

Saving for College – A Case Study
How Investor Mindset and Risk Acceptance Influence Outcomes
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This paper looks at the mindsets of five fictitious investors (their willingness to accept the potential for loss balanced by their desire to achieve their goal) to determine their probability of success and how they might fare in worst-case and average-case scenarios. Historical monthly data from 1926 to 1996 (in the form of monthly total returns) are used to calculate every possible eight-year time frame (1/26-12/33, 2/26-1/34) for hundreds of portfolios. Although more research is needed, the general result is that more aggressive investors may significantly increase their likelihood of success while only moderately increasing their level of risk. The impact of taxes and inflation are ignored.

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Study conducted by Zunna, Inc. using WAT\$.

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This paper is more about risk-reward tradeoffs than it is about financing a college education. The college scenario is used because it suits itself well for studying a relatively short investment horizon (eight years, in this case) in which cash flows are going into and out of an account. The real focus of this study is how more conservative investors may be able to limit their losses in worst-case scenarios, but not without sacrificing very real opportunities for gain.

Consider this scenario:

You want to save for your child's college education. He will begin college five years from now. You plan to put \$8,000 a year into an account for eight years using equal monthly contributions of \$667 each. Beginning in the fifth year your son will begin withdrawing \$5,000 a quarter to pay for college. He will withdraw this amount each quarter for four years.

You believe that, given the right investments, the \$64,000 you invest over the next eight years should be able to cover your son's college expenses amounting to \$80,000.

There is a discrepancy of \$16,000 between the amount invested and the amount withdrawn. This discrepancy will either be earned through investing or borrowed. The goal, then, is to pay for college without borrowing.

Can it be done?

Well, not with 100% certainty. Your chances for success depend a great deal on how much risk you are willing to take. On the issue of risk, we decided to investigate five possible investor mindsets. These five mindsets run from very conservative to very aggressive. They are as follows:

Table 1 - Fictitious Investor Mindsets

Investor	Mindset
1	Minimize my potential for loss.
2	At a minimum, maintain my principle. Beyond that, maximize my average gain.
3	Give me a 50% chance that I won't have to borrow. At the same time, minimize the loss in the worst case.
4	Maximize my chance of meeting my goal.
5	Maximize my average gain.

We chose these mindsets somewhat arbitrarily, in that our purpose was not to represent the mindset of any one particular investor, but rather to show a series of mindsets ranging from very conservative to very aggressive. We could have considered other mindsets but for reasons of brevity and clarity we did not.

In forming and testing portfolios we used monthly total returns from 1926 through 1996 for six core asset classes:

Table 2 - Core Asset Classes

Code	Description
T	Thirty-Day T-Bills
IG	Intermediate-term Government Bonds
LG	Long-term Government Bonds
CB	Corporate Bonds
L	Large Company Stocks
S	Small Company Stocks

We considered many combinations of the above assets to find portfolios that did a good job of meeting the requirements of each investor. We did not strive to find optimal portfolios for each investor because to do so would have required a level of computer optimization we weren't prepared to do. Instead, we tested several hundred portfolios by allowing the percentage invested in each asset to vary by 10% at a time (maximum three assets in portfolio). We then refined our

allocations to find portfolios that were very good, if not optimal, candidates for each investor mindset.

We looked at every 96-month period from January 1926 to December 1996 (1/26 - 12/33, 2/26 - 1/34, etc). For each portfolio, we have 757 observations to consider. From these observations we can determine the worst, average and best cases, as well as the percentage of time we meet our goal of not borrowing.

The portfolios we uncovered, and their vital statistics, are as follows:

Table 3 - Portfolio Statistics for Each Mindset

Mindset	Portfolio	Worst case	Avg case	Best case	Success rate
1	89% IG, 11% L	-\$13,477	-\$7,851	\$11,740	11%
2	85% CB, 15% S	-\$15,656	-\$5,655	\$19,477	22%
3	40% S, 39% CB, 21% L	-\$30,264	\$1,480	\$25,648	50%
4	68% L, 32% S	-\$36,814	\$5,403	\$36,438	72%
5	100% S	-\$39,606	\$15,927	\$115,825	69%

Negative amounts in the above table represent the amount to be borrowed to finish paying for college; Positive amounts represent the surplus remaining in the account after the eight years.

To interpret the results in Table 2 we consider the results for Investor 2.

At a minimum, Investor 2 wants to maintain the original \$64,000 he invests. Beyond that, he wants a portfolio that will maximize his average gain. Historically, a good portfolio meeting his requirements (given the eight-year horizon of this study) consists of 85% Corporate Bonds and 15% Small Company Stocks.

With this portfolio, Investor 2 would have never lost money. That was a key element of his mindset, so he is happy about that. The other columns of the table, however, reveal the price he pays for his conservatism.

The column labeled *Success Rate* shows that Investor 2 was able to fund college without borrowing only 22% of the time. In other words, Investor 2's conservative portfolio is likely to remain in the black, but it is also likely to require additional funding to pay off the expense of college.

The column labeled *Worst case* shows that Investor 2 needed to borrow \$15,656 to fully pay for college. This is derived as follows: \$64,000 invested + \$344 earned in the worst case + \$15,656 = \$80,000 needed for college. Note that interest is not figured in the above equation.

Likewise, in the average case, Investor 2 needed to borrow \$5,655 to finish paying for college. Compare this to Investor 3 who, on average, had a surplus of \$1,480 left in the account after graduation and Investor 5 who, on average, had \$15,927 left in the account.

It's surprising how varied these results are. On the one hand, Investors 1 and 2 never lost money. Unfortunately, they had a high likelihood (89% and 78%, respectively) they would need to borrow to finish paying for college. Their primary risk is that they will not reach their investment goal.

On the other hand, Investors 3, 4 and 5 meet the goal of not borrowing 50% of the time. Their primary risk is that, if they hit a particularly bad eight-year period, they will end up spending considerably more than \$80,000 for \$80,000 worth of education, perhaps as much as 30% more (\$103,606 in the worst-case for Investor 5).

As a basis for comparing the five portfolios listed in Table 2 we show how the individual asset classes performed in the table below. To create this table we ran each core asset by itself such that the core asset was the only asset in the portfolio.

Table 4 - Portfolio Statistics for Core Assets

Core Asset	Worst case	Avg case	Best case	Success rate
T	-\$15,945	-\$11,144	\$1,041	3%
IG	-\$14,794	-\$8,872	\$10,433	9%
LG	-\$17,728	-\$9,073	\$18,908	16%
CB	-\$17,684	-\$8,129	\$20,238	17%
L	-\$35,149	\$2,276	\$37,166	58%
S	-\$39,606	\$15,927	\$115,825	69%

Table 4 makes it clear that, in a worst-case scenario, you pay a price for investing in 100% stocks rather than 100% government securities or bonds. On the other hand, in the average case, 100% bond investors pay a high penalty for being too conservative in that 100% stock investors meet their goals more than half the time (as compared to less than 20% of the time for bond investors). Proper diversification between stocks and bonds goes a long way for improving worst-case outlooks while balancing the potential for the rewards that go with investing in stocks.

As a final comment, compare Investors 4 and 5 from Table 3. In the worst case, Investor 5 loses nearly \$3,000 more than Investor 4; in the average case, Investor 5 earns roughly \$10,500 more; in the best case, Investor 5 earns nearly \$80,000 more!

Provided we accept the possibility of loss, a look at worst-case scenarios might lead us to choose Investor 4 over Investor 5. There are some other questions we might want to ask, though, such as:

- How often does Investor 5 do better than Investor 4?
- When Investor 5 does worse, how much less money does he have?
- When Investor 5 does better, how much more money does he have?

If we sort all 757 observations (that is, the ending dollar values for every time frame calculated) for each investor, with the worst outcomes first and the best outcomes last, we can answer these questions. The results are interesting.

Investor 5 ends up with more money than Investor 4 more than two-thirds of the time. When Investor 5 does worse than Investor 4, he finishes with an average of \$2,888 less than Investor 4. When Investor 5 does better than Investor 4, he finishes with an average of \$16,674 more than Investor 4.

There is perhaps a lesson here: The difference of being fairly aggressive as compared to very aggressive on the downside is moderate (average of \$2,888 less in one-third of the cases) whereas the difference on the upside can be substantial (average of \$16,674 more in two-thirds of the cases). While this study supports this theory, the reader should keep in mind the narrow parameters used in this study, in particular the eight-year horizon and our choice of assets. More research is needed before any general conclusions of this kind can be made.