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Changing How We Discount to Make Public Policy More Responsive To Citizens' Time Preferences

Robert L. Axtell and Gregory J. McRae [*]

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[*] Robert L. Axtell is a Senior Fellow in Economic Studies for the Center on Social and Economic Dynamics at The Brookings Institution. Gregory J. McRae is a professor at Massachusetts Institute of Technology.

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Executive Summary

Laws and regulations have both benefits and costs, comparisons of which provide useful information. When such benefits and costs occur over time it is normal practice to *discount* them, with costs in the distant future considered less important than those occurring in the present, and distant benefits less valuable than present benefits. Conventionally, this discounting is done at a constant rate each period—so-called exponential discounting— with both cost and benefit streams being treated as if they were financial assets. However, humans are not exponential discounters. Rather, people tend to discount more than exponentially in the short run but less than exponentially in the long run. Such 'hyperbolic' discounting is empirically ubiquitous but neglected administratively. The recent 'data quality act' requires that information utilized by Federal agencies "adhere to a basic standard of quality, including objectivity, utility and integrity." Here we argue that exponential discounting of many benefit streams—particularly non-pecuniary ones—fails the 'data quality' test and should be abandoned in favor of empirically-observed hyperbolic discounting.

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1. Discounting

The value of an economic good today is greater than its value tomorrow—its future value is *discounted* relative to its present value. This simple idea has been the source of controversy at least since the time of Ancient Greece. Because a dollar tomorrow is less valuable than a dollar today, money-lenders have demanded a premium—interest or usury—for monies loaned. Both Plato and Socrates thought that charging interest was unjustifiable. However, as everyone with a home mortgage or car loan knows, the practice of charging interest is now the norm.

Today we understand that there are both psychological and social dimensions to discounting over time. Most people exhibit *pure time preference* in their behavior, preferring to have economic goods today instead of tomorrow when given a choice—the good today is apparently more valuable than the same good tomorrow.

The social dimension enters in through the prevailing rate of interest. Whether interest rates are high or low depends on the supply of capital to be borrowed and on the demand for such borrowing. It is standard to interpret high rates as signifying that capital is scarce while low rates mean the opposite. Interest rates are a measure of the *social return to capital*.

2. Exponential Discounting

Conventionally, discount calculations are performed via a constant period-to-period interest rate, leading to an exponential discount function. The origin of this method was its simplicity, and it is ubiquitous today.

Exponential discounting turns out to be the only *time consistent* way to value goods over time. That is, a decision made today on the basis of exponential discounting will continue to be the correct decision when re-evaluated in the future. Non-exponential discounting generates *time inconsistency*, in which decisions made in the present may not be viewed as correct in the future. Essentially all discount computations today—in the economy, in the economics research literature, and in government affairs—are performed using exponential discounting.

The only adjustable parameter in this formalism is the discount rate. In practice it may vary substantially across domains, as when one rate is used for Federal borrowing while a different rate is employed for evaluating an environmental regulation. Any particular rate may also vary substantially with time, especially insofar as markets are increasingly being used to determine the appropriate rate in specific domains, e.g., mortgage lending. This temporal variation in rates can cause even exponential discounting to be time inconsistent, *ex post*.

3. Discount Rate Heterogeneity

At any instant of time there is significant heterogeneity in the discount rates emerging from market processes and therefore in those being used commercially and in government. One need only peruse the real estate section of their local newspaper to find great variety of rates, as well as other charges, being advertised by lenders. Some of these differences are domain-specific, as when used car interest rates exceed mortgage rates. Other times they survive within particular domains, as in the mortgage market where, for a particular product—a 30 year mortgage, for example—there is a significant distribution of rates available to potential borrowers.

Ostensibly, the most important question in the administrative application of discounting to public policy is finding the right discount rate to use, particularly in non-market environments or other areas having weak connection to markets, such as basic research. Indeed, the Office of Management and Budget (OMB) regularly issues formal guidance for the appropriate discount rate to use for Federal projects. These numbers have been in the 4-6% range recently, after being more commonly in the 6-8% range during the 1990s.

Interestingly, it turns out that a *portfolio* of projects having a distribution of discount rates does not display exponential discounting overall. Rather, any significant discount rate heterogeneity is sufficient to produce non-exponential discounting, and therefore ostensibly time inconsistent behavior. Discount rate heterogeneity is, therefore, one reason to consider non-exponential discounting. Another is that most people don’t behave in accord with exponential discounting.

4. Behavioral Discounting

The peculiar thing about discounting is that while all people do it, no one seems to do it perfectly consistently, in the way that exponential discounting demands. Rather, actual discounting is more *hyperbolic*—people discount the short run more than exponential and the long run less. Myriad empirical studies have demonstrated this under a wide variety of conditions, with human subjects motivated in many different ways. Indeed, this phenomenon is so ubiquitous in experimental economics as to stand today as one of the pillars of behavioral economics, a burgeoning sub-field within economics and for which a Nobel Prize was awarded a few years back.

The careful, reproducible studies of the experimental economists have really just confirmed and reinforced what behavioral scientists have long known—that people do not judge the future in a consistent way. For a whole industry is built around this facet of human behavior: the credit card industry.

Credit cards are an integral part of American life today. They are a convenience for shopping and nothing more for those who pay their entire balance each month. For those who don't pay off their balance, credit cards also provide easy access to capital. The typical American family with credit card debt owes some $8,000, a significant fraction of the $54,000 median family income in the U.S. in 2004. Thus the credit card business is a $1.5 trillion industry today.

Hyperbolic discounting has emerged as a consensus explanation for the existence of such high credit card balances. People decide to make purchases today and pay tomorrow. Tomorrow they repeat this behavior, and soon they have large balances that take a long time to pay back. Credit card debt is but one clear example of people engaging in time inconsistent behavior. Commitment devices to promote savings, such as penalties for early withdrawal, further exemplify the importance of taking hyperbolic discounting into account. The existence of such devices gives a non-exponential discounter some assurance that her present savings will not be raided by her future self. In a world of perfect exponential discounters such devices would not serve a useful function, but they are widespread today, and behavioral economists argue that perhaps we could use more.

5. Financial Costs and Non-Financial Benefits of Public Policy

Governments make major use of the discounting calculus in cost-benefit analysis, especially by agencies involved in regulatory activities. Here it is conventional to discount both costs and benefits, although often costs are borne primarily up-front while benefits are realized in the future.

Since 1981, the Federal government has attempted to put the use cost-benefit analysis on a systematic footing, going so far as to require it for many regulatory evaluations and certain legal analyses. When costs for a particular project or regulation are borne over time, they are discounted in accord with prevailing interest rates in the market place. And when benefits accrue to either government or citizens over time, such as when an environmental regulation yields a stream of pollution tax payments or reduced health care costs, these sums too are discounted in accord with market conditions. Rational assessment of costs and benefits occurring over different periods requires some version of such a calculus.

There are many government activities that, while their costs are certainly monetary and usually borne up front, the stream of benefits is often diffuse, perhaps divided over thousands or millions of individuals, over great lengths of time, and most importantly, may not have any natural monetary expression.

For example, when the U.S. National Park Service was born in 1916, the fact that it would provide great benefits to generations of Americans would have been obvious to Theodore Roosevelt and others who had begun setting land aside for “public used, resort, and recreation…inalienable for time.” That the benefits of the parks are largely non-monetary would not have been in dispute in the early 20th Century.

The non-financial character of benefit streams has not stopped economists from trying to assign monetary value to them. Beginning some 20 years ago a host of novel ‘value elicitation’ techniques were developed to try and tease out from people the values they implicitly assign to such intangibles as waiting in traffic, visiting a National Park, and so on. While many numbers have been calculated and back-calculated from such surveys, interviews, ‘revealed preference’ analyses, and related methods, suffice it to say there that these techniques have so far yielded estimates of use or existence values that are of dubious reliability. More problematically, it has

often been the case that such monetized benefits have been calculated on a per period (e.g., annual) basis and then discounted using conventional exponential discounting.

6. Hyperbolic Discounting of Non-Pecuniary Value Streams

Given the non-financial character of many benefit streams accruing to government projects, a much more satisfactory methodology would be to discount such benefits the way people apparently do, that is, hyperbolically. Indeed, this is the only *scientifically justifiable* approach to discounting behavior, given the wealth of data on how humans actually behave.

Hyperbolic discounting of benefits suggests a new way of thinking about benefit-cost analysis. In the conventional calculus, benefits and costs are discounted identically and exponentially, so there is a natural sense of direct comparability of these two distinct streams. An analyst performs sensitivity tests on his results—that a particular project has benefits that exceed costs and so should be undertaken, or else the reverse—in order to determine the extent to which they depend on, for example, the assumed discount rate. For projects defined by large up-front costs and benefits that appear far downstream, there is typically some critical value of the discount rate such that the project—no matter how large the ultimate benefits—becomes untenable. Below this critical discount rate the project is viable.

But with hyperbolic discounting this simple connection between costs and benefits is broken, for while the cost of capital may ebb and flow with market conditions, there is little evidence that people's intrinsic discounting behavior is significantly modified by such changes. High market interest rates might even be good for project feasibility when evaluated in this hyperbolic way, for it could induce some of the costs to be shifted in a way more suited to people's actual time preferences.

Consider an example: Imagine a project with $1 billion up-front costs that saves 10 lives annually, in perpetuity. At a 5% discount rate, the value of a human life needed for the project to be marginal is $4.76 million; for larger values, the project is worthwhile. Substituting hyperbolic discounting of the project's benefits yields, for a reasonable parameterization, a marginal value of $4.08 million for a human life. However, this can fall to as little as $1.00 million for discount functions imputed from survey data. Clearly, hyperbolic discounting lowers the threshold for public investment when the costs are borne early-on and the benefits are long-lived.

7. A New Rationale for Public Goods: Current Citizens and Future Benefits

More generally, conventional discounting of costs coupled with behavioral discounting of benefits can be viewed as a novel rationale for social investment. For the use of hyperbolic discounting to value benefit streams should yield policies that are more commensurate with the desires of citizens. To see this, consider again the credit card industry. Credit card companies make profits by lending people money at exponential rates while people are assessing the benefits of the goods they buy with this money at non-exponential rates. In effect, the companies are arbitraging a person's current self against his or her future self, giving money to the current person with the knowledge that the future person will repay it with interest. The credit industry thrives because of this arbitrage opportunity.

Having government play the role of arbitraging one generation's borrowing so that future generations will be better off is as old as public finance. And many important projects—national defense and highways, local schools and roads, state research universities—have grown up exactly this way, presumably with their benefits outweighing their costs. What is novel about inserting hyperbolic discounting into these otherwise mundane administrative affairs is that the resulting policy decisions—either to undertake particular projects or not—would be much more in line with people's wishes. That is, if the data and procedures employed by regulators more accurately represent actual human behavior then the resulting decisions should be less contentious, more attuned to people's underlying values.

8. The Data QualityAct

The Treasury and General Government Appropriations Act of 2000, that year's omnibus spending bill, contained brief language directing the Office of Management and Budget (OMB) to issue guidelines to maximize "the quality, objectivity, utility, and integrity of information…disseminated by Federal agencies." This has been interpreted by the OMB Office of Information and Regulatory Affairs (OIRA) as requiring the federal government to make decisions on the basis of "sound science," certainly a laudable goal. The 'data quality act' has been invoked to mandate that regulatory assessments take into account *all available* scientific studies, concerning product safety, for example. Here we suggest that it can also be used to

compel regulators to employ the best research on how people *actually* discount the future, instead of the empirically false exponential discounting method.

9. Summary

People don't discount future streams of goods and services in the way that economics textbooks teach. People care less about the near term but more about the long run than prescribed by the formalism currently in place administratively for benefit-cost analyses. This needs to be changed and the Federal government can be compelled to do so through the 'data quality act.' Doing so will make public policy more responsive to the goals and desires of citizens.

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