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Investing in Future Generations:
Relating Debt Reduction and Environmental Protection

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Summary

Governments often engage in activities that affect the welfare of future generations in opposite directions. Long-term projects aimed at protecting the environment benefit future generations, whereas increasing government debts, including the accrued benefits in Social Security and Medicare, cost them. From an efficiency point of view, these government activities should be coordinated.

It is established that, given the debt-reducing options that benefit future generations, the discount rate for environmental programs that also benefit future generations should be the marginal productivity of capital, i.e., the gross (tax-inclusive) interest rate.

Two questions then arise as to what the value of the gross interest rate is and whether there are realistic options for debt reduction. The value of the gross interest rate is found to be between 5% and 9% depending on the associated risk and is much higher than the 1% to 3% discount rate currently recommended in government guidelines for intergenerational discounting. Therefore, if government's environmental policy based on the low discount rates is implemented, then there would be too many environmental programs and regulations from an efficiency point of view.

The study also reviews the recent growth in government debts of various forms. As of 2015, the total federal liabilities when Social Security and Medicare commitments to current retirees are included were almost $40 trillion or 222% of GDP. Therefore, the room for debt-reducing reforms is substantial.

The study concludes that more efficiently coordinated generational policies would evaluate environmental projects with a stricter criterion (a higher discount rate for benefits to future generations) than the existing one, and debt-reducing options (including reducing or containing elderly entitlement debts) would be given comparable consideration.

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With an Eye to the Future: Debt Reduction and Environmental Protection

Consideration of future generations has been part of the national mindset since the country's inception. George Washington, in his 1796 farewell address, expressed his concern about leaving government debts to future generations.

"*…avoiding likewise the accumulation of debt, not only by shunning occasions of expense, but by vigorous exertion in time of peace to discharge the debts which unavoidable wars may have occasioned, not ungenerously throwing upon posterity the burden which we ourselves ought to bear.*"

Thomas Jefferson, in a 1789 letter to James Madison, indicates that he too was concerned about leaving government debts to the next generation.

"*Then no generation can contract debts greater than may be paid during the course of its own existence."*

Concern for future generations has also motivated environmental protection as is shown in the following excerpt from a 1910 speech of Theodore Roosevelt.

"… I recognize the right and duty of this generation to develop and use the natural resources of our land; but I do not recognize the right to waste them, or to rob, by wasteful use, the generations that come after us."

As implied by these presidential quotes, both government debt policy and environmental policy have impacts on the welfare of future generations. The current generations can help future generations by leaving the latter a lower level of debt and a cleaner environment.

However, today's debt policy and environmental policy are at cross-purposes. Whereas new environmental programs and regulations – such as those in the areas of global climate change, radioactive waste disposal and biodiversity preservation – benefit future generations at a cost to the current generations in the form of higher tax payments or higher production costs, recent expansions in various forms of government debts (liabilities) increase the burden on future generations while benefiting the current generations.

For example, the official federal government liabilities reported in the Financial Report of

the United States Government – which include the best known government liability, "debt held by the public", as a main component – grew 99% between 2007 and 2015 to a total of $21.5 trillion. Beyond the official liabilities, the accrued benefits to Social Security and Medicare participants who are currently receiving benefits – which is a conservative measure of the implicit debts in Social Security and Medicare – have risen from 71% of GDP in 2007 to 103% of GDP in 2015.

Given that the current generations can help future generations through either debt reduction (or at least lower debt growth) and environmental protection, economic efficiency requires that government's debt policy and environment policy be harmonized.

In this study, we explore the implication of the policy option to reduce government debts for the evaluation of environmental programs and regulations. In particular, we want to study what the appropriate discount rate should be for the environmental benefits to future generations, given that the future generations can also be made better off through debt reduction.

We first establish that the appropriate discount rate for the environmental benefits to future generations should be the marginal productivity of capital, i.e., the gross (tax-inclusive) interest rate. This is done by showing that accepting any environmental program or regulation with a rate of return lower than the gross interest rate is inefficient in the sense that all current and future generations would be better off without the program, as long as a set of appropriately designed intergenerational transfers from present to future generations are put in place.

Two questions arise from the above theoretical argument regarding what numerical value should be given to the gross interest rate as well as the feasibility of the intergenerational transfers that are required for efficiency. It is shown that the value of the gross interest rate falls between 5% and 9%, which are respectively corresponding to the risk-free gross interest rate and the fully risk inclusive gross interest rate.

For the feasibility of the required intergenerational transfers, we document the recent growth in various forms of government debts and show that the room for debt reducing reforms – which transfer resources from current to future generations – is substantial.

Evaluation of Environmental Programs/Regulations in the Presence of Debt-Reducing Options

The discount rate plays a critical role in the cost-benefit analysis of projects when costs and benefits are distributed over time, especially when benefits and costs are a long time apart such as in an environmental program. Because environmental programs tend to incur costs much earlier than to generate benefits, the scale of environmental protection is, to a large degree, determined by the required discount rate for the evaluation of environmental programs: The higher the discount rate, the fewer the programs that will be accepted.

Although a higher discount rate would result in less environmental protection, it is not necessarily unfavorable to future generations. This is because, regardless of the discount rate for environmental programs, future generations can be alternatively helped by debt-reducing policy options.

Therefore, the question becomes: What is the appropriate discount rate for environmental programs when intergenerational transfers implemented through adjustments in the debt policy are feasible?

The simple reasoning below demonstrates that the marginal productivity of capital, i.e., the gross (tax-inclusive) interest rate, is the appropriate discount rate for environmental benefits to future generations. Consider a long-term environmental project, which, if enacted, incurs an immediate cost of $\$C$ and generates a benefit worth $\$B$ to a future generation t years from now. If the government can invest in the private market to earn a gross interest rate r, then it only needs to tax the present generation with the amount $\$B/(1+r)^t$ to be able to provide the future generation t years from now with $\$B$. Therefore, the environmental project is the more efficient way (with a lower cost to the present generation) to provide for the future generation than the investment alternative, and hence the project should be accepted, if and only if $B/(1+r)^t > C$. In other words, given the government's investment opportunity, the required discount rate for long-term environmental projects is the gross interest rate r.

Note that this conclusion – that environmental benefits to a future generation should be discounted at the gross interest rate – is independent of whether or not the future generation warrants government help. For example, suppose that value judgement requires that the current generation is responsible for a welfare improvement of the future generation t years from now that is worth $\$B$, but project analysis yields $B/(1+r)^t < C$. Then the government can take $\$B/(1+r)^t$ from the current generation and invest it in private market, which will generate $\$B$ for the generation t years from now.

On the other hand, suppose that value judgement indicates that it is not the current generation's responsibility for a future generation's welfare improvement, but the project analysis yields $B/(1+r)^t > C$. Then the government can undertake the project and finance it by borrowing $\$C$ from the current generation. At the same time the future generation t years from now is made to pay for the retirement for the increased debt. The current generation is indifferent to this arrangement whereas the future generation is better off because $B/(1+r)^t > C$.

Comparison of Approaches to Discounting

This project evaluation criterion using the gross interest rate as the discount rate can be compared to the dominant criterion today, where the discount rate, known as the social rate of time preferences (SRTP), is looked upon as an expression of ethical judgment on how the consumption of current and future generations should be relatively weighted. According to this approach, consumption of a future generation might be given a lower weight than that of a

present generation for two reasons. First, due to economic growth and diminishing marginal utility of consumption, an additional unit of consumption by a future generation has less value than an additional unit of consumption by the present generation. Second, the utility value of a future generation may be valued less than the utility value of the present one by a decision-maker, probably because the decision-maker – inevitably belonging to the present generation – is selfish. Combining those two reasons for discounting, the social rate of time preference has two components: a pure time preference rate for discounting future utility, and a growth factor – equaling the product of the elasticity of marginal utility with respect to consumption and the growth rate of per capita income – that represents the need for discounting due to economic growth. In other words, SRTP=$\rho+\Theta g$, where ρ is the pure time preference rate, Θ is the (absolute value of) elasticity of marginal utility of consumption and g is the growth rate of per capita income.

The SRTP approach to discounting has an implementation difficulty. That is, the two parameters representing value judgement regarding intergenerational equity – the pure time preference rate ρ and the elasticity of marginal utility Θ – cannot be obtained in an objective way. Even if one takes the position that the decision maker should not be biased in favor of the present generation so that ρ should be zero on moral grounds, one is still left with the value judgement parameter Θ.[1]

From our perspective, an even bigger and more fundamental problem (than implementation) with the SRTP approach is that given the intergenerational transfers through adjustments in government's debt policy, the discount rate for future benefits should always be the gross interest rate, regardless of the value judgement regarding intergenerational equity.

This view of discounting based on intergenerational equity, as embedded in the SRTP approach, is problematic because it ignores the fact that future generations can also be helped by debt reduction. Given the existence of competing means to help future generations, through environmental protection or debt reduction, the question of the appropriate discount rate becomes one of efficiency rather than equity.

Two questions arise from the above theoretical argument regarding the feasibility of the intergenerational transfers that are required for efficiency and what numerical value should be given to the gross interest rate.

In the rest of the paper, we first discuss the numerical value of the gross interest rate, and the implications of using a higher discount rate for environment quality and for intergenerational equity. We then review the evidence of recent growth in various forms of government debts. It is shown that substantial debts have been accumulated not only in the publicly held debt but also in the accrued benefits in Social Security and Medicare, which places a large burden on future

[1] Some economists believe that ρ and Θ can be estimated from observed market behavior. A criticism of this revealed preferences view is that observed intertemporal choices in the marketplace are based on individual preferences, which may not be the same as the preferences of the social planner.

taxpayers. Therefore, long-term projects aimed at helping future generations should be evaluated based on their efficiency relative to reducing the size of government debts.

Numerical Values of the Gross Interest Rate

Then what is the marginal productivity of capital or the (tax-inclusive) gross interest rate? How is this value compared to the officially recommended discount rate for intergenerational discounting?

The answer to the first question depends on whether one includes the risk premium. The risk premium cum gross rate of return has been variously estimated to be from 8.5% to above 9%. For example, Poterba (1999) estimates the real rate of return on non-financial corporate capital as 8.5% between 1959 and 1996.

However, these relatively high rates of return are risk-inclusive, and the risk-free gross rate of return should be considerably lower. Investment assets that are closest to being risk-free are government bonds. The Trustees of the Social Security System have used 2.9% in recent years for their long-term estimate of real returns (Social Security Trustees, 2008-2015). To arrive at the risk-free gross rate of return, the 2.9% bond rate must be adjusted upward to incorporate the corporate income tax effect. The corporate income tax rate must reflect levies on corporations at the federal, state, and local levels. Feldstein (1998) suggests that the total corporate income tax rate is about 40%, implying a risk-free gross rate of return of about 5%.

Therefore, the gross rate of return that is appropriate for intergenerational discounting is between 5% and 9%, depending on the risk involved. These discount rates are considerably higher than those recommended in government guidelines based on the dominant SRTP approach to intergenerational discounting. In SRTP=$\rho+\Theta g$, setting the pure time preference rate ρ and the elasticity of marginal utility Θ to be 0 and 1 to 1.5, respectively, the SRTP falls in the range of 1% to 3% if the per capita real income growth rate is 1% to 2%.[2] Using the concept of SRTP and the range of 1% to 3% for SRTP, OMB's (2003) guideline for intergenerational discounting is consistent with that of the Congressional Budget Office that recommends a 2% real discount rate.[3]

The quantitative significance of using a 5% to 9% gross interest rate rather than a 1% to 3% SRTP can be seen from the following table. In each cell is the present value of $1 million (in 2015 dollar) to a generation 50 (100, 200) years from now, under various real discount rate. Even the difference between the 3% discount rate and the 5% discount rate is quite dramatic, especially for the distant future. The present value using the 3% discount rate is 2.6 (6.8, 46.7) times of that using the 5% discount rate in 50 (100, 200) years.

[2] See Portney and Weyant (1999) for some of the estimates of SRTP that OMB (2003) cited.

[3] In practice, however, the CBO equalizes the SRTP to the consumer rate of interest since the 2% SRTP comes from a study of rates of return on government Treasury bills (Hartman 1990).

Discount Rate	50 years	100 years	200 years
1%	$608,039	$369,711	$136,686
3%	$228,107	$52,033	$2,707
5%	$87,204	$7,604	$58
9%	$13,449	$181	$0.03

Under the stricter criterion, using the 5%-9% discount rates, fewer environmental projects will be undertaken, but that does not suggest that the criterion is unfriendly to future generations. This criterion merely emphasizes the opportunity cost of long-term projects aimed at helping future generations. An alternative way to help future generations is to simply leave them with less debt. Reducing implicit Social Security and Medicare debts through benefit cuts or prefunding is a good option in this regard. Prefunding or cutting benefits requires sacrifice from the current generations since they must pay more taxes during the transition or have reduced benefits after retirement. However, with corresponding deregulations and cuts in long-term project financing, using this criterion to judge efficiency, current generations could also be better off.

Relation to Alternative Accounting of Future Environmental Benefits

Using a higher, market-based gross interest rate as the discount rate for an environmental program's benefits to future generations is not inconsistent with some existing arguments for using a lower discount rate for long-term environmental programs based on considerations of uncertainty. For example, Becker et al. (2010) point out that, due to the inevitable uncertainty regarding the long-term damage of climate change, greenhouse gas emission abatement may provide additional insurance benefits to future generations. Therefore, they contend that incorporating these insurance benefits of environmental projects requires using a lower discount rate than would otherwise be appropriate. Alternatively, these insurance benefits of environmental projects could be incorporated into the evaluation by adding them directly to the benefits to future generations without any downward adjustment in the discount rate.

Recent Growth in Various Forms of Government Debts

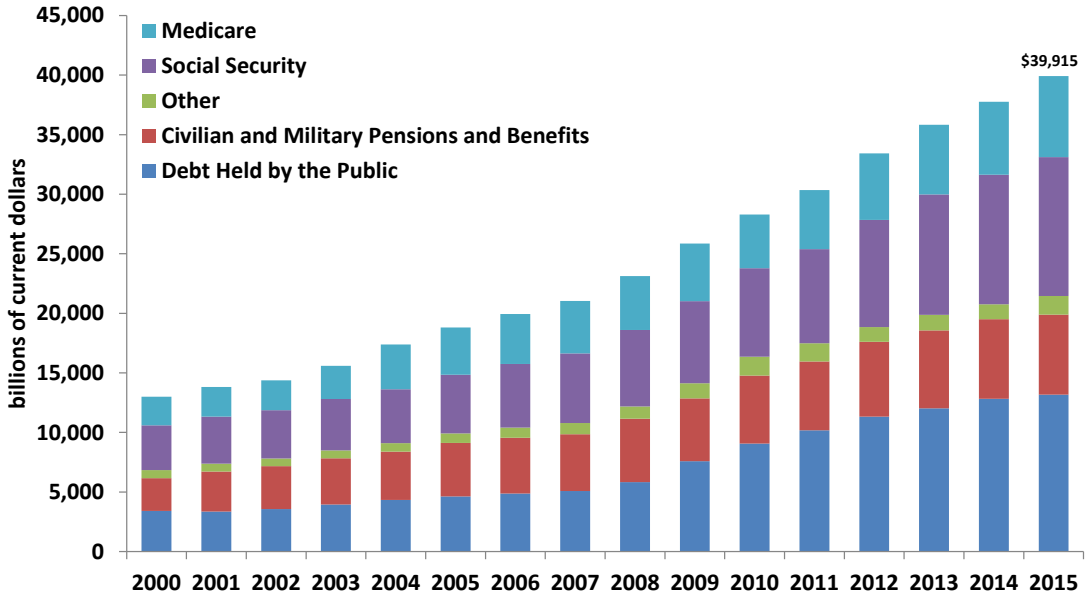
A potential criticism of using the market-based 5% or 9% discount rate to evaluate environmental benefits to future generations is that the investment alternative for the government to help future generations may be infeasible. For one thing, historical evidence suggests that it is hard for any government to accumulate interest-earning assets. Moreover,

giving the federal government the right to invest in stock markets may politicize investment decisions.

However, the government, if it has the political will, can always reduce the size of the debts it owes its people. As far as the intergenerational transfer is concerned, debt reduction serves the same function as government investment. Government debts include not only the widely publicized publicly-held debt but also other government liabilities. At the federal level, these other government liabilities are mainly comprised of accrued retirement and disability benefits to federal employees and veterans, and accrued benefits in Social Security and Medicare.

Figures 1 and 2 below depict the size of various forms of government debts in nominal dollars and as a share of GDP, respectively. As Figure 1 shows, the total federal government liabilities were almost $40 trillion as of 2015, and the debt held by the public is but one form of federal liability that places a burden on future generations.

Figure 1. Federal Liabilities Including Accrued Social Security and Medicare Benefits Payable to Participants Who Have Attained Eligibility Age

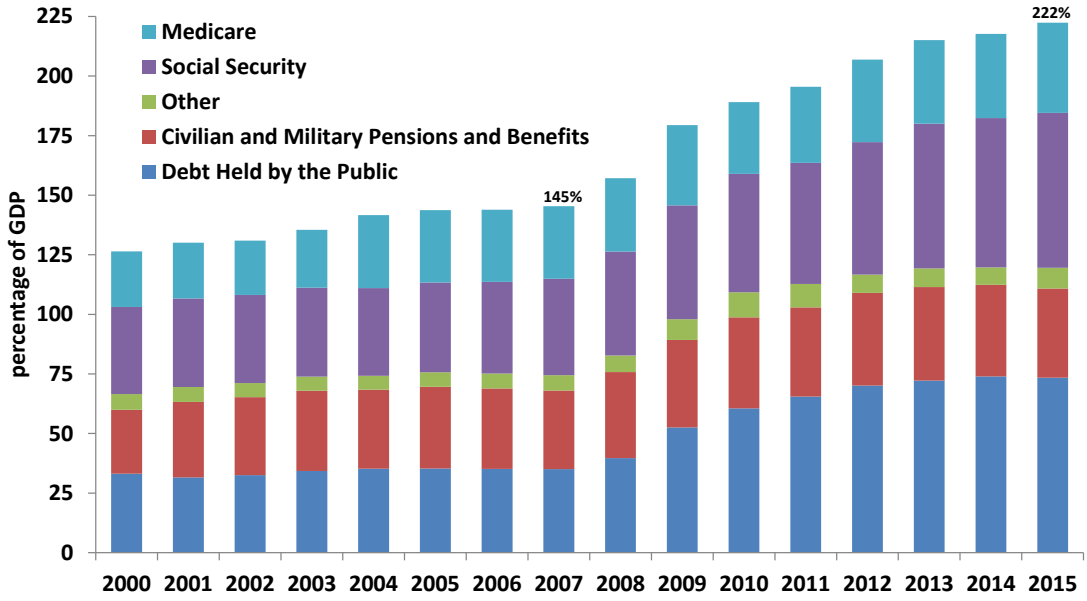


Sources: Financial Reports of the United States Government (2000-2015). See text for discussion of the Government Accountability Office's opinion of the Medicare estimates beyond 2009.

Indeed, the $18 trillion in accrued Social Security and Medicare benefits payable to current retirees comprised 45% of the total and were 38% higher than the debt held by the public. Moreover, all the component liabilities have been increasing and together they have more than doubled in size over the last decade.

Figure 2 depicts these liabilities as a share of GDP. As the figure shows, the total liabilities as a percentage of GDP has increased considerably since 2007 and reached 222% by 2015. Therefore, the room for debt reduction in the U.S. is very large, both in the area of publicly held debt and in the area of implicit entitlement debts in Social Security and Medicare.[4]

Figure 2. Federal Liabilities Including Accrued Social Security and Medicare Benefits Payable to Participants Who Have Attained Eligibility Age as a Percentage of GDP



Sources: Financial Reports of the United States Government (2000-2015). GDP from the Bureau of Economic Analysis.

Concluding Discussions

To summarize, both environmental policy and debt policy affect future generations, and they need to be coordinated to improve efficiency. It would be inefficient to use a low 1 to 3 percent discount rate to evaluate environmental programs that benefit future generations, as suggested by existing guidelines, and at the same time increasing the tax burden on future generations by growing the debt held by the public and/or implicit debts in Social Security and Medicare. As is demonstrated in this study, we should consider using a discount rate of 5% to 8% (i.e., the gross interest rate associated with various degrees of risk) to reflect available market opportunity.

Equating the discount rate to the higher gross interest rate provides a mechanism to balance environmental projects on the one hand, and Social Security and Medicare debt reductions on

[4] See Liu, Rettenmaier, and Saving (2016) for further discussion of all federal liabilities.

the other. A higher discount rate will certainly lead to fewer environmental projects being accepted, but it does not necessarily imply the direction and the degree of intergenerational transfers. If undertaking all the environmental projects that pass the cost-benefit test is not enough to reflect concern for future generations, then we should consider debt-reducing options. If, on the other hand, the current generation feels that enough has already been done in the area of generational altruism, but there are more environmental projects that pass our cost-benefit test than already undertaken, then it is appropriate to accept those projects, which benefits future generations at a cost to the current generations, while at the same time scaling up entitlement or explicit debts, which benefits the current generations at a cost to future generations.[5]

Of course, it is hard to say how much care for future generations is appropriate. If one believes in the principle of revealed preferences, then the current scale of generational care is about right. Then, given that our cost-benefit test based on the gross interest rate is stricter than what is implied by existing federal guidelines using a lower discount rate, it may well be efficiency-improving to scale down environmental projects and regulations that are aimed at helping future generations, and at the same time maintain the same level of generational altruism by leaving future generations less implicit or explicit debts.

Therefore, government's generational policies should pay more attention to reducing government debts in various forms. As we have reviewed in this study, there is plenty room for debt reduction, especially in the area of Social Security and Medicare.

It is important to note that debt reductions have other beneficial effects. It is now well-known that government borrowing reduces national income and impedes economic growth: borrowing internally crowds out domestic investment (citizens end up holding government bonds instead of productive assets); borrowing externally increases foreign ownership of the economy. The detrimental effects of a government running extremely high level of debt has been evident from the decades-long economic stagnation in Japan (where the debt-to-GDP ratio is 227%), the economic hardship and political drama in Greece (with a debt-to-GDP ratio of 175%). In comparison, while the debt-to-GDP ratio in the U.S. is still below 100% (but it has been steadily rising in recent years), the total federal liability-to-GDP ratio is already 222% according to a conservative estimate, as we mentioned earlier.

Evaluating long-term projects that affect people many decades or centuries down the road is a complicated business. This gives another reason for balancing the government's generational policy related to environmental protection and debt reduction. Taking greenhouse gas (GHG) emissions abatement for example, the scientific premise of GHG abatement is that increased concentration of CO_2 and other greenhouse gases in the atmosphere causes the global temperature to rise, yet exactly how much the temperature would increase without any major

[5] This provides a situation that entitlement programs like Social Security and Medicare may have helped maintain a better environment.

abatement is not clear. This lack of precise scientific knowledge is, at least in part, because, while the effects of GHG concentration are long-term, the recorded history of the interactions between GHG concentration and global temperature is relatively short.

Moreover, if the climate effects concerning the GHG emissions were precisely established, we would still be faced with how the economic effects of climate change caused by these emissions should be estimated. Since the bulk of the effects of climate change will take place in the far future, what new technologies will be available between now and then for coping with these effects --- which are important to estimating the economic gains from abatement --- is not totally clear.[6] Further, for a long-term project that generates environmental amenities for generations hundreds of years from now, evaluating its benefits in terms of willingness to pay would involve at best only an educated guess at the preferences of those whose value systems are little known to us.

At any point in time when an existing generation considers how its actions and policies may affect the generations to come it needs to foresee how a future generation would inform present policy choices. Any particular type of project that uses resource now and generates benefits decades or even centuries later must be evaluated in light of the alternative of a larger economy, more advanced technology, and the potential of greater wealth in the future.

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[6] Accounting for efficient adaptive behavior to reduce potential damages is deemed important for evaluating the economic costs from global warming. Generally speaking, accounting for adaptive behavior would make global warming less costly, hence, GHG emissions abatement now is likely less beneficial.

monographs. He has published in *Journal of Public Economics, Journal of Health Economics, Health Economics, Southern Economic Journal,* and *Economic Inquiry*, among other economic journals.

Thomas R. Saving is the Director of the Private Enterprise Research Center at Texas A&M University. A University Distinguished Professor of Economics at Texas A&M, he also holds the Jeff Montgomery Professorship in Economics. Dr. Saving received his Ph.D. from the University of Chicago and served on the faculty at the University of Washington at Seattle and Michigan State University before moving to Texas A&M University in 1968. Dr. Saving's research has covered the areas of antitrust economics, monetary economics, and health economics. He has served as a referee or as a member of the editorial board of the major United States economics journals, and as co-editor of *Economic Inquiry* from 1997-2006. His current research emphasis is on the benefit of markets in solving the pressing issues in health care and Social Security. He is the co-editor of *Medicare Reform: Issues and Answers*, University of Chicago Press, 1999, and the co-author of The *Economics of Medicare Reform*, W.E. Upjohn Institute, 2000, and The *Diagnosis and Treatment of Medicare*, AEI, 2007. In addition, he has many articles in professional journals and two influential books on monetary theory. Dr. Saving has been elected to the post of President of the Western Economics Association, the Southern Economics Association and the Association of Private Enterprise Education. In 2000, President Clinton appointed Dr. Saving as a Public Trustee of the Social Security and Medicare Trust Funds; he served as Trustee until 2007. He also served on President Bush's bipartisan Commission to Strengthen Social Security.

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