed qualitative readings of the literature to identify contributions that mattered to a particular topic, despite potentially employing different terms.

In any way, the rising trends are an evident confirmation of the casual observations replicated in the introduction and the previous section that BE has increased in popularity and ascended toward the mainstream in the past two decades. The lines for the relative frequencies of BE (figure 1) and the seminal groundwork papers of Kahneman and Tversky (figure 3, upper panel) have all been subject to trend shifts in the upward direction following Kahneman's Nobel in 2002. A closer look at figure 1 also shows that BE was almost constantly (over the whole period observed) mentioned relatively more frequently in top journals than in the other categories, even when it still appeared far less often than recently (e.g., the 1970s and 1980s). The figures for BR and "satisficing" were similar in this respect, that is, that the terms appeared relatively more frequently (albeit, especially concerning "satisficing", more seldom in general) in top journals—which indicates that the authors behind the most influential research have always been at least more aware of BE and related concepts than economists in general (independent of whether this awareness was combined with favorable opinions). Indeed, this confirms Herbert Simon's (1991: 326) comment on the surprise many economists had expressed in 1978: "If I was an outsider to the economics profession as a whole, I was an insider to its elite. Without that accreditation, I suspect that I would not have won the prize."

13. What is more, BR is used outside of BE, too: A prime example is Sargent's *Bounded Rationality in Macroeconomics* (1993), which hardly bears any resemblance to what Simon had originally meant (see Selten 1999: 4; Sent 1997).

Still, at least by the citation and string-count metrics employed here, those pictures nonetheless show the relatively small impact Simon had on economics on a broad scale. Indeed, his work sparked the discussion on satisficing, but despite the Nobel Prize, "satisficing" now appears no more frequently than 40 years ago. By contrast, BR began its rise to wider fame in the mid to late 1970s—this, however, is also when Kahneman and Tversky published their work on PT (which does not contain the term BR, though) and subsequently on framing. Thaler (1980: 40) also included a reference—to "Herbert Simson [*sic*]"—and has used the term from the start. This impression can be specified further by taking the results of studies [2a] and [3] into account: Simon's 1955 paper, published in the *QJE*, reached a far greater audience than the 1956 *PR* article. Arguably, though, both papers form a unity that shapes Simon's concept of BR as both determined by the actors and the environment they live in. This aspect, which is emphasized by modern "old" BE authors, however, did not quite catch on as the term of BR did: As argued in the previous section and confirmed by these data for a broader scale, economists, especially "new" BE, picked up the term but did not really take the concept along with it. The only paper in study [2] that showed a positive trend in relative citation frequencies over the past one to three decades was Simon (1955).[14] This impression is additionally strengthened by comparing figures 1 and 3 once more: It was especially the term and related work of BE that experienced the immense surge over the past decade while the frequency of BR had already reached similar levels a decade earlier.

Another interesting result from study [3] is the relatively low number of citations of Akerlof's Nobel Lecture, especially the fact that it was not quoted a single time in a top journal until 2013. It is, however, interesting to see that both title and content of Akerlof's Nobel Lecture are not quite identical to what he was awarded the Nobel Prize for, namely his analysis of markets with asymmetric information. Therefore, the same analysis as for the Nobel Lecture was conducted for his earlier seminal work on the "Market for Lemons" (1970). This paper was cited 2,644 times (1,243 in economics) until 2013, and 114 of these—about 4 percent (respectively 9 percent)—were from top journals. It thus seems as if Akerlof, despite many publications and especially his Nobel Lecture, is not primarily perceived for his work in BE by other economists. Similarly, it is worth pointing out that Kahneman et al. (1986) is not the most frequently cited item on the SSCI with "fairness" in the title. The highest count, 869, is attained with another BE paper by Fehr and Schmidt (1999). This paper also differs from the other in that it was on a steeply rising trend immediately after its publication until reaching a level of around 0.6 percent in the late 2000s (another important BE paper on fairness, Fehr et al. 1993, moves very similarly to Kahneman et al. 1986). A closer look at such examples will be necessary to gauge the impact of

14. The fact that citation frequencies for Simon are markedly lower than appearances of the term BR hints at some degree of "obliteration by incorporation." However, as McCain (2014: 1456 f.) shows in a detailed study, that level is lower than the level for many other key scientific terms and does not display a clear upward trend over time either. Still, the argument holds true that many uses of BR do not employ the term for the same meaning Simon had in mind.

different branches of BE related to BR, BW, and BSI, respectively, because study [1] has shown that the topical notions hardly feature in articles.

Furthermore, study [3] also showed a difference between the trends of the groundwork on BE and particular applications of it. The major contributions of Kahneman and Tversky underlying much of "new" BE mostly displayed rising trends for their relative citation frequencies after Kahneman's Nobel. In contrast, no such general observation could be made for the papers in [3e]. A possible explanation is that BE may be branching out currently and developing into multiple directions, so that no individual application necessarily gains increased citation frequencies, because new and more advanced approaches may have come up. In contrast, the psychological groundwork from Kahneman and Tversky still features in newer papers. Nonetheless, it is worthwhile pointing out once more that the stable relative citation counts are a result of these papers' rising absolute numbers toward the end of the observation period. Overall, the citation patterns observed are thus quite unusual: For example, none of the archetypes documented in detail by Costas et al. (2010), and already similarly categorised by Aversa (1985), seem to fit at first glance, although the articles might technically fall into the "delayed papers" category, that is contributions that receive peak citations several years after their original publication and are subsequently cited over a longer period.

Clearly, to gauge the overall diffusion of "new" BE through citation numbers here it would be desirable to have an analysis of citation frequencies for all BE papers. This set of papers could be identified using *JEL* codes, similar to how Duarte and Giraud (2016) assess the dissemination of papers on the history of economic thought. However, as pointed out in the beginning of this section, this is not possible due to the recency of the *JEL* codes pertinent to BE. The assessment of the spread of "new" BE groundwork within decision theory articles is another similar measure, but clearly not the same. All that can be said for certain with the data assembled here is that the rise of BE, observable on a general level in study [1], clearly features in the groundwork papers of "new" BE ([3b]–[3d]) but is not necessarily correlated with a similar rise in relative citation frequencies for individual "new" BE papers.

As a last and anecdotal note, it deserves to be mentioned that among the top journals, the key terms from study [1] appeared by far the least frequently in the *JPE*, both in absolute and relative terms. This is true overall and for the large majority of individual years. For example, from 1950 to 2012, BR appeared in 337 research articles (i.e., 1.51 percent) in top journals whereas it was mentioned in only 19 of the almost 4,007 items in the *JPE*. It seems that the Chicago tradition is still alive and vigorously holds its ground.

Conclusion

Overall, the three studies presented in this article confirm the story about the rise of BE as it is usually told in the academic literature (see especially Sent 2004). BE basically started in the 1950s, primarily with Simon, but it never really caught on

until Kahneman and others entered the picture and it has seen a substantial increase in spread since the 1990s and especially 2000s. However, the quantitative analysis helped to clarify some issues and has also provided interesting new insights at some points. Some notable additional side notes were also derived, for example, on the relative lack of BE-related topics in the *JPE*. Further research may pick up these results and investigate the additional question of whether the confirmed rise of BE translated into shifts in practical matters, for example, economic policy (advice).

Especially the two studies concerning the individual papers should be regarded as exploratory work, as has been pointed out in the caveats throughout the paper. Further research may specify the results derived here, such as by a more detailed comparative analysis of the relative spreads and discussions of BR, BW, and BSI, and expand them to related fields, for example finance and business. The article is an exercise in quantitative history of economic thought, and, yet, this is a rarely visited field. If a careful theoretical analysis of the history should hint at a different set of papers to analyze quantitatively, then this is perfectly in line with the intention of this article and calls for an expansion of it in additional research work.

Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/ssh.2017.17.

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