Efficient Portfolios For Saving For College

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This article uses 69 years of real rates of return for six types of financial assets to find efficient portfolios for saving for college, in terms of mean and minimum accumulations. Small stocks are in every efficient portfolio. For 10 and 15 year time frames, the portfolio that was the safest consisted of 89% intermediate term government bonds and 11% small stocks. A family willing to stay 100% invested in small stock mutual funds until each year's college costs must be met can greatly reduce the burden of saving for college, at relatively low risk.

In saving for college, the allocation of asset categories in the portfolio is a crucial decision. Most people are not willing to take above average risks to obtain above average returns on their investments (Avery & Elliehausen, 1986). Saving for college is a difficult investment challenge, as few families can afford to invest large lump sums early, so the most common investment plan consists of periodic investments over a relatively short time period. In considering risk versus return, various approaches have been taken, including a focus on the possibility of a shortfall in consumption or in some arbitrary goal (e.g., Leibowitz & Langetieg, 1989; Leibowitz & Kogelman, 1991; Ho, Milevsky & Robinson, 1994). For college saving, consideration of a shortfall is complex, and must be placed in the context of a comprehensive financial plan. The unique contributions of this article are the discussion of saving for college in the context of a comprehensive financial plan, the use of real rates of return, and the calculation of efficient portfolios for college saving.

Saving for college is often presented as merely a mathematical exercise, using future value tables and estimates of future college costs to generate the required periodic contribution to a college fund (e.g., Leonetti & Feldman, 1995). Ideally, though, saving for college should be considered in the context of a comprehensive financial plan. All of the areas of financial planning may be relevant to saving for a college fund. The usual advice -- to start contributing to a college fund as soon as a child is born — should be modified if a family does not have adequate insurance coverage or has outstanding balances on credit cards. The family's values and goals, and short term needs, such as finding quality child care for a young child, need to be considered along with a goal of starting a college fund early. Tax planning is a very important for deciding whose name should be listed for a college fund. For some wealthy parents or grandparents, estate planning may be important in considering a funding a child's college education. Retirement planning is important to saving for college, as the time between paying for college and retirement of the parents may be important to the acceptability of the parents taking out loans to cover part of the costs of a child's college.

What Will College Cost in the Future?

The tuition increases of the past 10 years are not sustainable -- if the price of anything increases much faster than wages, eventually the entire national income would be devoted to that product. Frank (1994), Pennar (1995), and Weagley (1995) all suggested that the rapid increases in college tuition in the past 20 years might not persist in the future. Colleges may not have unlimited power to increase tuition, and only 5% of students in 1994 attended colleges with annual tuition over $15,000 (Topolnicki & O'Connell, 1994). In this article, the assumption in examples given is that tuition will increase at the rate of general inflation. However, none of the conclusions in the article are changed by changing the assumption about how fast tuition increases. The possibility of continued rapid increases in tuition makes the case for more aggressive investing stronger.

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Why Don't Most Parents Save for College?

The standard advice is to start saving as early as possible to take advantage of compound interest. Relatively few parents save a substantial amount of money for their children's college education, however. Churaman (1992) reported that only 14% of two-parent families and 11% of single-parent families had saved money for their child's college. Connolly (1989) noted that a young family may be more concerned about car and house payments, etc. than saving for college. Young parents may be saving to buy or furnish a home. When children are very young, it is likely that wage income is relatively low or there are high child care costs. Furthermore, parents may expect their salaries will be much higher in the future than today. For some occupations, salaries after 20 years may be 50% to 100% higher in real terms than entry level salaries. For instance, the average full professor at the University of Michigan makes about 60% more than the average assistant professor (Wright & Dwyer, 1990, p. 113). This type of increase between entry level salaries and the salaries of experienced workers is common in many professions, although there may be low real growth for unskilled jobs. If inflation is included, young parents could plausibly expect their family income in nominal dollars to triple in the next 20 years.

Unless parents have a long period during which they can save money for a variety of goals before having children, it is likely they will have low levels of financial assets after the children are born. Therefore, the most realistic scenario for saving for college will be a periodic saving plan rather than investing of a large lump sum when the child is very young. If parents expect family income to double or more by the time the child enters college, it may be more rational to plan for equal proportions of income saved each year, rather than equal amounts of nominal dollars saved each year. For instance, if annual family income is expected to increase from $30,000 at age 25 to $100,000 at age 45 (increase of 6% per year), planning to save 5% of income each year would mean that $1500 would be contributed to a college fund the first year and $5,000 the 20th year. This would be a very different pattern than is usually recommended. It would not take full advantage of the power of compound interest, because of the lower early contributions. On the other hand, this pattern might be more realistic in a life cycle context for many young families.

Are the Incentives for Saving Perverse?

The "curious game of financial aid" (Willis, 1989) may lead some parents to conclude that it is not worthwhile to save for college. Case and McPherson (1986) analyzed the incentive structure of the federal student aid system and the Uniform Methodology used by many private colleges. There is a steep penalty on current income above moderate income (in terms of reductions in financial aid), 25% for the federal aid system and 47% for the Uniform Methodology. The effective penalty on assets accumulated can be as high as 21% for the four years of college for the Uniform Methodology (Case & McPherson, 1986, p. 3). Nevertheless, Case and McPherson concluded that the student aid system did not provide substantial disincentives to saving for college. The prominent economist Martin Feldstein reached the opposite conclusion, however (*Fortune*, 1992, p. 42). If the child will attend a college that covers all financial need, there may be a disincentive for saving resulting from the financial aid system. Many private colleges such as Harvard provide grants and low cost loans to cover all costs beyond what they calculate the family should be able to pay. However, many other colleges do not cover estimated financial need. For those colleges, the disincentives for saving listed above would not be relevant.

Taxes

In the past, some experts advised parents to establish savings in the child's name because of the lower federal and state income tax rates the child might pay compared to the parents' rates. This advice is now outdated by changes in federal income tax rules and by the rules of the federal and private college aid systems (Weagley, 1995). *If* a child qualifies for some financial aid, the amount of aid received by the child over four years of college may be reduced by an amount equal to over 80% of the amount of assets accumulated in the child's name, so good advice now for most parents is to avoid putting savings in a child's name (Baldwin, 1991; Dolan & Dolan, 1995b; Brouder, 1992; Quinn, 1995; Rowland, 1995; Wang, 1996;Willis, 1989). Saving in the parents' names is subject to federal and state income taxes unless it is put into tax sheltered retirement accounts, which have the advantage of not being counted at all for the federal and many private financial aid calculations. This strategy has been recommended by some (e.g., Willis, 1989; Cohen, 1989) although Jane Byrant Quinn (1995) regarded it as unethical. There may also be practical difficulties in terms of requirements for repayment, etc. (Dolan & Dolan, 1995a), although about 75% of retirement plans of large employers recently surveyed allowed loans against them (Schultz, 1995). If grandparents are in a position to help, the recommended strategy is that they pay the tuition bill directly (Quinn,

1995).

How Many Years to Invest?

Even though some parents estimate SAT scores based on toddler behavior, it is not always clear what the aptitudes and interests of a young child will be 15 to 20 years later. For middle income families, saving for a college fund may compete with funds for quality child care when a child is very young and with funds for family vacations when a child is somewhat older. Starting saving early has substantial advantages in terms of the power of compound interest, but some experiences cannot be deferred. Parents have only one year to experience taking a particular five year old to Disney World and to do other things together as the child grows.

The Need to Try for a High Rate of Return

Despite the reasons listed above, the standard set of calculations presented by experts assume that each year the parents would contribute the same number of dollars (in nominal terms) to a college fund (e.g., Kobliner, 1989b). If parents put one dollar at the end of each year into a savings account, at the end of 15 years they would have $15 plus accumulated interest. The assumptions used by Garman and Forgue (1994, p. 445) are based on an 8% annual return and 6% annual increases in the price of college. Therefore, an investment of one dollar per year would accumulate to $27 (Garman & Forgue, p. A-7) but the price of college would have increased by a factor of 2.4 (Garman & Forgue, p. A-3) so that the investment of $15 would only purchase the amount of college that would cost $11 today! One would have to obtain a nominal rate of return of over 10% per year to accumulate a real purchasing power equal to $15 today from an investment of one dollar per year for 15 years.

Given the above calculations *and* the previous discussion concerning the life cycle patterns of real incomes, the temptation to try for high rates of return should be obvious. If one obtains a nominal rate of return of 8% per year and the cost of college is increasing 6% per year, parents who start investing for a college fund when the child is three would have to invest almost $0.09 per year for every dollar that college costs *today*. If we use the crude approximation that all 4 years of the college fund would be needed in 15 years, a goal of saving for a college education that today costs $50,000 would require that the parents set aside $4,413 this year and then again next year, etc. If the parents could obtain a 12% annual rate of return, only $3,215 would have to be invested each year in order to reach the goal.

Strategies Recommended for Investing for College

The problem faced by parents in choosing investment alternatives is that higher rates of return can be achieved only by accepting higher volatility of returns. Some of the risk can be reduced at little sacrifice by diversification, hence the common advice to invest in mutual funds rather than individual stocks. This advice is not universal (c.f. diverse advice in Sullivan; 1993; Grover & Zweig, 1994; Connolly; 1989; *The Outlook*, 1995) and some experts suggest both aggressive mutual funds and growth funds for an infant's college fund (e.g., Garman & Forgue, 1994, p. 445; Kobliner, 1989a). Perry (1991) and Weagley (1995) suggested starting with a no load mutual fund and gradually shifting to less risky investments when five years away from college. Rowland (1995) suggested investing in stocks to save for college. Despite the common advice to invest in stocks, a *Money Magazine* poll found that half of families were investing entirely in fixed-income accounts (Wang, 1996).

Risk Versus Return

How should parents resolve the issue of risk versus return in investing for a college fund? It is well known that stocks have a higher mean rate of return than bonds. Between the beginning of 1926 and the end of 1994, a dollar invested in small stocks would have grown to $2843, compared to $811 for the S&P 500, $26 for long term government bonds, $31 for intermediate government bonds, $38 for corporate bonds and $12 for Treasury bills (Ibbotson Associates, 1995, p.99). If the long run patterns from the past are the best indicators of the future, an investor who wanted to maximize expected return and had a long term perspective would have a portfolio consisting only of small stocks.

In order to obtain higher rates of return, an investor must accept greater risk, or at least greater volatility. However, even this supposed truism is not true in the long run. Small stocks performed best of six investment categories in 47 out of 50 possible 20 year periods between 1926 and 1994, and the S&P 500 performed best in the other three 20 year periods (Ibbotson Associates, 1995, p. 43). If all future 20 year periods resemble these 50 time periods, small stocks present the least risk to the investor. A 20 year time frame may not be appropriate for many investors, however. The standard deviations of one year returns of the Ibbotson investment categories range from 35% for small capitalization stocks to 3% for Treasury bills (Ibbotson Associates, 1995, 33). How should an investor balance the mean return and the volatility as represented by the standard deviations?

State Prepaid Tuition Programs as Insurance

How can parents reduce the risk that a college savings fund will not be adequate to cover tuition? Some states have marketed prepaid tuition programs as a way to guarantee that college costs will be covered. Michigan was the first state to promote such a program. However, the treasurer of the state of Michigan was quoted in 1991 as having doubts about the financial soundness of the state's Michigan Education Trust (Blumenstyk,1991). Despite the fact that the marketing implies that the state guarantees payment of actual tuition, there is not an absolute guarantee (Blumenstyk, 1991). Several states have experienced problems with declining surpluses (e.g., Lively, 1993; Button & Koselka, 1994; Carmona, 1994). There is uncertainty about the tax status of such programs, and even though the Michigan program received a favorable decision against the IRS on appeal, it was a split decision and the IRS is considering an appeal (Healy, 1994). Financial aid programs usually count such investments as being in the child's name, so potential financial aid can be reduced substantially by these investments. These programs are expensive -- in order to be guaranteed payment of tuition in 18 years at a college that has a tuition of $10,000 today, one might have to invest more than $10,000 today. Given the uncertainties and disadvantages of these programs, they should not considered unless parents or grandparents want to increase the chance that funds will be used for a child's education rather than some other purpose (c.f., Wang, 1996).

Purpose

This article focuses on efficient portfolios for saving for college -- what combinations of investments in six major financial asset categories provide the highest rate of return for each level of risk. The measure of risk in this article is not the commonly used variance or standard deviation of the annual rates of return of investments. Instead, a shortfall measure is used -- based on the real rates of return during the period 1926-1994, the minimum accumulated value of a portfolio.

Methods

Time Frame

The choice of a time frame for analysis is of fundamental importance to analysis of optimal portfolios. A one year time frame is clearly not valid for someone years away from college.

In this article, three analyses are conducted based on the Ibbotson Associates (1995) data for six financial asset categories[a] from January 1, 1926 to December 31, 1994. All possible portfolios of the six Ibbotson Associates (1995) asset categories were analyzed for a 15 year time frame and a 10 year time frame, for accumulation of a college fund. Then, a 100% small stock portfolio was analyzed on the assumption that the family started 15 years before the freshman year and stayed fully invested until each year's college costs had to be paid.

The Research Question

Given that many parents need to carefully evaluate risk and return of periodic savings for college for their children, all possible portfolios composed of the six Ibbotson Associates financial asset categories were evaluated to find the portfolios that provide the highest minimum return for each level of mean return, based on 15 and 10 years of periodic savings.

Real Rates of Return

The real rate of return is the appropriate basis for evaluating investments. Tax considerations may make the nominal rate of return relevant. However, in this article, tax considerations are ignored. This may be a reasonable assumption if the portfolio is tax sheltered. The implications of this assumption are discussed later in the article.

The nominal rates of return and the inflation rates were drawn from the Ibbotson Associates *Stock, Bonds, Bills and Inflation Yearbook, 1995*. Table 1 shows the six asset categories and the annual nominal geometric mean and standard deviations.

Table 1
Annual Nominal Geometric Mean and Standard Deviation of Six Financial Asset Categories, 1926-1994.

Category	Mean Annual Rate of Return(%)	Standard Deviation
Large company stocks	10.2	20.3
Small company stocks	12.2	34.6
Long-term corporate bonds	5.4	8.4
Long-term government bonds	4.8	8.8
Intermediate-term government bonds	5.1	5.7
U.S. Treasury bills	3.7	3.3

Source: Ibbotson Associates, 1995, p. 33.

The real rate of return was calculated as: (1 + nominal rate)/(1 + inflation rate) - 1.

Simulations of Periodic Saving for College

There were 55 overlapping 15 year periods in the Ibbotson Associates (1995) dataset. Portfolios with all possible combinations (in increments of 1%) of each of the six types of investments were evaluated. For each 15

year period, the real accumulation (end value) resulting from investing one dollar per year was calculated.[b] For each portfolio, the mean accumulation and the minimum accumulated for all 15 year periods were calculated. The same process was used for all 10 year time periods.

Results

15 Year Time Frame

The portfolio giving the highest mean accumulation consisted of 100% small stocks, with a mean accumulation of $42.22 from an investment of one dollar per year for 15 years. The minimum accumulation for this portfolio was $11.31. The portfolio giving the best *worst case scenario* consisted of 89% intermediate government bonds and 11% small stocks, with a minimum accumulation of $14.70 and a mean accumulation of $19.53. All of the portfolios were sorted from highest mean return to lowest, and any portfolio with a lower minimum return compared to the portfolio with the next highest mean return was eliminated as inefficient. Figure 1 shows the resulting *efficient frontier*. All of the efficient portfolios contain small stocks, and all but the one with the highest mean return contain intermediate government bonds. No other types of financial assets were in any efficient portfolio. All other possible portfolios resulted in a lower mean accumulation than was possible for the same *worst* case. Table 2 illustrates some of the results for both 10 years and 15 years of investing one dollar per year in constant dollars. For 15 years of investing, the superiority of small stocks over large stocks is clear — a portfolio consisting of 100% large stocks would have a lower mean accumulation ($30.07) and a lower minimum accumulation ($10.94) than would a portfolio with 100% small stocks (mean of $42.22, minimum of $11.31). For the 15 year horizon, reducing the amount going into small stocks below 11% of the portfolio would not increase the safety of the portfolio, as a portfolio consisting of 100% intermediate government bonds would have a lower minimum accumulation ($11.60) than an efficient portfolio consisting of 89% intermediate government bonds and 11% small stocks ($14.70).

Figure 1 is seemingly similar to more traditional mean variance analyses (e.g., Ibbotson Associates, 1995, p. 161), with the minimum or worst case return replacing the variance or standard deviation for the risk measure. The usual measure of risk, the standard deviation of annual returns, does not provide intuitive information to the ordinary investor. For instance, some investments may have high returns and high volatility, yet, if the distribution of returns is above the distribution of returns for a less volatile investment, the high volatility (high standard deviation) investment may be superior to the less volatile investment even for very risk averse investors.

Figure 1
Minimum Accumulation by Mean Accumulation for Efficient Portfolios (line) and 2 Selected Inefficient Portfolios for a 15 year Time Frame, For $1 per Year Investment.

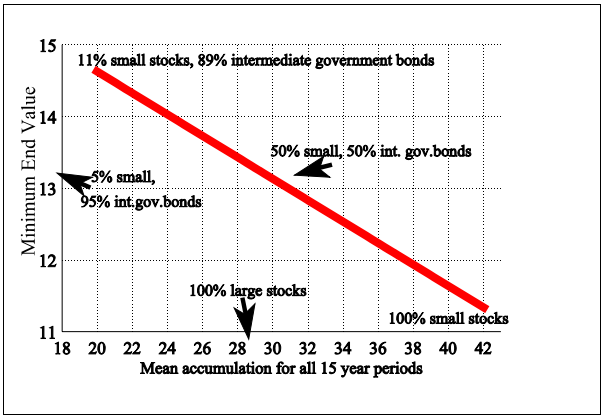


Table 2
Examples Of Mean And Minimum Accumulations Of Investing $1 Per Year For 10 Years and for 15 Years.

	10 year		15 year	
	Mean	Mini-mum	Mean	Mini-mum
100% Small Stocks	20.26	5.28	42.22	11.31
50% Small Stocks, 50% Intermediate Government Bonds	15.87	7.53	29.92	13.21
11% Small Stocks, 89% Intermediate Government Bonds	12.05	9.29	19.53	14.70
5% Small Stocks, 95% Intermediate Government Bonds	11.70	8.54	18.41	13.24
100% Intermediate Government Bonds	11.24	7.68	17.13	11.60
100% Large Stocks	16.03	6.21	30.07	10.94

For the efficient portfolios, only the most conservative one (89% intermediate government bonds and 11% small stocks) has substantial chance of *not having at least a*

$15 accumulation. The most conservative portfolio has a 9% chance of not having at least a $15 accumulation, whereas the 100% small stock portfolio has only a 2% chance of not having at least a $15 accumulation.

10 Year Time Frame

The results for 10 years of saving were similar to the results for 15 years of saving (Table 2). An investment of one dollar per year in a portfolio consisting of 100% small stocks would on the average grow to $20.26 after 10 years. The worst result of a 100% small stock portfolio was a real accumulation of only $5.28. The portfolio with the best worst case consisted of 89% intermediate government bonds and 11% small stocks, just as with the 15 year time frame. The worst accumulation was $9.29, and the mean accumulation was $12.05. No other types of investments were in efficient portfolios. Because of the similarity to the 15 year results, the discussion below is based only on the 15 year results.

Consequences of the Worst Case

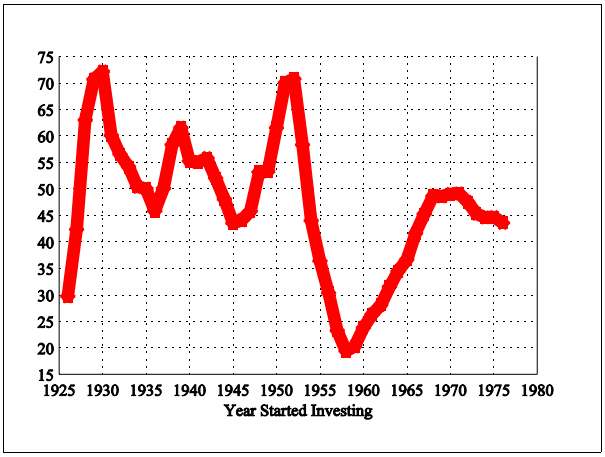
The conservative portfolio is predictable but would require more sacrifice on the average than the most aggressive portfolio (100% small stocks.) Parents who put all their contributions to the college fund in a small stock mutual fund have a small risk (less than 2%) of having an accumulation of only $11.31 for 15 years of investing one dollar per year. The second worst accumulation for a 100% small stock portfolio was $15.67, which was better than the worst eight outcomes for the most conservative efficient portfolio (89% intermediate government bonds, 11% small stocks.) There would be some risk from assuming the mean rate of return for the 100% small stock portfolio, as half of the time the accumulation would be less than $42 for each dollar per year invested. If the parents started investing shortly after the child was born, it would be possible to vary the timing of the liquidation of the small stock portfolio until the market got better. The parents could rely on educational loans (Kobliner, 1994) or a home equity loan to help cover educational expenses until the time was better to liquidate the portfolio.

Obviously, conservative investors would find the preceding strategies distasteful. The research reported in this article demonstrates that any desired level of risk reduction can be achieved simply by increasing the proportion of the portfolio devoted to intermediate government bonds. These types of bonds are not familiar to many investors, but there are mutual funds available composed of these types of bonds (Meyer, 1991).

Liquidation Over Four Years

The preceding analysis is based on the assumption that the periodic investment takes place for 15 years, then the fund is liquidated, and presumably used for college expenses or put into very liquid, safe investments until needed for college expenses. If, however, parents start investing 15 years before their child will start college, take out enough for freshman expenses, but leave the balance fully invested for the three subsequent years' expenses, what will be the result if all contributions are invested in small stock funds that match the performance of the Ibbotson small stock category? In real terms, the worst starting year (1958) would have produced $19.40 for every one dollar per year contributed ($0.25 each year for 15 years, another $0.25 each year for 16 years, etc.). The mean accumulation was $46.96. Figure 2 shows the pattern for starting points since January 1, 1926.

Figure 2
Real Accumulation, For $1 per Year Investment, Starting 15 Years Before College, and Staying Fully Invested in a Small Stock Fund Until Each Year's College Expenses Paid.



Predicting future patterns may be difficult, but the worst periods to start on an aggressive investing program were associated with just before the Great Depression and with a period that went into the turmoil of the 1970's. If one is optimistic that the domestic and international political patterns of those periods will not be repeated, then a prudent assumption would be that each year $400 (in constant dollar terms) should be invested for every $10,000 needed for college, if the freshman year is 15 years away. Each year, the contribution should be increased by the rate of increase in college costs. If somewhat different broadly based small stock funds were

held, the investor might be able to choose which one to liquidate for each year's college costs.

Starting More Than 15 Years Early

If the family starts more than 15 years before the funds are needed, small stocks become even less risky. For annual investing with a 20 year time frame, small stocks had a better worst-case outcome than any other possible portfolio based on the Ibbotson asset categories. A family that stayed fully invested would do much better most of the time, and somewhat better almost all of the time, if the investment period were 18 to 21 years. Saving for post-B.S. education would make small stocks even more advantageous.

Limitations

The analyses presented in this article are based on the assumption that real returns of financial assets have patterns similar to the patterns since January 1, 1926, and that the future relationships among the asset categories are similar to the past[c].

Conclusions

The technical results of this article are unique in presenting an efficient set of investment portfolios based on periodic investing over a 10 or 15 year time frame. The similarity of the 10 and 15 year results suggests that the results are fairly robust for time frames of 10 years or more. All efficient portfolios in terms of mean and minimum real accumulation contained small stocks, and for the 15 year time frame, the only other type of investment in efficient portfolios was intermediate government bonds. If a small stock portfolio were held until needed for each year of college, there would be relatively little risk of a shortfall, if the small stock mutual funds chosen matched the record of the Ibbotson small stock index. For families who would otherwise have little chance of accumulating a substantial amount of funds for college costs, the aggressive investment strategy suggested in this article may provide the only alternative that would come close to meeting a goal of sending one or more children to college.

Income taxes were not considered in the analyses. If the portfolio income were taxable, the superiority of small stocks would increase, especially if they were purchased in an index mutual fund which bought and held them, generating low levels of realized capital gains.

Ideally, the evaluation of the investment choices for saving for college would consider many aspects of the family's financial situation, including the expected income patterns over the years, the length of time between college costs and retirement, and, for some families, estate planning factors. Future changes in income tax regulations, for instance in the use of tax sheltered retirement savings for educational costs, will have an impact on optimal investment strategies. Many factors may objectively influence the best choice of a portfolio for a particular family, in addition to the family's subjective level of risk aversion. What this article has shown, however, is that of the thousands of possible portfolios for saving for college, only a small number should be considered by any family. All of the other portfolios would be inferior in the minimum accumulation likely for any given level of expected accumulation.

The results of this article are applicable to any investment goal for which someone made periodic contributions for a period of 10 to 20 years. For any type of goal, each family would have different considerations in evaluating the possibility of an investment falling short of the desired goal.

The results presented also provide an additional argument for starting to invest early. To prudently take advantage of high rates of return of small stocks, one must start about 20 years before a goal.

Endnotes

a. *The Ibbotson Associates (1995) categories are:*
Large Company Stocks: S&P 500 composite with dividends reinvested. (S&P 500, 1957 - present; S&P 90, 1926-1957)
Small Company Stocks: Fifth capitalization quintile of stocks on the NYSE for 1926-1981. Performance of the Dimensional Fund Advisors (DFA) Small Company fund 1982-Present.
Corporate Bonds: Salomon Brothers Long-term High grade Corporate Bond Index.
Long-Term Government Bonds: 20 year U.S. Bonds.
Intermediate-Term Government Bonds: Government Bonds with 5 year maturities.
Treasury Bills: 30 day T-bills.

b. *The authors wrote a computer program to calculate the end values of portfolios based on the Ibbotson Associates (1995) annual returns, assuming that at the beginning of each year one dollar (in constant dollar terms) is contributed to a fund. There were roughly 100 million calculations necessary to find the efficient portfolios.*

c. *In the analysis presented in this paper, the historical record consists of the Ibbotson Associates (1995) rates of return on six financial asset categories. The simulations conducted by the authors implicitly take into account relationships among the asset categories. Even though the historical record is only 69 years, there is some evidence from almost two centuries of records that stocks tend to outperform bonds (Siegel, 1994).*

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