

# Fuzzy Math and Household Finance: Theory and Evidence<sup>\*</sup>

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## ABSTRACT

Recent work on intertemporal choice has varied the specification of every key aspect of modeling except the opportunity cost of consumption. We present evidence that consumers have present-biased perceptions about the opportunity cost of consumption: they tend to underestimate the cost of short-term borrowing and the return to long-term saving. We develop a new theory that fits this evidence and is based on a more general cognitive tendency to underestimate exponential series. The theory predicts that more biased consumers will save less and hold less wealth, hold more short-term installment debt and fewer stocks, and use and benefit from financial advice relatively intensively. The data bear out these predictions and show that an easily measured metric of opportunity cost misperception correlates with household financial condition in statistically and economically important ways.

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## I. Introduction

The main parameters economists use to model intertemporal choice are *preferences* over consumption at different times and risk, *beliefs* about future events that impact utility, and *interest rates* measuring the costs and benefits of shifting consumption across time.

Because models using strict neoclassical specifications of these parameters can struggle to explain real-world financial behavior, a growing body of work develops alternative specifications of preferences and belief parameters. Related work focuses on whether and how well consumers solve problems, given parameter values.<sup>1</sup>

But economics and finance has largely ignored specification issues regarding the opportunity cost of consumption. Theoretical and empirical work continues to assume that consumers correctly perceive the decline (increase) in future consumption that results from borrowing (saving) today.

We explore how people actually perceive the costs of intertemporal tradeoffs, and find evidence that perceptions are present-biased: consumers tend to underestimate the opportunity cost of current consumption. We then analyze the theoretical and empirical implications for household finance, and find evidence that the bias significantly affects savings rates, portfolio choice, and wealth accumulation.

Our work builds on some prior survey and lab evidence suggesting that consumer perceptions of the opportunity cost of consumption are systematically present-biased. Consumers have been found to underestimate compounded returns to saving,<sup>2</sup> and to underestimate the borrowing interest rates implied by other loan terms.<sup>3</sup> Firms seem to recognize these biases and respond accordingly. Lenders try to exacerbate the tendency to underestimate borrowing costs by shrouding interest rates (Stango and Zinman 2007).<sup>4</sup>

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<sup>1</sup> For “rule of thumb” alternatives to dynamic optimization see, e.g., Lettau and Uhlig (1999), and Hurst (2006). There is also a related literature on financial planning; see e.g., Ameriks, Caplin, and Leahy (2003) and Lusardi (2003). For alternative formulations of beliefs see, e.g., Brunnermeier and Parker (2005) and Puri and Robinson (forthcoming). For alternative formulations of preferences see, e.g., Angeletos, Laibson, Repetto, Tobacman, and Weinberg (2001), Barberis, Huang, and Santos (2001), and Gul and Pesendorfer (2004). DellaVigna (2007) provides a more comprehensive summary of field evidence on these three types of deviations from neoclassical assumptions.

<sup>2</sup> Eisenstein and Hoch (2005), Lusardi and Mitchell (forthcoming).

<sup>3</sup> See, e.g., Juster and Shay (1964), National Commission on Consumer Finance (1972), Day and Brandt (1974), Parker and Shay (1974) and Kinsey and McAlister (1981).

<sup>4</sup> See Gabaix and Laibson (2006) for a model of a shrouding equilibrium.

Investment firms try to counteract the tendency to underestimate compound returns with product presentations that highlight future values (Eisenstein and Hoch 2005).

The existing evidence on how consumers perceive borrowing costs and returns to saving is suggestive but has three important limitations. First, it has not systematically established bias in nationally representative data, or measured whether the severity of bias varies over different time horizons. Second, it is piecemeal: there is no unifying theory that explains why consumers systematically underestimate both borrowing costs and returns to saving, identifies the comparative statics of bias with respect to maturity on savings and debt, and generates predictions on the relationship between bias and financial decisions. Third, existing work has not tested whether misperceptions matter empirically for the key outcomes of interest in household finance: borrowing and saving rates, portfolio choice, and wealth accumulation. Our work addresses each of these limitations.

First, we provide new evidence on misperceptions of borrowing costs, using data from the 1977 and 1983 Surveys of Consumer Finance. As in prior studies, we find that nearly all consumers exhibit *payment/interest bias*: they substantially underestimate the interest rate implied by a stream of repayments on a short-term loan. This holds whether bias is measured using a hypothetical loan or actual loans the consumer is currently repaying. We also find novel evidence that payment/interest bias is much more severe for short-term loans than longer-term loans, and essentially zero on the modal 30-year mortgage.<sup>5</sup> So, biased perceptions of borrowing costs decrease with maturity.

Our second contribution is developing a theory of why and how consumers tend to underestimate borrowing costs and returns to saving. The theory relies on a single, general cognitive microfoundation: *exponential growth bias*. This tendency to underestimate the growth of exponential series has been documented in a variety of problem-solving contexts in cognitive psychology. Its economic applications to-date have been limited to perceptions about savings (Eisenstein and Hoch 2005) and inflation (Keren 1983; Jones 1984; Kemp 1984).<sup>6</sup> We show that a consumer with exponential growth bias will underestimate both installment borrowing costs

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<sup>5</sup> We have no new data that directly measures perceived returns to saving, but show below that biased perceptions of borrowing costs map into biased perceptions of savings returns under general assumptions.

<sup>6</sup> See Appendix A for additional discussion and references.

















































































































