

THE EXPONENTIAL GROWTH BIAS: MATHEMATICS, PSYCHOLOGY, AND LAW

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1. INTRODUCTION

According to an ancient legend, the ruler Shirhām was full of joy and admiration when presented with the game of Chess. To show his gratitude, he offered the inventor, Sissa Ibn Dāhir, 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, 64th 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.¹

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¹ 3 IBN KHALLIKAN'S BIOGRAPHICAL DICTIONARY, part 1 71–72 (William MacGuckin De Slane trans., Oriental Translation Fund of Great Britain and Ireland, 1845). The total amount of grains is 18,446,744,073,709,551,615.

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 growth of bacterial cultures and 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 have examined this phenomenon since the 1970s. For example, one experimental study of people’s estimations of exponential growth found that 90% of the participants gave estimates that were less than half the correct answer; and two-thirds gave estimates that were less than one-tenth of the correct answer.²

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.³ However, despite its direct relevance to several pressing legal issues, the exponential growth *bias* has hardly been mentioned—let alone analyzed systematically—in the legal scholarship.⁴ Thus, for example, in his seminal, behaviorally informed studies of consumer credit, Oren Bar-Gill discusses various cognitive biases—including hyperbolic discounting and over-optimism—but not the EGB.⁵ 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

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

³ See, e.g., James M. Chen, *Leaps, Metes, and Bounds: Innovation Law and Its Logistics*, 2015 MICH. ST. L. REV. 845 (discussing various models of exponential growth and their relevance to innovation law); Robert D. Cooter & Uri Y. Hacothen, *Progress in the Useful Arts: Foundations of Patent Law in Growth Economics*, 22 YALE J.L. & TECH. 191 (2020) (discussing the exponential 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. POL’Y 125, 166–67 (2015) (discussing teaser rates and the EGB); 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); Peter H. Huang, *Boost: Improving Mindfulness, Thinking, and Diversity*, 10 WM. & MARY BUS. L. REV. 139, 176 (2018) (same). A more substantive discussion (about one-page long) of the EGB in the narrow context of consumer credit can be found in 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 in a particular context. 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 OREN BAR-GILL, *SEDUCTION BY CONTRACT* 176 & n.125 (2012) (hereinafter BAR-GILL, *SEDUCTION BY CONTRACT*) (citing an early version of 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 an earlier version of Victor Stango & Jonathan Zinman, *Exponential Growth Bias and Household Finance*, 64 J. FIN. 2807 (2009) (hereinafter – Stango & Zinman, *Exponential Growth Bias*)); Oren Bar-Gill & Elizabeth Warren, *Making Credit Safer*, 157 U. PA. L. REV. 1, 25 n.44 (2008) (citing Stango & Zinman, *Exponential Growth Bias*, and mentioning consumers’ EGB in the context of consumers’ failure to seek advice).

our own).⁶ 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.⁷ Be that as it may, this Article aims to fill this large and surprising gap in legal scholarship.

The EGB adversely affects decision-making 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 appreciate the scope of the threat they face and fail to respond promptly. A key example of the adverse effect of the EGB on governmental decision-making 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.⁸ Less dramatic, but not less important, some of the processes that contribute to global warming are non-linear and involve feedback effects that accelerate temperature change. The current failure of the legal system to adequately respond to the threat of climate change, might be driven by an underestimation of the threat posed.⁹ As for individuals' decision-making, 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,¹⁰ and make suboptimal decisions regarding saving for their post-work years.¹¹ Such imprudent decisions may significantly diminish individual welfare, and may even have macro-level and global ramifications, as in the case of the 2007-08 subprime mortgage crisis.¹²

Legal policymakers around the world have long struggled with these issues, and an immense body of legal scholarship has discussed the causes, social ramifications, and existing and potential tools for improving the situation. Paying heed to the EGB sheds new light on the legal measures that are already in use, and highlights new ways to alleviate these problems. In the sphere of governmental and transnational policymaking, intuitive and "holistic" judgments by laypersons (including politicians) should be replaced or complemented by structured decision processes that rely on empirical evidence and use mathematical models and computer-based decision-support systems. In the sphere of individual decision-making, the focus on the EGB calls for the introduction of new disclosure duties that could assist people in overcoming this bias. For example, whenever

⁶ These include, in chronological order, Behavioral Law and Economics (Cass R. Sunstein ed., 2000); Richard H. Thaler & Cass R. Sunstein, *Nudge: Improving Decisions About Health, Wealth, and Happiness* (rvsd. ed. 2009); *The Behavioral Foundations of Public Policy* (Eldar Shafir ed., 2013); *The Oxford Handbook of Behavioral Economics and the Law* (Eyal Zamir & Doron Teichman eds., 2014); *Nudges 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").

⁸ See *infra* Section 3.2.

⁹ See *infra* Section 3.3.

¹⁰ See *infra* Section 4.1.

¹¹ See *infra* Section 4.2.

¹² On the personal and social costs of overconsumption of credit, see generally Robert D. Manning, *Credit Card Nation: The Consequences of America's Addiction to Credit* (2000); Teresa A. Sullivan, Elizabeth Warren & Jay Lawrence Westbrook, *The Fragile Middle Class: Americans in Debt* (2020). On the subprime mortgage crisis, see generally RICHARD A. POSNER, *A FAILURE CAPITALISM: THE CRISIS OF '08 AND THE DESCENT INTO DEPRESSION* (2009).

possible, it is preferable to provide information on the actual dollar cost of financial products, rather than on the interest, which requires further computation. Furthermore, sometimes, 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 advisable 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.¹³

The Article proceeds as follows. After this brief introduction, Part 2 sets the stage by explaining the mathematical notion of exponential growth and the psychological phenomenon of the EGB. Part 3 then examines how the EGB adversely affects the design of legal policies dealing with exponential phenomena, and explores ways to counteract its harmful effect, with particular focus on pandemics and global warming. Part 4 analyzes the ramifications of the EGB for individuals' decision-making and possible corrective measures, focusing on several key issues, such as excessive consumer borrowing, insufficient savings for retirement, and participation in pyramid schemes. Finally, Part 5 concludes and highlights potential paths for future research.

2. APPLIED MATHEMATICS AND COGNITIVE PSYCHOLOGY

2.1. 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 five 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 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...

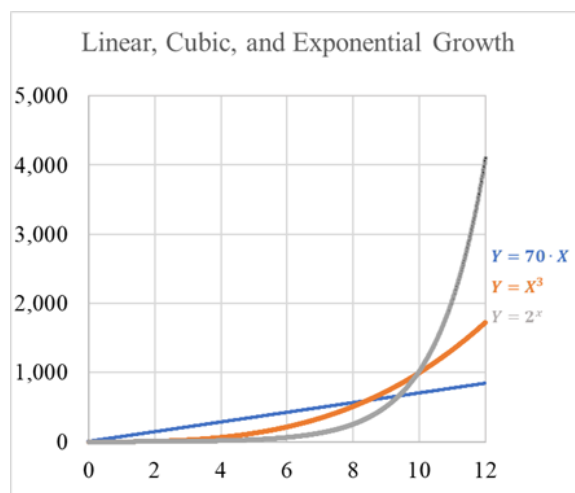
In other cases, the growth might accelerate over time, and is best represented by a polynomial function in which the highest power is greater than 1. For example, a quantity may be proportional to the square of the function argument— $f(x) = x^2$ (or, more generally, $f(x) = ax^2 + bx + c$). In this example of a quadratic function, if $a = 1$, and both b and c equal 0, the series would be 1, 4, 9, 16, 25.... Such a function might possibly describe the daily output of a production unit if, thanks to increasing expertise, the produced quantity increases every day.

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 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.¹⁴ Most significantly, as the figure below illustrates, exponential growth tends to surpass both polynomial and linear growth. The figure also illustrates that

¹³ See *infra* notes [175–179](#), [201](#), and accompanying text.

¹⁴ 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).

at the beginning of the process, exponential growth tends to appear deceptively slower than other types of growth.



Exponential growth functions approximate—or at least serve as a first approximation of—a large range of physical, chemical, biological, medical, economic, and social phenomena. These include nuclear chain reactions;¹⁵ the growth of bacterial cultures;¹⁶ the development of a fertilized egg into a baby during pregnancy;¹⁷ the spread of contagious diseases;¹⁸ the spread of technological innovations and of economic growth induced by innovation;¹⁹ the effect of compound interest on loans and savings;²⁰ the spread of videos on the internet;²¹ and more.²²

¹⁵ Carey Sublette, *Nuclear Weapons Frequently Asked Questions (NWFAQ)*, Sec. 2.0: Introduction to Nuclear Weapon Physics and Design, in THE NUCLEAR WEAPON ARCHIVE: A GUIDE TO NUCLEAR WEAPONS (updated Feb. 20, 2019), available at: <http://nuclearweaponarchive.org/Nwfaq/Nfaq2.html>.

¹⁶ Jacques Monod, *The Growth of Bacterial Cultures*, 3 ANN. REV. MICROBIOLOGY 371 (1949) (reviewing the early research on the subject).

¹⁷ Krzysztof Dudek et al., *Mathematical Modelling of The Growth of Human Fetus Anatomical Structures*, 92 ANATOMICAL SCI. INT'L 521 (2017) (examining the adequacy of various growth functions for modeling fetal development).

¹⁸ Gerardo Chowell et al., *Mathematical Models to Characterize Early Epidemic Growth: A Review*, 18 PHYSICS OF LIFE REV. 66 (2016) (reviewing various mathematical models that capture the early stages of the transmission of pathogens); Solomon Hsiang et al., *The Effect of Large-Scale Anti-Contagion Policies on the COVID-19 Pandemic*, 584 NATURE 262 (2020) (empirically evaluating the effect of anti-contagion policies).

¹⁹ See Chen, *supra* note 3 (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).

²⁰ W.D. WALLIS, MATHEMATICS IN THE REAL WORLD 208–14 (2013) (explaining how compound interest is calculated). See also *infra* Sections 4.1 (loans) and 4.2 (savings).

²¹ For an analysis of the role of emotional response and video source on the likelihood of videos “going viral,” see Rosanna E. Guadagno et al., *What Makes a Video Go Viral? An Analysis of Emotional Contagion and Internet Memes*, 29 COMPUTERS HUM. BEHAV. 2321 (2013).

²² See, e.g., Catherine Picart et al., *Molecular Basis for the Explanation of the Exponential Growth of Polyelectrolyte Multilayers*, 99 PROC. NAT'L ACAD. SCI. (USA) 12531 (2002) (describing the progressive formation of micrometer-thick films through the alternating dipping of a charged surface into different solutions); Frank Thorn, Jane Gwiazda & Richard Held, *Myopia Progression is Specified by a Double Exponential Growth Function*, 82 OPTOMETRY & VISION SCI. E286 (2005) (demonstrating that a double exponential growth function describes the progression of myopia in children).

To be sure, the question of whether a given growth dynamic is actually exponential—as opposed to, say, polynomial—is often debated.²³ 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.²⁴ For example, in closed systems, exponential growth does not continue indefinitely. Rather, it stops at a certain point; or corresponds to an S-shape (sigmoidal) function;²⁵ or goes through different phases, such as exponential growth, retardation, stationary, and decline.²⁶ 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 declines.²⁷

Nevertheless, the basic notion of exponential growth is key to understanding a whole host of situations. It follows that 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.

2.2. Exponential Growth Bias

Behavioral research of people’s misperception of exponential growth—the so-called *exponential growth bias* (EGB)—dates back to the 1970s. In a seminal study, William Wagenaar and Sabato Sagaria presented participants with indices of air pollution for five consecutive years (e.g., 1970–1974)—either numerically (e.g., 3, 7, 20, 55, and 148) or graphically.²⁸ 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 is 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. The study included numerous variations of this basic design. 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—less than 10% of the correct answer. Moreover, the accuracy of the estimates did not improve when the participants were asked to produce estimates for each of the

²³ See, e.g., MARC GALANTER & THOMAS M. PALAY, *TOURNAMENT OF LAWYERS: THE TRANSFORMATION OF THE BIG LAW FIRM* (1991) (arguing that big law firms grow exponentially); Vincent R. 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 generally 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 Function in Copyright Law*, 59 U. TORONTO L.J. 525, 531 (2009) (describing the diffusion of successful copyright-protected works).

²⁶ See, e.g., Monod, *supra* note 16, at 373–74 (discussing the growth of bacterial cultures). See also *infra* Section 4.3.

²⁷ See generally C. Jessica E. Metcalf, *Understanding Herd Immunity*, 36 TRENDS IN IMMUNOLOGY, 753 (2015).

²⁸ Wagenaar & Sagaria, *supra* note 2.

following five years (rather than for the fifth year only), or when the growth was presented graphically with a curve.²⁹

EGB was similarly evident when the exponential growth was presented not by a numerical series or a curve, but simulated on a computer screen, where 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 more time it would take for the duckweed to cover the entire pond.³⁰ 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.³¹

Subsequent studies, involving various experimental designs, types of participants, and vignettes, have corroborated these findings.³² 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.”³³ As further discussed below, several studies have also found correlations between people’s susceptibility to the EGB and their actual behavior—for example, in the contexts of retirement savings and borrowing.³⁴

Scholars have developed several mathematical models of the EGB—some of which aim to reflect the thought process that induce people to underestimate exponential growth,

²⁹ In fact, presenting the data graphically exacerbated the bias, irrespective of the length-to-width ratio of the graphs. *Id.* at 420–21.

³⁰ Willem A. Wagenaar & Han Timmers, *The Pond-and-Duckweed Problem: Three Experiments on the Misperception of Exponential Growth*, 43 ACTA PSYCHOLOGICA 239 (1979).

³¹ See *infra* Section 4.3.

³² 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. PSYCHOL. 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 Saving Growth: Implications for Savings Behavior*, 48 J. MARKETING RES. 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).

³³ 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 (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, rather than intuitive, mode of thinking. See Shane Frederick, *Cognitive Reflection and Decision Making*, 19 J. ECON. PERSP. 25 (2005) (developing the original, three-item CRT); Maggie E. Toplak, Richard F. West & Keith E. Stanovich, *Assessing Miserly Information Processing: An Expansion of the Cognitive Reflection Test*, 20 THINKING & REASONING 147 (2014) (proposing the seven-item scale).

³⁴ See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5 (finding that more biased households borrow more, save less, and resort to and benefit more from financial advice); Matthew Levy & Joshua Tasoff, *Exponential-Growth Bias and Lifetime Consumption*, 14 J. EUR. ECON. ASS’N 545, 566–67 (2016) (finding that people who display greater EGB accumulate less assets); Gopi Shah Goda et al., *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).

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).³⁵ 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.³⁶ Finally, Matthew Levy and Joshua Tasoff developed a third model of the EGB, which allows for differences between individuals.³⁷ 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; and agents may lie anywhere between these two extremes.³⁸

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, or make the same errors.³⁹ 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.⁴⁰ 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).⁴¹ 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 (which could, however, result in accurate estimates by chance).⁴²

³⁵ Wagenaar & Sagaria, *supra* note 2, at 417, 419–20. *See also* Gregory V. Jones, *A Generalized Polynomial Model for Perception of Exponential Growth*, 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) (adopting Wagenaar & Sagaria's model) (hereinafter – Keren, *Cultural Differences*); 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).

³⁶ Jones, *Perceptions of Inflation*, *supra* note 35.

³⁷ Levy & Tasoff, *supra* note 34, at 549–59.

³⁸ 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 ET AL., *THE ILLUSION OF LINEARITY: FROM ANALYSIS TO IMPROVEMENT* (2007); Dirk De Bock et al., *Improper Use of Linear Reasoning: An In-Depth Study of the Nature and the Irresistibility of Secondary School Students' Errors*, 50 EDUCATIONAL STUD. MATHEMATICS 311 (2002).

³⁹ On individual differences in judgment and decision-making, see generally ZAMIR & TEICHMAN, BLE, *supra* note 6, at 111–14.

⁴⁰ Christandl & Fetchenhauer, *supra* note 32, at 388–91.

⁴¹ A similar result was obtained in a survey of a sample of U.S. population. *See* Levy & Tasoff, *supra* note 34, at 547, 548, 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 34, at 564–65 (reporting that 15% of the participants in their survey belonged to this group). In fact, in several studies conducted by Christandl and Fetchenhauer (*supra* note 32, at 388) in the context of forecasting economic growth, the mean estimation for a 5% annual growth over five years was lower than 125%—

Various factors affect the accuracy of people's predictions of exponential growth. One such factor is the saliency of the change. Thus, it was 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.⁴³ Making the change more salient does not even require 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).⁴⁴

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.⁴⁵ Relatedly, it has been found that in the context of inflation, Israelis made better estimates of exponential growth than Canadians—possibly owing to the former's experience with hyper-inflation, which provided them with continuous feedback.⁴⁶

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.⁴⁷ Another study found no association between people's EGB and their age, race, or education.⁴⁸ In some studies (but not others), female participants exhibited a more pronounced EGB than their male counterparts.⁴⁹ 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.⁵⁰ Finally, one study found an inverse relationship between exhibited EGB and people's IQ and higher education.⁵¹

The extent to which people display the EGB is influenced by other biases, such as *motivated reasoning* and the *confirmation bias*.⁵² Such influences may explain, for

below the linear growth. As the authors concede, however, this result may reflect participants' familiarity with the real world, where economic growth seldom endures for many years.

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

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

⁴⁵ Christandl & Fetchenhauer, *supra* note 32, at 383–85.

⁴⁶ Keren, *Cultural Differences*, *supra* note 35.

⁴⁷ Goda et al., *supra* note 34, at 1653.

⁴⁸ Levy & Tassof, *supra* note 34, at 549, 566.

⁴⁹ *See, e.g.*, Christandl & Fetchenhauer, *supra* note 32, at 385–88 (finding such difference); Levy & Tassof, *supra* note 34, at 566, 578 (finding no such difference); Goda et al., *supra* note 34, at 1646 & Table B.3 in the supplementary online appendix (stating that women exhibited greater EGB, but according to the table, this result was not even marginally statistically significant).

⁵⁰ Christandl & Fetchenhauer, *supra* note 32, at 385–88. On the *Need for Cognition* scale, see generally John T. Cacioppo & Richard E. Petty, *The Need for Cognition*, 42 J. PERSONALITY & SOC. PSYCHOL. 116 (1982).

⁵¹ Goda et al., *supra* note 34, Table B.3 in the supplementary online appendix. No statistically significant association was found in this study between the EGB and ethnicity.

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 generally* ZAMIR & TEICHMAN, BLE, *supra* note 6, at 58–61 (summarizing the literature).

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.⁵³ Importantly, notwithstanding the fact that the EGB may exacerbate the effect of other cognitive limitations and biases (such as myopia, bounded willpower, and procrastination),⁵⁴ the EGB must not 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 (including investing in housing, borrowing, and bankruptcy filing) found that while both biases affect some of those aspects, only one of them is correlated with others.⁵⁵ As further discussed below, distinguishing between the EGB and other phenomena is important, because they may each warrant different interventions.⁵⁶

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.⁵⁷ Monetary incentives to make correct estimations have also failed to mitigate the EGB.⁵⁸ 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.⁵⁹

In the last study, in a bid to enhance the external validity of the findings, the participants were allowed to use any decision aid—including pencil and paper, calculators, and spreadsheets—which many of them actually did.⁶⁰ Even then, however, the EGB was not eliminated. 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.⁶¹ However, another study suggests that using a computer-based, decision-support system may somewhat mitigate the EGB.⁶²

Another potential debiasing technique is to provide people with feedback on their estimations. Wagenaar and Sagaria found that giving people feedback and guiding them

⁵³ Joris Lammers, Jan Crusius & Anne Gast, Correcting Misperceptions of Exponential Coronavirus Growth Increases Support for Social Distancing, 117 PROC. NAT'L. ACAD. SCI. USA 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 and 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 34, 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 34, at 565) nor Goda et al. (*supra* note 34, Table B.3 in the supplementary online appendix) replicated this result.

⁵⁶ See Goda et al., *supra* note 34, at 1637 (explaining that while pre-commitment measures may mitigate procrastination on retirement savings, it may actually exacerbate the harmful effects of the EGB); *infra* subsection 4.2.2 and text accompanying notes [164–179](#).

⁵⁷ Wagenaar & Sagaria, *supra* note 2, at 420–21; Levy & Tasoff, *supra* note 34, at 560–61, 569.

⁵⁸ Christandl & Fetchenhauer, *supra* note 32, 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 34, at 1641.

⁶⁰ *Id. id.*

⁶¹ McKenzie & Liersch, *supra* note 32, at S3–S4.

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

about the EGB increases their accuracy in an estimation task they performed immediately thereafter.⁶³ 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.⁶⁴ However, in real-life contexts, 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.⁶⁵

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.⁶⁶ 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.⁶⁷ 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 impact in the long run.⁶⁸

The above survey of the behavioral research on the EGB is far from exhaustive. Among other things, we did not describe studies that compared estimations of exponential growth with estimations of *exponential decline*,⁶⁹ nor the literature that compared the performance of children of various ages and adults.⁷⁰ Neither have we discussed closely related phenomena, such as people's difficulties in estimating the magnitude of expressions of the type a^n (such as 9^5 or 5^9),⁷¹ or the so-called *MPG illusion* (people's failure to understand the difference between describing fuel efficiency in terms of miles per gallon, versus gallons per 100 miles, and such like).⁷² Nonetheless, this survey should suffice in laying the groundwork for examining the legal implications of this prevalent bias.

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 32, at 385–88. On cognitive biases and expertise, see generally ZAMIR & TEICHMAN, BLE, *supra* note 6, at 114–17 (2018).

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*, 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 & MARKETING 66 (2013).

⁶⁹ See, e.g., Han Timmers & Willem A. Wagenaar, *Inverse Statistics and Misperception of Exponential Growth*, 21 PERCEPTION & PSYCHOPHYSICS 558 (1977); Mirjam Ebersbach et al., *Forecasting Exponential Growth and Exponential Decline: Similarities and Differences*, 127 ACTA PSYCHOLOGICA 247 (2008).

⁷⁰ See, e.g., Ebersbach et al., *supra* note 69.

⁷¹ Munoz Sastre & Mullo, *supra* note 33.

⁷² Richard P. Larrick & Jack B. Soll, *The MPG Illusion*, 320 SCI. 1593 (2008) (demonstrating that people falsely believe that the amount of gasoline consumed by a car decreases as a linear function of its MPG, when in fact the relationship is curvilinear).

Before proceeding to this examination—first in the context of policymaking and then in the sphere of individuals’ decision-making—it should be noted 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 $f(x) = x^4$, which produces the series 1, 16, 81, 256, 625...). Insofar as this is true, the following discussion may possibly be relevant to other contexts, as well. However, given the scarcity of behavioral studies of such misperceptions, we shall focus on phenomena involving exponential growth.

3. COUNTERACTING POLICYMAKERS’ BIAS

Having presented the concept of exponential growth and the psychological phenomenon of exponential growth bias in Part 2, 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 the design of legal policies, and draws some tentative normative conclusions. The primary examples to be analyzed are pandemics and global warming.

3.1. Behavioral Public Choice Theory and the Exponential Growth Bias

The research that behavioral law and economics is founded on focuses mostly on the decisions made by individuals. And while some behavioral research has examined decisions made in small groups,⁷³ the methods used by behavioral research are generally unsuitable for studying decision-making in large institutional settings, such as the administrative state.⁷⁴ Research on the EGB is no exception in this regard: all of the behavioral studies reviewed in this Article examined individual decision-making.⁷⁵

Nonetheless, recent studies in the field of behavioral public choice theory have applied insights from behavioral economics to the decisions made by states.⁷⁶ This body of work

⁷³ See e.g., ZAMIR & TEICHMAN, BLE, *supra* note 6, at 120–24 (reviewing the behavioral literature on group decision-making).

⁷⁴ Samuel Issacharoff, *Behavioral Decision Theory in the Court of Public Law*, 87 CORNELL L. REV. 671, 671–73 (2001); William N. Eskridge, Jr., & John Ferejohn, *Structuring Lawmaking to Reduce Cognitive Bias: A Critical View*, 87 CORNELL L. REV. 616, 620–21 (2002).

⁷⁵ See *supra* Section 2.2. 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.

⁷⁶ 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); W. Kip Viscusi & Ted Gayer, *Behavioral Public Choice: The Behavioral Paradox of Government Policy*, 28 HARV. J.L. & PUB. POL’Y 973, 988–96 (2015).

has highlighted two channels in which heuristics and biases may affect policy decisions.⁷⁷ First, political decision-makers, 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.⁷⁸ 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 (note 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.”⁷⁹

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. It is worth noting at the outset that the EGB is clearly not the single driving force in any of the cases reviewed below. Nonetheless, examining these cases in light of the EGB can enhance our understanding of the complex political decision-making process that results in legal change.

3.2. Exponential Growth Bias and Legal Policymaking: Applications

This section turns to explore the impact of the EGB in concrete contexts. A salient recent 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 province of Wuhan.⁸⁰ Given its highly contagious nature, it spread at an exponential rate.⁸¹ At the

⁷⁷ See Doron Teichman & Eyal Zamir, *Nudge Goes International*, 30 EUR. J. INT’L L. 1263, 1266–67 (2020). See also Gary M. Lucas, Jr. & Slaviša Tasić, *Behavioral Public Choice and the Law*, 118 W. VA. L. REV. 199, 204–17 (2015).

⁷⁸ *Id.* at 408 (reviewing findings on politicians’ irrationality).

⁷⁹ The opening line of Bartlett’s lecture, *Arithmetic, Population and Energy* (1969), available at: https://www.youtube.com/watch?v=s11C9DyIi_8.

⁸⁰ See Peng Zhou et al., A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin, 579 NATURE 270, 270 (2020).

⁸¹ 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).

time of writing of this Article, the global death toll of the pandemic has surpassed three million lives.⁸²

Generally speaking, countries were late to respond to the spread of the coronavirus in early 2020.⁸³ While many factors probably drove this late response,⁸⁴ in all likelihood the delay was in part due to peoples' underestimation of the risk posed by a deadly virus spreading at an exponential rate.⁸⁵ As a result of this underestimation, politicians were reluctant to adopt the necessary legal measures needed to stop the spread of the virus, despite clear recommendations by public health experts to act swiftly. At the federal level, President Trump repeatedly focused on the low numbers of confirmed cases in the initial stages of the pandemic, while downplaying the risks it posed, concluding that "everything's going to be great."⁸⁶ 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."⁸⁷ The tendency of politicians to act slowly in the face of clear expert advice was also evident in administrations that eventually took a more aggressive stance toward the virus. 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.⁸⁸

Despite the short time that has lapsed since the outbreak of COVID-19, numerous empirical studies have already documented the effect of the EGB on how people perceive the pandemic's risks.⁸⁹ 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."⁹⁰ As a result, they underestimated the actual growth rate of the virus by 45.7%.⁹¹ The study also documented a link between the EGB and peoples' attitude toward public health policies. When participants' EGB was mitigated (by instructing them to calculate the growth rate of the virus in five intermediate

⁸² See Roshan Abraham & Anurag Mann, *Global COVID-19 Death Toll Surpasses 3 Million Amid New Infections Resurgence*, REUTERS, 6 April 2021. <https://www.reuters.com/article/us-health-coronavirus-global-casualties-idUSKBN2BT0V9>.

⁸³ Lammers, Crusius & Gast, *supra* note 53, at 16264 (2020) (noting that a "sizeable opposition among politicians and the general population has delayed, prevented, or terminated early measures to increase social distancing").

⁸⁴ See Doron Teichman & Kristen Underhill, *Infected by Bias: Behavioral Science and the Legal Response to COVID-19*, __ AM. J. L. & MED __, __ (2021) (reviewing the different behavioral phenomena that impacted the COVID-19 policy debate).

⁸⁵ Howard Kunreuther & Paul Slovic, *Learning from the COVID-19 Pandemic to Address Climate Change*, 1 MGMT. & BUS. REV. 92, 93 (2021) (noting that "[o]ne of the reasons that the general public and key decision makers largely ignored the coronavirus in January or February is that they failed to appreciate the looming menace of its exponential growth").

⁸⁶ 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).

⁸⁷ *Id.* at 507.

⁸⁸ See David Goodman, *How Delays and Unheeded Warnings Hindered New York's Virus Fight*, N. Y. TIMES, April 8, 2020, <https://www.nytimes.com/2020/04/08/nyregion/new-york-coronavirus-response-delays.html>.

⁸⁹ See Lammers, Crusius & Gast, *supra* note 53; Ritwik Banerjee et al., *Exponential-Growth Prediction Bias and Compliance With Safety Measures Related to COVID-19*, 268 SOC. SCI. MED. (2021); Alexander Podkul et al., *Understanding Exponential Growth Amid Pandemic: An International Perspective* (August 1, 2020), <https://www.raymond duch.com/files/understanding-exponential-growth-amid-pandemic.pdf>; Ritwik Banerjee & Priyama Majumdar, *Exponential Growth Bias in the Prediction of COVID-19 Spread and Economic Expectation*, SSRN (September 9, 2020), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3687141.

⁹⁰ Lammers, Crusius & Gast, *supra* note 53, at 16265.

⁹¹ *Id.*

steps of 3 days, rather than in one step of 15 days),⁹² their support for social distancing measures and a lockdown grew significantly.⁹³

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, 56.5% of reported infections, and 54.0% of reported deaths, as of May 3, 2020, could have been avoided.⁹⁴ 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 31st, while delaying the measures by a week could have increased the number of confirmed cases to 1,407,600.⁹⁵

Another context in which policymaking may be affected by the EGB is climate change. Climate change is thought to be “the single greatest threat that societies face.”⁹⁶ Global warming is projected to have dire consequences on multiple fronts—including human health, the environment, economic growth, and food security.⁹⁷

A voluminous body of legal scholarship has been dedicated to climate change.⁹⁸ 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 the EGB.⁹⁹ 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.¹⁰⁰ Many of these processes are non-linear, and entail feedback effects that amplify temperature change.¹⁰¹ Furthermore, some of the economic consequences of climate change are non-linear.¹⁰² However, unlike the COVID-19 pandemic, in which exponential growth is measured in

⁹² *Id.*

⁹³ *Id.* at 16266.

⁹⁴ See Sen Pei, Sasikiran Kandula & Jeffery Shaman, *Differential Effects of Intervention Timing on COVID-19 Spread in the United States*, MEDRXIV (May 29, 2020), <https://www.medrxiv.org/content/10.1101/2020.05.15.20103655v2>.

⁹⁵ Oguzhan Alagoz, 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, 9 FRONTIERS IN PHYSICS Article 650943 (2021) (discussing the ramifications of the exponential character of the spread of the coronavirus for legal policymaking).

⁹⁶ James Gustave Speth, *The Single Greatest Threat*, 27 HARV. INT’L REV. 18, 18 (2005).

⁹⁷ For an overview, see Ove Hoegh-Guldberg et al., *Impacts of 1.5°C Global Warming on Natural and Human Systems*, in: GLOBAL WARMING OF 1.5°C 175, 177–81 (Valérie Masson-Delmotte et al. eds., 2018).

⁹⁸ For book-long treatments of the topic, see 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).

⁹⁹ See Jeffrey J. Rachlinski, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299 (reviewing the various psychological phenomena that impede the response to the threat of climate change).

¹⁰⁰ See Ulrich Cubasch et al., *Introduction*, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 119, 123–30 (Thomas F. Stocker et al. eds., 2013) available at https://www.ipcc.ch/site/assets/uploads/2017/09/WG1AR5_Chapter01_FINAL.pdf.

¹⁰¹ *Id.* at 127.

¹⁰² 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).

days, climate processes are unfolding at a much slower rate.¹⁰³ Consequently, the public may fail to grasp the scope of the threat, and is unwilling to incur the necessary costs associated with preventing it. As Howard Kunreuther and Paul Slovic recently noted, “our failure to appreciate the exponential growth of climate-destroying processes has caused political leaders to resist acting to reduce carbon dioxide (CO₂) emissions.”¹⁰⁴ And much as in the case of COVID-19, postponing critical legislation is expected to increase the future costs of climate change.¹⁰⁵

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 grows out of control.¹⁰⁶ 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.¹⁰⁷ Some technologies—most notably artificial intelligence—are also growing at an exponential rate,¹⁰⁸ raising concerns that regulation may not keep up with the risks that such new technologies generate.¹⁰⁹ 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.

3.3 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.¹¹⁰ 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

¹⁰³ 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, 2011) (noting that “[i]ncrements of climate change are usually barely noticeable”).

¹⁰⁴ See Kunreuther & Slovic, *supra* note 85, at 95. See also HAYDN WASHINGTON, CLIMATE CHANGE DENIAL: HEADS IN THE SAND 92 (2011) (arguing that “[f]ailure to understand exponential growth means a failure to act urgently on environmental problems and aids denial”).

¹⁰⁵ See EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES, THE COST OF DELAYING ACTION TO STEM CLIMATE CHANGE 4–6 (2014) *available at* https://obamawhitehouse.archives.gov/sites/default/files/docs/the_cost_of_delaying_action_to_stem_climate_change.pdf.

¹⁰⁶ On invasive species, see generally Daniel Simberloff, *Invasive Species: What Everyone Needs to Know* (2013).

¹⁰⁷ See e.g., Nicole Gurran & Peter Phibbs, *When Tourists Move In: How Should Urban Planners Respond to Airbnb?*, 83 J. AM. PLANNING 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*, 20 CESIFO FORUM 20, 22–3 (2019) (reporting data suggesting exponential growth of tourism in Amsterdam, and discussing the legal response).

¹⁰⁸ See Gonenc Gorkaynak, Ilay Yilmaz & Gunes Haksever, *Stifling Artificial Intelligence: Human Perils*, 32 COMPUTER L. & SECURITY REV. 749, 752–53 (2016).

¹⁰⁹ 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).

¹¹⁰ See *supra* notes 23–24 and accompanying text.

decline—may still obstruct prudent policymaking.¹¹¹ 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.

Once policymakers confidently identify a given phenomenon as requiring quick intervention due to its exponential nature, it may be difficult to recruit the 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.¹¹² 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, peoples’ tendency to form perceptions of disputed factual questions to suit the values of their cultural identity.¹¹³ Thus, in the context of COVID-19 policies in the United States, studies have shown that peoples’ 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.¹¹⁴ Similar results were documented with respect to assessing the risks of climate change, and support for legal responses to the problem.¹¹⁵

The implication of the forgoing analysis is that policy decisions could be improved by creating an institutional design that bolsters the role of expert decision makers. Such experts can rely on empirical evidence and mathematical models, and make use of computer-based decision-support systems, which on a whole generate more accurate assessments of exponential phenomena. The COVID-19 example demonstrates how public authorities learned to integrate experts into the political decision-making process. As the pandemic progressed, governments around the world increasingly relied on epidemiologists, mathematical biologists, biostatisticians, and physicists in the policy-setting process.¹¹⁶ 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.¹¹⁷

¹¹¹ On the shift from exponential growth to decline, see *supra* note 26 and accompanying text.

¹¹² 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 Kahan & Dietram A. Scheufele eds., 2017); Philipp Schrögel & Christian Humm, *Science Communication, Advising, and Advocacy in Public Debates*, in *SCIENCE COMMUNICATION* (Annette Leßmöllmann, Marcelo Dascal & Thomas Gloning eds., 2020).

¹¹³ Dan Kahan et al. The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks, 2 *NATURE CLIMATE CHANGE* 732, 732 (2012).

¹¹⁴ For a review of the findings, see Teichman & Underhill, *supra* note 84.

¹¹⁵ See e.g., Kahan et al. *supra* note 113; Robert R. M. Verchick, *Culture, Cognition, and Climate*, 2016 *U. ILL. L. REV.* 969, 976–81 (2016).

¹¹⁶ Christopher M. Weible et al., *COVID-19 and the Policy Sciences: Initial Reactions and Perspectives*, 53 *POL’Y SCI.* 225, 231 (2020) (highlighting the role of experts in policy decisions during the COVID-19 pandemic).

¹¹⁷ See David Conn et al., *Revealed: The Inside Story of the UK’s COVID-19 Crisis*, *GUARDIAN*, 29 Apr. 2020; <https://www.theguardian.com/world/2020/apr/29/revealed-the-inside-story-of-uk-covid-19-coronavirus-crisis>

To be sure, expert decision making is no panacea. Predictions of exponential growth can diverge significantly depending on small nuances in the models.¹¹⁸ This divergence could be exacerbated in situations of incomplete information in which modelers might impute controversial factual assumptions into their model. Thus, designing the model might reflect experts' biases or normative priors and intuitive judgments.¹¹⁹ That said, expert decision-making does have a comparative advantage over intuitive judgements in situations involving exponential growth.¹²⁰ 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.¹²¹ Yet when compared to the actual outcome (6,385,254), the experts' median estimate (4,000,000) was significantly more accurate than laypeople' median estimate (250,000).¹²² Over time, rigorous scientific analysis can lead to the emergence of a consensus regarding the most accurate modeling and the required response.¹²³

Even if scientists can generate uncontroversial predictions regarding exponential growth, expert decision making cannot supplant political decision making. Policy decisions routinely entail delicate tradeoffs; hence, they cannot be left to epidemiologists or climate scientists. Legal policies impact 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, as well as the specific policy question in play.¹²⁴ A collective choice to delegate decision-making 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.¹²⁵ 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 the “carbon budgets” allocated for

(reporting on the UK's change of policy, and concluding that “the evidence that appears to have prompted the change of course was contained in the Imperial College paper”).

¹¹⁸ 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*, 35 PEDIATRIC RESPIRATORY REV. 64 (2020).

¹¹⁹ 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”).

¹²⁰ See ZAMIR & TEICHMAN, BLE, *supra* note 6, at 170 (highlighting the comparative advantages of expert decision-making).

¹²¹ See Gabriel Recchia, Alexandra L. J. Freeman & David Spiegelhalter, *How Well Did Experts and Laypeople Forecast the Size of the COVID-19 Pandemic?*, 16 PLOS ONE (2020) at pp. 3–4.

¹²² *Id.*

¹²³ 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).

¹²⁴ 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).

¹²⁵ Climate Change Act, 2008, c. 27 §32 (UK) (establishing the CCC).

each five-year period, and the ultimate reduction goal.¹²⁶ Over time, the CCC has proven to be instrumental in promoting a consensus over climate policies in the United Kingdom,¹²⁷ and the model of the CCA has been viewed as successful by numerous jurisdictions around the world that subsequently adopted similar frameworks.¹²⁸

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 lay people to grasp exponential growth,¹²⁹ even in the context of policy setting.¹³⁰ Furthermore, the experience gained during the COVID-19 pandemic might assist in explaining the risks associated with other phenomena such as climate change. But in all likelihood, this shall be an uphill battle, which will require tremendous effort and attention as to how scientific facts are presented to the public.¹³¹

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 impacted by heuristics and biases.¹³² Thus, there is a risk 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 might be especially likely when the legislature or the executive respond promptly to the threat, and adopt 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 at the end of the day prove less detrimental to the competing interests they wish to protect than a more gradual approach that fails to control exponential growth early on.¹³³

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 in the face of threats growing at an exponential rate. 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 carbon emissions highlight this point.¹³⁴ Both rulings identify climate change as a long-term challenge, and underscore the need for

¹²⁶ *Id.* at §33 (advice on target); *id.* at §34 (advice on carbon budget).

¹²⁷ 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).

¹²⁸ *Id.* at 95.

¹²⁹ See *supra* notes 57–68 and accompanying text (reviewing debiasing research).

¹³⁰ Lammers, Crusius & Gast, *supra* note 53, at 16265–66 (debiasing with respect to COVID-19 spread rate).

¹³¹ See e.g., John D. Sterman, *Communicating Climate Change Risks in a Skeptical World*, 108 CLIMATE 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 95.

¹³⁴ See Bundesverfassungsgericht [BVerfG] [Federal Constitutional Justice] March 24, 2021 [complete volume and page] (F.R.G.); an official English abbreviation of the ruling is available at:

<https://www.bundesverfassungsgericht.de/SharedDocs/Pressemitteilungen/EN/2021/bvg21-031.html>; Maiko Meguro, *State of the Netherlands v. Urgenda Foundation*, 114 AM. J. INT'L LAW 729 (2020) (translation of Dutch case).

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.¹³⁵

4. 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.

4.1. 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.

4.1.1. General

The sphere of consumer credit is vast and complex. Along with mortgages (which account for the lion's share of total household debt), Americans use various other types of credit—including credit cards, student loans, payday loans, installment loans, auto title loans, rent-to-own, and consumer litigation funding.¹³⁶ 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.¹³⁷ According to the Household Debt and Credit Report published by the Federal Reserve Bank of New York, in the first quarter of 2021 the total household debt in the United States was 14.64 trillion dollars (\$14,640,000,000,000).¹³⁸ 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—the average household debt is still extremely high. Divided by the number of households in the United States, which is

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

¹³⁶ On mortgages and their regulation, see generally ANDREW G. PIZOR ET AL., MORTGAGE LENDING: LOAN ORIGINATION, PREEMPTION, AND LITIGATION (3rd ed. 2019). On the various types of non-mortgage consumer credit and their regulation, see generally CAROLYN L. CARTER ET AL., CONSUMER CREDIT REGULATION: CREDIT CARDS, PAYDAY LOANS, AUTO FINANCE, AND OTHER NON-MORTGAGE CREDIT (3rd ed. 2020).

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

¹³⁸ See FED. RESERVE BANK OF N.Y., QUARTERLY REPORT ON HOUSEHOLD DEBT AND CREDIT, 2021: Q1 (May, 2021), available at: https://www.newyorkfed.org/medialibrary/interactives/householdcredit/data/pdf/HHDC_2021Q1.pdf.

nearly 130 million, 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.¹³⁹ Thus, consumer credit can play a positive role in people's lives, and contribute to economic growth. But over-borrowing 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—not to mention its adverse effect on retirement savings.¹⁴⁰ Typically, the outcomes of excessive consumer debt are harsher for poorer (often minority) borrowers, thus raising distributional concerns as well.¹⁴¹ As the subprime mortgage crisis made painfully apparent, micro-level inability to repay loans can have devastating macro-level ramifications.¹⁴²

Neoclassical economics, which posits that market players, including consumers, are rational maximizers, 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.¹⁴³ 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).¹⁴⁴ 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.¹⁴⁵ However, more than fifty years later, the TILA appears to have had only a modest impact on the market.¹⁴⁶ Arguably, this suggests that the malfunctioning of this market is not exclusively due to information problems (or both).

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

¹³⁹ See Andrew T. Hayashi, *Myopic Consumer Law*, 106 VA. L. REV. 689 (2020).

¹⁴⁰ 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 191, (alluding to a similar phenomenon in consumer litigation funding).

¹⁴¹ See OREN BAR-GILL, *SEDUCTION BY CONTRACT*, *supra* note 5, at 125 (highlighting that contracts that prey on peoples' behavioral limitations “have adverse distributive consequences, disproportionately burdening financially weaker—often minority—borrowers”).

¹⁴² See *supra* note 12.

¹⁴³ 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, 200–203, 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).

¹⁴⁴ 15 U.S.C. § 1601. See also Regulation Z, 12 C.F.R. pt. 226 (2020) (implementing TILA).

¹⁴⁵ See, e.g. 15 U.S.C. §§ 1632; 12 C.F.R. §§ 226.5, 226.17 (2020).

¹⁴⁶ 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 RES. 21 (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”; *id.* at 31); 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).

role played by several cognitive biases in this regard.¹⁴⁷ These include the inability of individuals to process large and complex information—which is exacerbated by lenders’ deliberate use of complex terms, in a bid to hide the true cost of credit.¹⁴⁸ Another key phenomenon is the present bias, which induces consumers to overestimate immediate benefits, and underestimate the future costs, of credit.¹⁴⁹ This bias is often coupled with over-optimism, which causes people to underestimate the risk of future economic hardship that results from job loss, medical problems, and the like.¹⁵⁰ It may also be coupled with bounded willpower and self-control problems.¹⁵¹

These behavioral analyses of consumer credit rarely, if ever, allude to the EGB.¹⁵² Nevertheless, the EGB is clearly relevant in this context since 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.”¹⁵³ If compound interest sparks a feeling of wonder, it must be because it grows exponentially; and 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 installments of \$100 (totaling \$1,200) would still owe the lender, at the end of the year, \$1,000.

¹⁴⁷ See BAR-GILL, *SEDUCTION BY CONTRACT*, *supra* note 5, at 78–97 and 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 143, at 175–79 (same).

¹⁴⁸ 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 186–193).

¹⁴⁹ BAR-GILL, *SEDUCTION BY CONTRACT*, *supra* note 5, at 81–87; Gustavo 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 147, at 1543–48.

¹⁵⁰ BAR-GILL, *SEDUCTION BY CONTRACT*, *supra* note 5, at 88, 157; Sunstein, *supra* note 147, at 252; Block-Lieb & Janger, *supra* note 147, at 1540–42.

¹⁵¹ Oren Bar-Gill, *Seduction by Plastic*, 98 NW. U. L. REV. 1373, 1395–96 (2004); Sunstein, *supra* note 147, 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). Other relevant cognitive limitations and biases are inattention to the aggregate effect of a large number of small borrowing decisions (BAR-GILL, *SEDUCTION BY CONTRACT*, *supra* note 5, at 87–88; Sunstein, *supra* note 147, at 251); procrastination that leads to late payments (Barboza, *supra* note 149; Sunstein, *supra* note 147, at 251–52); anchoring, that results in excessively low monthly repayments of credit-card debt (Neil Stewart, *The Cost of Anchoring on Credit-Card Minimum Repayments*, 20 PSYCHOL. SCI. 39 (2009)); loss aversion and framing, that are manipulated by lenders to induce excessive borrowing (Yoav Ganzach & Nili Karshai, *Message Framing and Buying: A Field Experiment*, 32 J. BUS. RES. 11 (1995)); and mental accounting (Rob Ranyard et al., *The Role of Mental Accounting in Consumer Credit Decision Processes*, 27 J. ECON. PSYCHOL. 571 (2006)).

¹⁵² 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).

¹⁵³ See, e.g., Candice Elliot, *Compound Interest: The 8th Wonder of the World* (2020), <https://www.listenmoneymatters.com/compound-interest>.

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.¹⁵⁴ Nonetheless, many consumer credit transactions explicitly include compound interest, which are generally presumed to be valid.¹⁵⁵ When considering the implications of the EGB for these transactions, two distinctions are paramount. The first 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 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; as well as 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.¹⁵⁶ Such transactions may be problematic for other reasons, but do not raise the difficulty associated with the EGB. 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).¹⁵⁷ In these cases, the EGB is likely to result in imprudent decision-making 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 governmental 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 one. Cognitive (or *thin*) rationality refers to the structure of people's set of preferences and their strategy of decision-making. 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.¹⁵⁸ This is true from an economic perspective, which

¹⁵⁴ See CARTER ET AL., *supra* note 136, at 228–33.

¹⁵⁵ 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 Center, Federal Reserve Bank of Philadelphia, Discussion Paper No. 03-02, 2003), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=572585). The Consumer Financial Protection Bureau maintains a dataset of credit card agreements of hundreds of card issuers (available at:

<https://www.consumerfinance.gov/credit-cards/agreements/>). 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.

¹⁵⁶ CARTER ET AL., *supra* note 136, at 228–30; Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2808 n.4.

¹⁵⁷ 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.

¹⁵⁸ See Eyal Zamir, *The Efficiency of Paternalism*, 84 VA. L. REV. 229, 248–49 (1998).

generally takes people's preferences as a given.¹⁵⁹ 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.¹⁶⁰

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.¹⁶¹ 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 decision-maker*.¹⁶² It is therefore easier to justify measures that are designed to decrease over-borrowing once it is understood that such borrowing is due in part to the EGB. Of course, taking the effect of the EGB does not end the debate, which involves a host of conflicting policy considerations.¹⁶³

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. However, our main interest (and contribution) 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 (such as debiasing techniques, nudges, and educational campaigns), 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).¹⁶⁴ Indeed,

¹⁵⁹ *Id.* at 254–67 (constructing a model for assessing paternalistic policies that aim to overcome people's cognitive—but not motivational—deviations from rational decision-making).

¹⁶⁰ 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).

¹⁶¹ *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).

¹⁶² *See* Goda et al., *supra* note 34, at 1639 (noting that the welfare implications of EGB's status is a perceptual error, rather than a preference). *Cf.* Jacob H. Russell, *Misbehavioral Law and Economics*, 51 *U. MICH. J.L. REFORM* 549 (2018) (drawing a comparable distinction between *tastes* and *circumstances*, and considering how regulators could try to tell them apart).

¹⁶³ Moreover, the very distinction between motivational and cognitive biases is sometimes blurred. For example, to the extent decision makers 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 decision makers who misunderstand their own preferences).

¹⁶⁴ Michael S. Barr, Sendhil Mullainathan & Eldar Shafir, *Behaviorally Informed Regulation*, in *THE BEHAVIORAL FOUNDATIONS OF PUBLIC POLICY*, *supra* note 6, at 447–49; Sunstein, *supra* note 147, 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*

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 findings from the context of payday loans, which suggests that a simple disclosure of the dollar cost of a loan is likely to have the greatest impact on borrowers' decisions.¹⁶⁵ 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 over-borrowing.¹⁶⁶ 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.¹⁶⁷ The prospects of nudges are particularly dim when sophisticated suppliers (here, the lenders) have a strong incentive to negate their effect.¹⁶⁸ 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.¹⁶⁹ 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.¹⁷⁰ However, as long as lenders make extra profits (in some cases, most of their profit) from delinquent borrowers,¹⁷¹ they have a strong incentive to render this requirement ineffectual. A more 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

¹⁶⁵ *supra* note 146, and *infra* note 286, and accompanying text. On the contribution of psychological insights to the design of disclosure duties, see Cass R. Sunstein, & Russell Golman, *Disclosure: Psychology Changes Everything*, 6 ANN. REV. ECON. 391 (2014).

¹⁶⁶ 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).

¹⁶⁷ Sunstein, *supra* note 147, at 261–67; Bubb & Pildes, *supra* note 4, at 1646–47; Freeman, *supra* note 143, at 177–78.

¹⁶⁸ On debiasing, see generally ZAMIR & TEICHMAN, BLE, *supra* note 6, at 127–34.

¹⁶⁹ See Barr, Mullainathan & Shafir, *supra* note 164, 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 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).

¹⁷⁰ Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2840–42.

¹⁷¹ See Dodd-Frank Wall Street Reform and Consumer Protection Act §§ 1411–12, 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).

¹⁷² See *supra* note 140.

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extend credit to borrowers who are likely to fall behind (or have already fallen 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.”¹⁷² The HOEPA also sets caps and imposes procedural limitations on the charging of late fees in high-cost mortgages¹⁷³—as does the CARD Act with regard to credit cards.¹⁷⁴ 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.”¹⁷⁵ 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.¹⁷⁶

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 is compounded daily.¹⁷⁷ 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.¹⁷⁸ 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

¹⁷² 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)).

¹⁷³ 15 U.S.C. § 1639(k).

¹⁷⁴ 12 CFR §§ 226.52(b), 1026.52(b). See also Sunstein, *supra* note 147, 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 (discussing the CARD Act effects on the credit card market, and finding that it modestly lowered late payment fees).

¹⁷⁵ 15 U.S.C. § 1639(f).

¹⁷⁶ 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 Stewart, *supra* note 151.

¹⁷⁷ See *supra* note 155.

¹⁷⁸ See Furletti, *supra* note 155, at 15.

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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 and standardized periods for compounding, and imposing strict disclosure duties.¹⁷⁹

Having discussed the impact of the EGB on consumer credit in general, the following two subsections discuss in greater detail two concrete contexts in which the EGB might play a significant role. The first is consumer litigation funding, which provides a striking example of exploitation of borrowers' EGB. The second is mortgage forbearance, which illustrates the importance of the EGB in a timely context.

4.1.2. Consumer Litigation Funding

Third-party litigation funding—a rapidly growing industry—comprises various types of transactions.¹⁸⁰ For present purposes, two related distinctions are of particular importance. One is between commercial and consumer plaintiffs.¹⁸¹ 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).¹⁸² 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.¹⁸³ Like other types of third-party litigation funding, CLF offers borrowers a non-recourse loan: the lender recovers from the proceeds of the claim; and if

¹⁷⁹ 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).

¹⁸⁰ For an overview of the third-party litigation funding market, emphasizing the differences between various types of transactions, see STEVEN GARBER, *ALTERNATIVE LITIGATION FUNDING IN THE UNITED STATES: ISSUES, KNOWN, AND UNKNOWN* 7–16 (2010).

¹⁸¹ *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).

¹⁸² On the contingency-fee market, see generally Herbert M. Kritzer, *Risks, Reputations, and Rewards: Contingency Fee Legal Practice in the United States* (2004).

¹⁸³ 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. PROB. 117, 124–26 (2017)

these proceeds do not cover the principal and interest, the lender recovers only partially, or not at all.

Most theoretical and policy analyses of CLF have estimated the APR in CLF anywhere between 80 and 425 percent, based on imprecise assessments and anecdotes.¹⁸⁴ Recently, however, Ronen Avraham and Anthony Sebok conducted a large-scale empirical analysis, based on a dataset of approximately 200,000 loan applications handled by one of the largest providers of such funding, to produce a much more reliable picture of these transactions (although it is unclear how representative this firm is of the market as a whole).¹⁸⁵ Avraham and Sebok found that only about half of the applications submitted to the financing firm were approved, and that the average loan was around 7% of the estimated case value.¹⁸⁶ 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 loan was paid back before the end of that period.¹⁸⁷ 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.¹⁸⁸ 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.¹⁸⁹ The average total amount of funding was approximately \$7,000, and the median – around \$2,250.¹⁹⁰

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” (buried in the fine print of the agreement), the median APR was over three times higher—115%.¹⁹¹

While the EGB is key to understanding borrowers’ decision-making 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

¹⁸⁴ See Avraham & Sebok, *supra* note 181, at 1137–38 (reviewing a wide range of estimates of the interest rates charged in CLF and observing that the debate on the subject “has been conducted in an environment of anecdote and speculation”); Skiba & Xiao, *supra* note 183, at 119 (2017) (noting “the lack of empirical research upon which policymakers can make effective and educated decisions” in this sphere).

¹⁸⁵ Avraham & Sebok, *supra* note 181,

¹⁸⁶ *Id.* at 1141.

¹⁸⁷ *Id.* at 1151–54.

¹⁸⁸ *Id.* at 1144.

¹⁸⁹ *Id.* at 1154–57.

¹⁹⁰ *Id.* at 1156.

¹⁹¹ *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*). 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 140.

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for borrowers to assess the true cost of the loan.¹⁹² This difficulty is exacerbated by the fact that the people who use CLF are often in financial distress, and possibly in poor health, as well, due to the injury for which they are suing—which impairs their cognitive performance.¹⁹³

Given its key features—including the socio-economic 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.¹⁹⁴ 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.¹⁹⁵

Some states already regulate CLF transactions—mostly by imposing disclosure duties similar to those imposed by TILA, or by capping interest rates and fees.¹⁹⁶ However, these techniques are problematic. With regard to disclosures, Paige Skiba and Jean Xiao have cogently 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.”¹⁹⁷

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.¹⁹⁸

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

¹⁹² *Id.* 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).

¹⁹³ On the adverse effects of financial distress on decision-making, see generally SANDHIL MULLAINATHAN & ELДАР 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’ decision-making in the context of CLF include over-optimism, mental accounting, salience, and framing. See Skiba & Xiao, *supra* note 183, at 126–29.

¹⁹⁴ 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).

¹⁹⁵ 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).

¹⁹⁶ *Id.* at 144–45 (summarizing states’ regulations as of 2016).

¹⁹⁷ *Id.* at 120. See also Avraham & Sebok, *supra* note 181, at 1174 (expressing similar concerns).

¹⁹⁸ See Skiba & Xiao, *supra* note 183, at 134–37 (advocating these measures); Avraham & Sebok, *supra* note 181, at 1174–75 (questioning the efficacy of these measures); Cain, *supra* note 195, at 45–49 (advocating more conventional disclosure duties and attorneys’ acknowledgement).

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harmful to borrowers, and in any case are not available to the unemployed).¹⁹⁹ Another problem is that lenders can be expected to find ingenious ways of evading such caps.²⁰⁰

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).²⁰¹ Such a measure would likely be not only more effective than capping interest rates, but also facilitate more rational contracting, which is key to the efficient functioning of the market.

4.1.3. Mortgage Forbearance

As previously noted,²⁰² when consumers decide to put off payments (either when they are entitled to do so, or when they are in default) this may trigger compound interest. In such instances, consumers may fail to grasp the long-term costs of their decisions due to the EGB. 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.²⁰³ Borrowers facing temporary financial difficulties can use the deferral time to reorganize their finances, and avoid the tremendous damage caused by defaulting (such as loss of home and adverse credit rating).²⁰⁴ 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).²⁰⁵ 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.²⁰⁶

That said, borrowers who exhibit the EGB can make systematic mistakes when deciding whether or not to defer mortgage payments. To the extent that compound interest accrue during the forbearance period, borrowers are prone to underestimate the cost of postponing payments. Regulators should therefore strive to create a decision-making environment that ensures that borrowers make decisions that serve their long-term interests.

¹⁹⁹ Skiba & Xiao, *supra* note 183, at 133.

²⁰⁰ *Id.* at 134.

²⁰¹ Avraham & Sebok, *supra* note 181, 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 179, at 325–30.

²⁰² See text accompanying *supra* notes [Error! Bookmark not defined, 175–179](#).

²⁰³ See e.g., John Y. Campbell, Nuno Clara & João F. Cocco, *Structuring Mortgages for Macroeconomic Stability*, NBER Working Paper 27676, August 2020, <https://www.nber.org/papers/w27676> (highlighting the mutual advantages of mortgages that allow borrowers to pay only interest on their loan during a recession).

²⁰⁴ 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).

²⁰⁵ See Charles A. Capone, *Cost-Benefit Analysis of Single-Family Foreclosure Alternatives*, 13 J. REAL ESTATE FIN. ECON. 105, 106 (1996) (noting that “[f]rom the lender’s perspective, foreclosure is the most costly post-default outcome”).

²⁰⁶ 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).

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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.²⁰⁷ 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.²⁰⁸

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 lenders, who cannot relend the collected sums of money to other borrowers, and in effect provides borrowers with free credit.²⁰⁹ As a result, banning compound interest may undercut lenders' incentives to show leeway to borrowers in distress. Thus, 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 this explicit dollar amount be presented to borrowers in a simple and salient way before they choose to defer their mortgage payments.

4.2. Retirement Savings

4.2.1. The Retirement Crisis and the Exponential Growth Bias

It is widely acknowledged that the United States is facing a major retirement crisis.²¹⁰ In fact, this crisis extends well beyond the United States.²¹¹ As a result of "chronic under-saving,"²¹² many American baby boomers experience significant financial distress as they grow older.²¹³ According to one prominent study, 50% of American households may not be able to sustain their standard of living after retirement,²¹⁴ and it is estimated that out of current American workers between the ages of fifty and sixty-four, 48% will be poor or

²⁰⁷ 15 U.S.C. § 9056(b)(2).

²⁰⁸ Fanie Mae, Lender Letter (LL-2020-07) at 5; <https://singlefamily.fanniemae.com/media/22916/display>.

²⁰⁹ See Jackson T. Anderson, David M. Harrison & Michael J. Seiler, *Strategic Forbearance and Unintended Consequences of the CARES Act* (unpublished manuscript on file with author) (arguing that the low costs of forbearance under the CARES Act create a moral hazard problem).

²¹⁰ 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 (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 Khitatrakun, *Are Americans Saving "Optimally" for Retirement?*, 114 J. POL. ECON. 607, 609 (2006) (finding that 80% of American households have sufficient savings, and that for the remaining households the magnitude of the deficit is small).

²¹¹ 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").

²¹² 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).

²¹³ Secunda, *supra* note 210, at 507.

²¹⁴ See Alicia H. Munnell, Wenliang Hou & Geoffrey T. Sanzenbacher, *National Retirement Risk Index Shows Modest Improvement in 2016* (Ctr. for Retirement Research at Boston Coll., 2018), https://crr.bc.edu/wp-content/uploads/2018/01/IB_18-1.pdf.

near poor when they retire.²¹⁵ On aggregate, the latest projection suggests that the deficit in savings for American households, as of 2019, is a staggering \$3.83 trillion.²¹⁶

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.²¹⁷ DB plans require little involvement on the part of savers, since they guarantee participants a fixed annuity based on their years of employment.²¹⁸ In contrast, DC plans require participants to make critical decisions about their savings.²¹⁹ 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.²²⁰

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 under-save for retirement. This body of work has focused mostly on peoples' inability to optimize over long time horizons, and have highlighted phenomena such as present bias, hyperbolic discounting, and procrastination as the main driving forces behind insufficient saving.²²¹ Notably, despite its tremendous volume, this body of work has yet to incorporate the findings regarding the EGB.²²²

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.²²³ Such systematic errors may have two conflicting effects. On the one hand, the tendency to underestimate the value of long-term savings may cause people to save too much for retirement. 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.²²⁴ As a result, when balancing between present consumption

²¹⁵ See Teresa Ghilarducci, *Retirement Security Worse on ERISA's 40th Anniversary*, 6 DREXEL L. REV. 453, 453 (2014).

²¹⁶ Dana M. Muir, *How Behavioral Science Ultimately Fails Retirement Savers: A Noble Experiment*, 56 AM. BUS. LAW J. 707 (2019) (citing a study published by the Employee Benefit Research Institute).

²¹⁷ See Secunda, *supra* note 210, at 518; Benartzi & Thaler, *supra* note 211, at 1152.

²¹⁸ Secunda, *supra* note note 210, at 513.

²¹⁹ *Id.* at 514–15.

²²⁰ To be sure, the policy choice between DB and DC is complex and involves many considerations that go well beyond the scope of this Article. See Edward A. Zelinsky, *The Defined Contribution Paradigm*, 114 YALE L.J. 451 (2004).

²²¹ See Andrew Hayashi & Daniel P. Murphy, *Savings Policy and the Paradox of Thrift*, 34 YALE J. REG. 743, 752 (2017) (noting that “[t]he 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 210, at 522–23 (present bias and procrastination); Shaviro, *supra* note 212, at 1246–48 (myopia). Other behavioral phenomena noted within this body of work include over-optimism, 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 210, at 225–26 (omission bias); Shaviro, *supra* note 212, at 1249–51 (inattentiveness).

²²² 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 212, at 1246–53 (presenting a “taxonomy of possible explanations for unduly low retirement saving,” and making no reference to the EGB).

²²³ See Levy & Tasoff, *supra* note 34, at 545 (“[p]roper computation of exponential functions is thus at the heart of many economic decisions such as lifecycle consumption”).

²²⁴ See Goda et al., *supra* note 34, 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 34, at 547–48.

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and saving for future consumption, they may place excessive weight on the former, and not save enough. They may begin to save for retirement too late, or contribute too little to their retirement savings account—or both.²²⁵

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.²²⁶ They found that the EGB is associated with a large decrease in savings.²²⁷ Later studies augmented this finding by eliciting participants' EGB directly and by focusing more specifically on retirement.²²⁸ For example, Gopi Shah Goda and colleagues developed a five-question survey to construct an EGB scale, and collected data on participants' retirement savings.²²⁹ They then examined the correlation between the two, using a rich set of controls.²³⁰ With this observational data, their study documented a statistically significant association between the EGB and low retirement savings: specifically, an increase of one standard deviation of the EGB was associated with an 11% decrease in retirement savings.²³¹ Notably, this effect was independent of the effect of the present bias (that was also examined in this study), and is actually somewhat larger.²³² 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.²³³ Similar results were obtained in lab experiments.²³⁴ Note that, insofar as some of the population does tend to over-save (due to the EGB or other causes), the extent of under-saving by those who are prone to do so is even greater than currently acknowledged.

4.2.2. 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,²³⁵ (2) tax incentivizes (most notably Individual Retirement Accounts (IRAs) and 401(k)

²²⁵ 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 32, at S5–S6 (presenting results suggesting that people put off retirement saving due to the EGB).

²²⁶ Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2812–16, 2826–31.

²²⁷ *Id.* at 2837–40.

²²⁸ See Goda et al., *supra* note 34. See also Levy & Tasoff, *supra* note 34; Mckenzie & Liersch, *supra* note 32.

²²⁹ Goda et al., *supra* note 34, at 1641–44 (describing study design and data).

²³⁰ *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).

²³¹ *Id.* at 1648.

²³² *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).

²³³ 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).

²³⁴ 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 (2020) (experimentally demonstrating that “a diagram relating contributions to income projections prompted more participants to advocate higher contributions”); Mckenzie & Liersch, *supra* note 32 (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”).

²³⁵ See Shaviro, *supra* note 212, at 1128–30.

programs),²³⁶ and (3) nudges that foster greater saving.²³⁷ Policymakers can encourage employers to adopt such measures, as Congress did when it included in the Pension Protection Act of 2006 a safe harbor that shielded from fiduciary liability employers that set a default of automatic enrolment into their 401(k) programs.²³⁸ These policies were enacted amidst an academic and political debate over whether or not government should be involved in peoples' saving decisions, and the limits of paternalistic legislation.²³⁹

When considering regulatory responses to the EGB, the distinction mentioned in the context of consumer credit,²⁴⁰ 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.”²⁴¹ Rather, such an intervention enables people to fulfil 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, and thus tilts the balance toward widening the scope of mandatory saving programs.²⁴² Such an approach could be achieved by increasing social security benefits,²⁴³ or by making private 401(k) programs universal and mandatory,²⁴⁴ thereby negating the effect of the EGB on the decisions when to begin saving, and how much to save. That said, while the EGB can certainly add an important dimension to the debate, it is not expected to end it entirely. Choosing the optimal legal regime requires striking a delicate balance between a host of policy considerations.²⁴⁵

²³⁶ See *id.* at 1124–27.

²³⁷ See Shlomo Benartzi & Richard H. Thaler, *Heuristics and Biases in Retirement Savings Behavior*, 21 J. ECON. PERSP. 81, 99–102 (2007).

²³⁸ See 29 U.S.C. § 1104(c)(5); 29 C.F.R. § 2550.404c-5 (2000). See also Brigitte Madrian & Dennis Shea, *The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior*, 66 Q.J. ECON. 1149 (2001) (proposing this technique and empirically demonstrating its efficacy); Dana M. Muir, *Choice Architecture and the Locus of Fiduciary Obligation in Defined Contribution Plans*, 99 IOWA L. REV. 30–32 (2013) (reviewing the legislative provisions).

²³⁹ For recent contributions, see Bubb & Pildes, *supra* note 4, at 1607–37 (incorporating behavioral analysis into the welfare analysis); Hayashi & Murphy, *supra* note 221, at 758–64 (highlighting the macro-economic 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 (2006) (reviewing the political debate).

²⁴⁰ See *supra* notes 158–163, and accompanying text.

²⁴¹ 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, 901 (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., Joshua D. Wright & Douglas H. Ginsburg, *Behavioral Law and Economics: Its Origins, Fatal Flaws, and Implications for Liberty*, 106 NW. U. L. REV. 1033, 1056–57 (2012).

²⁴² For voices supporting this line of reasoning, see Bubb & Pildes, *supra* note 4, at 1632–37 (highlighting the importance of mandated savings); Secunda, *supra* note note 210, at 540–41 (same).

²⁴³ See Bubb & Pildes, *supra* note 4, at 1637 (discussing reforms to social security that would enlarge payoffs at retirement).

²⁴⁴ Secunda, *supra* note note 210, at 510–11 (advocating for such a reform, inspired by the Australian retirement saving program).

²⁴⁵ Shaviro, *supra* note 212, at 1218 (acknowledging that “[g]iven the large and complicated set of plausible causes for underserving, no single response to the problem is likely to be optimal”).

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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 interest. One tool that may be used to clarify the effect of compound interest are 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 pension encourages investors to increase their contribution rate.²⁴⁶ Moreover, such information would also be beneficial to people who possibly save too much for retirement.

Congress has recently moved forward on this front, by enacting the Setting Every Community Up for Retirement Enhancement (SECURE) Act.²⁴⁷ 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.”²⁴⁸ 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.²⁴⁹ 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.²⁵⁰

The EGB highlights the special 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 is made explicitly clear to non-savers, 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 savings the incentives of savers and financial institutions are better aligned, and the latter could play a constructive role in debiasing savers.²⁵¹ That said, in line with the general findings about the limited impact of financial (and other) disclosures,²⁵² the impact of additional information on decisions regarding retirement savings may be rather small as well.²⁵³

²⁴⁶ See *supra* note 233, and accompanying text.

²⁴⁷ Further Consolidated Appropriations Act, 2020, Pub. L. No. 116-94, Div. O, (2020), <https://bit.ly/3evdkXH>.

²⁴⁸ 29 U.S.C. §1025(a)(2)(D)(II).

²⁴⁹ 29 U.S.C. §1025(iv).

²⁵⁰ For an illustration, see Goda, Manchester & Sojourner, *supra* note 233, at 84 (graphics depicting to subjects how much additional annual income at retirement they can expect to have if they raise their saving contributions).

²⁵¹ See Stango & Zinman, *Exponential Growth Bias*, *supra* note 5, at 2810 (noting that “firms selling saving and investment products have incentives to debias consumers”).

²⁵² See BEN-SHAHAR & SCHNEIDER, *supra* note 164; ZAMIR & TEICHMAN, BLE, *supra* note 6, at 171–77, 314–18. See also *supra* note 146, and *infra* note 286, and accompanying text.

²⁵³ See Goda, Manchester & Sojourner, *supra* note 233, 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”).

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Another key aspect of the regulatory framework with respect to retirement savings that could be revisited in light of the EGB are the fees collected from savers. Researchers have documented the adverse impact of high fees on the accumulation of wealth for retirement.²⁵⁴ The underlying problem is that people “are unable to understand the effect of higher fees on long-term returns.”²⁵⁵ The EGB makes it easier to understand peoples’ 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 rollover their retirement savings into relatively expensive IRAs.²⁵⁶ Moreover, this insight could guide the creation of new and more effective cost disclosures that assist savers impacted by the EGB. Just as earnings disclosures should highlight the long-term effects of investment decisions, cost disclosures should point to the long-term impact 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, 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.²⁵⁷ 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 impact of the EGB.²⁵⁸ 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%,²⁵⁹ 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.²⁶⁰ At present, it is difficult to see American employers offering such advice to their employees,

²⁵⁴ See e.g., Ian Ayres & Quin 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 210, at 520.

²⁵⁵ Muir, *supra* note 216, at 729. See also Medill, *supra* note 221, at 336 (noting that investors with short-term planning horizon tend to disregard fees).

²⁵⁶ See Ayres & Curtis, *supra* note 254, at 1524–31 (proposing low cost investment tools as defaults); Muir, *supra* note 216, at 765–69 (discussing rules that would impede rollovers into IRAs).

²⁵⁷ See e.g., Medill, *supra* note 221, at 348–61 (promoting a financial literacy campaign led by the federal government).

²⁵⁸ McKenzie & Liersch, *supra* note 32, 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).

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since their incentives are not aligned.²⁶¹ Indeed, employers might want to minimize employees' contributions to savings plans to lower their own matching obligations,²⁶² while encouraging employees to purchase high-fee investment tools—since those fees finance the costs of the financial services that the employer receives.²⁶³

4.3. Pyramid Schemes

Having discussed two major spheres in which the EGB strongly affects people's decision-making—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 funds from new recruits to those higher in the organization.”²⁶⁴ Every year, hundreds of thousands of Americans lose considerable amounts of money in such schemes.²⁶⁵ Aside from their financial cost, pyramid schemes can inflict broader societal harm, since they build upon 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.²⁶⁶

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*.²⁶⁷ 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 (“Crew”), 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.

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.

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 & MARKETING 139, 142 (2002).

²⁶⁵ KEITH B. ANDERSON, *MASS-MARKET CONSUMER FRAUD IN THE UNITED STATES: A 2017 UPDATE* 25 (Fed. Trade Comm'n, 2019), <https://www.ftc.gov/reports/mass-market-consumer-fraud-united-states-2017-update>.

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

²⁶⁷ See Corey Matthews, *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).

Some iterations of the pyramid scheme attempt to mask their activity by incorporating product marketing into the program.²⁶⁸ Such pyramids present 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.²⁶⁹ 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.²⁷⁰ This process, however, cannot continue indefinitely.²⁷¹ 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,²⁷² 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.²⁷³

People who are invited to join a pyramid scheme therefore have to assess an exponential growth function—a task in which people err systematically. 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 simulation, Wagenaar and Timmers asked subjects to estimate the speed at which a pond would be filled to capacity by duckweed that is growing exponentially.²⁷⁴ Even though participants in this study could clearly observe that exponential growth was

²⁶⁸ See William W. Keep & Peter J. Vander Nat, *Multilevel Marketing and Pyramid Schemes in the United States: An Historical Analysis*, 6 J. HIS. RES. MARKETING 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 \$150,000,000 in compensation. See *FTC v. Advocare International*, Case No. 4:19-cv-715-SDJ. For an overview of the distinguishing factors, see FED. TRADE COMM’N, BUSINESS GUIDANCE REGARDING MULTILEVEL MARKETING (2018), <https://www.ftc.gov/tips-advice/business-center/guidance/business-guidance-concerning-multi-level-marketing>; 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. 89 n.37 (2008) (“[t]he 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 31.

²⁷³ See JOHN M. TAYLOR, THE 5 RED FLAGS: FIVE CAUSAL AND DEFINING CHARACTERISTICS OF PRODUCT-BASED PYRAMID SCHEMES, OR RECRUITING MLM’S 14 (2006), https://www.ftc.gov/system/files/documents/public_comments/2006/07/522418-12585.pdf. 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).

²⁷⁴ See Wagenaar & Timmers, *supra* note 30, at 241–45 (describing experiment 1).

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constrained by the size of the pool, they did not appreciate the speed with which the pool would be filled by the duckweed.²⁷⁵

More recently, behavioral economists have directly examined peoples' decision-making in a pyramid game, through a stylized experimental setting.²⁷⁶ 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, participants in the experiment were presented 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,²⁷⁷ and half of them were even clearly advised to “think carefully about your odds of winning each option before choosing.”²⁷⁸

In these somewhat idealized conditions, 44.2% of the participants chose to pay to join the pyramid scheme.²⁷⁹ 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.²⁸⁰ Even with complete information, and after fully understanding the parameters of the game, many participants failed to foresee just how quickly the population of potential entrants would dry up.

Contrary to the experimental setting, in the real world people do not ordinarily have full 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 over-optimism, might, therefore, interact with the EGB, and exacerbate its impact.²⁸¹ Unsurprisingly, some attention has been drawn to the possibility of extending the disclosure duties imposed on pyramid organizers.²⁸² However, if people fail to appreciate exponential growth, providing them with more information will not fix the problem.²⁸³ Given the complexity of the compensation structure in many pyramid

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 et al., *Decision-Making and Vulnerability in a Pyramid Scheme Fraud*, 80 J. EXPERIMENTAL & BEHAV. 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.*

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).

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schemes,²⁸⁴ carefully crafted disclosures may ultimately be truthful, yet not very useful.²⁸⁵ 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 futility of mandated disclosure as a means of overcoming entrenched cognitive biases.²⁸⁶

The insight that the EGB impairs peoples' decision-making with respect to pyramid schemes can shed new light on the ongoing legal debate over how such schemes should be treated.²⁸⁷ In the United States, pyramid schemes are currently governed by a complex web of regulation. At the federal level, there is no anti-pyramid statute.²⁸⁸ Rather, enforcement is built mostly upon the existing legal framework that empowers the FTC and the SEC.²⁸⁹ The FTC generally targets pyramid schemes based on Article 5 of the FTC Act, that prohibits "unfair or deceptive acts or practices in or affecting commerce."²⁹⁰ The SEC similarly engages in enforcement activity against pyramid schemes, on the theory that such schemes are securities whose sale involves prohibited deceptive practices.²⁹¹ Thus, federal enforcement hinges mostly on proof of fraud or deception.²⁹² At the state level, while some states follow the federal framework and focus on fraud and deception, other states have enacted specific anti-pyramid statutes that ban the practice altogether.²⁹³

The overall success of these legal measures is limited.²⁹⁴ 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.²⁹⁵ While this inaction may be due to a variety of factors, one key issue is the need to prove fraud or deception. This extremely costly process requires a detailed case-by-case analysis of recruitment events, which hinders enforcement efforts.²⁹⁶ The lack of meaningful federal enforcement

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 95–6 (highlighting how pyramid operators may circumvent disclosure limitations regarding expected earnings).

²⁸⁶ See *supra* notes 164, **Error! Bookmark not defined.**, **Error! Bookmark not defined.**, 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 The Department of Justice may also prosecute pyramid schemes that engage in mail fraud or money laundering, though such cases are relatively rare. See Pareja, *supra* note 269, at 103–04.

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 "SEC enforcement also focuses on misleading information").

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, *id.* at 94 ("observing that [b]ecause gathering evidence of 'unfair' or 'deceptive' acts is extremely difficult, the FTC does not use this provision frequently"); Pareja, *supra* note 269, at 103.

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.²⁹⁷

The focus of federal law on fraud and deception in the context of pyramid schemes seems unwarranted. The findings on the EGB reviewed above demonstrate that many people systematically err when faced with a pyramid scheme, even if they are presented with complete and accurate information.²⁹⁸ Thus, the key problem in pyramid schemes lies in their very structure, and in how they prey on peoples' systematic tendency to underestimate the speed with which they will collapse, due to EGB.²⁹⁹ Accordingly, the Unfair Commercial Practices Directive of the European Union bans pyramid schemes altogether.³⁰⁰ As noted, some states have taken the same route in the United States.³⁰¹ This policy appears to be well founded.

5. 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 peoples' systematic tendency to underestimate exponential growth. As the discussion in the Article suggests, the EGB may justify a new generation of disclosure duties, which will help people make better decisions in situations involving exponential growth. It may also necessitate the enactment of new mandatory rules geared toward banning abusive practices that prey on peoples' misperception of exponential phenomena. In addition, the Article highlighted governmental failures to respond promptly to risks involving exponential growth, such as pandemics and climate change. This tendency requires the design of institutions and decision-making processes that will help promote more prudent legal policymaking.

Given the large gap in both the behavioral-economic 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 as which model best captures peoples' 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 peoples' choices, and evaluate potential interventions.

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 103 (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 are therefore even less aware of how close the scheme is to its saturation point. See Witiw, *supra* note 267, at 1637.

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 (“it 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 Item 14 of Annex I of Directive 2005/29/EC on Unfair Business-to-Consumer Commercial Practices in the Internal Market (2005).

³⁰¹ See PRIDGEN & ALDERMAN, *supra* note 293, at §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*, 193 Or. App. 388, 400 (2004).

Humanity's recent 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, over the years, developed robust models of exponential viral spread, 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.