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Economic Letter

Cost of Decisionmaking Influences Individual Selections

by Anton Cheremukhin and Antonella Tutino

A rational person may be willing to err if the cost of making a mistake is less than the cost of a precise and correct evaluation of each option.

Market prices are often driven by choices later viewed as mistakes. Waves of optimism or pessimism sometimes dramatically move prices; a burst bubble of euphoria can bring significant macroeconomic consequences.

A sudden change of sentiment may occur when a large number of stock market professionals consistently err by holding on to stocks for too long when they should sell, or by selling equities too quickly when they should be holding on to them. Yet, these individuals are specialists with every incentive to evaluate stocks correctly.

Behavioral experiments show that in laboratory conditions, people behave like market participants.[1] When faced with the same question repeatedly within any single experiment, they frequently change their minds.

Why are people so inconsistent? Do rational people blunder? Theories on how individuals and groups reach decisions don't provide a satisfactory answer. By and large, the mystery of costly human errors remains unsolved. Understanding why such mistakes occur can help researchers interpret change in observed behavior and carries implications for the behavior of financial markets.

Weighing the cost of making decisions may provide an answer.[2] A rational person may be willing to err if the cost of making a mistake is less than the cost of a precise and correct evaluation of each option. A rational person balances the gain from a consistently beneficial choice with the cost of paying attention—that is, the cost of being precise.

Though information is abundant, not all of it is necessary to make a well-informed choice. Inattention to some information is a perfectly rational response in these circumstances.

A Theory of Error

We can illustrate the implications of rational inattention. Suppose a person is asked to choose between option A, which provides a guaranteed payout of $10, and a risky option B. Classical *rational choice theory* holds that if the value of option B is higher than that of option A, the person should choose option B. It makes no difference how much better option B is; if the person is asked to choose 100 times, option B should be selected 100 times.

Experimental data testing the theory show that people do not behave in the predicted manner. Chart 1 compares the prediction of rational choice theory with observed responses to an experiment in

which the A and B choices are offered. The data suggest that it is very common for a person to pick the better option only 70 to 80 times out of 100, even if that option is unquestionably superior.

Rational inattention theory can explain this seemingly erratic behavior.[3] It postulates that rational people are prone to mistakes if they believe that the effort of making an informed choice is greater than the benefit of a correct choice. Further, this theory not only helps clarify individual preferences but also plays a pivotal role in discerning what a person considers a costly mistake. For instance, a risk-averse individual may favor a safe and informed choice over a riskier and more profitable bet. By contrast, a risk-loving person may lean toward more risky gambles, even without fully analyzing the properties of such an option, if the stakes are high enough.

While rational choice theory predicts deterministic outcomes—sure events—the thrust of rational inattention theory stems from its focus on expressing the likelihood of people's choices in terms of probability. A rationally inattentive person behaves in terms of "odds," flipping a coin as each choice is made. While the outcome of a particular choice is unpredictable, rational inattention theory predicts the probability of each occurrence.

Measuring Responses in the Lab

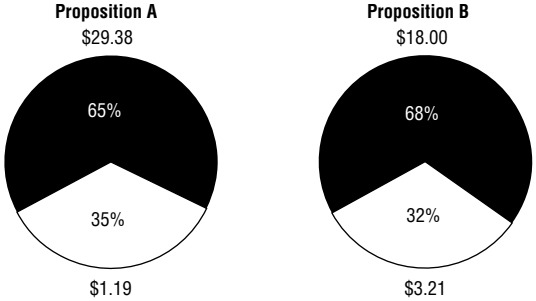
Forty individuals were repeatedly asked to compare 20 pairs of propositions—a choice between proposition A and proposition B, each with two potential payouts—in an experiment Michel Regenwetter conducted at the University of Illinois at Urbana–Champaign in 2009. Each individual faced each proposition 60 times. The set of propositions per individual was shuffled to ensure that the experiment was unaffected by memory effects—when people recall the answer they gave to the same question previously.

The table below gives an example of the propositions participants faced. Each question contains two propositions. Participants were asked to choose one of them.

Sample of Gamble Payouts and Probabilities

	Proposition A				or	Proposition B			
Question no.	Payout A_1 (dollars)	Probability A_1 (percent)	Payout A_2 (dollars)	Probability A_2 (percent)		Payout B_1 (dollars)	Probability B_1 (percent)	Payout B_2 (dollars)	Probability B_2 (percent)
1	29.38	65	1.19	35		18.00	68	3.21	32
2	27.98	42	18.89	58		25.44	47	3.90	53
3	26.44	52	1.92	48		26.03	34	5.77	66
4	25.05	24	24.01	76		25.32	66	10.56	34
5	23.64	71	10.78	29		25.03	98	6.86	2

The diagram below is derived from a sample screen from the experiment representing question 1 from the table. The pie chart illustrating proposition A offers $29.38 at a 65 percent probability and $1.19 otherwise. The pie chart illustrating proposition B offers $18 at a 68 percent probability and $3.21 otherwise.



Laboratory Tests Behavior

The natural place to study probabilistic choices is in the laboratory. We focus on laboratory experiments where subjects are repeatedly asked the same sets of questions to see whether and under which circumstances they change their answers. Behavioral patterns emerging from the laboratory show that our model based on rational inattention can reconcile theory and evidence. The lab experiments test the ability of people to make a consistent choice over pairs of propositions that promise different expected payoffs. The actual gambles played in one experiment are shown in the box, "Measuring Responses in the Lab."

In Chart 1, experimental data are depicted together with the predictions of rational choice theory[4] (dashed line) and our rational inattention model (solid line). Our model predicts that the greater the difference in values between options A and B, the more consistent people will be in their responses. The slope of the curve predicted by our model reflects the cost of attention. The more costly attention is, the greater the difference between two options must be for a person to pay close attention.

The actual experimental data seem to agree well with the theory's predictions, allowing quantification of the effort associated with paying attention and giving it a monetary value.

To illustrate this point, consider a person who wants to reduce uncertainty by asking simple binary (yes/no) questions. Each answer to a binary question would reduce uncertainty, but it costs effort to process that can be quantified in terms of lower expected payoff.

We estimate the cost of attention to be on the order of six questions per 1 cent

of expected payoff. This implies that an average person values the effort associated with answering six simple yes/no questions at 1 cent.

Risk Aversion and Inattention

Drawing on rational inattention theory, individual attitudes toward risk and inattention can be measured. While the cost of attention determines the slope of the curve, attitude toward risk determines perceived values of options A and B. Thus, people's risk aversion determines the sorting of options along the horizontal axis of Chart 1.

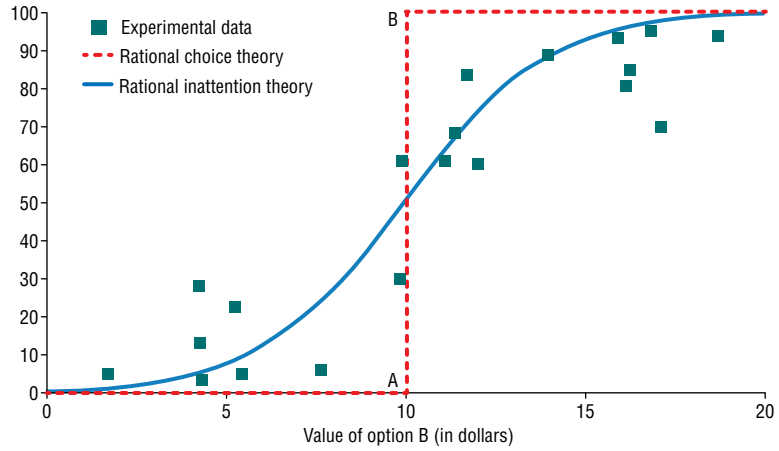
The attitude toward risk and the cost of attention for the 40 participants in the experiment are estimated using experimental data. In Chart 2, we use two indicators: the risk aversion characteristic on the vertical axis and the cost of attention on the horizontal axis.

Side-by-side consideration of two propositions illustrates risk aversion. Offer A yields a $20 winner 50 percent of the time; a losing wager is worth nothing. Offer B yields a sure-fire $10 winner 100 percent of the time. A risk-neutral person will be indifferent toward the two propositions. The risk-neutral person is denoted by zero on Chart 2. By contrast, a risk-averse person will prefer offer B, and the value of his risk-aversion characteristic would be in the positive portion of the vertical axis. Finally, a risk-loving person would prefer offer A, and his risk-aversion characteristic would be in the negative range of values on the vertical axis. Likewise, a less-attentive person—someone more concerned about effort than an expected return—would be characterized by low values on the horizontal axis of Chart 2. A more-attentive person—someone more concerned about an expected return than effort—would take on high values.

Chart 2 shows an overwhelming difference in these two characteristics across a sample of fairly similar people. Although the majority of participants were drawn from a relatively homogeneous student population at the University of Illinois campus, their responses demonstrate remarkably different behavior.[5] Some participants are very averse to risk—corresponding to a factor of risk aversion equal to +4. Others are willing to take on a substantial amount of risk if they think the stakes are good enough—corresponding to a factor of risk aversion equal to –2.

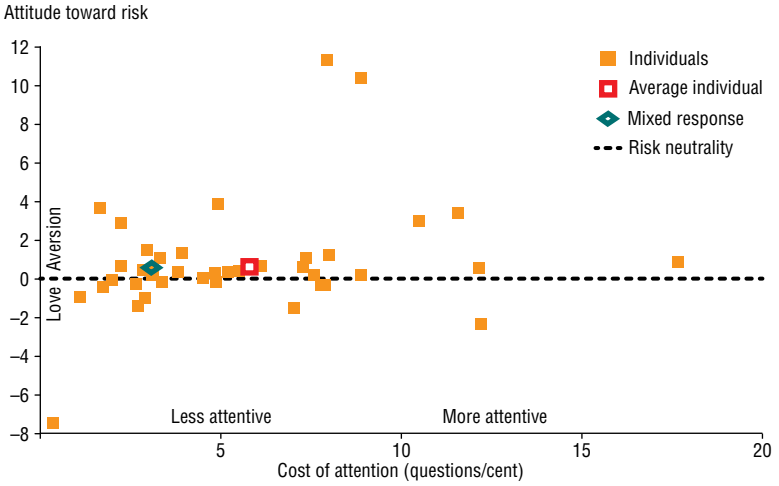
The cost of attention characteristic takes on an even wider range of values. Individual participants are motivated to pay attention and give answers in a consistent way to between one and 12 questions for each cent paid.

Chart 1 Rational Inattention Theory Guides Betting Choices



SOURCES: Michel Regenwetter, University of Illinois at Urbana–Champaign; authors' calculations.

Chart 2 Group Reaction Differs from Individual Decisions



SOURCES: Michel Regenwetter, University of Illinois at Urbana–Champaign; authors' calculations.

People Aren't Equally Attentive

Our estimates show that people are extremely different in both their costs of paying attention and attitudes toward risk. One stark implication of these differences involves the tendency of group behavior to diverge from that of the individual. Evidence presented in Chart 2 suggests that the average individual response (depicted by the square) is characterized by a cost of

attention twice that of the group aggregate (depicted by the diamond) for participants in the experiment.

To understand the implications of this finding, consider the following example. After a market-price bubble bursts, standard theory would predict that once the average market participant realizes an asset is overvalued, the overall market would quickly reprice the asset to its fundamental value. However, we find that it will take more than half of market participants to realize that the asset is overvalued for its price to be corrected.

While rational choice theory cannot easily account for this result, it fits comfortably within rational inattention theory postulating a mixed response as an outcome of participants' choices.

Tempering Market Bubbles

This has important implications for comprehending the behavior of stock markets, which similarly aggregate choices of market participants. Each individual market participant must be somewhat inattentive, like every single participant of our experiment. If differences in levels of attention among market participants are at least as large as those observed in the laboratory, then aggregation bias (the difference between individual decisions and implied group decisions) should have a substantial impact on the way market-price fluctuations are interpreted. The prediction of rational inattention theory is that the behavior of the market as a whole should look as if produced by an extremely inattentive "representative" market participant.

This result may aid recognition of how market fluctuations take form and whether they can be tempered by some entity or mechanism. Maybe bubbles cannot be avoided, but they might be lessened by appropriate action and aggregation of information, such as making more and better information available to market participants on traded assets.

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Notes

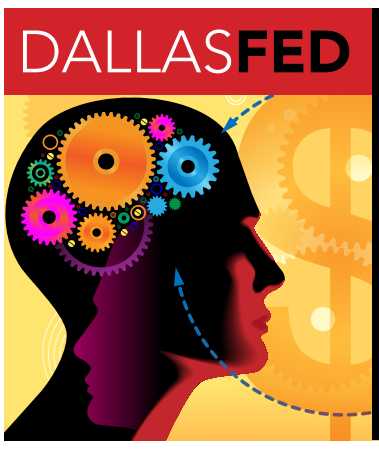
[1] "An Experimental Measurement of Utility," by Frederick Mosteller and Philip Nogee, *Journal of Political Economy*, vol. LIX, no. 5, 1951, pp. 371–404.

[2] This article is based on a joint paper with Anna Popova: "Experimental Evidence on Rational Inattention," by Anton Cheremukhin, Anna Popova and Antonella Tutino, Federal Reserve Bank of Dallas, Working Paper no. 1112, December 2011.

[3] See "Implications of Rational Inattention," by Christopher A. Sims, *Journal of Monetary Economics*, vol. 50, no. 3, 2003, pp. 665–90, and "'Rational Inattention' Guides Overloaded Brains, Helps Economists Understand Market Behavior," by Antonella Tutino, Federal Reserve Bank of Dallas *Economic Letter*, vol. 6, no. 3, March 2011.

[4] Rational choice theory postulates that individuals behave quickly and precisely in any environment. To account for observed variations in responses, a relationship between the error probability and the values of the options is often exogenously postulated. This assumed relationship gives rise to curves used to describe the data. For an axiomatic approach to formulating such a relationship, see *Individual Choice Behavior: A Theoretical Analysis*, by R.D. Luce, New York: John Wiley, 1959.

[5] We thank, without implicating, Michel Regenwetter for kindly providing access to the data. Anna Popova's work and data collection were supported by National Science Foundation grant SES # 08-20009 (PI: M. Regenwetter, University of Illinois at Urbana–Champaign), titled "A Quantitative Behavioral Framework for Individual and Social Choice," awarded by the Decision, Risk and Management Science Program.



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