

WHAT SHOULD BE THE RETURN ON PUBLIC-SECTOR INVESTMENT?

Policymakers need to be mindful of opportunity costs.

BY RICHARD O. ZERBE JR.

What social rate of return should the public sector pursue for spending that is intended to yield long-term benefits—that is, for “government investment”? People who favor less government spending support higher rates because they would discourage interventions, while people who favor more government spending support lower rates. Economic analysis suggests a different rationale: that when government builds a bridge or invests in early childhood education, it should expect a rate of return at least equal to the yield from alternative uses of the money.

The social rate of return would include all benefits and costs to members of society, not just financial returns to government itself. Serious analysts agree that rates should take into account both the displacement of private capital that occurs when government invests and the reduction in consumption that contributes to the government source of capital.

Using this approach, David Burgess and I concluded in a 2011 *Journal of Benefit-Cost Analysis* paper that public investment should pursue a 7 percent real rate of return (that is, the return after inflation) on average, with a range of 6–8 percent for different, “typical” government projects. At the extremes, when project funding and benefits affect only consumption and not capital availability, the acceptable rate might be as low as 3.5 percent; yet when projects reduce private capital but don’t contribute to capital formation,

rates should be as high as 8.5 percent. It is, however, expensive to determine those differential consumption and capital effects on a project-by-project basis, so a useful rule of thumb suggests that projects should yield returns in the 6–8 percent range.

This simple but correct answer has been difficult to implement. Federal agencies have exhibited striking inconsistencies in their use of discount rates, not only across agencies but, in the case of some regulations, within agencies. More extreme, the Environmental Protection Agency and the National Oceanic and Atmospheric Administration have used low discount rates (3 percent) for benefits and high rates (7–10 percent) for costs, even during the same time period—a procedure that appears particularly problematic.

In an attempt to standardize the rate used, the Office of Management and Budget began issuing discount rate guidelines in 1972 and continues to issue them on an annual basis. In 1992, just prior to Bill Clinton entering the Oval Office, the guidelines lowered their recommendation from 10 percent to 7 percent, which remains the OMB-recommended expected return today.

Unfortunately, OMB guidelines have had little effect on rates actually used by government. This should not be surprising; the lower the rate, the more projects an agency can justify, while agencies that use higher rates are put at a competitive disadvantage.

ALTERNATIVE RATES—AND WHY THEY'RE WRONG

A number of rationales exist for not following the OMB-recommended 7 percent real rate. The most common one is the belief



that market interest rates (e.g., for government or corporate bonds) represent the opportunity cost of capital, and that cost should not influence government investment. But in fact, market rates of interest do not take into account the actual returns on private investment, which is around 8.5 percent in real terms. (Burgess and I calculated this return as the ratio of national income minus compensation to labor divided by the replacement value of capital.)

Some proponents of alternative rate-of-return targets suggest using rates based only on the rate of time preference—that is, the amount one must pay an individual to induce him to delay consumption from today to the future. Such rates will be lower than the returns available on alternative investments. But this policy seems irrational if one's goal is enhancing public welfare; focusing

only on the cost of consumption delay ignores the opportunity costs of higher-yielding investments that are forgone because money is routed to lower-returning investments. In a world of capital constraints, should we invest in a project that yields 2 percent when projects yielding 7 percent are available? In addition, the rates of pure time preference ascertained from surveys vary wildly across individuals and thus provide little guidance for public investment choices.

Arrow / Recently, in a paper published in the journal *Science*, Nobel economics laureate Kenneth Arrow and coauthors proposed social rates that vary from 1 percent to 3.94 percent, with the higher rate for projects with shorter time horizons and the rate falling toward 1 percent as the time horizon increases and benefits are realized further into the future. Those rates are based on time preference rates that vary from 1 percent to 7 percent. To translate the time preference rates into social rates, Arrow et al. start with the assumption that time preference rates in any future period vary from 1 percent to 7 percent with equal likelihood. Because they

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TABLE 1

ARROW ET AL. DISCOUNT RATES

Present values of \$1,000 realized at various future times and certainty-equivalent rates.

TIME IN YEARS	1% INTEREST RATE PRESENT VALUE	7% INTEREST RATE PRESENT VALUE	AVERAGE EXPECTED PRESENT VALUE	CERTAINTY-EQUIVALENT RATE (%)
1	990.05	932.22	961.22	3.94
10	904.84	469.59	700.71	3.13
100	367.88	0.91	184.40	1.02

are interested in the effect of each of those rates, they average not the rates themselves, *but the discount factors* (DFs) associated with each rate for each time period of future returns.

The discount factor is determined from the interest rate through the expression $1 \div (1 + r)^t$, where r is the interest rate (from 1 to 7 percent) and t is time. For example, let r be 4 percent and t be 10 years. The DF is then $1 \div 1.04^{10} = 0.675$. This discount factor is used to find the present value of a future sum received in 10 years. For \$1,000 received in 10 years, the present value would be $1,000 \times 0.675 = \$675$. Said differently, \$675 deposited today and receiving 4 percent annual interest would increase to \$1,000 in 10 years. (This example differs slightly from the Arrow et al. paper because they assume continuous rather than annual compounding).

Arrow et al. calculate the present value for each of the seven integer interest rates from 1 percent to 7 percent. From the average of those present values, they then calculate the average DF, from which they calculate an interest rate. In the example of 4 percent and 10 years, the rate is about 3.13 percent. They call such rates the “certainty-equivalent rate.” The certainty-equivalent rate will fall as the time period increases because the discount factors for higher rates fall more quickly with time and the lowest rate has more relative effect.

The calculations for the Arrow et al. rates are shown in Table 1 for selected time periods. The calculations are dependent on the original assumption of the 1–7 percent range of appropriate interest rates. (It is unclear whether the Arrow et al. rates are sug-

gested rates or arbitrary rates used for the purpose of illustration.) There is absolutely no reason to accept the preference rates of 1–7 percent that yield the certainty-equivalent rates the authors find.

If, instead, you use the range of 6–8 percent based on Burgess and my reasoning, the certainty-equivalent rates are as shown in Table 2. These rates are significantly higher than the rates recommended by Arrow et al. Clearly, the choice of the interest rate range (1–7 percent vs. 6–8 percent) has a major influence on the certainty-equivalent rates.

Weitzman / A third source of recommended interest rates lower than the OMB-recommended rate comes from a 2001 *American Economic Review* paper by Martin Weitzman. In the now-famous article, he infers rates from the distribution of responses to a survey he conducted of 2,160 doctorate-holding economists. The certainty-equivalent rates vary from about 4 percent to about 0 percent, depending again on the timing of benefit realization.

There are several reasons to reject this approach and the values it produces. The use of a poll, even of economists, is a dubious way to determine the discount rate. For one reason, the respondents are not all experts on this particular topic. In fact, I speculate that only a distinct minority of them could be so considered. This approach also fails to guarantee that projects will be rejected if they are inferior to private investment alternatives. Instead, this method will result in projects with long time horizons that match the preferences of a minority of individuals with low time preference rates. Clearly, for projects over the next 10 years, the appropriate rates are within the bounds that Burgess and I calculated.

Special rates / A final source of low rates is the claim that certain goods are special and should be evaluated using low discount rates or that low discount rates are morally superior. Some argue for a 0 percent discount rate, reasoning that a good consumed tomorrow is as valuable as the same good consumed today; a life in the future is as valuable as a life now. The claim is true, but it provides no rationale for lower or 0 percent rates. For example, a

case is made (by Derek Parfit and others) that when the benefits are those of consumption, as in the preservation of a park, the benefits involve no opportunity cost. This is a puzzling assertion because the creation of parks clearly does involve opportunity costs and they should not be ignored.

If a project is solely funded by the displacement of private capital, Burgess and I—and others—argue the costs should be discounted at

TABLE 2

BURGESS-ZERBE DISCOUNT RATES

Present values of \$1,000 realized at various future times and certainty-equivalent rates.

TIME IN YEARS	6% INTEREST RATE PRESENT VALUES	7% INTEREST RATE PRESENT VALUES	8% INTEREST RATE PRESENT VALUES	AVERAGE EXPECTED PRESENT VALUE	CERTAINTY-EQUIVALENT RATE (%)
1	941.76	932.39	923.11	932.43	7.00
10	548.81	496.59	449.33	498.24	6.97
100	2.47875	0.91	0.0033546	0.01242	6.69
1,000	875.65E-26	397.54E-29	180.49E-33	292.00E-25	6.11

8.5 percent. This would be the Burgess-Zerbe calculated return to capital and would be the relevant rate were all funds to come at the expense of capital. If a project displaces only other consumption and no capital penalty is incurred, the costs should be discounted

Suggested alternative rates are confusing because they incorporate extraneous values as part of the rate, including special values for goods such as health or life, or rates derived from polls of economists.

at the rate of time preference because the park is more valuable the earlier it is built, so that both people today and tomorrow can enjoy its benefits. As I stated earlier, surveys will not give a clear rate. By looking at the real economy, however, we can estimate the average post-tax return to consumers, which Burgess and I estimate to be 3.5 percent—a rate that represents people's real choices about the timing of consumption.

A DIFFERENT APPROACH FOR POSSIBLE CATASTROPHES

Some proponents of lower return rates claim the rates are especially justified in cases where government investment is intended to lessen or ward off some potential catastrophe, such as climate change. How much should we invest now to prevent harm in the far future, given that alternative investments in the shorter time period will yield 7 percent per year for the next 10 years? Rather than use low discount rates in such an analysis, as is currently fashionable, one should tackle uncertainty directly.

One possible approach takes future option price values and adjusts them for high relative risk aversion of 10 (where normal is 1). Under such conditions, option prices would exceed expected values by about 20 percent, according to a 2013 *Water Resources Journal* paper by Scott Farrow and Michael Scott. The current gross world product (GWP) is about \$85 trillion. The high range of estimates of expected value damage from climate change is about 8 percent of GWP. Increasing this by 20 percent gives us 9.6 percent of GWP, or about \$8 trillion in current damages. At the lower bound, suppose damages are 1 percent of GWP (\$850 billion). Assuming these damage figures grow by 3.5 percent per year for the next 200 years (following estimates by Brad DeLong on the historical rate of GWP growth), the present value of total damages over the next 200 years discounted at 7 percent lies between \$27 trillion and \$228 trillion. This range of damage estimates appears to span the range of literature estimates. Richard Tol's high estimate is about 4 percent of GWP. William Nordhaus's

estimates of efficient spending to reduce climate change and its effects are far lower. (See "Pricing Carbon When We Don't Know the Right Price," Summer 2013.)

Current U.S. spending for reducing the effects of climate change is about \$10 billion a year. The central question is whether we should spend more to prevent damages that are an order of magnitude higher even when discounted at the Burgess-Zerbe rates. As Massachusetts Institute of Technology economist Robert Pindyck recently noted, climate models tell us very little for policy purposes. They, along with economic models, do suggest—as Weitzman and Pindyck both note—that we should hedge (take out insurance) to reduce the possibility of catastrophic harm. Using low discount rates does not contribute to this decision. The goal should be to get the right discount rate and reduce the uncertainty of estimates of future values.

CONCLUSION

Public sector investments should occur if and only if their return exceeds the opportunity cost of available projects. This cost consists of reduced consumption and displaced private capital. Other suggested rates are confusing because they incorporate extraneous values as part of the rate, including special values for goods such as health or life, or rates derived from polls of economists. Rates of individual time preferences from survey data are too varied and uncertain to use alone. More fundamentally, they fail to correctly treat the capital penalty of government investment. Ethical and moral considerations are best treated as values attached to the value of goods to be counted in the present. These extraneous factors can be, and should be, counted separately and not as part of the interest rate. R

READINGS

- "An Attack on the Social Discount Rate," by Derek Parfit. In *Values and Public Rules*, edited by Claudia Mills. Harcourt Brace Jovanovich College Publishers, 1992.
- "Appropriate Discounting for Benefit-Cost Analysis," by David F. Burgess and Richard O. Zerbe. *Journal of Benefit-Cost Analysis*, Vol. 2, No. 2 (2011).
- "Climate Change Policy: What Do the Models Tell Us?" by Robert S. Pindyck. *Journal of Economic Literature*, Vol. 51, No. 3 (2013).
- "Comparing Multistate Expected Damages, Option Price, and Cumulative Prospect Measures for Valuing Flood Protection," by Scott Farrow and Michael Scott. *Water Resources Journal*, Vol. 49 (2013).
- "Determining Benefits and Costs for Future Generations," by Kenneth Arrow et al. *Science*, Vol. 341 (2013).
- "Estimates of the Damage Costs of Climate Change," by Richard S.J. Tol. *Environmental Resource Economics*, Vol. 21 (2002).
- "Gamma Discounting," by Martin L. Weitzman. *American Economic Review*, Vol. 91, No. 1 (2001).
- "Why the Far-Distant Future Should Be Discounted at Its Lowest Possible Rate," by Martin L. Weitzman. *Journal of Environmental Economics and Management*, Vol. 36, No. 3 (1998).