

10-2022

## Exponential Growth Bias and the Law: Why Do We Save Too Little, Borrow Too Much, and Fail to React on Time to Deadly Pandemics and Climate Change?

Doron Teichman, Professor of Law  
*Hebrew University of Jerusalem*

Eyal Zamir, Professor of Commercial Law  
*Hebrew University of Jerusalem*

Follow this and additional works at: <https://scholarship.law.vanderbilt.edu/vlr>



Part of the [Law and Society Commons](#), and the [Public Law and Legal Theory Commons](#)

---

### Recommended Citation

Doron Teichman, Professor of Law and Eyal Zamir, Professor of Commercial Law, *Exponential Growth Bias and the Law: Why Do We Save Too Little, Borrow Too Much, and Fail to React on Time to Deadly Pandemics and Climate Change?*, 75 *Vanderbilt Law Review* 1345 (2023)  
Available at: <https://scholarship.law.vanderbilt.edu/vlr/vol75/iss5/2>

This Article is brought to you for free and open access by Scholarship@Vanderbilt Law. It has been accepted for inclusion in *Vanderbilt Law Review* by an authorized editor of Scholarship@Vanderbilt Law. For more information, please contact [mark.j.williams@vanderbilt.edu](mailto:mark.j.williams@vanderbilt.edu).

## ARTICLES

### **Exponential Growth Bias and the Law: Why Do We Save Too Little, Borrow Too Much, and Fail to React on Time to Deadly Pandemics and Climate Change?**

*Doron Teichman  
Eyal Zamir\**

*Many human decisions, ranging from the taking of loans with compound interest to fighting deadly pandemics, involve phenomena that entail exponential growth. Yet a wide and robust body of empirical studies demonstrates that people systematically underestimate exponential growth.*

---

\* Doron Teichman is the Jacob I. Berman Professor of Law, and Eyal Zamir is the Augusto Levi Professor of Commercial Law at the Hebrew University of Jerusalem. The authors contributed equally and are listed in alphabetical order. For invaluable comments on previous drafts we thank Katya Assaf, Ronen Avraham, Oren Bar-Gill, Ryan Bubb, Hanjo Hamman, Ori Katz, Russell Korobkin, Ofer Malcai, Jeff Rachlinski, Michal Shur-Ofry, Cass Sunstein, Joshua Teitelbaum, the participants in the Annual Meetings of the American Law and Economics Association at Columbia Law School, the European Law and Economics Association in Barcelona, the Israeli Private Law Association in Tel Aviv, the German Law and Economics Association in Berlin, the Notre Dame–Tel Aviv University Conference on Empirical, Behavioral, and Experimental Analyses of Law, and workshops held at Georgetown Law Center, University of Virginia School of Law, USC Gould School of Law, the Hebrew University in Jerusalem, the Bucerius Law School in Hamburg, and the Interdisciplinary Center in Herzliya. This research was supported by the Israel Science Foundation (Grant No. 699/20).

*This phenomenon, dubbed the exponential growth bias (“EGB”), has been documented in numerous contexts and across different populations, using both experimental and observational methods.*

*Despite its centrality to human decisionmaking, legal scholarship has thus far failed to account for the EGB. This Article presents the first comprehensive study of the EGB and the law. Incorporating the EGB into legal analysis sheds a new light on a long list of policy debates and highlights new solutions to many problems that the legal scholarship has been grappling with. More concretely, in the sphere of policymaking, the EGB explains the systematically delayed legal response to novel exponential risks such as the COVID-19 pandemic and climate change. Building on this insight, this Article highlights new legal strategies that could improve officials’ ability to react promptly and effectively to such threats. In the sphere of individual decisionmaking, this Article shows that the EGB causes people to systematically err when making decisions that involve exponential phenomena. Consequently, people often borrow too much, save too little, and fall prey to sophisticated marketing tactics. In light of these findings, this Article presents a novel regulatory framework, which includes new disclosure duties that could assist people to grasp the long-term implications of their choices, and the imposition of mandatory rules that would minimize the exploitation of the EGB by savvy profit-maximizing entrepreneurs.*

INTRODUCTION .....	1347
I. APPLIED MATHEMATICS AND COGNITIVE PSYCHOLOGY.....	1350
A. <i>Exponential Growth</i> .....	1350
B. <i>Exponential Growth Bias</i> .....	1353
II. COUNTERACTING POLICYMAKERS’ BIAS.....	1360
A. <i>Behavioral Public Choice Theory and the Exponential Growth Bias</i> .....	1360
B. <i>Exponential Growth Bias and Legal Policymaking: Applications</i> .....	1362
C. <i>Possible Solutions</i> .....	1366
III. COUNTERACTING INDIVIDUALS’ BIAS.....	1371
A. <i>Consumer Credit</i> .....	1371
1. <i>General</i> .....	1371
2. <i>Consumer Credit and the Exponential Growth Bias</i> .....	1374
3. <i>Consumer Litigation Funding</i> .....	1381
4. <i>Mortgage Forbearance</i> .....	1384
B. <i>Retirement Savings</i> .....	1386
1. <i>The Retirement Crisis and the Exponential Growth Bias</i> .....	1386

2.	Policy Implications .....	1389
C.	Pyramid Schemes .....	1393
	CONCLUSION.....	1399

## INTRODUCTION

According to an ancient legend, the ruler Shirhàm was full of joy when presented with the game of Chess. To show his gratitude, he offered the inventor, Sissa Ibn Dàhir, whatever he wished for. In response, Sissa asked that a grain of wheat be placed on the first square of the chessboard, two on the second, four on the third, and so on, progressively doubling the number of grains, until the last, sixty-fourth square is attained—and the total amount be given to him. The king reproached Sissa for asking so little—only to discover that all the wheat in the world would not suffice to fulfill Sissa’s request.<sup>1</sup>

While it is impossible to verify the authenticity of this story, it nicely demonstrates the mathematical notion of *exponential growth*. Quantities may grow in various ways. When they grow exponentially, the rate of change is proportional to the quantity, as in the wheat and chessboard legend. Exponential growth characterizes various natural, social, and economic processes—from the spread of viral diseases and memes on the internet, to the accumulation of debt or wealth due to compound interest. However, the wheat and chessboard legend demonstrates yet another phenomenon—namely, people’s difficulty in grasping the notion of exponential growth and their tendency to underestimate it. This is known as the *exponential growth bias* (“EGB”). As described below, a considerable body of behavioral studies has examined this phenomenon since the 1970s. For example, one experimental study found that 90% of the participants gave estimates that were less than half of the correct answer; two-thirds gave estimates that were less than one-tenth of the correct answer.<sup>2</sup>

Given its prevalence and significance, it is little wonder that the notion of exponential growth has been discussed in various contexts in the legal literature.<sup>3</sup> But despite its direct relevance to several pressing

1. 3 IBN KHALLIKAN’S BIOGRAPHICAL DICTIONARY 69–71 (William MacGuekin De Slane trans., Oriental Translation Fund of Gr. Brit. & Ir. 1868) (1845). The total amount of grains is 18,446,744,073,709,551,615.

2. William A. Wagenaar & Sabato D. Sagaria, *Misperception of Exponential Growth*, 18 PERCEPTION & PSYCHOPHYSICS 416, 416–17 (1975).

3. See, e.g., James Ming Chen, *Leaps, Metes, and Bounds: Innovation Law and Its Logistics*, 2015 MICH. ST. L. REV. 845 (discussing the relevance of exponential growth to innovation law);

legal issues, the exponential growth *bias* has hardly been mentioned—let alone analyzed systematically—in the legal scholarship.<sup>4</sup> Thus, for example, in his seminal, behaviorally informed studies of consumer credit, Oren Bar-Gill discusses various cognitive biases—including hyperbolic discounting and overoptimism—but not the EGB.<sup>5</sup> In fact, the EGB is not even mentioned in any of the major books, handbooks, or collections of studies on behavioral law and economics (including our own).<sup>6</sup> It is hard to say why behavioral law and economics has had such a blind spot with regard to the EGB. Perhaps it is because the EGB has largely been overlooked by behavioral economists, as well.<sup>7</sup> Be that as it may, this Article aims to fill this large gap in legal scholarship.

The EGB adversely affects decisionmaking by both legal policymakers and the law's addressees. Policymakers, who need to respond to phenomena that grow at an exponential rate, might fail to

---

Robert D. Cooter & Uri Y. Hacohen, *Progress in the Useful Arts: Foundations of Patent Law in Growth Economics*, 22 YALE J.L. & TECH. 191 (2020) (discussing the economic growth triggered by innovation); Brian J. Love, David J. Love & James V. Krogmeier, *Like Deck Chairs on the Titanic: Why Spectrum Reallocation Won't Avert the Coming Data Crunch but Technology Might Keep the Wireless Industry Afloat*, 89 WASH. U. L. REV. 705 (2012) (considering the policy implications of the exponential growth of wireless data traffic).

4. For a brief mention of the EGB in the legal literature, see Patrick M. Corrigan, “Abusive” Acts and Practices: Dodd-Frank’s Behaviorally Informed Authority over Consumer Credit Markets and Its Application to Teaser Rates, 18 N.Y.U. J. LEGIS. & PUB. POLY 125, 166–67 (2015) (discussing teaser rates and the EGB); and Ward Edwards & Detlof von Winterfeldt, *Cognitive Illusions and Their Implications for the Law*, 59 S. CAL. L. REV. 225, 258 (1986) (mentioning the EGB along with other cognitive biases). For a more substantive discussion (about one-page long) of the EGB in the narrow context of consumer credit, see Jonathan Zinman, *Consumer Credit: Too Much or Too Little (or Just Right)?*, 43 J. LEGAL STUD. S209, S224–S225 (2014). A few studies do not use the term EGB but relate to a specific manifestation of it. See, e.g., Ryan Bubb & Richard H. Pildes, *How Behavioral Economics Trims Its Sails and Why*, 127 HARV. L. REV. 1593, 1641–42 (2014) (describing people’s difficulty to understand compound interest).

5. Bar-Gill cites articles that deal with the EGB, but only in the context of the (often limited) efficacy of corrective measures, without addressing the EGB as such. See, e.g., OREN BAR-GILL, SEDUCTION BY CONTRACT 176 & n.125 (2012) [hereinafter BAR-GILL, SEDUCTION BY CONTRACT] (citing Victor Stango & Jonathan Zinman, *Fuzzy Math, Disclosure Regulation, and Market Outcomes: Evidence from Truth-in-Lending Reform*, 24 REV. FIN. STUD. 506 (2011) [hereinafter Stango & Zinman, *Fuzzy Math*]); Oren Bar-Gill, *The Law, Economics and Psychology of Subprime Mortgage Contracts*, 94 CORNELL L. REV. 1073, 1128 n.190 (2009) [hereinafter Bar-Gill, *Subprime Mortgages*] (citing Victor Stango & Jonathan Zinman, *Exponential Growth Bias and Household Finance*, 64 J. FIN. 2807 (2009) [hereinafter Stango & Zinman, *Exponential Growth Bias*]).

6. See, e.g., BEHAVIORAL LAW AND ECONOMICS (Cass R. Sunstein ed., 2000); RICHARD H. THALER & CASS R. SUNSTEIN, NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS (Penguin Books 2009) (2008); THE OXFORD HANDBOOK OF BEHAVIORAL ECONOMICS AND THE LAW (Eyal Zamir & Doron Teichman eds., 2014); NUDGE AND THE LAW: A EUROPEAN PERSPECTIVE (Alberto Alemanno & Anne-Lise Sibony eds., 2015); EUROPEAN PERSPECTIVES ON BEHAVIOURAL LAW AND ECONOMICS (Klaus Mathis ed., 2015); RESEARCH HANDBOOK ON BEHAVIORAL LAW AND ECONOMICS (Joshua C. Teitelbaum & Kathryn Zeiler eds., 2018); EYAL ZAMIR & DORON TEICHMAN, BEHAVIORAL LAW AND ECONOMICS (2018) [hereinafter ZAMIR & TEICHMAN, BLE].

7. See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2808 n.3 (“Exponential growth bias does not appear in any of the many reviews of psychological evidence for economists.”).

appreciate the scope of the threats they face. Consequently, they do not adopt the necessary regulatory response promptly, which tends to magnify the resulting harm. A key example of the adverse effect of the EGB on governmental decisionmaking is the delayed response to the COVID-19 pandemic in many countries. This delay had deadly consequences, since early response is critical where exponential growth is involved.<sup>8</sup> Less dramatic, but not less important, some of the processes that contribute to global warming are nonlinear and involve feedback effects that accelerate temperature change. The failure of the legal system to adequately respond to the threat of climate change might be driven by an underestimation of the threat posed.<sup>9</sup> As for individuals' decisionmaking, the EGB is likely to affect people's financial decisions involving compound interest, which by their very nature require an understanding of exponential processes. Consequently, individuals are likely to borrow too much to finance their present consumption<sup>10</sup> and make suboptimal decisions regarding saving for their post-work years.<sup>11</sup> Such imprudent decisions may significantly diminish individual welfare and could even have macro-level and global ramifications, as in the case of the 2007–2008 subprime mortgage crisis.<sup>12</sup> Finally, people's participation in pyramid schemes, which typically results in the loss of considerable amounts of money, is most likely due to the EGB, as well.<sup>13</sup>

Legal policymakers have long struggled with these issues, and an immense body of legal scholarship has discussed the causes, social ramifications, and required policy responses. Paying heed to the EGB sheds new light on the legal measures that are already in use and highlights novel ways to alleviate these problems. In the sphere of governmental policymaking, given the catastrophic consequences of failing to address exponential threats, some of the assumptions regarding the structure of state decisionmaking should be revisited. Thus, the law should create institutions that shift intuitive and “holistic” judgments by laypersons (including politicians) towards structured decision processes that rely on empirical evidence and use

---

8. *See infra* Section II.B.

9. *See infra* Section II.B.

10. *See infra* Section III.A.

11. *See infra* Section III.B.

12. On the personal and social costs of overconsumption of credit, see ROBERT D. MANNING, *CREDIT CARD NATION: THE CONSEQUENCES OF AMERICA'S ADDICTION TO CREDIT* (2000); and TERESA A. SULLIVAN, ELIZABETH WARREN & JAY LAWRENCE WESTBROOK, *THE FRAGILE MIDDLE CLASS: AMERICANS IN DEBT* (2020). On the subprime mortgage crisis, see RICHARD A. POSNER, *A FAILURE CAPITALISM: THE CRISIS OF '08 AND THE DESCENT INTO DEPRESSION* (2009).

13. *See infra* Section III.C.

mathematical models and computer-based decision-support systems. In the sphere of individual decisionmaking, the focus on the EGB calls for the introduction of new disclosure duties that could assist people to overcome this bias. For example, whereas the current paradigm within disclosure duties applying to financial products focuses on the interest rate, the analysis in this Article suggests that whenever possible it is preferable to provide information on the actual dollar cost of financial products. Interest disclosures require further computation, and apparently many people get these computations terribly wrong even when provided with timely and accurate information, rendering current disclosure mandates futile. Furthermore, given the systematic errors people make when dealing with exponential phenomena, in some settings new mandatory rules—rather than mere disclosures—are necessary to minimize the exploitation of the EGB by savvy profit-maximizing entrepreneurs. For instance, it may be desirable to mandate that the periods for which the compound interest is calculated must not be shorter than the repayment period(s). Under such a rule, contrary to existing practices, no compound interest would be charged as long as the loan is repaid in full and on time.<sup>14</sup>

The Article proceeds as follows. Part I sets the stage by explaining the mathematical notion of exponential growth and the psychological phenomenon of the EGB. Part II then examines how the EGB adversely affects the design of legal policies dealing with exponential phenomena, and explores ways to counteract its harmful effects, with particular focus on pandemics and global warming. Part III analyzes the ramifications of the EGB for individuals' decisionmaking and possible corrective measures, focusing on key issues, such as excessive consumer borrowing, insufficient savings for retirement, and participation in pyramid schemes. The Conclusion highlights potential paths for future research.

## I. APPLIED MATHEMATICS AND COGNITIVE PSYCHOLOGY

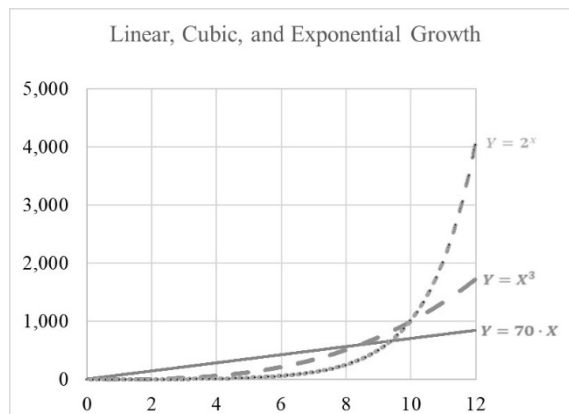
### A. *Exponential Growth*

Quantities may grow over time in various ways. The growth of some quantities is best represented by a linear function, where the change in quantity is proportional to elapsed time. For example, if an author adds 5 pages to a manuscript every day, the number of pages equals the number of days times five ( $f(x) = 5x$ ), and the series of quantities is therefore: 0, 5, 10, 15 . . . . If the manuscript is already 6

---

14. See *infra* notes 177–181, 203 and accompanying text.

pages long at the start, the number of pages would equal  $5x + 6$  (or, more generally,  $f(x) = ax + b$ ), and the series would be 6, 11, 16, 21 . . . . In other cases, the growth might accelerate over time and is best represented by a polynomial function in which the highest power is greater than 1. For example, a quantity may be proportional to the square of the function argument ( $f(x) = x^2$  or, more generally,  $f(x) = ax^2 + bx + c$ ). In this example of a quadratic function, if  $a = 1$ , and both  $b$  and  $c$  equal 0, the series would be 1, 4, 9, 16, 25 . . . . Sometimes, however, the *rate of change* is proportional to the *quantity* itself. For example, if a microorganism splits into two daughter microorganisms every three seconds, then the growth of a culture of these organisms, starting with a single organism, is best represented by the exponential function ( $f(x) = 2^x$  or, more generally,  $f(x) = a^x$ ). Thus, the growth of a culture of bacteria may be represented by the series 1, 2, 4, 8, 16, 32 . . . . Needless to say, there are innumerable linear, quadratic, cubic, exponential, and other growth functions.<sup>15</sup> Most significantly, as the figure below illustrates, exponential growth tends to surpass both polynomial and linear growth. The figure also illustrates that at the beginning of the process, exponential growth tends to appear deceptively slower than other types of growth.



Exponential growth functions approximate a large range of physical, chemical, biological, medical, economic, and social

---

15. For a general introduction to nonlinear functions and their varied applications, see STEVEN H. STROGATZ, *NONLINEAR DYNAMICS AND CHAOS: WITH APPLICATIONS TO PHYSICS, BIOLOGY, CHEMISTRY, AND ENGINEERING* (2d ed. 2015).



phenomena. These include nuclear chain reactions;<sup>16</sup> the growth of bacterial cultures;<sup>17</sup> the development of a fertilized egg into a baby during pregnancy;<sup>18</sup> the spread of contagious diseases;<sup>19</sup> the spread of technological innovations and of economic growth induced by innovation;<sup>20</sup> the effect of compound interest on loans and savings;<sup>21</sup> and the spread of videos on the internet.<sup>22</sup>

To be sure, the question of whether a given growth dynamic is actually exponential—as opposed to, say, polynomial—is often debated.<sup>23</sup> Moreover, unlike the world of mathematical functions and abstract models, in the real world, processes of growth and decline are typically affected by multiple factors, and therefore often cannot be described by a simple mathematical function. Rather, they may change over time.<sup>24</sup> For example, in closed systems, exponential growth stops at a certain point or corresponds to an S-shape (sigmoidal) function.<sup>25</sup> A single process may also go through different phases, such as

16. Carey Sublette, *Introduction to Nuclear Weapon Physics and Design*, NUCLEAR WEAPON ARCHIVE: NUCLEAR WEAPONS FREQUENTLY ASKED QUESTIONS, <http://nuclearweaponarchive.org/Nwfaq/Nfaq2.html> (last updated Feb. 20, 2019) [<https://perma.cc/GYG4-KSF6>].

17. Jacques Monod, *The Growth of Bacterial Cultures*, 3 ANN. REV. MICROBIOLOGY 371 (1949) (reviewing the early research on the subject).

18. Krzysztof Dudek, Wojciech Kędzia, Emilia Kędzia, Alicja Kędzia & Wojciech Derkowski, *Mathematical Modelling of the Growth of Human Fetus Anatomical Structures*, 92 ANATOMICAL SCI. INT'L 521 (2017) (examining various growth functions for modeling fetal development).

19. Gerardo Chowell, Lisa Sattenspiel, Shweta Bansal & Cécile Viboud, *Mathematical Models to Characterize Early Epidemic Growth: A Review*, PHYSICS LIFE REV., Sept. 2016, at 66 (reviewing mathematical models that capture the early stages of the transmission of pathogens).

20. See Chen, *supra* note 3, at 855–60 (discussing the diffusion of technological innovations); Cooter & Hacoen, *supra* note 3 (arguing that innovations trigger exponential economic growth and discussing the implications for patent law).

21. W.D. WALLIS, MATHEMATICS IN THE REAL WORLD 208–11 (2013) (explaining how compound interest is calculated); see also *infra* Sections III.A, III.B. (discussing loans and savings, respectively).

22. For an analysis of the causes and likelihood of videos “going viral,” see Rosanna E. Guadagno, Daniel M. Rempala, Shannon Murphy & Bradley M. Okdie, *What Makes a Video Go Viral? An Analysis of Emotional Contagion and Internet Memes*, 29 COMPUTS. HUM. BEHAV. 2312 (2013).

23. See, e.g., MARC GALANTER & THOMAS PALAY, TOURNAMENT OF LAWYERS: THE TRANSFORMATION OF THE BIG LAW FIRM 3 (1991) (arguing that big law firms grow exponentially); Vincent Robert Johnson, *On Shared Human Capital, Promotion Tournaments, and Exponential Law Firm Growth*, 70 TEX. L. REV. 537, 547–62 (1991) (criticizing the claim that law firms grow exponentially); John M. Golden, *Innovation Dynamics, Patents, and Dynamic-Elasticity Tests for the Promotion of Progress*, 24 HARV. J.L. & TECH. 47 (2010) (arguing, contrary to previous arguments, that technological progress usually follows a pattern of power-law, rather than exponential, growth).

24. See HORST R. THIEME, MATHEMATICS IN POPULATION BIOLOGY (2003) (describing various mathematical models used in population biology).

25. See, e.g., Michal Shur-Ofry, *Popularity as a Factor in Copyright Law*, 59 U. TORONTO L.J. 525, 531 (2009) (describing the diffusion of successful copyright-protected works).

exponential growth, retardation, stationary, and decline.<sup>26</sup> Thus, the exponential spread of a virus within the community might end once a significant part of the population has been infected by the virus or vaccinated, and the number of potential hosts has declined.<sup>27</sup>

Nevertheless, the basic notion of exponential growth is key to understanding a whole host of situations. When policymakers and the addressees of the law cope with such situations, systematic misperceptions of exponential growth are likely to have adverse, or even ruinous, effects. Alas, as the next Section explains, such systematic misperceptions are all too common.

### *B. Exponential Growth Bias*

Studies of people's misperception of exponential growth—the so-called EGB—date back to the 1970s. In a seminal study, William Wagenaar and Sabato Sagaria presented participants with indices of air pollution for five consecutive years (i.e., 1970–1974)—either numerically (i.e., 3, 7, 20, 55, and 148) or graphically.<sup>28</sup> Some of the participants were asked to intuitively predict the level of pollution in five years (1979), and others were asked to estimate when the pollution would reach a certain level of pollution units (25,000) if nothing was done to stop it. In this example, the correct answer to the first question was 25,000, and the correct answer to the second was 1979. It was found that people not only make large mistakes when estimating exponential growth but do so in a systematic and predictable way. More specifically, the study found that people tend to greatly underestimate exponential growth. In some of the conditions, 90% of the participants gave estimates that were less than half of the correct answer, and two-thirds of the participants gave estimates that were less than 10% of the correct answer.<sup>29</sup> Moreover, the accuracy of the estimates did not improve when the participants were asked to produce estimates for each of the following five years (rather than for the fifth year only), or when the growth was presented graphically with a curve.<sup>30</sup>

---

26. See, e.g., Monod, *supra* note 17, at 373–74 (discussing the growth of bacterial cultures); see also *infra* Section III.C.

27. See C.J.E. Metcalf, M. Ferrari, A.L. Graham & B.T. Grenfell, *Understanding Herd Immunity*, 36 TRENDS IMMUNOLOGY 753 (2015).

28. Wagenaar & Sagaria, *supra* note 2, at 416, 420.

29. *Id.* at 416–17.

30. *Id.* at 420–21. Notably, the recent attention drawn to this seminal article has uncovered significant flaws in the design of the experiment used by the authors. As was shown, the numeric series used in the experiment did not actually reflect an exponential function. Furthermore, the context of the experiment—air pollution—does not necessarily reflect an exponential process, thus

In addition to studies that document the EGB when presenting participants with a numerical series or a curve, the EGB was similarly evident when a computer screen simulated exponential growth. In one study, a 10x10 cm square (representing the surface of a pond) was gradually covered by small squares at an exponential rate (representing the expansion of duckweed), and the participants were asked to predict how much time it would take the duckweed to cover the entire pond.<sup>31</sup> This experiment demonstrated another consequence of the EGB, which we return to below: when exponential growth occurs in a closed environment, underestimation of the growth rate results in overestimation of the time it would take the growth to come to a halt.<sup>32</sup>

Subsequent studies, involving various experimental designs, types of participants, and vignettes, have corroborated these findings.<sup>33</sup> The bottom line of these studies is nicely encapsulated by the observation that “exponential progression does not appear to be part of the repertory of basic intuitions of the majority of individuals.”<sup>34</sup> As further discussed below, several studies have also found correlations

---

allowing participants to make different assumptions about future trends in the data. See Hanjo Hamann, *On Getting It Right by Being Wrong: A Case Study of How Flawed Research May Become Self-Fulfilling at Last*, 119 PROC. NAT'L ACAD. SCI., Apr. 12, 2022, at 2. Importantly for present purposes, this pointed criticism of Wagenaar and Sagaria's original study does not undermine the vast body of research that has built on it in the EGB context.

31. Willem A. Wagenaar & Han Timmers, *The Pond-and-Duckweed Problem: Three Experiments on the Misperception of Exponential Growth*, 43 ACTA PSYCHOLOGICA 239 (1979).

32. See *infra* Section III.C.

33. See, e.g., Uri Benzion, Alon Granot & Joseph Yagil, *The Valuation of the Exponential Function and Implications for Derived Interest Rates*, 38 ECON. LETTERS 299 (1992) (studying students' estimations of the future value of investments that yield compound interest and finding that the EGB increases with the duration of the period and the level of the interest rate); Fabian Christandl & Detlef Fetchenhauer, *How Laypeople and Experts Misperceive the Effect of Economic Growth*, 30 J. ECON. PSYCH. 381 (2009) (investigating estimations of economic growth by students with and without relevant training and finding that both groups display the EGB); Craig R.M. McKenzie & Michael J. Liersch, *Misunderstanding Savings Growth: Implications for Retirement Savings Behavior*, 48 J. MKTG. RSCH. (SPECIAL ISSUE) S1 (2011) (establishing the existence of the EGB in the context of savings and discussing its policy implications); Annamaria Lusardi & Peter Tufano, *Debt Literacy, Financial Experiences, and Overindebtedness*, 14 J. PENSION ECON. & FIN. 332 (2015) (finding that people with a lower understanding of the meaning of exponential growth in the context of debt tend to resort to high-cost borrowing).

34. Maria Teresa Munoz Sastre & Etienne Mullet, *Evolution of the Intuitive Mastery of the Relationship Between Base, Exponent, and Number Magnitude in High-School Students*, 4 MATHEMATICAL COGNITION 67, 69 (1998). The unintuitiveness of exponential growth is also manifested by the common mistake people make when asked how many days it would take for a patch of lily pads to cover half of a lake, if every day the patch doubles its size and it takes 48 days to cover the entire lake (the correct answer is 47; the intuitive one is 24). This question is part of the Cognitive Reflection Test (“CRT”), which is often used to test people's disposition to use an analytic mode of thinking. See Shane Frederick, *Cognitive Reflection and Decision Making*, J. ECON. PERSPS., Fall 2005, at 25 (developing the three-item CRT).

between people's susceptibility to the EGB and their actual behavior—for example, in the contexts of retirement savings and borrowing.<sup>35</sup>

Scholars have developed several mathematical models of the EGB—some of which aim to reflect the thought process that induces people to underestimate exponential growth, and others that offer a mathematical representation of people's estimations, without necessarily trying to reflect their actual reasoning. Thus, Wagenaar and Sagaria hypothesized that people understand the meaning of exponential growth yet still underestimate the exponent (and insufficiently compensate for this underestimation by multiplying the result by a constant).<sup>36</sup> Gregory Jones suggested that people's estimates can best be described by a simple polynomial function, such as a quadratic function (e.g.,  $f(x) = ax^2 + bx + c$ ), which (as previously noted), also results in considerable underestimation.<sup>37</sup> Finally, Matthew Levy and Joshua Tasoff developed a third model of the EGB, which allows for differences between individuals.<sup>38</sup> They modeled an agent's perception such that an asset is divided into two accounts: a fraction that grows with a given compounding interest rate and a complementary fraction that grows with simple interest. Thus, if the first fraction consists of the entire asset, the agent displays no bias; if this fraction equals 0, then the agent misperceives the growth as linear rather than exponential. Agents may lie anywhere between these two extremes.<sup>39</sup>

35. See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5 (finding that more biased households borrow more and save less); Matthew Levy & Joshua Tasoff, *Exponential-Growth Bias and Lifecycle Consumption*, 14 J. EUR. ECON. ASS'N 545, 566–67 (2016) (finding that people who display greater EGB accumulate fewer assets); Gopi Shah Goda, Matthew Levy, Colleen Flaherty Manchester, Aaron Sojourner & Joshua Tasoff, *Predicting Retirement Savings Using Survey Measures of Exponential-Growth Bias and Present Bias*, 57 ECON. INQUIRY 1636 (2019) (establishing a correlation between the EGB and savings when controlling for cognitive ability, financial literacy, and various demographic characteristics).

36. Wagenaar & Sagaria, *supra* note 2, at 417, 419–20; see also Gregory V. Jones, *A Generalized Polynomial Model for Perception of Exponential Series*, 25 PERCEPTION & PSYCHOPHYSICS 232 (1979) (criticizing Wagenaar & Sagaria's theoretical model); Gideon Keren, *Cultural Differences in the Misperception of Exponential Growth*, 34 PERCEPTION & PSYCHOPHYSICS 289 (1983) [hereinafter Keren, *Cultural Differences*] (adopting Wagenaar & Sagaria's model); Gregory V. Jones, *Perception of Inflation: Polynomial Not Exponential*, 36 PERCEPTION & PSYCHOPHYSICS 485 (1984) [hereinafter Jones, *Perception of Inflation*] (criticizing Keren's theoretical analysis); Gideon Keren, *Do Not Inflate Exponentially the Evidence for the Polynomial Model: A Reply to Jones*, 36 PERCEPTION & PSYCHOPHYSICS 488 (1984) (replying to Jones' criticism).

37. Jones, *Perception of Inflation*, *supra* note 36.

38. Levy & Tasoff, *supra* note 35, at 549–59.

39. The insight that some people misperceive exponential growth as linear is compatible with the findings of studies that have identified a so-called *illusion of linearity*—namely, a general tendency to assume that functions and graphs are linear. See, e.g., DIRK DE BOCK, WIM VAN DOOREN, DIRK JANSSENS & LIEVEN VERSCHAFFEL, *THE ILLUSION OF LINEARITY: FROM ANALYSIS TO IMPROVEMENT 2* (2007).

Ultimately, the questions of how people think about exponential growth, and how biased they are in their estimations, are empirical rather than theoretical—and there is indeed no reason to assume that all people use the same thought process. In fact, when Fabian Christandl and Detlef Fetchenhauer asked participants to describe their thoughts while making the estimation, they found that people use various processes.<sup>40</sup> About one-third of the participants ignored the exponential element altogether and simply multiplied the growth rate per period by the number of periods (as if it were a linear growth).<sup>41</sup> Other participants calculated this product and added some (often insufficient) value on account of the exponential growth. Still others made quite arbitrary guesses or incorrect calculations.<sup>42</sup>

Various factors affect the accuracy of people's predictions of exponential growth. One such factor is the saliency of the change. Thus, one study demonstrated that when, in addition to the series of values, people are presented with the successive differences between those values, they assess growth more accurately.<sup>43</sup> Making the change more salient does not even require one to explicitly state the differences between the values. Simply reducing the number of data points (for example, by substituting the series of 3, 5, 10, 20, 39, 76, 148, with the series 3, 20, 148) obtained a similar effect because it made the change look more dramatic (even when keeping constant the time that elapsed between the first and last data points—in this example, 3 and 148).<sup>44</sup>

Another factor is the context in which an estimation is made. Some people make better estimates in certain contexts than in others, even if the underlying growth function is the same. For example, it has been found that people make more precise estimations with regard to financial investments than in the context of economic growth.<sup>45</sup> Relatedly, research suggests that in the context of inflation, Israelis made better estimates of exponential growth than Canadians—possibly

---

40. Christandl & Fetchenhauer, *supra* note 33, at 388–91.

41. *Id.* at 389. A similar result was obtained in a survey of the U.S. population. See Levy & Tasoff, *supra* note 35, at 547–48, 564.

42. The last observation is in line with the finding that some people provide estimates of exponential growth that are even lower than that of a linear growth, or higher than that of the correct exponential growth. See, e.g., Levy & Tasoff, *supra* note 35, at 550, 564–65 (reporting that 15% of the survey participants belonged to this group).

43. Paul B. Andreassen & Stephen J. Kraus, *Judgmental Extrapolation and the Saliency of Change*, 9 J. FORECASTING 347, 353–57 (1990).

44. W. A. Wagenaar & H. Timmers, *Extrapolation of Exponential Time Series Is Not Enhanced by Having More Data Points*, 24 PERCEPTION & PSYCHOPHYSICS 182 (1978).

45. Christandl & Fetchenhauer, *supra* note 33, at 383–85.

owing to the former's experience with hyperinflation, which provided them with continuous feedback.<sup>46</sup>

There is mixed evidence as to whether or not the EGB is associated with various demographic and personal characteristics. Thus, while a large-scale survey found strong (and expected) correlations between people's EGB and their retirement savings, it found no significant correlation between people's EGB and their income.<sup>47</sup> Another study found no association between people's EGB and their age, race, or education.<sup>48</sup> In some studies (but not others), female participants exhibited a more pronounced EGB than their male counterparts.<sup>49</sup> It has also been found that a higher *need for cognition*—i.e., the tendency to engage in effortful cognitive endeavors, as measured by people's self-characterization—is negatively correlated with the EGB.<sup>50</sup> Finally, one study found an inverse relationship between exhibited EGB and people's IQ and higher education.<sup>51</sup>

The extent to which people display the EGB is influenced by other biases, such as *motivated reasoning* and the *confirmation bias*.<sup>52</sup> Such influences may explain, for example, the finding that in the United States, conservatives were more likely than liberals to underestimate the spreading of the coronavirus during the COVID-19 pandemic.<sup>53</sup> Importantly, notwithstanding the fact that the EGB may exacerbate the effect of other cognitive limitations and biases (such as myopia, bounded willpower, and procrastination),<sup>54</sup> the EGB must not

---

46. Keren, *Cultural Differences*, *supra* note 36.

47. Goda et al., *supra* note 35, at 1653.

48. Levy & Tasoff, *supra* note 35, at 549, 566.

49. *See, e.g.*, Christandl & Fetchenhauer, *supra* note 33, at 385–88 (finding such difference); Levy & Tasoff, *supra* note 35, at 566, 578 (finding no such difference); Goda et al., *supra* note 35, at 1646 & online app. tbl.B.3 (stating that women exhibited greater EGB, but according to the table, this result was not even marginally statistically significant).

50. Christandl & Fetchenhauer, *supra* note 33, at 385–88. On the *Need for Cognition* scale, see John T. Cacioppo & Richard E. Petty, *The Need for Cognition*, 42 J. PERSONALITY & SOC. PSYCH. 116 (1982).

51. Goda et al., *supra* note 35, online app. tbl.B.3. No statistically significant association was found in this study between the EGB and ethnicity. *Id.*

52. *Motivated reasoning* is the tendency to acquire and process information, and use other strategies that yield a desired conclusion. A key manifestation of motivated reasoning is the *confirmation bias*—namely, the inclination to seek and process information in a manner that supports one's interests, beliefs, and expectations. *See* ZAMIR & TEICHMAN, BLE, *supra* note 6, at 58–61 (summarizing the literature).

53. Joris Lammers, Jan Crusius & Anne Gast, *Correcting Misperceptions of Exponential Coronavirus Growth Increases Support for Social Distancing*, 117 PROC. NAT'L ACAD. SCI. 16264 (2020).

54. *Myopia* (a.k.a. the *present bias*, or *hyperbolic discount rate*) is the tendency to overly discount future costs and benefits compared with immediate ones. This tendency is related to impulsiveness and lack of self-control. *Procrastination* involves voluntarily putting off performing

be confused with other phenomena, as they may have independent, or even contrasting, effects. Thus, for example, a large-scale survey that tested the effect of the EGB and the *present bias* (myopia) on people's retirement savings and other aspects of financial behavior found that while both biases affect some of those aspects, only one of them is correlated with others.<sup>55</sup> As further discussed below, distinguishing between the EGB and other phenomena is important because they may each warrant different interventions.<sup>56</sup>

Given the potentially large adverse effects of the EGB on individual welfare and on the welfare of society at large, several studies have examined ways in which it might be counteracted, or at least mitigated. As previously noted, presenting the data graphically, rather than as a series of numbers, has not proven useful.<sup>57</sup> Monetary incentives to make correct estimations have also failed to mitigate the EGB.<sup>58</sup> In another study, increasing the incentive for accuracy—from considerable (up to \$15) to very considerable (up to \$75) sums of money—produced no effect.<sup>59</sup>

In a bid to enhance the external validity of their experiments, researchers in some studies allowed participants to use any decision aid—including pencil and paper, calculators, and spreadsheets.<sup>60</sup> Even these aids, however, did not eliminate the EGB. In another study, a direct comparison between participants who were told to calculate their answers with a calculator or with pencil and paper, and others who were forbidden to do so, revealed no difference between the two groups.<sup>61</sup> However, another study suggests that using a computer-based decision-support system may somewhat mitigate the EGB.<sup>62</sup>

---

tasks or making decisions—even while realizing that such delay will be detrimental. For a short survey of the literature, see ZAMIR & TEICHMAN, BLE, *supra* note 6, at 87–93.

55. See Goda et al., *supra* note 35, at 1646–51. One study found that the magnitude of the EGB is negatively correlated with standard measures of financial literacy. Johan Almenberg & Christer Gerdes, *Exponential Growth Bias and Financial Literacy*, 19 APPLIED ECON. LETTERS 1693 (2012). However, neither Levy & Tasoff, *supra* note 35, at 565 nor Goda et al., *supra* note 35, online app. tbl.B.3, replicated this result.

56. See Goda et al., *supra* note 35, at 1637 (explaining that while precommitment measures may mitigate procrastination on retirement savings, it may actually exacerbate the harmful effects of the EGB); *infra* Section III.B.2 and text accompanying notes 166–181.

57. Wagenaar & Sagaria, *supra* note 2, at 420–21; Levy & Tasoff, *supra* note 35, at 560–61, 569.

58. Christandl & Fetchenhauer, *supra* note 33, at 385–88 (finding that offering prizes for the most accurate estimations significantly increased the time participants spent on making the estimations but had no effect on their accuracy).

59. Goda et al., *supra* note 35, at 1641.

60. *Id.*

61. McKenzie & Liersch, *supra* note 33, at S3–S4.

62. David Arnott & Peter O'Donnell, *A Note on an Experimental Study of DSS and Forecasting Exponential Growth*, 45 DECISION SUPPORT SYS. 180 (2008).

Another potential debiasing technique is to provide people with feedback on their estimations. Wagenaar and Sagaria found that giving people feedback and guiding them about the EGB increases their accuracy in an estimation task they performed immediately thereafter.<sup>63</sup> In another study, participants were asked to make 100 consecutive predictions of the values of a single series, each referring to the next item in the series, and provided with the correct answer immediately after each of their predictions. As expected, the predictions were very accurate.<sup>64</sup> In real-life contexts, however, more often than not people make predictions for the longer term, and very rarely do they receive immediate feedback on dozens of their short-term predictions. Indeed, when subjects were asked to make predictions for two consecutive periods rather than one—and received feedback only after making the two predictions—their mean errors were still very small, but larger by an order of magnitude.<sup>65</sup>

Finally, there is mixed evidence regarding the efficacy of education in general and financial education in particular. Thus, advanced students of economics and business administration, who have studied relevant courses, still exhibited the EGB, albeit to a lesser degree than other students.<sup>66</sup> Some studies have found that educating people about exponential growth and the expected outcomes of varying levels of savings for retirement results in a large increase in savings.<sup>67</sup> However, the overall picture from a meta-analysis of 201 effect sizes of financial education is rather bleak. While such education may influence immediate decisions, it has almost no effect in the long run.<sup>68</sup>

The above survey of the behavioral research on the EGB is far from exhaustive. It should nevertheless suffice in laying the groundwork for examining the legal implications of this prevalent bias. Before proceeding to this examination—first in the context of

---

63. Wagenaar & Sagaria, *supra* note 2, at 421–22.

64. Andrew J. Mackinnon & Alexander J. Wearing, *Feedback and the Forecasting of Exponential Change*, 76 ACTA PSYCHOLOGICA 177, 180–85 (1971).

65. *Id.* at 185–88.

66. See Christandl & Fetchenhauer, *supra* note 33, at 385–88. On cognitive biases and expertise, see generally ZAMIR & TEICHMAN, BLE, *supra* note 6, at 114–17.

67. See, e.g., Changcheng Song, *Financial Illiteracy and Pension Contributions: A Field Experiment on Compound Interest in China*, 33 REV. FIN. STUD. 916 (2020) (reporting the encouraging results of a field experiment conducted in rural China); see also Bryan Foltice, *How to Decrease the Amortization Bias: Experience vs. Rules*, 43 J. FIN. EDUC. 273 (2017) (experimentally examining the effect of various learning methods on the EGB exhibited by business students, immediately after the tutorial and three weeks afterwards); *infra* notes 257–263 and accompanying text.

68. Jack B. Soll, Ralph L. Keeney & Richard P. Larrick, *Consumer Misunderstanding of Credit Card Use, Payments, and Debt: Causes and Solutions*, 32 J. PUB. POL'Y & MKTG. 66 (2013).



policymaking and then in the sphere of individuals' decisionmaking—one should note that the abovementioned studies focused on people's misperceptions of exponential growth, while paying little attention to other nonlinear processes. We surmise that a similar misperception may characterize other nonlinear processes (such as the one presented by the function  $f(x) = x^d$ , which produces the series 1, 16, 81, 256, 625 . . .). Insofar as this is true, the following discussion may be relevant to other contexts as well. But given the scarcity of behavioral studies of such misperceptions, we shall focus on phenomena involving exponential growth.

## II. COUNTERACTING POLICYMAKERS' BIAS

Having presented the concept of exponential growth and the psychological phenomenon of exponential growth bias in Part I, we turn to examine the legal ramifications of the EGB. The EGB may be harmful to both public officials who design legal policies and to individuals who manage their own affairs. However, there is an important difference between the two spheres in terms of the measures that can be taken to counteract the EGB. To mitigate individuals' biases, the law can use measures designed to ensure rational and informed choices, limit the options available to them, or design a choice architecture that would nudge individuals in the right direction. In contrast, when it comes to policymakers, the latter possibilities (mandates and nudges) are usually deemed inappropriate.

This Part focuses on policymaking. It first highlights how the EGB might affect policy decisions, then reviews some real-world examples in which the EGB appears to have influenced legal policies, and finally draws some tentative normative conclusions. The primary examples to be analyzed are pandemics and climate change.

### *A. Behavioral Public Choice Theory and the Exponential Growth Bias*

Behavioral studies focus mostly on the decisions made by individuals. While some behavioral research has examined decisions made in small groups,<sup>69</sup> the methods used by behavioral research are generally unsuitable for studying decisionmaking in large institutional settings, such as the administrative state.<sup>70</sup> Research on the EGB is no

---

69. See, e.g., ZAMIR & TEICHMAN, BLE, *supra* note 6, at 120–24 (reviewing the behavioral literature on group decisionmaking).

70. Samuel Issacharoff, *Behavioral Decision Theory in the Court of Public Law*, 87 CORNELL L. REV. 671, 671–73 (2002); William N. Eskridge, Jr. & John Ferejohn, *Structuring Lawmaking to Reduce Cognitive Bias: A Critical View*, 87 CORNELL L. REV. 616, 620–21 (2002).

exception: all of the behavioral studies reviewed in this Article examined individual decisionmaking.<sup>71</sup>

Nonetheless, recent studies in the field of behavioral public choice theory have applied insights from behavioral economics to the decisions made by states.<sup>72</sup> This body of work has highlighted two channels in which heuristics and biases may affect policy decisions.<sup>73</sup> First, political decisionmakers, like everyone else, may be susceptible to cognitive biases and heuristics. Second, even if policymakers are perfectly rational, or even if the bureaucratic apparatus of the state generates unbiased choices, political motivations may drive policymakers towards decisions that appeal to their boundedly rational constituency.<sup>74</sup> While the behavioral literature has not even begun to untangle these two mechanisms, they both suggest a similar outcome: policies that are swayed by a host of psychological phenomena.

Incorporating the EGB into this line of reasoning suggests that the law may be systematically late in reacting to processes involving exponential growth. People—be they the policymakers themselves or the population that the politicians are accountable to—do not appreciate the gravity of risks that grow exponentially. This lack of appreciation may be greatest with respect to new or rare risks, which are difficult to grasp without relevant experience. It may be further exacerbated by the fact that, unlike deliberately designed growth patterns (such as the charging of compound interest in loans), natural and social processes entail far greater uncertainty. Consequently, the legal response to such new risks may be deferred until the scope of harm is overwhelming. It is for this reason that Albert Allen Bartlett famously noted that “[t]he greatest shortcoming of the human race is our inability to understand the exponential function.”<sup>75</sup>

---

71. See *supra* Section I.B. Note, however, that the subjects in one of the studies reviewed were members of the Pennsylvania Joint Conservation Committee. See Wagenaar & Sagaria, *supra* note 2, at 422.

72. For an overview of the empirical work in the field, see Jan Schnellenbach & Christian Schubert, *Behavioral Political Economy: A Survey*, 40 EUR. J. POL. ECON. 395 (2015). For notable examples of legal scholarship within this body of work, see Timur Kuran & Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683 (1999); and W. Kip Viscusi & Ted Gayer, *Behavioral Public Choice: The Behavioral Paradox of Government Policy*, 38 HARV. J.L. & PUB. POLY 973, 988–96 (2015).

73. See Doron Teichman & Eyal Zamir, *Nudge Goes International*, 30 EUR. J. INT’L L. 1263, 1266–67 (2019); see also Gary M. Lucas, Jr. & Slavisa Tasic, *Behavioral Public Choice and the Law*, 118 W. VA. L. REV. 199, 204–17 (2015).

74. See Lucas & Tasic, *supra* note 73, at 213–17 (reviewing findings on politicians’ irrationality).

75. Albert A. Bartlett, *Arithmetic, Population, and Energy*, YOUTUBE, at 0:41 (Jan. 26, 2012), [https://www.youtube.com/watch?v=sI1C9DyIi\\_8](https://www.youtube.com/watch?v=sI1C9DyIi_8) [<https://perma.cc/5QWR-JDUR>] (giving a lecture presentation).

In light of the methodological challenges described, it is impossible to make strong causal claims about the influence of the EGB on legal policies. There are, however, various examples that are consistent with the late-response hypothesis. While the EGB is clearly not the single driving force in any of the cases reviewed below, examining them in light of the EGB can enhance our understanding of the complex political decisionmaking process that results in legal change.

### *B. Exponential Growth Bias and Legal Policymaking: Applications*

A salient example of the impact of the EGB on governmental policymaking is the legal response to the COVID-19 pandemic. In December 2019, a novel coronavirus (SARS-CoV-2) that causes an acute respiratory syndrome (COVID-19) appeared in the Chinese city of Wuhan.<sup>76</sup> Given its highly contagious nature, it spread at an exponential rate.<sup>77</sup> At the time of the writing of this Article, the death toll of the pandemic in the United States approaches one million lives, and the global death toll surpassed six million.<sup>78</sup>

Generally speaking, countries were late to respond to the spread of the coronavirus in early 2020.<sup>79</sup> While many factors probably drove this late response,<sup>80</sup> in all likelihood, the delay was in part due to people's underestimation of the risk posed by a deadly virus spreading at an exponential rate.<sup>81</sup> As a result of this underestimation, politicians were reluctant to adopt the necessary legal measures needed to slow the spread of the virus, despite clear recommendations from public health experts to act swiftly. At the federal level, President Trump

---

76. See Peng Zhou et al., *A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin*, 579 NATURE 270, 270 (2020).

77. Shi Zhao et al., *Preliminary Estimation of the Basic Reproduction Number of Novel Coronavirus (2019-nCoV) in China, from 2019 to 2020: A Data-Driven Analysis in the Early Phase of the Outbreak*, 92 INT'L J. INFECTIOUS DISEASES 214 (2020) (modeling the spread of coronavirus in China).

78. See WHO *Coronavirus (COVID-19) Dashboard*, WORLD HEALTH ORG., <https://covid19.who.int/> (last visited June 12, 2022) [<https://perma.cc/AR8Q-C9W4>] (place the cursor over the image of the United States).

79. See, e.g., Shiming Zheng, Hongxia Li & Hao Sun, *Crisis Lifecycle, Policy Response, and Policy Effectiveness*, PUB. MGMT. REV., Sept. 6, 2021, at 1, 19–20 (highlighting the late response to the pandemic in the United States and Italy).

80. See Doron Teichman & Kristen Underhill, *Infected by Bias: Behavioral Science and the Legal Response to COVID-19*, 47 AM. J.L. & MED. 205, 212–14 (2021) (reviewing the different behavioral phenomena that delayed the response to the pandemic).

81. Howard Kunreuther & Paul Slovic, *Learning from the COVID-19 Pandemic to Address Climate Change*, 1 MGMT. & BUS. REV. 92, 93 (2021) (“One of the reasons that the general public and key decision makers largely ignored the coronavirus in January and February is that they failed to appreciate the looming menace of its exponential growth.”).

repeatedly focused on the low numbers of confirmed cases in the initial stages of the pandemic, while downplaying the risks it posed.<sup>82</sup> Consequently, “[i]n spite of various warnings coming from the health policy community of experts, intelligence agencies, economic council, and the CDC, President Trump was . . . very slow to institute any actions or policy responses.”<sup>83</sup> Even administrations that ultimately took a more aggressive stance toward the virus tended to act slowly in the face of clear expert advice early on. In New York City, for instance, the mayor postponed the closure of public schools until the city’s head of disease control threatened to step down if this was not done.<sup>84</sup> This slow response continued as the pandemic progressed and new variants of the virus emerged. In the United States, for example, guidelines requiring people to wear masks indoors were reinstated only months after the Delta variant emerged and well after the ensuing fourth wave began.<sup>85</sup>

Indeed, several empirical studies have documented the effect of the EGB on how people perceive the pandemic’s risks.<sup>86</sup> A study conducted in the United States in the second half of March 2020 showed that “participants’ averaged estimates of the virus’s growth could, for practical purposes, be described as linear.”<sup>87</sup> As a result, they underestimated the actual growth rate of the virus by 45.7%.<sup>88</sup> The study also documented a link between the EGB and people’s attitudes toward public health policies. When participants’ EGB was mitigated (by instructing them to calculate the growth rate of the virus in five intermediate steps of 3 days, rather than in one step of 15 days),<sup>89</sup> their

---

82. Paul E. Rutledge, *Trump, COVID-19, and the War on Expertise*, 50 AM. REV. PUB. ADMIN. 505, 506 (2020) (citing numerous statements by President Trump).

83. *Id.* at 507.

84. See J. David Goodman, *How Delays and Unheeded Warnings Hindered New York’s Virus Fight*, N.Y. TIMES, <https://www.nytimes.com/2020/04/08/nyregion/new-york-coronavirus-response-delays.html> (last updated July 18, 2020) [<https://perma.cc/6RN3-VSMB>].

85. See Gabriele Steinhauser & Brianna Abbott, *Omicron Variant Sends Policy Makers Scrambling as Science Lags Behind*, WALL ST. J., <https://www.wsj.com/articles/omicron-variant-covid-science-policy-11638301683> (last updated Nov. 30, 2021, 5:04 PM) [<https://perma.cc/X6SZ-9Q4Y>] (noting that the Delta variant “drove a devastating wave in India months before . . . officials in the U.S. revisited guidelines on masking and other measures to contain its spread”).

86. See Lammers et al., *supra* note 53; Ritwik Banerjee, Joydeep Bhattacharya & Priyama Majumdar, *Exponential-Growth Prediction Bias and Compliance with Safety Measures Related to COVID-19*, 268 SOC. SCI. & MED., Oct. 2021, at 1; Sebastian Jäckle & Felix Ettensperger, *Boosting the Understanding and Approval of Anti-Corona Measures—Reducing Exponential Growth Bias and Its Effects Through Educational Nudges*, 27 SWISS POL. SCI. REV. 809 (2021).

87. Lammers et al., *supra* note 53, at 16265.

88. *Id.*

89. *Id.*

support for social distancing measures and a lockdown grew significantly.<sup>90</sup>

The delay in reaction to the pandemic—plausibly due to the EGB—proved, quite literally, to be lethal. Decisions made in the initial stages of the pandemic had a tremendous impact on the overall death toll. One study estimated that if social distancing measures had been implemented in the United States just one week earlier than they were in March of 2020, 52.6% of reported infections and 49.4% of reported deaths as of May 3, 2020, could have been avoided.<sup>91</sup> Similarly, a simulation study of New York City estimated that implementing social distancing measures one week earlier could have reduced the number of cases from 203,261 to 41,366 by May 31, while delaying the measures by a week could have increased the number of confirmed cases to 1,407,600.<sup>92</sup>

Another context in which policymaking may be affected by the EGB is climate change. Climate change is described by some as “the single greatest threat that societies face.”<sup>93</sup> The process is projected to have dire consequences on multiple fronts—including human health, the environment, economic growth, and food security<sup>94</sup>—and has become the focal point of international relations. Recently, 120 world leaders met at the UN Climate Change Conference in Glasgow and signed the Glasgow Climate Pact.<sup>95</sup>

A voluminous body of legal scholarship has been dedicated to climate change.<sup>96</sup> This literature has examined the design of the optimal legal responses to climate change and has highlighted various impediments to achieving them. Notably absent from this body of work—even that dealing explicitly with behavioral analysis of law—is

---

90. *Id.* at 16266.

91. See Sen Pei, Sasikiran Kandula & Jeffrey Shaman, *Differential Effects of Intervention Timing on COVID-19 Spread in the United States*, 6 SCI. ADVANCES, Dec. 2020, at 4.

92. Oguzhan Alagoz, Ajay K. Sethi, Brian W. Patterson, Matthew Churpek & Nasia Safdar, *Effect of Timing of and Adherence to Social Distancing Measures on COVID-19 Burden in the United States: A Simulation Modeling Approach*, 174 ANNALS INTERNAL MED. 50 (2020); see also Ofer Malcai & Michal Shur-Ofry, *Using Complexity to Calibrate Legal Response to Covid-19*, FRONTIERS IN PHYSICS, Apr. 2021, at 1 (discussing the ramifications of the exponential character of the spread of the coronavirus for legal policymaking).

93. James Gustave Speth, *The Single Greatest Threat*, 27 HARV. INT'L REV. 18, 18 (2005).

94. For an overview, see Ove Hoegh-Guldberg et al., *Impacts of 1.5°C of Global Warming on Natural and Human Systems*, in GLOBAL WARMING OF 1.5°C 175, 177–81 (Valérie Masson-Delmotte et al. eds., 2018), [https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15\\_Full\\_Report\\_High\\_Res.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf) [<https://perma.cc/6SRF-AECR>].

95. See *COP26: Together for Our Planet*, UNITED NATIONS, <https://www.un.org/en/climatechange/cop26> (last visited June 12, 2022) [<https://perma.cc/J3E4-HR3Z>].

96. See, e.g., DANIEL A. FARBER & CINNAMON P. CARLARNE, CLIMATE CHANGE LAW (2018) (focusing on the United States); DANIEL BODANSKY, JUTTA BRUNNÉE & LAVANYA RAJAMANI, INTERNATIONAL CLIMATE CHANGE LAW (2017) (focusing on international law).

the EGB.<sup>97</sup> However, as it turns out, the EGB may in fact be playing a key role in the political process surrounding the enactment of legal policies aimed at tackling climate change.

The process of climate change is highly complex and involves a large number of factors including the atmosphere, the oceans, and the ice sheets.<sup>98</sup> Many of these processes are nonlinear and entail feedback effects that amplify temperature change.<sup>99</sup> Furthermore, some of the economic consequences of climate change are nonlinear.<sup>100</sup> Unlike the COVID-19 pandemic, however, in which exponential growth is measured in days, climate processes are unfolding at a much slower rate.<sup>101</sup> Consequently, the public may fail to grasp the scope of the threat, and policymakers will not adopt the necessary legal measures.<sup>102</sup> As Howard Kunreuther and Paul Slovic noted, “our failure to appreciate the exponential growth of climate-destroying processes has caused political leaders to resist acting to reduce carbon dioxide (CO<sub>2</sub>) emissions.”<sup>103</sup> And much as in the case of COVID-19, postponing critical legislation is expected to increase the future costs of climate change.<sup>104</sup>

Coping with the spread of contagious diseases and with climate change are not the only spheres in which the EGB may adversely affect policymaking. An invasive species may initially inflict little to no harm but have devastating consequences to the ecosystem as its population

---

97. See Jeffrey J. Rachlinski, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299 (reviewing various psychological phenomena that impede the response to the threat of climate change).

98. See Ulrich Cubasch et al., *Introduction*, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 119, 123–30 (Thomas F. Stocker et al. eds., 2013), [https://www.ipcc.ch/site/assets/uploads/2017/09/WG1AR5\\_Chapter01\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2017/09/WG1AR5_Chapter01_FINAL.pdf) [<https://perma.cc/7XTE-VLD8>].

99. *Id.* at 127.

100. See, e.g., Wolfram Schlenker & Michael J. Roberts, *Nonlinear Temperature Effects Indicate Severe Damages to U.S. Crop Yields Under Climate Change*, 106 PROC. NAT'L ACAD. SCI. 15594, 15594 (2009) (predicting a sharp decline in corn, soy, and cotton yields once a threshold temperature is crossed).

101. Dale Jamieson, *The Nature of the Problem*, in THE OXFORD HANDBOOK OF CLIMATE CHANGE AND SOCIETY 38, 48 (John S. Dryzek, Richard B. Norgaard & David Schlosberg eds., 2011) (“Increments of climate change are usually barely noticeable . . .”).

102. For example, following the Glasgow Climate Conference, the United Nations openly acknowledged that “[c]uts in global greenhouse gas emissions are still far from where they need to be to preserve a livable climate.” COP26: *Together for Our Planet*, *supra* note 95.

103. See Kunreuther & Slovic, *supra* note 81, at 95; see also HAYDN WASHINGTON & JOHN COOK, CLIMATE CHANGE DENIAL 92 (2011) (“Failure to understand exponential growth means a failure to act urgently on environmental problems and aids denial.”).

104. See EXEC. OFF. OF THE PRESIDENT OF THE U.S., THE COST OF DELAYING ACTION TO STEM CLIMATE CHANGE 4–6 (2014), [https://obamawhitehouse.archives.gov/sites/default/files/docs/the\\_cost\\_of\\_delaying\\_action\\_to\\_stem\\_climate\\_change.pdf](https://obamawhitehouse.archives.gov/sites/default/files/docs/the_cost_of_delaying_action_to_stem_climate_change.pdf) [<https://perma.cc/46NE-5VWM>].

grows out of control.<sup>105</sup> Tourism at some destinations appears to be growing at an exponential rate, adversely affecting local communities that are slow to adjust rules relating to issues like zoning.<sup>106</sup> Some technologies—most notably artificial intelligence—are also growing at an exponential rate,<sup>107</sup> raising concerns that regulation may not keep up with the risks that such new technologies generate.<sup>108</sup> Each such example merits in-depth analysis of the intricate details involved. Rather than analyzing each such phenomenon separately, we turn to sketch the general policy implications of the positive analysis.

### *C. Possible Solutions*

While diagnosing the problem stemming from the EGB in the policy-setting domain appears to be straightforward, prescribing solutions is far more difficult. A preliminary challenge stems from the difficulty of identifying new phenomena as being exponential in nature, since in the early stages it may be tough to distinguish between exponential, other nonlinear, and linear growth patterns.<sup>109</sup> Moreover, even if a novel phenomenon can be identified as exponential, other aspects of it—such as quantifying the harm generated by the phenomenon and predicting the point at which exponential growth will begin to decline—may still obstruct prudent policymaking.<sup>110</sup> Thus, it would be overly cautious to treat every new phenomenon that exhibits rapid growth rates as a threat that requires a swift and fierce regulatory response. Close monitoring of the pace of progress may facilitate increasingly accurate assessments and predictions based on existing models.

---

105. On invasive species, see DANIEL SIMBERLOFF, *INVASIVE SPECIES: WHAT EVERYONE NEEDS TO KNOW* (2013).

106. See, e.g., Nicole Gurran & Peter Phibbs, *When Tourists Move In: How Should Urban Planners Respond to Airbnb?*, 83 J. AM. PLAN. ASS'N 80 (2017) (documenting exponential growth in Airbnb listings in Sydney, Australia, and examining the policy implications regarding zoning regulation); Gert-Jan Hospers, *Overtourism in European Cities: From Challenges to Coping Strategies*, CESIFO F., Sept. 2019, at 20, 22–23 (reporting data suggesting exponential growth of tourism in Amsterdam, and discussing the legal response).

107. See Gonenc Gurkaynak, Ilay Yilmaz & Gunes Haksever, *Stifling Artificial Intelligence: Human Perils*, 32 COMPUT. L. & SEC. REV. 749, 752–53 (2016).

108. See, e.g., *id.* at 753–56 (discussing the policy implications); Matthew U. Scherer, *Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J.L. & TECH. 353, 393–98 (2016) (proposing the enactment of the Artificial Intelligence Development Act).

109. See *supra* notes 23–24 and accompanying text.

110. On the shift from exponential growth to decline, see *supra* note 26 and accompanying text.

Once policymakers confidently identify a given phenomenon as requiring quick intervention due to its exponential nature, it may be difficult to recruit the requisite public support for costly prevention measures, such as locking down the economy or shifting to expensive energy resources. Communicating complex and unintuitive scientific insights to the general public is a significant challenge, since it is beset by a host of psychological and sociological factors that obstruct the flow of information.<sup>111</sup> In contrast, costs borne in the present are very simple to grasp.

In many areas, this challenge may be further exacerbated by *cultural cognition*—namely, people’s tendency to form perceptions of disputed factual questions to suit the values of their cultural identity.<sup>112</sup> Thus, in the context of COVID-19 policies in the United States, studies have shown that people’s risk perception of the pandemic was associated with their cultural outlook, rather than by scientific facts—with a commensurate effect on their attitudes toward public-health policies.<sup>113</sup> Studies have documented similar results with respect to assessing the risks of climate change and support for legal responses to the problem.<sup>114</sup>

The implication of the foregoing analysis is that policy decisions could be improved by creating an institutional design that bolsters the role of expert decisionmakers. Such experts can rely on empirical evidence and mathematical models and make use of computer-based decision-support systems, which, on the whole, generate more accurate assessments of exponential phenomena. The COVID-19 example demonstrates how public authorities learned to integrate experts into the political decisionmaking process. As the pandemic progressed, governments around the world increasingly relied on epidemiologists, mathematical biologists, biostatisticians, and physicists in the policy-

---

111. For overviews of the empirical findings on science communication, see Heather Akin & Dietram A. Scheufele, *Overview of the Science of Science Communication*, in THE OXFORD HANDBOOK OF THE SCIENCE OF SCIENCE COMMUNICATION 25 (Kathleen Hall Jamieson, Dan M. Kahan & Dietram A. Scheufele eds., 2017); Philipp Schrögel & Christian Humm, *Science Communication, Advising, and Advocacy in Public Debates*, in SCIENCE COMMUNICATION 485 (Annette Leßmöllmann, Marcelo Dascal & Thomas Gloning eds., 2020).

112. Donald Braman, Dan M. Kahan, Ellen Peters, Maggie Wittlin, Paul Slovic, Lisa Larrimore Ouellette & Gregory N. Mandel, *The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks*, 2 NATURE CLIMATE CHANGE 732, 732 (2012).

113. For a review of the findings, see Teichman & Underhill, *supra* note 80, at 222–30.

114. See, e.g., Braman et al., *supra* note 112; Robert R.M. Verchick, *Culture, Cognition, and Climate*, 2016 U. ILL. L. REV. 969, 976–81.



setting process.<sup>115</sup> These experts developed models that predicted the spread of the virus throughout the population and recommended the necessary legal responses. In the United Kingdom, for example, the government's initial inclination to postpone its legal response to the pandemic in March 2020 gave way to a national lockdown, when experts at the Imperial College published a report that highlighted the catastrophic implications of inaction given the exponential spread of the virus within the community.<sup>116</sup>

To be sure, expert decisionmaking is no panacea. Predictions of exponential growth can diverge significantly depending on small nuances in the models.<sup>117</sup> This divergence could be exacerbated in situations of incomplete information in which modelers might impute controversial factual assumptions into their model. Thus, the model might reflect experts' biases or normative priors and intuitive judgments.<sup>118</sup> That said, expert decisionmaking does have a comparative advantage over intuitive judgements.<sup>119</sup> For example, when asked in April 2020 to predict the number of COVID-19 cases in the United Kingdom by the end of the year, both experts and laypeople underestimated the number of cases.<sup>120</sup> Yet when compared to the actual outcome (6,385,254), the experts' median estimate (4,000,000) was significantly more accurate than laypeople's median estimate (250,000).<sup>121</sup> Over time, rigorous scientific analysis can lead to the emergence of a consensus regarding the most accurate modeling and the required response.<sup>122</sup>

---

115. Christopher M. Weible et al., *COVID-19 and the Policy Sciences: Initial Reactions and Perspectives*, 53 POLY SCIS. 225, 231 (2020) (highlighting the role of experts in policy decisions during the COVID-19 pandemic).

116. See David Conn, Felicity Lawrence, Paul Lewis, Severin Carrell, David Pegg, Harry Davies & Rob Evans, *Revealed: The Inside Story of the UK's COVID-19 Crisis*, GUARDIAN (Apr. 29, 2020, 10:00 AM), <https://www.theguardian.com/world/2020/apr/29/revealed-the-inside-story-of-uk-covid-19-coronavirus-crisis> [<https://perma.cc/DZ6N-4QQZ>] (reporting on the UK's change of policy and its causes).

117. For an overview of the complexity associated with modeling the spread of COVID-19, see Michael T. Meehan et al., *Modeling Insights into the COVID-19 Pandemic*, PAEDIATRIC RESPIRATORY REVS., Sept. 2020, at 64 (2020).

118. Andrea Saltelli et al., *Five Ways to Ensure that Models Serve Society: A Manifesto*, 582 NATURE 482, 483 (2020) (noting that "[r]esults from models will at least partly reflect the interests, disciplinary orientations and biases of the developers").

119. See ZAMIR & TEICHMAN, BLE, *supra* note 6, at 170 (highlighting the comparative advantages of expert decisionmaking).

120. See Gabriel Recchia, Alexandra L. J. Freeman & David Spiegelhalter, *How Well Did Experts and Laypeople Forecast the Size of the COVID-19 Pandemic?*, PLOS ONE, May 5, 2021, at 1, 3–4, <https://doi.org/10.1371/journal.pone.0250935> [<https://perma.cc/QB9S-WTQ5>].

121. *Id.* at 3 tbl.1.

122. See, e.g., Nisreen A. Alwan et al., *Scientific Consensus on the COVID-19 Pandemic: We Need to Act Now*, 396 LANCET e71 (2020); Naomi Oreskes, *The Scientific Consensus on Climate Change*, 306 SCI. 1686 (2004).

But even if scientists can generate uncontroversial predictions regarding exponential growth, expert decisionmaking cannot supplant political decisionmaking. Policy decisions routinely entail delicate tradeoffs. Legal policies affect key issues like individual liberties, economic growth, and wealth distribution. The precise institutional balance between politically accountable politicians and experts hinges on the overall structure of the government, prevailing local norms regarding trust in science and in the governmental bureaucracy, and the specific policy question in play.<sup>123</sup> A collective choice to delegate decisionmaking power to experts is not very common. A more feasible option might be to create professional institutions that could steer politicians and public opinion towards the necessary policies.

An illustrative case is the British legal handling of climate change. The Climate Change Act of 2008 (“CCA”) delineates the decarbonization process of the British economy. From an institutional perspective, the key actor established by the CCA is the Climate Change Committee (“CCC”)—an expert body that devises British climate policies based on state-of-the-art scientific evidence.<sup>124</sup> While the CCA keeps the ultimate decision authority in the hands of elected officials, it delegates to the CCC the responsibility for advising the government regarding not only the “carbon budgets” allocated for each five-year period but also the ultimate reduction goal.<sup>125</sup> Over time, the CCC has proven to be instrumental in promoting a consensus over climate policies in the United Kingdom,<sup>126</sup> and the model of the CCA has been viewed as successful by numerous jurisdictions around the world that subsequently adopted similar frameworks.<sup>127</sup>

Given the fact that political authority over the regulation of phenomena that grow at an exponential rate is inevitable, policymakers who wish to promote social welfare must learn to explain exponential processes to the public. Behavioral research has highlighted mechanisms that may help laypeople to grasp exponential growth,<sup>128</sup>

---

123. See Tom Christensen & Per Lægreid, *Balancing Governance Capacity and Legitimacy: How the Norwegian Government Handled the COVID-19 Crisis as a High Performer*, 80 PUB. ADMIN. REV. 774, 776–77 (2020) (comparing the role of experts in Norway, Sweden, and the United States).

124. Climate Change Act 2008, c. 27, § 32 (UK), <https://www.legislation.gov.uk/ukpga/2008/27/contents> [<https://perma.cc/K5Y2-7DWS>] (establishing the CCC).

125. *Id.* At § 33 (advice on target); *id.* At § 34 (advice on carbon budget).

126. See Michael (Mishka) Lysack, *Best Practices in Effective Climate Policy Implementation, Governance, and Accountability: The UK Committee on Climate Change*, in ENERGY HUMANITIES CURRENT STATE AND FUTURE DIRECTIONS 89, 103 (Matúš Mišík & Nada Kujundžić eds., 2021).

127. *Id.* At 95.

128. See *supra* notes 57–68 and accompanying text (reviewing debiasing research).

even in the context of policy setting.<sup>129</sup> For example, people exhibit a better understanding of the impact of COVID-19 mitigation measures when the spread of the virus is communicated in terms of the time in which the number of cases will double as opposed to an equivalent growth rate.<sup>130</sup> Furthermore, the experience gained during the COVID-19 pandemic might assist in explaining the risks associated with other phenomena such as climate change. In all likelihood, however, this shall be an uphill battle, which will require tremendous effort.<sup>131</sup>

Finally, the analysis presented highlights the role of courts in dealing with phenomena entailing exponential growth. A vast body of behavioral research has demonstrated that judges are affected by heuristics and biases.<sup>132</sup> Thus, one might worry that judges facing cases involving legislative or executive measures that are aimed to halt exponential growth will underestimate the risks involved. Consequently, judges might view such measures as disproportional and strike them down. This may be especially likely when the legislature or the executive responds promptly to the threat and adopts harsh measures to stop exponential growth at a very early stage in which the phenomena involved might seem negligible. Courts should therefore adjust their analysis and account for the fact that early aggressive intervention might ultimately prove less detrimental to competing interests than a more gradual approach that fails to control exponential growth early on.<sup>133</sup>

At times, however, courts might facilitate the adoption of necessary legal policies when other branches of government postpone action due to the EGB. As noted, political institutions that are accountable to the public might exhibit greater susceptibility to the EGB and consequently opt for inaction. Given their relatively more limited political accountability, courts could function as a driving force, which pushes other branches of government to adopt the necessary legal responses in such settings. The recent rulings of the German Federal Constitutional Court and the Dutch Supreme Court regarding

---

129. Lammers et al., *supra* note 53, at 16265–66 (debiasing with respect to COVID-19 spread rate).

130. See Martin Schonger & Daniela Sele, *How to Better Communicate the Exponential Growth of Infectious Diseases*, PLOS ONE, Dec. 9, 2020, at 1, <https://doi.org/10.1371/journal.pone.0242839> [<https://perma.cc/PZE2-BVG4>].

131. See, e.g., John D. Sterman, *Communicating Climate Change Risks in a Skeptical World*, 108 CLIMATIC CHANGE 811, 820–25 (2011) (reviewing ways in which communication can be improved in the area of climate change).

132. For an overview, see ZAMIR & TEICHMAN, BLE, *supra* note 6, at 532–44.

133. See Malcai & Shur-Ofry, *supra* note 92.

carbon emissions highlight this point.<sup>134</sup> Both rulings identify climate change as a long-term challenge and underscore the need for immediate action to avoid future human suffering. Consequently, these rulings impose on the government an affirmative legal obligation to act and reduce current carbon emissions.<sup>135</sup>

### III. COUNTERACTING INDIVIDUALS' BIAS

This Part shifts the focus from policymakers to individuals. It discusses three key social problems: excessive consumer indebtedness, insufficient saving for retirement, and participation in pyramid schemes. While each of these problems has been extensively discussed in the past, the role the EGB plays in them has been largely overlooked. Recognizing the key role of the EGB offers new insights and points to new legal interventions.

#### A. Consumer Credit

A central aspect of individuals' financial planning relates to the decision to borrow money, thus transforming future income into present consumption in return for the payment of interest. This Section discusses the adverse effect of the EGB on consumer credit behavior and highlights numerous novel regulatory responses. After examining these issues in general, the analysis focuses on a specific type of transaction that epitomizes the exploitation of consumers' EGB by lenders—*consumer litigation funding* (“CLF”)—and then discusses the timely issue of mortgage forbearance.

#### 1. General

The sphere of consumer credit is vast and complex. Along with mortgages, Americans use various other types of credit—including credit cards, student loans, payday loans, installment loans, auto title

---

134. See *Constitutional Complaints Against the Federal Climate Change Act Partially Successful*, BVERFG (Mar. 24, 2021), <https://www.bundesverfassungsgericht.de/SharedDocs/Pressemitteilungen/EN/2021/bvg21-031.html> [<https://perma.cc/ZRE7-XVUF>]; Maiko Meguro, *State of the Netherlands v. Urgenda Foundation*, 114 AM. J. INT'L L. 729 (2020) (translation of Dutch case).

135. To be sure, these rulings are consistent with other rationales as well. For a discussion, see André Nollkaemper & Laura Burgers, *A New Classic in Climate Change Litigation: The Dutch Supreme Court Decision in the Urgenda Case*, EUR. J. INT'L L.: TALK! (Jan. 6, 2020), <https://www.ejiltalk.org/a-new-classic-in-climate-change-litigation-the-dutch-supreme-court-decision-in-the-urgenda-case/> [<https://perma.cc/92FH-WZH8>].

loans, rent-to-own, and CLF.<sup>136</sup> Thus, people obtain credit both by taking loans and by purchasing goods and services on credit; and by using both open- and closed-end credit.<sup>137</sup> According to the Household Debt and Credit Report published by the Federal Reserve Bank of New York, in the third quarter of 2021 the total household debt in the United States was \$15.24 trillion (\$15,240,000,000,000).<sup>138</sup> Even if one subtracts student loans (which are incurred to enhance one's human capital) and loans for purchasing homes (which serve the dual role of consumption and investment)—which together total around 80% of household debt<sup>139</sup>—the average household debt is still extremely high. Divided by the number of households in the United States, which is nearly 130 million,<sup>140</sup> the mean household debt exceeds \$100,000, and the mean household debt excluding student loans and mortgages is over \$20,000.

Borrowing can help smooth out consumption over one's life cycle, as well as increase one's long-term welfare, by investing in human and other capital, including durable goods.<sup>141</sup> Thus, consumer credit can play a positive role in people's lives and contribute to economic growth. But overborrowing can be detrimental to individuals, families, and the entire economy. The higher a household's debt burden, the smaller the proportion of its income that can be used for purposes other than servicing debt. This may result in a downward spiral that ends with consumer insolvency and bankruptcy.<sup>142</sup> Typically, the outcomes of excessive consumer debt are harsher for poorer (often minority)

---

136. On mortgages and their regulation, see ANDREW G. PIZOR, CAROLYN L. CARTER, SARAH BOLLING MANCINI, ELIZABETH RENUART, JONATHAN SHELDON & TARA TWOMEY, *MORTGAGE LENDING: LOAN ORIGINATION, PREEMPTION, AND LITIGATION* (3d ed. 2019). On the various types of non-mortgage consumer credit and their regulation, see CAROLYN L. CARTER ET AL., *CONSUMER CREDIT REGULATION: CREDIT CARDS, PAYDAY LOANS, AUTO FINANCE, AND OTHER NON-MORTGAGE CREDIT* (3d ed. 2020).

137. On these distinctions, see CARTER ET AL., *supra* note 136, at 26–27.

138. See FED. RSRV. BANK OF N.Y., *QUARTERLY REPORT ON HOUSEHOLD DEBT AND CREDIT, 2021: Q3 3* (Nov. 2021), [https://www.newyorkfed.org/medialibrary/interactives/householdcredit/data/pdf/HHDC\\_2021Q3.pdf](https://www.newyorkfed.org/medialibrary/interactives/householdcredit/data/pdf/HHDC_2021Q3.pdf) [<https://perma.cc/2EZQ-RP9U>].

139. *Id.* at 3.

140. *Number of Households in the U.S. from 1960 to 2021*, STATISTA (Nov. 2021) <https://www.statista.com/statistics/183635/number-of-households-in-the-us/#:~:text=How%20many%20households%20are%20in,million%20households%20in%20the%20U.S.> [<https://perma.cc/R8RK-ML5KJ>].

141. See Andrew T. Hayashi, *Myopic Consumer Law*, 106 VA. L. REV. 689 (2020).

142. One might assume that lenders would have strong incentives to ensure that borrowers have the means to repay their debt. While this is true of some lenders, it is not true of others, such as the major credit card companies, whose business model is based on debt-servicing revenue and whose “most profitable customers are sometimes the least likely to ever repay their debts in full.” See Ronald J. Mann, *Bankruptcy Reform and the “Sweat Box” of Credit Card Debt*, 2007 U. ILL. L. REV. 375, 384–92 (describing the business model of the major credit card issuers); see also *infra* note 193 (alluding to a similar phenomenon in consumer litigation funding).

borrowers, thus raising distributional concerns as well.<sup>143</sup> As the subprime mortgage crisis made painfully apparent, micro-level inability to repay loans can have devastating macro-level ramifications.<sup>144</sup>

Neoclassical economics tends to attribute the malfunctioning of the consumer credit market to familiar market failures—in particular, consumer information problems. Accordingly, the primary cure that it advocates is disclosure duties.<sup>145</sup> As early as 1968, the federal Truth in Lending Act (“TILA”) imposed detailed disclosure duties on lenders, including about the total annual cost of the credit, dubbed the *annual percentage rate* (“APR”).<sup>146</sup> The TILA regulates not only the substance of the disclosure, but also its form, with a view to making important terms of the transaction conspicuous and clear.<sup>147</sup> However, more than fifty years later, the TILA appears to have had only a modest effect on the market.<sup>148</sup> Arguably, this suggests that the malfunctioning of this market is not exclusively due to information problems.

In fact, there is growing recognition in recent years that the malfunctioning of the consumer credit market is largely due to *behavioral* market failures, rather than traditional ones. Leading scholars, such as Cass Sunstein and Oren Bar-Gill, have highlighted the role played by several cognitive biases in this regard.<sup>149</sup> One such bias is the inability of individuals to process large and complex

---

143. See BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 124 (highlighting that contracts that prey on peoples’ behavioral limitations “have adverse distributive consequences, disproportionately burdening financially weaker—often minority—borrowers”).

144. See *supra* note 12.

145. See Matthew A. Edwards, *Empirical and Behavioral Critiques of Mandatory Disclosure: Socio-economics and the Quest for Truth in Lending*, 14 CORNELL J.L. & PUB. POL’Y 199, 200–03, 205–06 (2005) (describing the standard economic perspective); Andrea Freeman, *Payback: A Structural Analysis of the Credit Card Problem*, 55 ARIZ. L. REV. 151, 169 (2013) (criticizing the neoclassical perspective).

146. 15 U.S.C. § 1601; see also Regulation Z, 12 C.F.R. pt. 226 (2022) (implementing the TILA).

147. See, e.g., 15 U.S.C. § 1632; 12 C.F.R. §§ 226.5, 226.17 (2022).

148. See, e.g., BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 174–80; George S. Day & William K. Brandt, *Consumer Research and the Evaluation of Information Disclosure Requirements: The Case of Truth in Lending*, 1 J. CONSUMER RSCH. 21, 31 (1974) (finding that the “improved knowledge of credit rates and charges that could reasonably be attributed to TIL had relatively little effect on credit search and usage behavior”); Edward L. Rubin, *Legislative Methodology: Some Lessons from the Truth-in-Lending Act*, 80 GEO. L.J. 233 (1991) (describing the failure of the TILA and its policy implications).

149. See BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 78–97, 156–64 (discussing a long list of pertinent behavioral biases in the contexts of credit card and mortgages, respectively); Cass R. Sunstein, *Boundedly Rational Borrowing*, 73 U. CHI. L. REV. 249, 251–53 (2006) (discussing various cognitive biases affecting borrowing decisions); Susan Block-Lieb & Edward J. Janger, *The Myth of the Rational Borrower: Rationality, Behavioralism, and the Misguided “Reform” of Bankruptcy Law*, 84 TEX. L. REV. 1481, 1534–48 (2006) (same); Bubb & Pildes, *supra* note 4, at 1640–44 (same); Freeman, *supra* note 145, at 175–79 (same).

information—which is exacerbated by lenders’ deliberate use of complex terms in a bid to hide the true cost of credit.<sup>150</sup> Another key phenomenon is the present bias, which induces consumers to overestimate immediate benefits, and underestimate the future costs, of credit.<sup>151</sup> This bias is often coupled with overoptimism, which causes people to underestimate the risk of future economic hardship that results from job loss, medical problems, and the like.<sup>152</sup> It may also be coupled with bounded willpower and self-control problems.<sup>153</sup> Alas, these behavioral analyses of consumer credit rarely, if ever, allude to the EGB.<sup>154</sup>

## 2. Consumer Credit and the Exponential Growth Bias

The EGB is clearly relevant in the context of consumer credit because loans often include *compound interest*, which increases the loan balance at an exponential rate. According to an urban legend, Albert Einstein once said that compound interest “is the eighth wonder of the world. He who understands it earns it . . . he who doesn’t . . . pays it.”<sup>155</sup> If compound interest sparks a feeling of wonder, it must be because it grows exponentially; if people do not fully understand it (as indeed appears to be the case), it must be due to the EGB. For example, many people would be surprised to learn that if one takes out a loan of \$1,000 to be repaid in full in one year, with a monthly compound interest of 10%, one would have to repay a sum of \$3,138. Many people would be similarly surprised to learn that a borrower who takes out a loan of \$1,000 with the same compound interest and repays it with monthly

---

150. See, e.g., BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 79–81 (pointing out that in the context of credit cards, cardholders “ignore certain price dimensions, miscalculate others, and, as a result, fail to appreciate the total cost of the credit card product”). The same holds true for mortgages, Bar-Gill, *Subprime Mortgages*, *supra* note 5, at 1102–06, and other credit transactions. On consumer litigation funding, see *infra* text accompanying notes 188–195.

151. BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 81–87; Gustavo A. Barboza, *I Will Pay Tomorrow, or Maybe the Day After. Credit Card Repayment, Present Biased and Procrastination*, 47 ECON. NOTES 455 (2018) (describing the results of a field study); Block-Lieb & Janger, *supra* note 149, at 1543–48.

152. BAR-GILL, SEDUCTION BY CONTRACT, *supra* note 5, at 88, 157; Sunstein, *supra* note 149, at 252; Block-Lieb & Janger, *supra* note 149, at 1540–42.

153. Oren Bar-Gill, *Seduction by Plastic*, 98 NW. U. L. REV. 1373, 1395–96 (2004); Sunstein, *supra* note 149, at 252. On contractual designs, including credit-card contracts, that exploit consumers’ limited self-control, see also Stefano DellaVigna & Ulrike Malmendier, *Contract Design and Self-Control: Theory and Evidence*, 119 Q.J. ECON. 353 (2004).

154. The main exception to this observation outside the legal literature is Stango & Zinman, *Exponential Growth Bias*, *supra* note 5. Within the legal literature, the notable exception is Bubb & Pildes, *supra* note 4, at 1641–42.

155. See, e.g., Candice Elliot, *Compound Interest: The 8th Wonder of the World*, LISTEN MONEY MATTERS, <https://www.listenmoneymatters.com/compound-interest> (last visited July 17, 2022) [<https://perma.cc/8BL2-DKK2>].

installments of \$100 (totaling \$1,200) would still owe the lender, at the end of the year, \$1,000.

To be sure, the EGB is irrelevant when debtors pay simple (as opposed to compound) interest. In many jurisdictions, the default is that lenders cannot charge compound interest unless the contract clearly entitles them to do so, and courts do not view compound interest favorably.<sup>156</sup> Nonetheless, many consumer credit transactions explicitly include compound interest terms, which are generally presumed to be valid.<sup>157</sup> When considering the implications of the EGB for these transactions, two distinctions are paramount. The *first distinction* is between cases in which debts are repaid on time and in full, and cases in which they are not. In the case of credit cards and other types of open-end credit, paying on time and in full means that at the end of each payment period there is no outstanding debt. Note that the latter category includes both consumers who rightfully pay only part of their revolving credit and consumers who default on their payments. The *other distinction* is between contracts in which the periods for calculating the compound interest are shorter than the repayment period(s), and contracts in which they are not. The latter category includes loans that are repaid in one payment at the end of the agreed period—say one year (a so-called *balloon loan*)—and the interest is compounded on a shorter (say, monthly) basis. It also includes loans that are repaid in monthly installments and the interest is compounded daily.

Whenever borrowers repay their debts on time and in full, and the periods in which the compound interest is calculated are not shorter than the repayment period(s), no compound interest is ever due, so the EGB does not come into play.<sup>158</sup> Such transactions may be problematic for other reasons, but they do not raise the difficulty associated with the EGB.

---

156. See CARTER ET AL., *supra* note 136, at 228–33.

157. This is the case, for example, in the credit card industry, where most issuers compound interest on a daily basis. See Mark J. Furletti, *Credit Card Pricing Developments and Their Disclosure* 15 (Payment Cards Ctr., Fed. Rsr. Bank of Phila. Discussion Paper, Paper No. 03-02, 2003), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=572585](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=572585) [<https://perma.cc/G6FN-VXVH>]. The Consumer Financial Protection Bureau maintains a dataset of credit card agreements of hundreds of card issuers. *Credit Card Agreement Database*, CONSUMER FIN. PROT. BUREAU, <https://www.consumerfinance.gov/credit-cards/agreements/> (last visited July 17, 2022). [<https://perma.cc/LM27-Q7XX>]. cursory examination of some of these agreements—such as the Credit Agreement for Bank of America®, Secured Mastercard®, and Visa® Accounts (as of June 30, 2020), and the American Express® Gold Card Agreement (as of January 8, 2020)—confirms Furletti’s observation.

158. CARTER ET AL., *supra* note 136, at 228–30; Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2808 n.4.



The EGB *is* relevant whenever the debtor does pay compound interest—either (1) because the compounding periods are shorter than the payment intervals, or (2) because the debtor pays only part of the debt (or both).<sup>159</sup> In these cases, the EGB is likely to result in imprudent decisionmaking by the borrower, both at the contracting stage and during the performance of the contract (when deciding how much debt to incur in open-end credit transactions and how much effort to exert to avoid defaults).

Introducing the EGB into the consumer-credit policy debate lends support for regulatory intervention in this context. Curtailing people's freedom in a bid to increase their welfare is easier to justify when the problem lies in deficiencies in people's cognitive rationality, as opposed to their motivational rationality. Cognitive (or *thin*) rationality refers to the structure of people's set of preferences and their strategy of decisionmaking. It includes elements such as transitivity of preferences and correct use of the rules of probability. It does not pertain to *the content* of one's preferences, which is a matter of motivational (or *thick*) rationality.<sup>160</sup> This is true from an economic perspective, which generally takes people's preferences as a given.<sup>161</sup> It is all the more true from a deontological, liberal perspective, which views the interference with people's choices on the grounds of alleged motivational irrationality as much more problematic than on the grounds of cognitive irrationality, because it refers to people's ends and not merely to means.<sup>162</sup>

As long as the debate focuses on people's time-inconsistent choices (the present bias and hyperbolic discounting), opponents of intervention can argue that balancing between present and future consumption is a matter of personal preference that should not be interfered with.<sup>163</sup> In contrast, the EGB is a computational bias that is clearly a matter of cognitive irrationality. It reflects an error in judgment *from the vantage point of the decisionmaker*.<sup>164</sup> It is therefore

---

159. As previously noted, the latter possibility encompasses both instances where the debtor is contractually entitled to pay only part of the debt and instances in which the debtor breaches her obligation to repay in full.

160. See Eyal Zamir, *The Efficiency of Paternalism*, 84 VA. L. REV. 229, 248–49 (1998).

161. *Id.* at 254–67 (constructing a model for assessing paternalistic policies that aim to overcome people's cognitive—but not motivational—deviations from rational decisionmaking).

162. EYAL ZAMIR & BARAK MEDINA, *LAW, ECONOMICS, AND MORALITY* 340 (2010); see also JOSEPH RAZ, *THE MORALITY OF FREEDOM* 422–23 (1986) (making a similar claim).

163. See, e.g., Mario J. Rizzo & Douglas Glen Whitman, *Little Brother Is Watching You: New Paternalism on the Slippery Slopes*, 51 ARIZ. L. REV. 685, 699–701 (2009); Joshua D. Wright & Douglas H. Ginsburg, *Behavioral Law and Economics: Its Origins, Fatal Flaws, and Implications for Liberty*, 106 NW. U. L. REV. 1033, 1059–62 (2012).

164. See Goda et al., *supra* note 35, at 1639 (noting that the welfare implications of the EGB's status is a perceptual error, rather than a preference); cf. Jacob H. Russell, *Misbehavioral Law*

easier to justify measures that are designed to decrease overborrowing once it is understood that such borrowing is due in part to the EGB. Of course, taking the effect of the EGB into account does not end the debate, which involves a host of conflicting policy considerations.<sup>165</sup>

In general, measures that are already in place, or have been advocated, to alleviate information problems and cognitive biases other than the EGB in the context of consumer credit can help protect consumers from their EGB as well. Inasmuch as such measures cause consumers to avoid unnecessary debt, they reduce the harmful effects of the EGB. The prevalence of the EGB lends support to those measures and calls for additional ones. Our main interest, however, is in policy responses that are specifically geared to handle the EGB. In the following paragraphs, we briefly consider disclosure duties, other choice-preserving measures, and mandatory rules that aim to cope with the particular challenges posed by the EGB.

As previously noted, the predominant method of dealing with failures in the consumer credit market has been, and still is, to impose disclosure duties. While there are growing doubts about the efficacy of disclosures (especially when the main problem is not lack of information but cognitive limitations and biases), they may be helpful to some extent (and the shaping of the disclosure duties may benefit from behavioral insights).<sup>166</sup> Indeed, one may argue that borrowers are entitled to such information even if it does not affect their decisions. In the specific context of the EGB, timely, clear, and conspicuous information about compound interest may have a beneficial effect. When possible, such disclosures should provide consumers with the explicit cost of borrowing for a designated period of time, in simple dollar terms, rather than focusing on the interest rate that is likely to be misunderstood. This recommendation is in line with empirical

---

and *Economics*, 51 U. MICH. J.L. REFORM 549, 551 (2018) (drawing a comparable distinction between *tastes* and *circumstances*, and considering how regulators could try to tell them apart).

165. Moreover, the very distinction between motivational and cognitive biases is sometimes blurred. For example, to the extent decisionmakers can be characterized as naïve hyperbolic discounters—that is, they err in their understanding of their own future preferences—they can be categorized as cognitively biased, as well. See Ted O'Donoghue & Matthew Rabin, *Doing It Now or Later*, 89 AM. ECON. REV. 103, 106 (1999) (discussing the concept of naïve decisionmakers who misunderstand their own preferences).

166. Michael S. Barr, Sendhil Mullainathan & Eldar Shafir, *Behaviorally Informed Regulation*, in THE BEHAVIORAL FOUNDATIONS OF PUBLIC POLICY 440, 447–49 (Eldar Shafir ed., 2013); Sunstein, *supra* note 149, at 260–61. On the limitations of disclosures, see generally OMRI BEN-SHAHAR & CARL E. SCHNEIDER, MORE THAN YOU WANTED TO KNOW: THE FAILURE OF MANDATED DISCLOSURE (2014); ZAMIR & TEICHMAN, BLE, *supra* note 6, at 171–77, 314–18. See also *supra* note 148 and *infra* notes 252, 286 and accompanying text. On the contribution of psychological insights to the design of disclosure duties, see George Loewenstein, Cass R. Sunstein & Russell Golman, *Disclosure: Psychology Changes Everything*, ANN. REV. ECON., 2014, at 391.

findings from the context of payday loans, which suggest that a simple disclosure of the dollar cost of a loan is likely to have the greatest impact on borrowers' decisions.<sup>167</sup> Explicit cost disclosures should be given at the outset, when the contract itself entails compounding interest, as well as at the point when contractual payments become exponential—for example, when a payment is missed, and interest begins to accrue.

Another set of measures comprises nudges and debiasing techniques—such as fair and efficient default rules, educational campaigns, and vivid warnings about the perils of overborrowing.<sup>168</sup> However, the available evidence about the success of such debiasing techniques in general, and in the context of the EGB in particular, does not give rise to much optimism.<sup>169</sup> The prospects of nudges are particularly dim when sophisticated suppliers (here, the lenders) have a strong incentive to negate their effect.<sup>170</sup> People can, of course, avail themselves of professional advice when handling their financial affairs, and there is evidence to suggest that such advice can be highly valuable.<sup>171</sup> But many consumers cannot afford such advice, are unaware of its importance, and would not seek it even if urged to do so.

If consumers are unlikely to seek advice on their own, can lenders be entrusted with the task of ensuring that borrowers are able to repay the loan on time? This technique is currently employed in the residential mortgage sector, where lenders are required to make a reasonable determination of applicants' ability to repay before extending credit.<sup>172</sup> However, as long as lenders make extra profits (in some cases, most of their profit) from delinquent borrowers,<sup>173</sup> they have a strong incentive to render this requirement ineffectual. A more

---

167. See Marianne Bertrand & Adair Morse, *Information Disclosure, Cognitive Biases, and Payday Borrowing*, 66 J. FIN. 1865, 1881–88 (2011) (reporting results on the effectiveness of different disclosure types).

168. Sunstein, *supra* note 149, at 261–67; Bubb & Pildes, *supra* note 4, at 1646–47; Freeman, *supra* note 145, at 177–78.

169. On debiasing, see generally ZAMIR & TEICHMAN, BLE, *supra* note 6, at 127–34.

170. See Barr et al., *supra* note 166, at 440–46 (highlighting the distinction between situations in which firms seek to overcome customer biases and situations in which they seek to exploit them); Lauren E. Willis, *When Nudges Fail: Slippery Defaults*, 80 U. CHI. L. REV. 1155, 1200–10 (2013) (arguing that default rules are unlikely to be sticky when consumers lack clear preferences, and suppliers are able to contract around the defaults); Stephanie M. Stern, *Outpsyched: The Battle of Expertise in Psychology-Informed Law*, 57 JURIMETRICS 45 (2016) (arguing that business and interest groups are better than government officials at deploying psychological insights); ZAMIR & TEICHMAN, BLE, *supra* note 6, at 177–85 (discussing the promise and pitfalls of nudges).

171. Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2840–42.

172. See Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub.L. 111–203, §§ 1411–12, 124 Stat. 1376, 2142–2148 (2010) (codified at 15 U.S.C. § 1639c). On the enactment and implementation of the ability-to-repay rule, see Patricia A. McCoy & Susan M. Wachter, *Why the Ability-to-Repay Rule Is Vital to Financial Stability*, 108 GEO. L.J. 649, 665–80 (2020).

173. See *supra* note 142.

effective step, therefore, may be to forbid or drastically limit lenders' right to charge increased (simple or compound) interest on sums in arrears and to charge high late fees. Such restrictions eliminate—or at least reduce—lenders' incentive to extend credit to borrowers who are likely to fall behind on their payments. Indeed, under the Home Ownership and Equity Protection Act (“HOEPA”), a high-cost mortgage (as defined in the Act) “may not provide for an interest rate applicable after default that is higher than the interest rate that applies before default.”<sup>174</sup> The HOEPA also sets caps and imposes procedural limitations on the charging of late fees in high-cost mortgages<sup>175</sup>—as does the Credit Card Accountability Responsibility and Disclosure Act with regard to credit cards.<sup>176</sup> The findings with regard to the EGB suggest that comparable rules should apply to other consumer credit transactions as well.

Two additional mandatory rules may directly address the EGB. First, whenever a borrower pays the debt by installments—be it with regard to an open-end credit (as in credit cards) or a closed-end one—the law can mandate that each installment be at least equal to the accumulated interest. Very often, it would be in the borrower's best interests to pay much higher installments to avoid a debt spiral, but such minimal payment would, at the very least, prevent such *negative amortization* and exclude compound interest. In fact, the HOEPA provides that a high-cost mortgage “may not include terms under which the outstanding principal balance will increase at any time over the course of the loan because the regular periodic payments do not cover the full amount of interest due.”<sup>177</sup> Again, given what we know about the EGB and other cognitive biases, this rule should apply to *any* consumer credit transaction. Even if such a mandate might preclude a few mutually beneficial transactions, its overall effect is most likely to be very positive.<sup>178</sup>

---

174. 15 U.S.C. § 1639(d). High-cost mortgage is defined in 15 U.S.C. § 1602(bb) (and not in § 1602(aa) as erroneously stated in § 1639(d)).

175. 15 U.S.C. § 1639(k).

176. 12 C.F.R. §§ 226.52(b), 1026.52(b) (2022); see also Sunstein, *supra* note 149, at 269 (tentatively supporting restrictions on late fees); Oren Bar-Gill & Ryan Bubb, *Credit Card Pricing: The CARD Act and Beyond*, 97 CORNELL L. REV. 967, 969–73, 988–92 (2012) (discussing the CARD Act's effects on the credit card market, and finding that it modestly lowered late payment fees).

177. 15 U.S.C. § 1639(f).

178. Admittedly, minimum monthly payments may adversely affect some borrowers, who might have paid higher installments but due to the *anchoring effect* pay the minimal sum, or close to it. See Neil Stewart, *The Cost of Anchoring on Credit-Card Minimum Repayments*, 20 PYSCH. SCI. 39 (2009).

A more drastic measure would be to mandate that the periods for which the compound interest is calculated must not be shorter than the repayment period(s). Thus, no compound interest would be charged in *balloon loans* if the loan is repaid on time. The lender may legitimately charge compound interest in the case of default for the post-default period. Had the borrower paid back the full amount (principal plus simple interest) on time, the lender could have used this amount to extend credit to other borrowers and collect interest on the said full amount. But during the loan period itself, the lender has no such opportunity. Most likely, the reason why lenders charge such interest is to exploit borrowers' EGB and other cognitive limitations. The same holds for credit card agreements, where cardholders pay on a monthly basis, but the interest on the revolving credit is compounded daily.<sup>179</sup> In those contracts, the daily interest is the declared APR divided by 365—but due to the daily compounding, the effective interest is higher than the stated APR.<sup>180</sup> Since the only reason for, or at least the primary effect of, using this formula is to mislead debtors, it should not be allowed.

We are then left with transactions in which the debt is repaid periodically, and the borrower determines how much he or she pays in each installment (usually, beyond a certain minimum)—as is usually the case with credit cards (setting aside the issue of shorter compounding periods). In these cases, a borrower who does not repay the outstanding debt in full is not in breach of any contractual obligation—but if he or she were to pay a higher amount, the lender could use it to extend credit to others. In such instances, it is more difficult to argue that there is no economic rationale for charging compound interest on the outstanding debt. That said, it is highly likely that borrowers who are susceptible to the EGB make suboptimal decisions in this context. Between the extremes of fully enforcing and totally banning compound interest in these cases, legal policymakers may consider interim arrangements—such as setting minimal, standardized periods for compounding and imposing strict disclosure duties.<sup>181</sup>

Having discussed the impact of the EGB on consumer credit in general, the following two Subsections discuss in greater detail two

---

179. See *supra* note 157.

180. See Furletti, *supra* note 157, at 15.

181. Once it is decided to opt for mandatory rules, a host of questions arise about the design of such rules, including whether to interfere with the wording of the contracts (rather than merely render certain terms unenforceable), what sanctions to impose for violations of such wording rules, and so forth. See generally Eyal Zamir (featuring Ian Ayres), *A Theory of Mandatory Rules: Typology, Policy, and Design*, 99 TEX. L. REV. 283, 310–39 (2020).

concrete contexts in which the EGB might play a significant role. The first is consumer litigation funding, which provides a striking example of exploiting borrowers' EGB. The second is mortgage forbearance, which illustrates the importance of the EGB in a timely context.

### 3. Consumer Litigation Funding

Third-party litigation funding—a rapidly growing industry—comprises various types of transactions.<sup>182</sup> For present purposes, two related distinctions are of particular importance. One is between commercial and consumer plaintiffs.<sup>183</sup> Our focus is on *consumer litigation funding* (“CLF”)—namely, the funding of individuals who typically claim damages for personal injuries. The other distinction is between the provision of funds to cover litigation costs (such as court fees and expert-witness expenses), and the provision of funds to cover other, unrelated purposes. The latter may include daily needs and medical expenses that may have arisen due to the accident that caused the injuries and its adverse impact on the plaintiff's earnings. Usually, tort plaintiffs hire an attorney on a contingent-fee basis—which means that the attorney finances the litigation costs in return for a share of the proceeds (very often one-third).<sup>184</sup> In these cases, which are at the heart of our discussion, the term *litigation funding* is somewhat misleading, as the funding is not for the litigation. Rather, the expected proceeds of the claim are used as collateral for a general-purpose loan.<sup>185</sup> Like other types of third-party litigation funding, CLF offers borrowers a nonrecourse loan: the lender recovers from the proceeds of the claim; if these proceeds do not cover the principal and interest, the lender recovers only partially, or not at all.

Analyses of CLF have estimated the APR in CLF to be anywhere between 80% and 425%.<sup>186</sup> Recently, Ronen Avraham and Anthony Sebok conducted a large-scale empirical analysis, based on a dataset of

---

182. For an overview, see STEVEN GARBER, *ALTERNATIVE LITIGATION FINANCING IN THE UNITED STATES: ISSUES, KNOWN, AND UNKNOWN* 7–16 (2010).

183. See Ronen Avraham & Anthony Sebok, *An Empirical Investigation of Third Party Consumer Litigant Funding*, 104 CORNELL L. REV. 1133, 1135, 1137, 1168–69 (2019) (discussing this distinction and its implications); Suneal Bedi & William C. Marra, *The Shadows of Litigation Finance*, 74 VAND. L. REV. 563, 575–77 (2021).

184. On the contingency-fee market, see HERBERT M. KRITZER, *RISKS, REPUTATIONS, AND REWARDS: CONTINGENCY FEE LEGAL PRACTICE IN THE UNITED STATES* (2004).

185. According to one dataset, consumer litigation funding is usually used for daily expenses, repayment of mortgage, and the like. See Paige Marta Skiba & Jean Xiao, *Consumer Litigation Funding: Just Another Form of Payday Lending?*, 80 LAW & CONTEMP. PROBS. 117, 124–26 (2017).

186. See Avraham & Sebok, *supra* note 183, at 1137–38 (reviewing a wide range of estimates of the interest rates charged in CLF).

approximately 200,000 loan applications handled by one of the largest providers of such funding. The purpose of the analysis was to produce a more reliable picture of these transactions (although it is unclear how representative this firm is of the market as a whole).<sup>187</sup> Avraham and Sebok found that only about half of the applications submitted to the financing firm were approved, and the average loan was around 7% of the estimated case value.<sup>188</sup> The median interest was 3% per month—and in the great majority of cases it was compounded on a monthly basis. In most of the contracts, there was a minimal period for which interest was charged, irrespective of the actual duration of the funding—usually three months. Beyond that period, the compound interest was commonly calculated by means of *interest buckets*—namely, minimal periods (usually of three months) for which interest was charged, even if the borrower paid back the loan before the end of that period.<sup>189</sup> The average period of the loans was 14 months. Most borrowers took out only one loan per case, but a sizeable minority received two, three, or even more loans per case.<sup>190</sup> Only applicants whose requests were approved were charged a processing fee, which was paid along with the principal and interest at the end of the loan period (subject to the same compound interest and buckets). The most frequent fee for the first funding request was \$250, with an additional fee of \$75 for each additional request in the same case.<sup>191</sup> The average total amount of funding was approximately \$7,000, and the median—around \$2,250.<sup>192</sup>

Given what we know about the EGB, one can reasonably surmise that most borrowers believed that the effective APR was 36% (the stipulated monthly rate multiplied by 12), or somewhat higher. In fact, due to the complex calculation of the monthly compound interest (including the use of so-called “buckets” often buried in the fine print of the agreement), the median APR was over three times higher—115%.<sup>193</sup>

---

187. *Id.*

188. *Id.* at 1141.

189. *Id.* at 1151–54.

190. *Id.* at 1144.

191. *Id.* at 1154–57.

192. *Id.* at 1156.

193. *Id.* at 1142. Truth be told, according to Avraham’s and Sebok’s findings, 12% of the borrowers paid back only the principal, or even less than the principal, and many more paid only part of the sum due, as the lender had not insisted on repayment in full (so-called *haircuts*). *Id.* at 1141–42. However, even taking these cases into account, the median effective APR collected by the lender was still very high—approximately 43%. *Id.* at 1142, 1171. In fact, the lender made greater profits on the transactions in which it agreed to take a haircut than those in which it did not. *Id.* at 1158. For a comparable phenomenon in the credit card market, see *supra* note 142.

While the EGB is key to understanding borrowers' decisionmaking in the context of CLF, it is by no means the only pertinent behavioral phenomenon. Closely related to the EGB, the exceedingly complex formulae described above make it all the more difficult for borrowers to assess the true cost of the loan.<sup>194</sup> This difficulty is exacerbated by the fact that the people who use CLF are often in financial distress and possibly in poor health (due to the injury for which they are suing)—which impairs their cognitive performance.<sup>195</sup>

Given its key features—including the socioeconomic characteristics of the borrowers and the prevailing high interest rates—it is hardly surprising that CLF is controversial. On the one hand, some commentators have highlighted the difficulties associated with CLF and have called to ban it altogether, or at least heavily regulate the content of the transaction.<sup>196</sup> On the other hand, it has been argued that, along with other subprime products, CLF serves an important social goal. Therefore, the funders should be subject to licensing and transparency requirements, but the substance of the agreements should not be paternalistically regulated.<sup>197</sup>

Some states already regulate CLF transactions—mostly by imposing disclosure duties similar to those imposed by the TILA or by capping interest rates and fees.<sup>198</sup> These techniques are problematic, however. With regard to disclosures, Paige Skiba and Jean Xiao have

---

194. Avraham & Sebok, *supra* note 183, at 1172–73 (analyzing the various aspects of the “unnecessary complexity” of the transaction as a manifestation of sophisticated firms' effort to widen the gap between the transaction's perceived and actual price).

195. On the adverse effects of financial distress on decisionmaking, see generally SENDHIL MULLAINATHAN & ELDAR SHAFIR, SCARCITY: WHY HAVING TOO LITTLE MEANS SO MUCH (2013); ZAMIR & TEICHMAN, BLE, *supra* note 6, at 483–85. This concern is mitigated inasmuch as plaintiffs consult with their attorneys before taking out the loan. Another possible explanation for plaintiffs' willingness to pay high interest rates in CLF is their *loss aversion*. This arrangement decreases their *gains* from the lawsuit in return for an assurance that they would not be exposed to the risk of having to repay the loan from their own pocket if the claim is dismissed (perceived as a *loss*). Cf. Eyal Zamir & Ilana Ritov, *Revisiting the Debate over Attorneys' Contingent Fees: A Behavioral Analysis*, 39 J. LEGAL STUD. 245 (2010) (experimentally establishing a similar point about clients' preference for contingency fees). Other cognitive biases that may affect borrowers' decisionmaking in the context of CLF include overoptimism, mental accounting, salience, and framing. See Skiba & Xiao, *supra* note 185, at 126–29.

196. See, e.g., Julia H. McLaughlin, *Litigation Funding: Charting a Legal and Ethical Course*, 31 VT. L. REV. 615 (2007) (concluding that legislators should regulate these loans in order to bar profiteering).

197. See Susan Lorde Martin, *Litigation Financing: Another Subprime Industry that Has a Place in the United States Market*, 53 VILL. L. REV. 83 (2008); Terrence Cain, *Third Party Funding of Personal Injury Tort Claims: Keep the Baby and Change the Bathwater*, 89 CHI.-KENT L. REV. 11 (2014).

198. See Skiba & Xiao, *supra* note 185, at 144–45 (summarizing states' regulations as of 2016).



observed that “[p]laintiffs do not have legal expertise and likely lack the financial sophistication necessary to estimate when a nonrecourse advance will be due and how much the eventual interest and fees will amount to. Even for the savviest plaintiffs, such computations would be difficult.”<sup>199</sup>

A potentially more effective disclosure duty may be to require lenders to provide borrowers with statistical information (based on the data they collect) of the expected length and the derived total cost (in simple dollar terms) of similar loans. In addition, the borrowers’ attorneys could be asked to confirm in writing that this information has been disclosed to their clients.<sup>200</sup>

As for the capping of interest rates, one problem is that if the cap is set too low, it may eliminate CLF altogether or drastically curtail its availability, especially to the neediest plaintiffs who can hardly get credit anywhere else (payday loans may be even more harmful to borrowers, and in any case are not available to the unemployed).<sup>201</sup> Another problem is that lenders can be expected to find ingenious ways of evading such caps.<sup>202</sup>

A more promising intervention, therefore—which takes the bull by the horns and neutralizes the EGB as well as some of the other cognitive limitations of borrowers—is to ban all forms of compounded interest, minimal periods, buckets, and fees paid upon repayment of the loan, leaving only a simple interest rate. It is not at all clear what the economic rationale of these features is, besides obfuscating the true cost of the loan (and, we would add, exploiting borrowers’ EGB).<sup>203</sup> Such a measure would likely not only be more effective than capping interest rates but also facilitate more rational contracting, which is key to the efficient functioning of the market.

#### 4. Mortgage Forbearance

Consumers’ decisions to put off payments may trigger compound interest, the significance of which they may fail to grasp due to the EGB.

---

199. *Id.* at 120; see also Avraham & Sebok, *supra* note 183, at 1174 (expressing similar concerns).

200. See Skiba & Xiao, *supra* note 185, at 134–37 (advocating these measures); Avraham & Sebok, *supra* note 183, at 1174–75 (questioning the efficacy of these measures); Cain, *supra* note 197, at 45–49 (advocating more conventional disclosure duties and attorneys’ acknowledgement).

201. Skiba & Xiao, *supra* note 185, at 133.

202. *Id.* at 134.

203. Avraham & Sebok, *supra* note 183, at 1167, 1169–71. Such mandated simplification of the transaction could be backed by punitive damages and administrative, or even criminal, sanctions. On ways to deter suppliers from including unenforceable terms in their contracts, see Zamir & Ayres, *supra* note 181, at 325–30.

One concrete example of such decisions is mortgage forbearance—the temporary suspension of mortgage payments.

Mortgage forbearance can be beneficial for borrowers and lenders alike.<sup>204</sup> Borrowers facing temporary financial difficulties can use the deferral time to reorganize their finances and avoid the tremendous damage caused by defaulting (such as home loss and adverse credit rating).<sup>205</sup> From the lenders' perspective, forbearance may also be the lesser evil since foreclosure entails significant costs (e.g., due to litigation and real-estate depreciation).<sup>206</sup> At the societal level, in cases of macro downturns in the economy, forbearance can help prevent real-estate prices from spiraling downward, thus deepening the economic crisis.<sup>207</sup>

That said, to the extent that compound interest accrues during the forbearance period, borrowers who exhibit the EGB are prone to underestimate the cost of postponing payments. Regulators should, therefore, strive to create a decisionmaking environment that ensures that borrowers make decisions that serve their long-term interests. One way to counteract the EGB is to ban compound interest entirely during the forbearance period. For example, in the wake of the COVID-19 crisis, the Coronavirus Aid, Relief, and Economic Security (“CARES”) Act required lenders of federally backed mortgages to temporarily suspend mortgage payments for six months (with a possible extension to twelve months) at the borrower's request.<sup>208</sup> Notably, this program did not entail compound interest, as lenders were instructed to transfer all principal and interest payments deferred during the forbearance period into a non-interest-bearing balance.<sup>209</sup>

While banning compound interest is possible in transactions in which the government is involved, it is less feasible with respect to private loans. Deferment of loan repayments creates a real loss to

---

204. See, e.g., John Y. Campbell, Nuno Clara & João F. Cocco, *Structuring Mortgages for Macroeconomic Stability*, 76 J. FIN. 2525, 2526–29 (2021) (highlighting the mutual advantages of mortgages that allow borrowers to pay only interest on their loan during a recession).

205. See Luigi Guiso, Paola Sapienza & Luigi Zingales, *The Determinants of Attitudes Toward Strategic Default on Mortgages*, 68 J. FIN. 1473, 1479–81 (2013) (analyzing borrowers' costs of defaulting).

206. See Brent W. Ambrose & Charles A. Capone, Jr., *Cost-Benefit Analysis of Single-Family Foreclosure Alternatives*, 13 J. REAL EST. FIN. & ECON. 105, 106 (1996) (noting that “[f]rom the lender's perspective, foreclosure is the most costly post-default outcome”).

207. See Adam M. Guren & Timothy J. McQuade, *How Do Foreclosures Exacerbate Housing Downturns?*, 87 REV. ECON. STUD. 1331, 1335–38 (2020) (reviewing data consistent with the price-default spiral hypothesis).

208. 15 U.S.C. § 9056(b)(2).

209. *Lender Letter (LL-2020-07)*, FANNIE MAE 5, <https://singlefamily.fanniemae.com/media/22916/display> (last updated Nov. 18, 2020) [<https://perma.cc/6RLD-D5TB>].

lenders, who cannot relend the collected sums of money to other borrowers, and in effect provides borrowers with free credit.<sup>210</sup> As a result, banning compound interest may undercut lenders' incentives to show leeway to borrowers in distress. Tailoring disclosure policies that are geared toward tackling the EGB may be a more constructive path in such cases. Since forbearance is granted for a specific period of time for an existing loan, lenders can easily calculate the precise cost that the forbearance will engender over the duration of the loan. Regulators may therefore require that lenders present this explicit dollar amount to borrowers in a simple and salient way before they choose to defer their mortgage payments.

### *B. Retirement Savings*

#### 1. The Retirement Crisis and the Exponential Growth Bias

It is widely acknowledged that the United States is facing a major retirement crisis.<sup>211</sup> In fact, this crisis extends well beyond the United States.<sup>212</sup> As a result of "chronic under-saving,"<sup>213</sup> many American baby boomers experience significant financial distress as they grow older.<sup>214</sup> According to one prominent study, 50% of American households may not be able to sustain their standard of living after retirement,<sup>215</sup> and it is estimated that out of current American workers between the ages of fifty and sixty-four, 48% will be poor or near poor

---

210. See Jackson T. Anderson, David M. Harrison & Michael J. Seiler, *Reducing Strategic Forbearance Under the CARES Act: An Experimental Approach Utilizing Recourse Attestation*, 2021 J. REAL EST. FIN. & ECON. 230, 232 (2021) (arguing that the low costs of forbearance under the CARES Act create a moral hazard problem).

211. See, e.g., Bubb & Pildes, *supra* note 4, at 1612 ("The weight of the evidence shows that many households do save too little."); Paul M. Secunda, *The Behavioral Economic Case for Paternalistic Workplace Retirement Plans*, 91 IND. L.J. 505, 506 (2016) ("The American retirement security system hangs treacherously on a precipice."); Adi Libson, *Confronting the Retirement Savings Problem: Redesigning the Saver's Credit*, 54 HARV. J. ON LEGIS. 207, 220 (2017) ("There is ample data regarding the insufficient private savings for retirement."). But see John Karl Scholz, Ananth Seshadri & Surachai Khittrakun, *Are Americans Saving "Optimally" for Retirement?*, 114 J. POL. ECON. 607, 609 (2006) (arguing that 80% of American households have sufficient savings, and that for the remaining households the magnitude of the deficit is small).

212. See Shlomo Benartzi & Richard H. Thaler, *Behavioral Economics and the Retirement Savings Crisis*, 339 SCI. 1152, 1152 (2013) (noting that "[m]any countries are facing a retirement savings crisis").

213. Daniel Shaviro, *Multiple Myopias, Multiple Selves, and the Under-Saving Problem*, 47 CONN. L. REV. 1215, 1240–41 (2015) (citing evidence supporting the chronic under-saving hypothesis).

214. Secunda, *supra* note 211, at 507.

215. See Alicia H. Munnell, Wenliang Hou & Geoffrey T. Sanzenbacher, *National Retirement Risk Index Shows Modest Improvement in 2016*, CTR. FOR RET. RSCH. AT B.C. (2018), [https://crr.bc.edu/wp-content/uploads/2018/01/IB\\_18-1.pdf](https://crr.bc.edu/wp-content/uploads/2018/01/IB_18-1.pdf) [<https://perma.cc/5FKB-Z9BX>].

when they retire.<sup>216</sup> On aggregate, a recent projection suggests that the deficit in savings for American households, as of 2019, is a staggering \$3.83 trillion.<sup>217</sup>

One of the main contributing factors to this crisis is the shift in American retirement savings from *Defined Benefits* (“DB”) plans to *Defined Contributions* (“DC”) plans.<sup>218</sup> DB plans require little involvement on the part of savers, since they guarantee participants a fixed annuity based on their years of employment.<sup>219</sup> In contrast, DC plans require participants to make critical decisions about their savings.<sup>220</sup> Thus, participants in DC plans must routinely decide whether to participate in a plan and how much to contribute to the plan, as well as to actively manage their savings throughout their working years.<sup>221</sup>

A large body of behavioral research has highlighted that the reliance of DC plans on the decisions by savers who are not perfectly rational has led people to undersave for retirement. This body of work has focused mostly on people’s inability to optimize over long time horizons and highlighted phenomena such as present bias, hyperbolic discounting, and procrastination as the main driving forces behind insufficient saving.<sup>222</sup> Notably, despite its tremendous volume, this body of work has yet to incorporate the findings regarding the EGB.<sup>223</sup>

---

216. See Teresa Ghilarducci, *Retirement Security Worse on ERISA’s 40th Anniversary*, 6 DREXEL L. REV. 453, 453 (2014).

217. Dana M. Muir, *How Behavioral Science Ultimately Fails Retirement Savers: A Noble Experiment*, 56 AM. BUS. L.J. 707, 708 (2019) (citing a study published by the Employee Benefit Research Institute).

218. See Secunda, *supra* note 211, at 518; Benartzi & Thaler, *supra* note 212, at 1152.

219. Secunda, *supra* note 211, at 513.

220. *Id.* at 514–15.

221. The policy choice between DB and DC involves many considerations that exceed the scope of this Article. For an overview, see Edward A. Zelinsky, *The Defined Contribution Paradigm*, 114 YALE L.J. 451 (2004).

222. See Andrew Hayashi & Daniel P. Murphy, *Savings Policy and the Paradox of Thrift*, 34 YALE J. ON REGUL. 743, 752 (2017) (“The most common explanation offered by economists who study this phenomenon is that people tend to discount the future costs and benefits of their actions more than even they think appropriate . . . .”); see also Bubb & Pildes, *supra* note 4, at 1613 (hyperbolic discounting); Secunda, *supra* note 211, at 522–23 (present bias and procrastination); Shaviro, *supra* note 213, at 1246–48 (myopia). Other behavioral phenomena noted within this body of work include overoptimism, omission bias, and inattentiveness. See Colleen E. Medill, *Transforming the Role of the Social Security Administration*, 92 CORNELL L. REV. 323, 331 (2007) (excessive optimism); Libson, *supra* note 211, at 225–26 (omission bias); Shaviro, *supra* note 213, at 1249–51 (inattentiveness).

223. While some legal scholars have incorporated findings on financial literacy into the retirement debate, these discussions do not include any reference to the EGB—which is a distinct phenomenon. See, e.g., Bubb & Pildes, *supra* note 4, at 1611–14 (focusing on present bias and hyperbolic discounting, and making no reference to the EGB); Shaviro, *supra* note 213, at 1246–

Since retirement savings involve long-term investments in which compound earnings play a central role, the EGB may cause people to err systematically when making decisions relating to their retirement savings.<sup>224</sup> Such systematic errors may have two conflicting effects. On the one hand, people who fail to grasp the speed at which their wealth accumulates may erroneously divert too many resources into their retirement savings. On the other hand, biased individuals may underestimate the future value of their savings.<sup>225</sup> As a result, when balancing between present consumption and saving for future consumption, they may place excessive weight on the former and not save enough. This is either because they begin to save for retirement too late, or because they contribute too little to their retirement savings account—or both.<sup>226</sup>

While empirical research on the EGB and retirement savings is still limited, the available findings corroborate the link between that bias and *insufficient* saving. Using responses from past consumer finance surveys to construct a proxy of participants' EGB, Victor Stango and Jonathan Zinman examined the correlation between participants' EGB and their savings, while controlling for many other factors, such as income, homeownership, age, and race.<sup>227</sup> They found that the EGB is associated with a large decrease in savings.<sup>228</sup> Later studies augmented this finding by eliciting participants' EGB directly and by focusing more specifically on retirement.<sup>229</sup> For example, Gopi Shah Goda and colleagues developed a five-question survey to construct an EGB scale and collected data on participants' retirement savings.<sup>230</sup> They then examined the correlation between the two, using a rich set of controls.<sup>231</sup> With this observational data, their study documented a statistically significant association between the EGB and low

---

53 (presenting a “taxonomy of possible explanations for unduly low retirement saving,” and making no reference to the EGB).

224. See Levy & Tasoff, *supra* note 35, at 545 (“Proper computation of exponential functions is thus at the heart of many economic decisions such as lifecycle consumption . . .”).

225. See Goda et al., *supra* note 35, at 1637 (“[A] person with EGB will underestimate the returns to saving . . .”); see also Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2811; Levy & Tasoff, *supra* note 35, at 547–48.

226. See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2819 (arguing that the EGB has a large effect on retirement planning); McKenzie & Liersch, *supra* note 33, at S5–S6 (presenting results suggesting that people put off retirement saving due to the EGB).

227. Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2812–16, 2826–31.

228. *Id.* at 2837–40.

229. See Goda et al., *supra* note 35; see also Levy & Tasoff, *supra* note 35; McKenzie & Liersch, *supra* note 33.

230. Goda et al., *supra* note 35, at 1641–44 (describing study design and data).

231. *Id.* at 1645 (reporting on controls such as gender, age, marital status, number of household members, state of residence, ethnicity, work status, education, and occupation).

retirement savings: specifically, an increase of one standard deviation of the EGB was associated with an 11% decrease in retirement savings.<sup>232</sup> Notably, this effect was independent of the effect of the present bias (that was also examined in this study) and is actually somewhat larger.<sup>233</sup> In the same vein, a recent field experiment has demonstrated that pointing out to investors the long-term consequences of their decisions by describing the effect of those decisions on their income in retirement years boosted their contribution rate.<sup>234</sup> Lab experiments have obtained similar results.<sup>235</sup> Note that, insofar as some of the population does tend to oversave (due to the EGB or other causes), the extent of undersaving by those who are prone to do so is even greater than currently acknowledged.

## 2. Policy Implications

Recognizing that people tend to save too little for retirement, policymakers have used three measures to tackle this issue: (1) mandated savings through Social Security;<sup>236</sup> (2) tax incentivizes (most notably Individual Retirement Accounts (“IRAs”) and 401(k) programs);<sup>237</sup> and (3) nudges that foster greater saving.<sup>238</sup> Policymakers can encourage employers to adopt such measures, as Congress did with the Pension Protection Act of 2006. Specifically, that Act includes a safe harbor that shields from fiduciary liability employers that set a default of automatic enrollment into their 401(k) programs.<sup>239</sup> These policies

---

232. *Id.* at 1648.

233. *Id.* (reporting that an increase of one standard deviation in the measure of the present bias is associated with a 10% decrease in retirement savings).

234. See Gopi Shah Goda, Colleen Flaherty Manchester & Aaron J. Sojourner, *What Will My Account Really Be Worth? Experimental Evidence on How Retirement Income Projections Affect Saving*, 119 J. PUB. ECON. 80 (2014).

235. See Féidhlim P. McGowan & Peter D. Lunn, *Supporting Decision-Making in Retirement Planning: Do Diagrams on Pension Benefit Statements Help?*, 19 J. PENSION ECON. & FIN. 323, 335 (2020) (discussing findings showing that participants who were exposed to a diagram that highlighted the tradeoff between monthly contributions and monthly pension payments “were more likely to propose an increase in contributions.”); McKenzie & Liersch, *supra* note 33, at S1 (experimentally demonstrating that the EGB “makes putting off saving more attractive than it should be,” and that “highlighting the exponential growth of savings motivates both college students and employees to save more for retirement”).

236. See Shaviro, *supra* note 213, at 1228–30.

237. See *id.* at 1224–27.

238. See Shlomo Benartzi & Richard H. Thaler, *Heuristics and Biases in Retirement Savings Behavior*, 21 J. ECON. PERSPS. 81, 99–102 (2007).

239. See 29 U.S.C. § 1104(c)(5); 29 C.F.R. § 2550.404c-5 (2000); see also Brigitte C. Madrian & Dennis F. Shea, *The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior*, 116 Q.J. ECON. 1149 (2001) (proposing this technique and empirically demonstrating its efficacy);

were enacted amidst an academic and political debate over whether or not government should be involved in people's saving decisions and the limits of paternalistic legislation.<sup>240</sup>

When considering regulatory responses to the EGB, the distinction mentioned in the context of consumer credit<sup>241</sup>—between subjective preferences and the choice of rational means of fulfilling those preferences (and the associated distinction between motivational and cognitive rationality)—is equally apposite. People legitimately vary in their discount rates and risk aversion, but if the reason they save too little stems from their misunderstanding of compound interest, then a regulatory intervention aimed at increasing retirement savings is not tantamount to directing people “to buy new sneakers instead of a new lawn mower.”<sup>242</sup> Rather, such an intervention enables people to fulfill more of their preferences over time.

Incorporating the EGB into the policy debate highlights yet another systematic mistake people might make when choosing when and how much to save. It thus tilts the balance toward widening the scope of mandatory saving programs.<sup>243</sup> However, while many legal systems in developed economies have shifted towards mandatory saving for retirement in recent years,<sup>244</sup> the adoption of such a program in the United States in the near future is unlikely.<sup>245</sup> Thus, inasmuch as policies continue to rely on individual choice with respect to savings, efforts should be made to help people understand the effect of compound

---

Dana M. Muir, *Choice Architecture and the Locus of Fiduciary Obligation in Defined Contribution Plans*, 99 IOWA L. REV. 1, 30–33 (2013) (reviewing the legislative provisions).

240. For recent contributions, see Bubb & Pildes, *supra* note 4, at 1607–37 (incorporating behavioral analysis into the welfare analysis); Hayashi & Murphy, *supra* note 222, at 758–64 (highlighting the macroeconomic implications of savings policy); Bernhard Ebbinghaus, *The Politics of Pension Reform: Managing Interest Group Conflicts*, in THE OXFORD HANDBOOK OF PENSIONS AND RETIREMENT INCOME 759 (Gordon L. Clark, Alicia H. Munnell & J. Michael Orszag eds., 2006) (reviewing the political debate).

241. See *supra* notes 160–165 and accompanying text.

242. Todd J. Zywicki, *Do Americans Really Save Too Little and Should We Nudge Them to Save More? The Ethics of Nudging Retirement Savings*, 14 GEO. J.L. & PUB. POL'Y 877, 904 (2016). Notably, Zywicki makes no reference to the EGB throughout his paper. This is also the case with other critics of the behavioral approach to retirement-savings policy. See, e.g., Wright & Ginsburg, *supra* note 163, at 1056–57.

243. For voices supporting this line of reasoning, see Bubb & Pildes, *supra* note 4, at 1632–37; Secunda, *supra* note 211, at 540–41. Such an approach could be implemented by increasing social security benefits, Bubb & Pildes, *supra* note 4, at 1637, or by making private 401(k) programs universal and mandatory, Secunda, *supra* note 211, at 510–11.

244. See OECD, PENSION MARKETS IN FOCUS 2021 15–20 (2020), <https://www.oecd.org/daf/fin/private-pensions/Pension-Markets-in-Focus-2021.pdf> [<https://perma.cc/7WZ6-QZ9S>] (reviewing data).

245. Richard H. Thaler, *Much Ado About Nudging*, BEHAV. PUB. POL'Y BLOG (June 2, 2017), <https://bppblog.com/2017/06/02/much-ado-about-nudging/> [<https://perma.cc/92TH-8KV9>] (arguing that it would be “sheer fantasy” to think that it is politically feasible to adopt mandatory savings in the United States).

interest. One tool that may be used to clarify that effect is the financial statements that savers periodically receive from the institutions managing their retirement plan. As previously mentioned, it has been demonstrated that providing investors with information about the effect of their saving decisions on the size of their pensions encourages investors to increase their contribution rate.<sup>246</sup> Moreover, such information would also be beneficial to people who possibly save too much for retirement because of their EGB.

Congress has recently moved forward on this front, by enacting the Setting Every Community Up for Retirement Enhancement (“SECURE”) Act.<sup>247</sup> The SECURE Act mandates that retirement-saving statements incorporate a lifetime income disclosure that describes “the amount of monthly payments the participant or beneficiary would receive if the total accrued benefits of such participant or beneficiary were used to provide lifetime income streams.”<sup>248</sup> Perhaps even more importantly, the SECURE Act created a safe harbor that shields financial institutions from liability regarding these projections, as long as they follow the rules set out by the Department of Labor.<sup>249</sup> This safe harbor may help financial institutions incorporate projections into their statements that help savers understand the pertinent tradeoffs between present and future consumption. For example, the statement could delineate the expected impact of each additional dollar invested on the monthly income at retirement.<sup>250</sup>

The EGB highlights the importance of encouraging people to begin saving relatively early. To this end, regulators might wish to mandate an annual financial statement that will be sent by employers offering a 401(k) program to their workers who did *not* enroll into this program. The statement will specify how much additional money these workers were projected to have at retirement had they joined the firm’s saving program. Once the long-term costs of not saving are made explicitly clear to nonsavers, some of them might decide to join their employer’s 401(k) program.

Note that, unlike the case of lending (as discussed in the previous Section)—where financial institutions are incentivized to exploit the EGB in a manner that harms borrowers—when it comes to

---

246. See *supra* note 234 and accompanying text.

247. Further Consolidated Appropriations Act, 2020, Pub. L. No. 116-94, Div. O.

248. 29 U.S.C. § 1025(a)(2)(D)(i)(II).

249. 29 U.S.C. § 1025(a)(2)(D)(iv).

250. For an illustration, see Goda et al., *supra* note 234, at 84, showing graphics depicting to subjects how much additional annual income at retirement they can expect to have if they raise their saving contributions.



savings the incentives of savers and financial institutions are better aligned, and the latter could play a constructive role in debiasing savers.<sup>251</sup> That said, in line with the general findings about the limited effect of financial (and other) disclosures,<sup>252</sup> the impact of additional information on decisions regarding retirement savings may be rather small as well.<sup>253</sup>

Another key aspect of the regulatory framework with respect to retirement savings that could be revisited in light of the EGB is the fees collected from savers. Researchers have documented the adverse impact of high fees on the accumulation of wealth for retirement.<sup>254</sup> The underlying problem is that people “are unable to understand the effect of higher fees on long-term returns.”<sup>255</sup> The EGB makes it easier to understand people’s inattention to fees in their retirement accounts. Unlike other prices, fees attached to retirement savings do not reduce people’s current consumption but rather their future consumption. Just as people systematically underestimate the power of compound earnings, they also systematically underestimate the cost of fees in terms of their diminished future consumption.

This insight lends further support to a long list of proposed strategies geared toward reducing fees in retirement programs. Examples include the creation of low-cost default funds and limiting the tendency of investors to roll over their retirement savings into relatively expensive IRAs.<sup>256</sup> Moreover, this insight could guide the creation of new and more effective cost disclosures that assist savers affected by the EGB. Just as earnings disclosures should highlight the long-term effects of investment decisions, cost disclosures should point to the long-term effect of fees on available income during retirement. For example, they might state the dollar amount of fees charged during the statement period and present a projection as to how this amount translates into lost income at the expected time of retirement. Financial institutions,

---

251. See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2810 (“[F]irms selling saving and investment products have incentives to bias consumers . . .”).

252. See BEN-SHAHAR & SCHNEIDER, *supra* note 166; ZAMIR & TEICHMAN, BLE, *supra* note 6, at 171–77, 314–18; see also *supra* notes 148, 166 and *infra* note 286 and accompanying text.

253. See Goda et al., *supra* note 234, at 81 (noting that their findings “suggest that on average, individuals contribute more, albeit a small amount, when provided with information about how current saving translates into income in retirement”).

254. See, e.g., Ian Ayres & Quinn Curtis, *Beyond Diversification: The Pervasive Problem of Excessive Fees and “Dominated Funds” in 401(k) Plans*, 124 YALE L.J. 1476 (2015); Secunda, *supra* note 211, at 520.

255. Muir, *supra* note 217, at 729; see also Medill, *supra* note 222, at 336 (noting that investors with short-term planning horizons tend to disregard fees).

256. See Ayres & Curtis, *supra* note 254, at 1524–31 (proposing low cost investment tools as defaults); Muir, *supra* note 217, at 765–69 (discussing rules that would impede rollovers into IRAs).

of course, have little incentive to draw attention to such fees in saving statements, so such disclosures need to be mandated.

Finally, the existing literature tends to link the errors associated with long-term savings with financial literacy and consequently advocates for public education campaigns geared toward enhancing people's knowledge on the topic.<sup>257</sup> But research on the EGB suggests that merely explaining the concept of compound interest to people is not enough, since understanding the concept does not, in and of itself, mitigate the bias.<sup>258</sup> And while a recent randomized field experiment in China did demonstrate that educating savers about the value of compound earnings in the long term can increase their contributions to a retirement savings program by as much as 40%,<sup>259</sup> implementing the procedure set out in that study in the United States may prove difficult. Participants in the study were approached personally just prior to making their contribution decision by agents with no conflict of interest; given an explanation on the concept of compound interest; and provided with the calculated benefit for each contribution level.<sup>260</sup> At present, it is difficult to see American employers offering such advice to their employees, since their incentives are not aligned.<sup>261</sup> Indeed, employers might want to minimize employees' contributions to savings plans to lower their own matching obligations,<sup>262</sup> while encouraging employees to purchase high-fee investment tools—since those fees finance the costs of the financial services that the employer receives.<sup>263</sup>

### C. Pyramid Schemes

Having discussed two major spheres in which the EGB strongly affects people's decisionmaking—excessive borrowing and insufficient savings—we turn next to a more specific issue: pyramid schemes. A pyramid scheme is a perpetual recruitment network “that transfers

---

257. See, e.g., Medill, *supra* note 222, at 348–61 (promoting a financial literacy campaign led by the federal government).

258. McKenzie & Liersch, *supra* note 33, at S6; see also *supra* notes 67–68 and accompanying text.

259. See Song, *supra* note 67, at 932.

260. *Id.* at 925 (describing the treatment in the financial education group of the experiment).

261. See Ryan Bubb, Patrick Corrigan & Patrick L. Warren, *A Behavioral Contract Theory Perspective on Retirement Savings*, 47 CONN. L. REV. 1317, 1364 (2015) (arguing that “employers do not have good incentives to design choice architectures that address the mistakes households make in planning and saving for retirement”).

262. *Id.* at 1354.

263. *Id.* at 1357–58.

funds from new recruits to those higher in the organization.”<sup>264</sup> Every year, hundreds of thousands of Americans lose considerable amounts of money in such schemes.<sup>265</sup> Aside from their financial cost, pyramid schemes can inflict broader societal harm, since they exploit and subvert trust within families and social networks. In one infamous case, an entire country was plunged into chaos nearing civil war when numerous pyramid schemes involving a large part of the population collapsed.<sup>266</sup>

In typical pyramid schemes, participants are required to pay upfront to join the scheme, recruit additional participants, and receive payment once enough members have been recruited. A simple case in point is the so-called *Airplane Game*.<sup>267</sup> Players enter this game at the fourth tier of the pyramid as “Passengers,” after paying an enrollment fee (which may be as high as \$5,000). Each passenger is then required to recruit two (or more, in some versions) additional players into the game. Based on their recruitment and the recruitment carried out by the people whom they recruit, players are promoted to the third tier (“Flight Attendant”), the second tier (“Co-pilot”), and eventually the top tier (“Pilot”). At this point, the Pilot receives the payments made by the eight new passengers recruited to the base of the pyramid and exits the game. The pyramid then splits into two pyramids—with each Co-pilot assuming the position of Pilot in one of the pyramids, and all other members promoted by one tier. Notice that the payoff structure of this game is built exclusively on the transfer of resources within the pyramid—from those who joined last to those who joined first.

Some pyramid schemes attempt to mask their true nature by incorporating product marketing into the program.<sup>268</sup> They present

---

264. See Peter J. Vander Nat & William W. Keep, *Marketing Fraud: An Approach for Differentiating Multilevel Marketing from Pyramid Schemes*, 21 J. PUB. POL’Y & MKTG. 139, 142 (2002).

265. KEITH B. ANDERSON, MASS-MARKET CONSUMER FRAUD IN THE UNITED STATES: A 2017 UPDATE, FED TRADE COMM’N. 25 (Oct. 2019), <https://www.ftc.gov/reports/mass-market-consumer-fraud-united-states-2017-update> [<https://perma.cc/3W97-BWHX>].

266. See Christopher Jarvis, *The Rise and Fall of Albania’s Pyramid Schemes*, 37 FIN. & DEV. 46 (2000).

267. See Corey Matthews, Note, *Using a Hybrid Securities Test to Tackle the Problem of Pyramid Fraud*, 88 FORDHAM L. REV. 2045, 2046–47 (2020) (describing the Airplane Game). Some schemes use a different terminology but employ the same framework. See, e.g., Eric Witiw, *Selling the Right to Sell the Same Right to Sell: Applying the Consumer Fraud Act, the Uniform Securities Law and the Criminal Code to Pyramid Schemes*, 26 SETON HALL L. REV. 1635, 1636 (1996) (describing the Network Game).

268. See William W. Keep & Peter J. Vander Nat, *Multilevel Marketing and Pyramid Schemes in the United States: An Historical Analysis*, 6 J. HIST. RSCH. MKTG. 188, 197 (2014) (a pyramid scheme may introduce a product “to fool people into thinking that they are engaged in a business”). A well-known recent case in point is *Advocare*, which ultimately agreed to end its multilevel marketing operation and pay \$150 million in compensation. See *FTC v. Advocare Int’l*, No. 4:19-

themselves as legitimate multilevel-marketing organizations, which focus on the distribution of a product through a network of representatives who earn bonuses. However, the key distinguishing factor between pyramid schemes and multilevel-marketing programs is simple: the source of the bonuses.<sup>269</sup> In legitimate multilevel-marketing programs, there is an actual product market, and therefore bonuses mostly come from product sales to end-consumers who are not part of the program. Conversely, in camouflaged pyramid schemes, bonuses are paid primarily for recruiting new people into the scheme.

The requirement to recruit an ever-growing number of additional players into the pyramid implies that the base of the pyramid will grow exponentially.<sup>270</sup> This process, however, cannot continue indefinitely.<sup>271</sup> Rather, as the population in which the pyramid scheme operates becomes saturated with people who have already been recruited into the scheme, finding additional members becomes increasingly difficult. In line with the general observation that in closed systems exponential growth stops at a certain point,<sup>272</sup> the stream of new recruits dwindles, and the pyramid collapses—leaving the most recent entrants unable to recoup their enrollment fee. The ultimate result is that the vast majority of those who invest in pyramid schemes (by some accounts, over 99%) fail to reach the higher echelons of the program and end up losing significant amounts of money.<sup>273</sup>

Since people fail to appreciate the speed at which exponential functions grow, they also neglect to realize how quickly growth will end. As previously mentioned, in a classic early EGB study using a digital

---

CV-715-SDJ, 2020 WL 6741968 (E.D. Tex. Nov. 16, 2020). For an overview of the distinguishing factors, see *Business Guidance Regarding Multilevel Marketing*, FED. TRADE COMM'N (June 2018), <https://www.ftc.gov/tips-advice/business-center/guidance/business-guidance-concerning-multi-level-marketing> [<https://perma.cc/53BS-5BB6>]; Vander Nat & Keep, *supra* note 264, at 145–50.

269. See Sergio Pareja, *Sales Gone Wild: Will the FTC's Business Opportunity Rule Put an End to Pyramid Marketing Schemes?*, 39 MCGEORGE L. REV. 83, 89 n.37 (2008) (“The overriding characteristic of all pyramid schemes . . . is that most of the money used to pay recruits comes from later recruits to the scheme.”).

270. See Vander Nat & Keep, *supra* note 264, at 141 (observing that “the number of new recruits grows rapidly, often at an exponential rate.”).

271. See, e.g., Pareja, *supra* note 269, at 86–87 (2008) (highlighting the connection between exponential growth and the collapse of pyramids); Vander Nat & Keep, *supra* note 264, at 141–42 (same).

272. See text accompanying *supra* note 32.

273. See JON M. TAYLOR, *THE 5 RED FLAGS: FIVE CAUSAL AND DEFINING CHARACTERISTICS OF PRODUCT-BASED PYRAMID SCHEMES OR RECRUITING MLM'S 3* (2004), <https://www.yumpu.com/en/document/read/30430391/the-5-red-flags-five-causal-and-defining-characteristics-ratbags> [<https://perma.cc/4L6E-YTGC>]; see also Heidi Liu, *The Behavioral Economics of Multilevel Marketing*, 14 HASTINGS BUS. L.J. 109, 112 (2018) (reviewing empirical findings on large losses of participants in pyramid schemes).

simulation, Wagenaar and Han Timmers asked subjects to estimate the speed at which a pond would be filled to capacity by duckweed that is growing exponentially.<sup>274</sup> Even though participants in this study could clearly observe that exponential growth was constrained by the size of the pool, they did not appreciate the speed with which the pool would be filled by the duckweed.<sup>275</sup>

More recently, behavioral economists have directly examined people's decisionmaking in a pyramid game in a stylized experimental setting.<sup>276</sup> Participants in the study were offered to join a pyramid game that simulated a four-tier airplane game, in which each participant was required to recruit three more players into the pyramid. The experiment was incentive-compatible, and participants needed to pay \$5 to join the pyramid. Joining the game entailed a 1% chance of winning \$10 and a 99% chance of winning \$1 (i.e., for a net loss of \$4) given the parameters of the game. Notably, the experimenters presented participants with complete and accurate information about the rules of the game, the number of participants who have already joined, and the size of the population in which the game can spread. Moreover, participants were not subjected to any form of aggressive marketing, as is often the case with real pyramid schemes,<sup>277</sup> and half of them were even clearly advised to "think carefully about your odds of winning each option before choosing."<sup>278</sup>

In these somewhat idealized conditions, 44.2% of the participants chose to pay to join the pyramid scheme.<sup>279</sup> Apparently, some subjects did not comprehend how many more players they would be competing against in the pyramid, while others could not properly calculate how many people they would have to recruit into the pyramid to achieve Pilot status. Interestingly, however, even among those who properly understood the scope of competition that they faced and correctly calculated the number of people they would have to recruit, only one third managed to correctly assess their probability of success in the game.<sup>280</sup> The others failed to foresee just how quickly the population of potential entrants would dry up.

---

274. See Wagenaar & Timmers, *supra* note 31, at 241–45 (describing experiment 1).

275. *Id.* at 244; see also Wagenaar & Sagaria, *supra* note 2, at 416–17 (showing that people significantly underestimate the time in which pollution will reach a given threshold).

276. See Stacie A. Bosley, Marc F. Bellemare, Linda Umwalia & Joshua Yorka, *Decision-Making and Vulnerability in a Pyramid Scheme Fraud*, 80 J. BEHAV. & EXPERIMENTAL ECON. 1 (2019).

277. See Liu, *supra* note 273, at 123–26 (2018) (describing recruitment events).

278. Bosley et al., *supra* note 276, at 3.

279. *Id.* at 5.

280. *Id.* at 6.

Contrary to the experimental setting, in the real-world people do not ordinarily have complete information about the size of the population in which the scheme can grow and the number of people who have already joined it. Information problems and other cognitive phenomena, such as overoptimism, might therefore exacerbate the impact of the EGB.<sup>281</sup> Unsurprisingly, some attention has been drawn to the possibility of extending the disclosure duties imposed on pyramid organizers.<sup>282</sup> But if people fail to appreciate exponential growth, providing them with more information is unlikely to fix the problem.<sup>283</sup> Given the complexity of the compensation structure in many pyramid schemes,<sup>284</sup> carefully crafted disclosures may ultimately be truthful, yet not very useful.<sup>285</sup> Indeed, emphasizing disclosure may even turn out to be counterproductive, as it will enable sophisticated pyramid organizers to shield themselves from legal liability. This echoes the general concerns over the limited effectiveness of mandated disclosure as a means of overcoming entrenched cognitive biases.<sup>286</sup>

The insight that the EGB impairs people's decisionmaking with respect to pyramid schemes can shed new light on the ongoing legal debate over how such schemes should be treated.<sup>287</sup> In the United States, pyramid schemes are currently governed by a complex web of regulation. At the federal level, there is no anti-pyramid-scheme statute.<sup>288</sup> Rather, enforcement is built mostly upon the existing legal framework that empowers the FTC and the SEC.<sup>289</sup> The FTC generally targets pyramid schemes based on Article 5 of the FTC Act, which prohibits "unfair or deceptive acts or practices in or affecting

---

281. See *supra* notes 52–56 and accompanying text (discussing the interaction between the EGB and other behavioral phenomena).

282. See Pareja, *supra* note 269, at 105–19 (analyzing proposed FTC rules enhancing disclosure); Liu *supra* note 273, at 122–27, 134–35 (presenting a behavioral analysis of disclosure in the context of pyramids and calling for a simplified disclosure regime).

283. See Pareja, *supra* note 269, at 107 (arguing that disclosure alone is unlikely to stop pyramid schemes).

284. See, e.g., *FTC v. BurnLounge, Inc.*, 753 F.3d 878, 882 (9th Cir. 2014) (describing the bonus program).

285. See Pareja, *supra* note 269, at 95–96 (highlighting how pyramid operators may circumvent disclosure limitations regarding expected earnings).

286. See *supra* notes 148, 166 and 252 and accompanying text.

287. Consistent with the lack of attention to the EGB in other contexts, legal scholars have not examined its relevance to pyramid schemes. The most recent comprehensive legal article dedicated to a behavioral analysis of pyramid schemes makes no reference to the EGB. See Liu, *supra* note 273.

288. See Matthews, *supra* note 267, at 2059.

289. See Pareja, *supra* note 269, at 89–103. The Department of Justice may also prosecute pyramid schemes that engage in mail fraud or money laundering, though such cases are relatively rare. See *id.* at 103–04.

commerce.”<sup>290</sup> The SEC similarly engages in enforcement activity against pyramid schemes on the theory that such schemes are securities whose sale involves prohibited deceptive practices.<sup>291</sup> Thus, federal enforcement hinges mostly on proof of fraud or deception.<sup>292</sup> At the state level, while some states follow the federal framework and focus on fraud and deception, others have enacted specific anti-pyramid-scheme statutes that ban the practice altogether.<sup>293</sup>

The overall success of these legal measures is limited.<sup>294</sup> According to one study, between 1997 and 2005 the FTC received 17,858 complaints against pyramid schemes—yet between 1990 and 2006, it prosecuted only twenty such cases.<sup>295</sup> While this inaction may be due to a variety of factors, one key issue is the need to prove fraud or deception. The need for a detailed case-by-case analysis of recruitment events hinders enforcement efforts.<sup>296</sup> The lack of meaningful federal enforcement on this front is important, since state regulation cannot offer an adequate response to pyramid schemes, given the mobility of such programs across state lines.<sup>297</sup>

The focus of federal law on deception in the context of pyramid schemes seems unwarranted. The findings on the EGB imply that many people systematically err when faced with a pyramid scheme, even if they are presented with complete and accurate information.<sup>298</sup> Thus, the key problem in pyramid schemes lies in their very structure and in how they prey on people’s systematic tendency to underestimate the

---

290. 15 U.S.C. § 45(a)(1). For an overview of the legal framework under the FTC Act, see Pareja, *supra* note 269, at 89–96.

291. 15 U.S.C. § 77x. For an overview of the legal conditions for SEC enforcement, see Pareja, *supra* note 269, at 96–103.

292. See Pareja, *supra* note 269, at 95, 97 (noting that the only way to prosecute a pyramid scheme under the FTC Act “is to prove that a company has misrepresented its earnings potential,” and that “almost all [SEC] cases involve claims of materially false or misleading statements”).

293. For an overview, see DEE PRIDGEN & RICHARD M. ALDERMAN, CONSUMER PROTECTION AND THE LAW § 3:14 (2019).

294. See Matthews, *supra* note 267, at 2058 (“FTC enforcement actions charging unfair and deceptive practices have thus far not proved especially effective at deterring pyramid scheme formation.”).

295. Pareja, *supra* note 269, at 94. To be sure, numerous complaints may refer to a single scheme. And yet, the FTC’s activity in this sphere appears to be very limited.

296. See Matthews, *supra* note 267, at 2062 (proving misrepresentation by a scheme “is a highly fact-intensive process that requires significant agency resources”); Pareja, *supra* note 269, at 94 (observing that “[b]ecause gathering evidence of ‘unfair’ or ‘deceptive’ acts is extremely difficult, the FTC does not use this provision frequently”).

297. See Matthews, *supra* note 267, at 2061 (noting that on the whole, state-level regulation “is not a particularly effective tool for combatting this national problem”); Pareja, *supra* note 269, at 105 (arguing that there is a “need for a comprehensive federal rule”).

298. In actuality, participants are “never told on which level they are entering the pyramid,” and they are therefore even less aware of how close the scheme is to its saturation point. See Witiw, *supra* note 267, at 1637.

speed with which they will collapse, due to the EGB.<sup>299</sup> Accordingly, the Unfair Commercial Practices Directive of the European Union bans pyramid schemes altogether.<sup>300</sup> As noted, some states have taken the same route in the United States.<sup>301</sup> This policy appears to be well founded.

## CONCLUSION

This Article introduced the first comprehensive analysis of the EGB in legal scholarship. It highlighted numerous examples in which the law interacts with exponential processes and examined the normative and policy implications of people's systematic tendency to underestimate exponential growth. The Article highlighted the role of the EGB in governmental failures to respond promptly to risks involving exponential growth, such as pandemics and climate change. This systematic tendency to react slowly requires the design of new institutions and decisionmaking processes that will help promote effective legal policymaking. In addition, the Article showed that the EGB might cause individuals to systematically err when making critical decisions, such as when to begin saving for retirement and how much to save. This insight suggested that there is a need for a new generation of disclosure duties, which will help people make better decisions in situations involving exponential growth. Additionally, this discussion demonstrated the necessity of new mandatory rules geared toward banning abusive practices that prey on people's misperception of exponential phenomena.

Given the large gap in both the behavioral economics and the legal scholarships with regard to the EGB, there is room for substantially more research in the area. On the behavioral side, empirical studies should deepen our understanding of questions, such

---

299. See, e.g., Bosley et al., *supra* note 276, at 2 (noting that “[t]he exponential structure [of the pyramid] is designed to pass money from losers to winners”); Matthews, *supra* note 267, at 2055 (arguing that “[p]yramids are deliberately designed to grow exponentially” and consequently “the large majority of participants lose money simply because they enter the scheme after it has already become unsustainable”); Pareja, *supra* note 269, at 96 (“[I]t is mathematically impossible for later participants to earn large profits because of the exponential number of new recruits needed to sustain a profit.”).

300. See Directive 2005/29, of the European Parliament and of the Council of 11 May 2005 Concerning the Unfair Business-to-Consumer Commercial Practices in the Internal Market, annex I(14), 2005 O.J. (L 149) 36.

301. See PRIDGEN & ALDERMAN, *supra* note 293, § 3:14. For example, the Oregon Court of Appeals explicitly rejected the theory that proof of deception or misrepresentation is required, on the grounds that the scheme itself is “inherently deceptive.” *Nielson v. Myers*, 90 P.3d 628, 634 (Or. Ct. App. 2004).



as: which model best captures people's understanding of exponential phenomena; are different groups of the population disparately affected by the EGB; and what, if any, are the treatments that can effectively debias the EGB? On the legal side, future research should continue to map various domains of the law in which exponential growth affects people's choices and evaluate potential interventions.

Humanity's experience with the COVID-19 pandemic caused exponential growth to become a household term. Consequently, we suspect that the number of legal studies dealing with exponential processes will grow exponentially. And just as epidemiologists have developed robust models of exponential viral spread over the years, jurists aiming to create sensible legal policies with respect to situations involving exponential growth should be required to come to the table with accurate models of human behavior in such settings and creative ideas about the necessary legal response.