

## DOCUMENT RESUME

ED 482 134

HE 036 378

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TITLE An Economic Approach to Setting Contribution Limits in Qualified State-Sponsored Tuition Savings Plans.

PUB DATE 2000-00-00

NOTE 12p.; In: National Tax Association Annual Conference on Taxation Proceedings (93rd, Santa Fe, NM, November 9-11, 2000). Washington, DC: National Tax Association, 2000. p107-116.

PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS Higher Education; Parent Financial Contribution; \*Paying for College; \*Resource Allocation; \*Tuition

IDENTIFIERS Student Financial Contribution; \*Tuition Savings Plans

## ABSTRACT

This study used an expected utility framework with a mean-lower partial moment specification for investor utility to determine the asset allocation and the allowable contribution limits for qualified state-sponsored tuition savings plans. Given the assumptions about state policymakers' perceptions of investor utility, the study determined the necessary level of contributions needed to fund 5 years of education at the most expensive higher education institution in the United States. The approach determines simultaneously the optimal asset allocation and the annual contribution level needed in order to achieve the savings target. The modeling framework incorporates a specific, and reasonable, definition of risk aversion and optimal investment behavior. The paper contains background information on qualified tuition plans, the saving and asset allocation model used in the analysis, with an explanation of the way various parameters are calibrated, baseline simulation results, some sensitivity tests, and concluding remarks. (SLD)

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**2000**

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# AN ECONOMIC APPROACH TO SETTING CONTRIBUTION LIMITS IN QUALIFIED STATE-SPONSORED TUITION SAVINGS PLANS

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**H**OUSEHOLDS MAY HAVE MANY REASONS TO accumulate significant amounts of financial assets. One of the most important motivations for saving is to finance higher education for their children. The federal and state governments have recently expanded tax incentives and introduced savings plans intended to encourage families to save for college expenses.

In order to be eligible for federal tax benefits, tuition plans must provide adequate safeguards to prevent contributions on behalf of a beneficiary in excess of those necessary to provide for qualified higher education expenses (IRC §529(b)(6)). In practice, the federal government allows each state to determine its own contribution limit based on actuarial projections of future college costs and investment performance under the plan. In addition, plans must provide that investors may not direct the investment (directly or indirectly) of contributions to the plan or its earnings (Prop. Treas. Reg. §1.529-2 (g)).<sup>1</sup> State policymakers must, therefore, act uniformly for all participants—that is, consider the “average” preferences of individual investors—when choosing asset allocation strategies and determining the allowable contribution limits under federal regulations.

In this paper, we use an expected utility framework with a mean-lower partial moment specification for investor utility to determine the asset allocation and the allowable contribution limits for qualified state-sponsored tuition savings plans. Given our assumptions regarding state policymakers’ perception of investor utility, we determine the necessary level of contributions needed to fund five years of education at the most expensive higher education institution in the nation, as allowed by the IRS regulations for Section

529 plans. Our approach determines simultaneously (1) the optimal asset allocation and (2) the annual contribution level needed in order to achieve the savings target.

Our modeling framework incorporates a specific, and we believe reasonable, definition of risk aversion and optimal investment behavior. This framework allows the determination of “appropriate” contribution levels, and enables analysis of the interaction between the contribution limits and risk-taking. The results of our research may have implications for the determination of contribution limits under the current IRS regulations for tuition savings plans.

The remainder of the paper is structured as follows: background information on qualified tuition plans; the saving and asset allocation model used in our analysis, with an explanation of how various parameters in the model are calibrated; the baseline simulation results and some sensitivity tests; and some concluding remarks.

## QUALIFIED STATE-SPONSORED TUITION PLANS

Qualified state-sponsored tuition plans (also called Section 529 plans) meet the requirements of Section 529 of the Internal Revenue Code (IRC) and the attendant regulations, and may be tuition savings plans or prepaid tuition plans. A tuition savings plan is an investment program that offers certain tax advantages, provided its accumulated assets are used to pay allowable expenses at an accredited institution of higher education. A prepaid tuition plan also offers tax advantages and usually allows the plan buyer to purchase future college tuition credits at today’s price, sometimes at a discount. Because the issue of contribution limits is fairly straightforward for prepaid tuition plans (most allow purchase of up to four years’ worth of tuition credits), we focus on tuition savings plans.

### Tax Benefits of Tuition Savings Plans

The primary tax benefits of tuition savings plans are as follows:

\*The views expressed in this paper are those of the authors and not necessarily those of TIAA-CREF. Our acknowledgment to Jeff Brown, Karen Elinski, Douglas Fore, Jim Musumeci, Mike Noone, Jim Poterba, Larry Rubin, and Jessica Seaton for helpful conversations and suggestions. We also thank attendees at the October 4, 2000, Washington DC Tax Economists Forum for helpful discussions and comments. This research was conducted while Julia Blohm was a research assistant at the TIAA-CREF Institute.

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- (1) Growth of earnings is tax deferred at the federal and state levels, provided that future withdrawals are used for qualified higher education expenses. Some states exempt earnings from state income tax and/or allow contributions to be deducted from state income tax.
- (2) When the withdrawals are made for qualified higher education expenses, the earnings are taxed at the beneficiary's tax rate, which is likely to be lower than that of the owner of the account.
- (3) Funds in tuition savings plans will not affect a family's eligibility for federal tax credits, such as Hope Scholarship Credit and Lifetime Learning Credit.
- (4) Anyone in any income bracket may contribute.

A program satisfies this requirement if it will bar any additional contributions to an account as soon as the account reaches a specified account balance limit applicable to all accounts of designated beneficiaries with the same expected year of enrollment. The total contributions may not exceed the amount determined by actuarial estimates that is necessary to pay tuition, required fees, and room and board expenses of the designated beneficiary for five years of undergraduate enrollment at the highest cost institution allowed by the program. (Prop. Treas. Reg. §1.529-2 (i)(2))

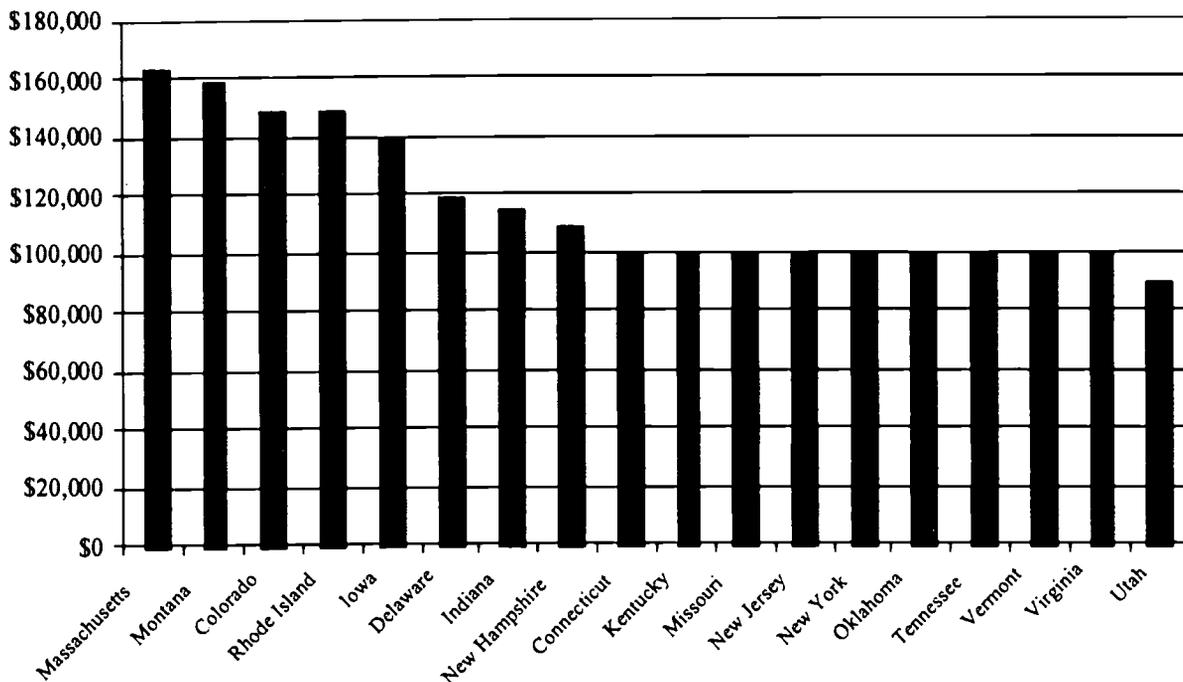
In practice, each state is allowed to set its own contribution limit, subject to understanding of the IRS rules. A few states (for example, New York) have statutory limits. The limits are formulated in two ways. Most states specify limits on contributions only, while a few limit account balances, that is, the accumulation of contributions and investment earnings. Further, almost all states have only lifetime limits (either on contributions or on account balances). In our paper, we formulate our analysis in an annual contribution limit framework, which, given a fixed investment horizon, can be translated into a lifetime contribution limit.<sup>2</sup>

**IRS Regulations on Contribution Limits**

The Internal Revenue Code requires adequate safeguards to prevent contributions on behalf of a beneficiary in excess of those necessary to provide for qualified higher education expenses. The proposed regulations on Section 529 provide a "safe harbor" provision, which if met will satisfy the general IRC requirement:

Figure 1 shows that contribution limits vary widely across plans. As of November 2000, Utah

Figure 1: Lifetime Contribution Limits for Tuition Savings Plans (2000 Level)



has a lifetime contribution limit of \$90,630 per beneficiary, the lowest among all plans, while Massachusetts has a lifetime contribution limit of \$164,375 per beneficiary, the highest among all plans. Several states have lifetime contribution limits close to or at \$100,000.

### THE SAVING AND ASSET ALLOCATION MODEL

Consider a state policymaker acting uniformly for all program participants who are saving for their children's future college education. The policymaker maximizes the investors' expected utility, which is a function of wealth at the end of the savings period (i.e., the date of enrollment). Utility is defined as:

$$u(w_T) = w_T - c(\min[0, w_T - w^*])^2$$

This function is a mean-lower partial moment utility function.  $w_T$  is accumulated wealth, and the subscript  $T$  indicates the final time period. The notation  $w^*$  represents the savings target. The risk aversion parameter  $c$  influences the investor's attitude toward risk. The larger the  $c$ , the more risk averse is an investor. Risk is defined by  $(\min[0, w_T - w^*])^2$ . The key feature of this function is that the investor has some established target level of wealth ( $w^*$ ) in mind, and risk is considered purely as a function of how often and by what magnitude the investor falls below this target. This approach is related to the "shortfall risk" approach in determining appropriate asset allocations (Leibowitz and Langetieg, 1989).

The state policymaker then uses a dynamic programming method to maximize this utility over the savings horizon. In the penultimate period ( $T - 1$ ), the maximization problem that the policymaker faces is to find  $V_{T-1}(w_{T-1}, y)$  where

$$(1) \quad V_{T-1}(w_{T-1}, y) = \max_{\alpha_T, \beta_T, \gamma_T} E_{T-1}[u(w_T)]$$

subject to  $w_t = (w_{t-1} + y)(1 + \alpha_t r_t^s + \beta_t r_t^b + \gamma_t r_t^c)$

$$1 = (\alpha_t + \beta_t + \gamma_t)$$

$$\alpha_t \geq 0, \quad \beta_t \geq 0, \quad \gamma_t \geq 0$$

The letter  $y$  above is a fixed per-period savings contribution. The  $r$  terms in the first constraint

above are the random returns on stocks (superscript  $s$ ), bonds (superscript  $b$ ) and cash (superscript  $c$ ). The Greek letters  $\alpha$ ,  $\beta$ ,  $\gamma$  are the portfolio weights for stocks, bonds, and cash, respectively. The five constraints are, first, the equation governing how wealth changes over time, second, the constraint that portfolio shares add up to 1 (note that this implies that the policymaker effectively chooses only two of the three portfolio weights), and the three non-negativity constraints on portfolio holdings.

Working backward from  $T - 1$ , the policymaker then finds the set of solutions to the following equations:

$$V_t(w_t, y) = \max_{\alpha_t, \beta_t, \gamma_t} E_t[V_{t+1}(w_{t+1}, y)]$$

In each period, the maximization is subject to the same constraints as above, and  $t$  runs from  $t = 0$  to  $t = (T - 1)$ . The set of solutions implies a set of optimal policy functions,  $F_t^*(w_t, y)$ , that map accumulated wealth in each period  $t$  to the optimal choices of  $\alpha$ ,  $\beta$ ,  $\gamma$  in that period.

We assume that the policymaker needs to begin making the asset allocation decision when the child is born. We also assume that the child begins attending college at age 18. Thus, we maintain a fixed time horizon of 18 years.

We follow Musumeci and Musumeci (1999) and use a dynamic programming technique, essentially a process of working backward from the desired target. This approach is based on simulations, using historical data, of the distribution of future asset returns. For example, with an 18-year investment horizon, we determine which allocation in year 17 would be optimal, given a utility function and other parameters (contribution level, accumulation target, and accumulated wealth) and a simulation of possible outcomes in year 18. Then, taking into account the optimal policy in year 17, we determine the optimal allocation in year 16. This process continues until the allocation in year one has been reached.

### Parameters

#### Asset Returns

We assume the policymaker uses three asset classes: common stocks, long-term Treasury bonds, and Treasury bills. We use real (inflation-adjusted) monthly return data for each asset class from 1926-1995 from *Stocks, Bonds, and Inflation: 1996 Year-*

book (Ibbotson, 1996). We employ the Musumeci and Musumeci (1999) algorithm to simulate annual returns for all asset classes by compounding monthly random returns, using a month-by-month sampling procedure. For example, first we simulate January returns for all assets by making a random draw from past January returns; then we simulate February returns by an independent random draw from past February data, etc., until we have a year's worth of randomly drawn data. This procedure preserves the contemporaneous correlation between asset classes. The set of randomly drawn monthly returns is then compounded to form a single simulated annual return for each asset class. Further, we assume an annual expense ratio of 80 basis points, which reduces the annual returns of each asset by 80 basis points.

For each year, for each wealth level, the algorithm produces expected utility for each portfolio combination by computing an equal-weighted average of the utility function over 10,000 of these simulated annual returns.<sup>3</sup> The optimal portfolio at each point in time, given each level of wealth, is simply the portfolio that generates the maximum average utility for that wealth level over all of the simulations.<sup>4</sup>

**Tuition Inflation and Cost of College**

We use a tuition inflation rate of 2 percent in excess of consumer price inflation, because this figure represents the average tuition inflation rate over the past 30 years (*Inflation Measures for Schools, Colleges, and Libraries: 1998 Update*, Research Associates, Washington, DC, 1998).

The College Board reports the cost of over 2,700 colleges and universities across the nation in its annual publication *College Cost and Financial Aid Handbook*. According to the 2001 edition, Sarah Lawrence College is the most expensive college across the country during the 2000-01 school year, with estimated expenses of \$35,058, including tuition, fees, and room and board. Under the "safe harbor" regulations, tuition savings plans may cover at most five years of tuition, fees, and room and board at the most expensive higher education institution. We therefore estimate the current inflation-adjusted cost of five years of the most expensive college education to be \$182,443, assuming a 2 percent real tuition increase per year. This same education will cost \$260,574 (in real terms) in 18 years; this establishes our savings goal or target.

**Risk Aversion**

Within the mean-lower partial moment framework, the investors' level of risk aversion depends on the parameter  $c$ . To gain a more intuitive understanding of the levels of risk aversion implied by different values of  $c$ , we present in Table 1 certainty equivalents (CEQs) for an example of various values of  $c$  and expected wealth levels ( $w$ ) given a hypothetical savings target ( $w^*$ ), and a specific, simple risky investment. The certainty equivalent of a risky investment is defined as the amount of risk-free wealth that would yield the investor the same level of utility or satisfaction as the risky investment. We also report in Table 1 the corresponding coefficient of relative risk aversion ( $\gamma$ ), for each combination of  $w$ ,  $w^*$ , and  $c$ .

Table 1  
**Certainty Equivalents, Willingness to Pay to Avoid All Investment Risk,  
 and the Corresponding Relative Risk Aversion Parameters ( $\gamma$ )**

Risk- aversion Parameter ( $c$ )	Expected Wealth and Risk Aversion								
	50% of Target \$150,000			75% of Target \$225,000			99% of Target \$297,000		
	CEQ	WTP	$\gamma$	CEQ	WTP	$\gamma$	CEQ	WTP	$\gamma$
0.01	\$149,252	\$748	1.00	\$223,516	\$1,484	3.00	\$287,310	\$9,690	97.38
0.0001	\$149,276	\$724	0.97	\$223,606	\$1,394	2.81	\$290,269	\$6,731	37.13
0.00001	\$149,438	\$562	0.75	\$224,103	\$897	1.80	\$295,576	\$1,424	5.60
0.000001	\$149,827	\$173	0.23	\$224,804	\$196	0.39	\$296,848	\$152	0.59

1) Assuming "Mean-lower Partial Moment" utility with a target wealth level of \$300,000.  
 2) As  $c$  becomes smaller and smaller (from 0.01 to 0.000001), the investor becomes less and less conservative.  
 3) The simple, risky investment has two possible outcomes: being \$15,000 below or above the expected wealth, each with a 50 percent chance.

Given a strictly concave utility function, the certainty equivalent will always be less than the expected wealth of the risky investment. We define an investor's willingness to pay (WTP) to avoid all investment risk as the difference between the CEQ and expected wealth. WTPs can be used to provide an intuitive indication of an investor's degree of risk aversion. Given the same investment risks and expected wealth, the larger the WTP, the more expected wealth the investor is willing to give up to avoid all uncertainty, the more risk averse is the investor. Table 1 reports certainty equivalents for the utility function described in Equation (1) for investors with three different expected wealth levels. For each expected wealth level, we calculate the certainty equivalents for four different risk aversion parameters. For each expected wealth level, we assume for simplicity that there are two possible outcomes for the next investment period: being \$15,000 below or above the expected wealth, each with a 50 percent chance. In these calculations, we use \$300,000 as the hypothetical target wealth level ( $w^*$ ).

Table 1 shows that for any given  $c$ , an investor becomes more conservative as the wealth gets closer to the target.<sup>5</sup> For example, for  $c$  equal 0.01 and expected wealth of \$150,000, the investor's CEQ is only \$748 less than the expected wealth. However, when his expected wealth equals 99 percent of the target, the investor becomes much more conservative, and is willing to give up \$9,690 of expected wealth to avoid the investment risk.

Table 1 also shows that for any given wealth level, the smaller the  $c$  the less conservative is the investor. When  $c$  equals 0.000001, the investor is almost risk neutral. (When  $c$  is zero, the investor is completely risk neutral.) For our baseline case, we use 0.0001 as the risk aversion parameter, because we believe it to represent risk tolerance levels among typical families, as assessed by state policymakers. We also conduct sensitivity tests with other levels of  $c$ .

### Reaching the Target

The simulation procedure determines the optimal portfolio allocations in each period as a function of (1) accumulated wealth at the beginning of each period, (2) the number of periods until the goal, and (3) the fixed level of annual contribution. This function is a discrete approximation of an optimal policy function—the functional solution to the dynamic programming problem—in which start-

ing wealth and the number of periods until the goal date are the state variables, and the annual contribution level is a fixed parameter.

To determine whether a particular fixed contribution level is sufficient to reach the savings target, one would ideally like to take an expectation over the distribution of final accumulated wealth, conditional on the use of the optimal policy function and the assumed contribution level. However, the calculation of this expectation would involve the evaluation of a multi-dimensional integral/sum, and is computationally burdensome.

Therefore, for the purpose of determining the appropriate contribution limit, we make a simplifying assumption regarding the evolution of future wealth. In particular, to evaluate the sufficiency of each contribution level, we assume that the mean asset return for each class will obtain, with certainty, in each year going forward. In other words, after determining an optimal policy based on a *stochastic* simulation, we determine final wealth based on the assumption that the optimal allocation policy will be followed over the 18-year horizon, given *deterministic* asset returns.<sup>6</sup> We then use an iterative search process, in which we alter the annual contribution limit, and re-run the simulations until we find an annual contribution level is just enough to produce the target accumulation at the end of the accumulation period.<sup>7</sup>

## RESULTS

We begin by discussing the simulation results from our baseline case. We then conduct some sensitivity tests to examine how results will change with asset returns and risk aversion parameters, and other methodological approaches.

### Baseline

In our baseline case, we consider a highly risk averse investor ( $c = 0.0001$ ) with no initial wealth. The target level of savings is \$260,574 and the investment horizon is 18 years. Table 2 presents simulation results. We find that an annual contribution of \$7,850 in real terms over 18 years (or \$141,300 total contribution), allocated optimally and given our assumptions about future asset returns, will result in a final wealth level of \$260,417 after 18 years of investment, just slightly below the target level.

Table 2 also reports the optimal asset allocation for each investment period. It suggests that given an annual contribution level of \$7,850, the opti-

Table 2  
**Asset Allocation and Wealth Accumulation – the Baseline Case**

Year	<i>Wealth at the Beginning of the Year</i>	<i>Share in Equities</i>	<i>Share in T-bonds</i>	<i>Share in T-bills</i>	<i>Assumed Return</i>	<i>Wealth at the End of the Year</i>
1	\$0	100%	0%	0%	8.4%	\$8,510
2	\$8,510	100%	0%	0%	8.4%	\$17,737
3	\$17,737	100%	0%	0%	8.4%	\$27,740
4	\$27,740	100%	0%	0%	8.4%	\$38,584
5	\$38,584	100%	0%	0%	8.4%	\$50,340
6	\$50,340	100%	0%	0%	8.4%	\$63,086
7	\$63,086	100%	0%	0%	8.4%	\$76,904
8	\$76,904	100%	0%	0%	8.4%	\$97,885
9	\$97,885	100%	0%	0%	8.4%	\$108,126
10	\$108,126	100%	0%	0%	8.4%	\$125,733
11	\$125,733	90%	10%	0%	7.7%	\$143,921
12	\$143,921	90%	10%	0%	7.7%	\$163,516
13	\$163,516	70%	30%	0%	6.4%	\$182,316
14	\$182,316	60%	40%	0%	5.7%	\$201,033
15	\$201,033	50%	40%	10%	4.9%	\$219,036
16	\$219,036	40%	30%	30%	3.8%	\$235,568
17	\$235,568	30%	10%	60%	2.6%	\$249,776
18	\$249,776	10%	20%	70%	1.1%	\$260,417

1) Target is \$260,574.

2) Fixed real annual contribution is \$7,850.

3) Annual rebalancing—all wealth is re-allocated each year according to the optimal portfolio.

4) Real asset returns: equities, 9.2% per year; T-bonds, 2.5% per year; T-bills, 0.7% per year.

5) The assumed returns reflect an annual expense ratio of 80 basis points.

mal asset allocation is to invest 100 percent in equities for the first ten years, then gradually reduce the percentage of equities and increase those of T-bonds and T-bills. It also shows that when far away from the goal date even a highly conservative investor invests aggressively. This in part follows from the mean-lower partial moment utility function, which imposes a high penalty for falling below the target. It is also partly a function of the fact that future contributions are assumed to occur with certainty. As the investor accumulates more wealth and gets closer to the goal date, he will become increasingly conservative. These results echo the CEQs and WTPs reported in Table 1.

### Sensitivity

#### Risk Aversion

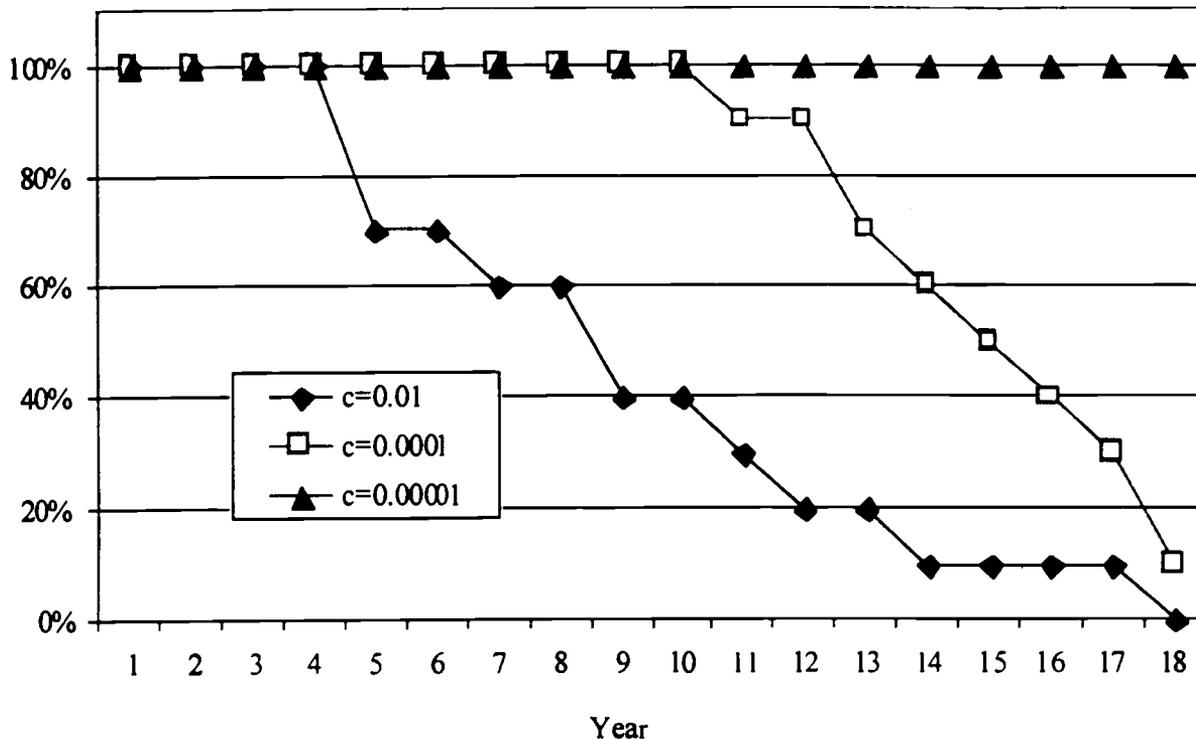
How will an investor's attitude toward risk affect the necessary contribution level and optimal asset allocation? To answer this question, we rerun the baseline case with two different risk aversion parameters ( $c = 0.01$  and  $c = 0.00001$ ). We again iterate to determine the annual contribution level and optimal asset allocation for these two types of investors.

Figure 2 shows the optimal asset allocations for investors with  $c$  equal 0.01, 0.0001, and 0.00001, respectively. Clearly, the investor with  $c$  equal 0.01 invests more conservatively than the investor with  $c$  equal 0.0001 and much more conservatively than the investor with  $c$  equal 0.00001. The investor with  $c$  equal 0.01 starts shifting away from stocks at the beginning of the fifth year, six years before the investor with  $c$  equal 0.0001 does so. With an annual contribution of \$11,500 (or a lifetime contribution of \$207,000), this investor will end up with a final wealth level of \$257,360 after 18 years. In the case of  $c$  equal 0.00001, the investor allocates 100 percent in stocks throughout the 18 years. An annual contribution of \$6,150 (or a lifetime contribution of \$110,700) after 18 years will result in a final wealth level of \$259,968.

#### Less Optimistic State Policymaker

The results presented in previous sections are based on historical asset returns from the Ibbotson data. Now consider a less optimistic state policymaker who believes that monthly returns on equities will likely to be about 0.25 percent lower

Figure 2: Suggested Allocations to Equities, with Different Risk Aversion Parameters



in the future than they have been during 1926-1995. For this purpose, we create a new set of asset return parameters, which results in a new average return for equities, 6.2 percent. As in the baseline case, we use tuition inflation of 2 percent and a target level of \$260,574. We also keep the baseline risk aversion parameter,  $c = 0.0001$ .

Figure 3 compares the optimal asset allocations for the lower stock return case and the baseline case. Not surprisingly, the same investor will allocate much less in stocks in the lower stock return case. The investor will invest aggressively for five years and start to become increasingly conservative. For the rest of the investment horizon, the investor will consistently invest less in stocks than in the baseline case. With the lower stock return, an annual contribution of \$10,950 (or a lifetime contribution of \$197,100) optimally allocated will result in a final wealth level of \$258,939 after 18 years of investing.

#### Different Assumed Path of Future Wealth

Changing the deterministic rates of return used in calculating final wealth also has a significant impact on the necessary contribution limits. In particular, we modify our baseline case so that our estimate of final wealth is based on the assump-

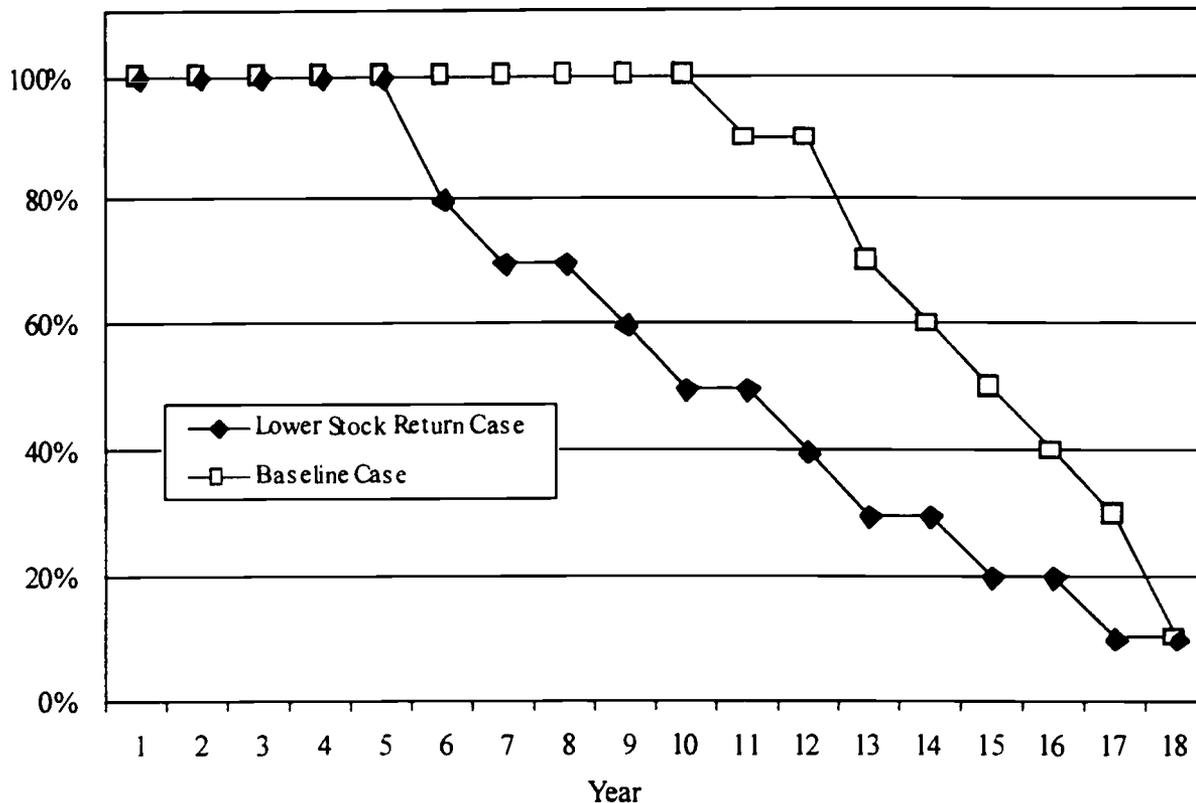
tion that the investor will realize the geometric mean rate of return in each year going forward (rather than the arithmetic mean). We find that the annual (lifetime) contribution necessary to attain the target wealth level after 18 years rises to \$9,100 (\$163,800). (The geometric average real returns are 7.2 percent, 2.0 percent, and 0.58 percent for stocks, bonds, and bills respectively.)

#### Baseline Case: Simulated Distribution of Final Wealth

For the purpose of comparison, we also simulate our wealth outcomes using 10,000 simulations of stochastic returns in conjunction with the optimal policy as determined in the baseline case. In each simulation, we draw randomly asset returns for 18 years and calculate the evolution of wealth, assuming that the fixed contributions are made in each year and the optimal asset allocation policy is followed. This generates a distribution of final wealth based on 10,000 simulations.

With a fixed annual contribution of \$7,850 (the baseline case), the average final wealth level across 10,000 simulations is \$306,476 and the median final wealth level is \$246,373. This suggests that while the expected wealth is well above the target, there is more than a 50 percent chance that the investor will not meet the target level of \$260,574.

Figure 3: Suggested Allocations to Equities - Baseline Case vs. Lower Stock Return Case



In order to meet the target with a 50 percent chance, the investor will need to contribute \$8,900 per year for 18 years (or a lifetime contribution of \$160,200). This level of contribution will result in an average final wealth of \$352,702.

#### SUMMARY AND CONCLUSIONS

We use the Musumeci and Musumeci (1999) framework to determine the allowable contribution limits in tuition savings plans. Given a fixed investment horizon and our assumptions about utility, an investor tends to invest more aggressively the farther from the goal date and to become more conservative as wealth increases and the goal date nears.

In the baseline case, we find that an annual contribution level of \$7,850 over 18 years (or \$141,300 total contribution) is just enough to make the target. This contribution level is at the high end of the contribution limits used by tuition savings plans. Further, our sensitivity analysis suggests that an investor's attitude toward risk has a strong impact on the optimal asset allocation and contribution level needed to meet the target. This result has implications for determining contribution limits in tuition savings plans under current IRS regulations.

Because the IRS regulations require that individual investors in these tuition plans not have control over asset allocations, it is important for the state policymaker to take into account the risk tolerance of a majority of investors when determining asset allocation and contribution limits.

As mentioned above, the focus of this paper is to examine the issue of contribution limits and asset allocation from viewpoint of the state policymaker rather than the individual investor. Individual investors may have other alternative methods to save for college, for example, Education IRA, Uniform Gifts to Minors accounts, 401(k), etc. Because the IRS regulations on tuition savings plans do not provide for consideration of other available resources, the state policymaker does not take these other resources into account when setting the contribution limit. Further, we note that the allowable contribution limits reflect the cost of attending the most expensive college in the nation, which is higher than the average cost of attending college.<sup>8</sup>

#### Notes

<sup>1</sup> Investors may choose from several investment options, however, when establishing an account. Further,

investors may change the percentage of new contributions going into each investment option.

- <sup>2</sup> We focus only on contribution limits in our paper. However, our simulation approach may be reformulated to examine the issue of setting account balance limits.
- <sup>3</sup> The expected utility calculations reflect the assumed contribution in the next period in addition to the simulated asset returns.
- <sup>4</sup> To make this process less computationally onerous, the investor is allowed to have portfolio shares in each asset class that are integral multiples of 10 percent—the universe of investment portfolios is therefore limited to 66 possible permutations. Wealth is assumed to increase in \$250 increments, and possible wealth levels vary between \$0 and \$2 million. These assumptions introduce some errors into the optimization calculations at upper bound of the assumed wealth range (introducing a conservative bias, because wealth above \$2 million yields the same utility as \$2 million), but our analysis focuses on the lower end and middle parts of the wealth range where these problems are not significant. See Musumeci and Musumeci (1999) and Musumeci (1998) for further details.
- <sup>5</sup> At wealth levels strictly below the target, the utility function exhibits increasing absolute risk aversion.
- <sup>6</sup> Given this approach, there is clearly a question regarding what assumptions should be made about future asset returns. In particular, it is not immediately clear whether a geometric average or arithmetic average is appropriate in this context. The baseline case in the analysis uses the arithmetic mean returns; but our sensitivity tests include the use of geometric mean returns as well.
- <sup>7</sup> For the purpose of comparison, we also use a simulation procedure to approximate the distribution of outcomes for our baseline case. We report the results under the head Baseline Case: Simulated Distribution of Final Wealth. In this procedure, we simulate 18 years

of randomly drawn asset returns 10,000 times. We then determine the evolution of future wealth in each of these simulations according to the optimal policy. Thus, we obtain a distribution of final wealth based on 10,000 simulations.

- <sup>\*</sup> For the 2000-2001 academic year, the average tuition charged by public and private four-year colleges and universities was \$3,510 (in-state) and \$16,332, respectively. For the same year, the average room and board cost for the two types of institutions was \$4,960 and \$6,209, respectively. (Source: The College Board, *Trends in College Pricing 2000*).

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## CHOOSING BETWEEN REFUNDABLE TAX CREDITS AND SPENDING PROGRAMS

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**I**NCREASINGLY, SOCIAL POLICY GOALS ARE BEING MET through the tax code rather than through expenditure programs. On the spending side, welfare reform severed the entitlement of cash assistance to low-income parents, and caps on discretionary spending created the potential for real cuts in social spending programs. In contrast, the decade began with a two-step expansion of the earned income tax credit (EITC), followed by the enactment of a \$500 child tax credit, an adoption tax credit, and the hope and lifetime learning tax credits.

Unlike exemptions or deductions, which reduce taxable income and the value of which depends on an individual's marginal tax rate, tax credits are calculated after income tax is computed and may have no relationship to the individual's tax bracket. Support for the tax credit approach spans political parties. In the FY 2001 budget, the Clinton Administration proposed 19 new tax credits for individuals and businesses and the expansion of eight existing ones.<sup>1</sup> President Bush called for refundable tax credits for health insurance and an expansion of the child tax credit during the 2000 campaign. Support for tax credits also crosses both state and international borders. Since 1997, 11 states and the District of Columbia have created or expanded state EITCs (Johnson, 2000). In the United Kingdom, one of the first acts of the Labour Government in 1997 was to propose the transformation of the family credit, a social security benefit for working families, into the working family tax credit.

Bipartisan (and even worldwide) support for the tax credit approach, however, masks critical tax policy concerns. In a recent paper, Toder (2000) argues that tax credits make the tax system less fair by enabling some taxpayers to pay less than others with the same income, less efficient by inducing taxpayers to substitute activities that are tax-

preferred for those that would benefit them more under a neutral tax regime, and more complicated by requiring detailed rules to distinguish among transactions that do and do not qualify for special benefits.

On the other hand, many advocates of the social policy goals served by tax credits worry that conventional credits do not go far enough. With the exception of the EITC (and to a more limited extent the child tax credit), enacted tax credits have been nonrefundable—that is, taxpayers generally can claim the credit only to the extent that they have an income tax liability. Thus, a nonrefundable tax credit is equal to the lesser of the credit amount or the individual's tax liability. This means that low-income families are not eligible because they do not have any income tax liability to offset and that even some moderate-income families may not receive the full credit amount.

That is, unless these tax credits are also made refundable. Refundable tax credits are not limited by income tax liability. But refundable tax credits raise even more fundamental tax policy concerns than nonrefundable credits because they may bear little, if any, relationship to actual income tax burdens. Indeed, while nonrefundable tax credits are scored as reducing income tax receipts in the budget, refundable tax credits both reduce tax receipts and—to the extent that they exceed tax liability—increase outlays. Total government spending thus increases whether the source of expenditures is a new spending program or the refundable portion of a tax credit.<sup>2</sup>

In this paper, I consider the arguments for and against refundable tax credits. In the first section, I show that some moderate-income taxpayers will not benefit greatly from further expansions of nonrefundable tax credits because recent tax changes, such as the child tax credit, have reduced or even eliminated their income tax liability. In the next section, I find that certain types of refundable tax credits—particularly those intended primarily to offset total tax burdens—can be justified on tax policy grounds, but generally only if they are targeted to workers who often have significant payroll tax burdens. In the final section, I compare the

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\*This paper was prepared for a session on Tax Complexity at the 93<sup>rd</sup> Annual Conference on Taxation held in Santa Fe, New Mexico, November 9-11, 2000. I thank Julie-Anne Cronin, Jim Cilke, Bob Gillette, Don Kiefer, Janet McCubbin, Jim Nunns, and David Weisbach for their assistance and comments on this paper. Views and opinions expressed in this paper are those of the author and do not necessarily represent the policies or positions of the Department of the Treasury.



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