

# What to do with your next dollar: A quantitative framework

Our financial lives can quickly become complex. Thankfully, tools and account types are available to help us save and invest for an uncertain future. These include employer retirement plans, IRAs, 529 education savings plans, and health savings accounts (HSAs). But in addition to managing their assets, most households are juggling liabilities, such as a mortgage or student loans.

How should investors prioritize cash flows on the household balance sheet? Should they invest more in a 401(k) retirement plan or focus on paying off their mortgage early? The goal is to maximize long-term after-tax net worth—assets minus debts—while also meeting shorter-term goals and spending needs to support investors' financial wellness.

This paper introduces a wealth maximization framework for evaluating the best use of your next discretionary dollar. Key to success is smart management of both sides of the balance sheet—your assets as well as your liabilities. Our framework has three components:

## **Understanding your investment options**

Maximize the use of tax-advantaged accounts to support your goals.

## **Evaluating debt-repayment opportunities**

Pay down high-interest debts, such as credit cards, because they detract from goal success. Manage other debts as your liquidity and debt preferences allow.

## **Balancing wealth maximization with other financial objectives**

When making a cash allocation decision, select the highest-returning opportunities appropriate for your goals while tailoring the allocation to your situation.

# Understanding your investment options

Many investors do not take full advantage of their options to save for the future. Vanguard research based on its recordkeeping business (Clark, 2022) revealed that approximately 30% of participants in workplace retirement plans with an employer match did not contribute enough to their plan to receive the full match.

In addition to undersaving, investors often do not use or are unaware of accounts at their disposal. About 1 in 3 surveyed adults enrolled in a high-deductible health plan did not have an HSA (Kullgren et al., 2020). A national survey conducted by Nebraska’s NEST 529 College Savings Plan revealed that 52% of Americans are unfamiliar with 529 plans (Nebraska State Treasurer’s Office, 2020).

If you are not aware of these opportunities or don’t know how to use them to your advantage, you’re leaving money on the table that could be used to achieve better financial outcomes. The first step toward maximizing such resources is understanding how these accounts can work for you.

## Tax advantages

Different account types have distinct tax benefits that can help maximize after-tax returns (Figure 1). These benefits do come at the cost of spending flexibility. Though the liquidity of tax-advantaged vehicles has expanded recently (through legislation such as the SECURE Act and the SECURE 2.0 Act of 2022), they are not ideal in all cases or for all purposes. For example, while HSAs provide a tax-advantaged way to save for health costs and IRAs are a tax-advantaged way to save for retirement, early or nonqualified use of both could result in taxes and penalties. It can be helpful to structure your investing strategy by setting your financial goals and aligning them with the most suitable combination of accounts. Vanguard’s *Guide to Financial Wellness* gives a detailed overview (see page 35) of how goals and accounts may best align with various investment objectives (Costa and Felton, 2022).

Structure your investing strategy by aligning your financial goals with the most suitable combination of accounts.

FIGURE 1  
Understand how accounts can best support your goals

Account type	Best purpose
IRA or employer plan	Retirement
Health savings account	Health expenses
529 college savings plan	Education
Taxable account	General use

Source: Vanguard, adapted from Vanguard’s *Guide to Financial Wellness*.

The key to making the most of tax advantages is to choose accounts with an eye toward your need for liquidity.<sup>1</sup> The objective is to maximize after-tax spending ability within the constraints of your investing goals. In some cases, it makes sense to give up favorable tax treatment to maintain the liquidity needed for emergency events or shorter-term goals. For example, even though a tax-advantaged 401(k) plan may offer a return that enables more spending in retirement, withdrawals are generally subject to penalties for account-holders prior to age 59½. That could render this type of account unsuitable for a short-term, preretirement goal or for those who may plan to retire and tap the account before age 59½.<sup>2</sup>

Taxable accounts tend to be well-suited to a variety of investment goals because there are no limitations or penalties on withdrawals, though taxes may apply.<sup>3</sup> Roth IRAs are a desirable choice for tax-advantaged growth with preservation of some liquidity because contributions can be withdrawn tax- and penalty-free.<sup>4</sup> HSAs can be valuable for covering health expenses both today and in the future—qualified withdrawals taken for health costs avoid taxation and penalties. Then, after account-holders reach age 65, HSAs can be accessed penalty-free for any use, an advantage similar to that of a traditional IRA.<sup>5</sup>

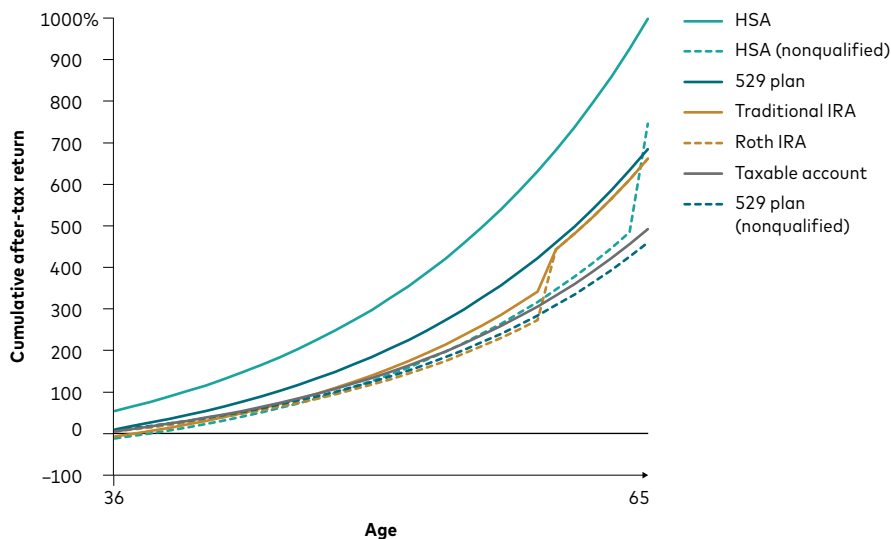
- 1 For the purposes of this paper, we define liquidity as the ability to spend money from a portfolio without penalty or debt financing.
- 2 Exceptions allowing investors to withdraw from a 401(k) plan include hardship withdrawals, which may be subject to an additional 10% income tax. See IRS Publication 575 and plan documents for more information. SECURE Act 2.0 provisions may also allow for other types of nonpenalized withdrawals once they go into effect. See IRS publication 590-B for more information on IRAs.
- 3 Be aware that short- and long-term capital gains are taxed differently. Income and dividends will also be subject to taxes. See IRS Publications 550 and 544 for more information.
- 4 See IRS publication 590-B for more information.
- 5 For more rules and information on HSAs, see IRS Publication 969.

## The power of tax-advantaged savings

By taking full advantage of the accounts at their disposal, investors have the opportunity to increase their future consumption power significantly. **Figure 2** shows the hypothetical after-tax growth of a one-time lump-sum investment in various account types under the same investment-return assumptions.

**FIGURE 2**

**Taking full advantage of various accounts can make a large difference over the long run**



**Notes:** This chart is for illustrative purposes only; it does not indicate the returns from any particular investment. The account comparison assumes 5% annual capital returns and 2% annual income returns. The assumed rate of return is not guaranteed and is an illustration of a long-term average return. After-tax return assumes a complete liquidation of the account and includes applicable taxes and penalties. The federal income tax rate is assumed to be 24%, the federal long-term capital gains tax rate is assumed to be 15%, and state tax rates are assumed to be 3% for both income and capital gains. HSA contributions are assumed to be made through a qualified employer plan and thus free from Social Security and Medicare taxation. 529 plan contributions are assumed to be deductible for state income taxes in the year in which they are made. Actual market returns are not constant and will fluctuate. Lower tax rates on dividends and capital gains may make the taxable investment more favorable and the difference between taxable and tax-deferred ending balances smaller. Any future changes in the tax treatment of investment earnings or a rate of return that is lower than the assumed rate of return may also affect the comparison. Investors should consider their time horizon, investment risk tolerance, and current and expected future tax rates before making an investment decision.

**Source:** Vanguard calculations.

The lines on the chart represent returns after taxes and any applicable penalties are paid. The inflection points at age 59½ and age 65 reflect the end of early withdrawal penalties for various accounts. "Nonqualified" indicates that a distribution from a respective account did not meet the IRS requirements for a qualified withdrawal and would be subject to taxes and/or penalties. "HSA (nonqualified)" shows what the return would be if the funds were spent for a non-health care purpose, and "529 plan (nonqualified)" shows what the return would be if the funds were not used for a qualified education purpose.<sup>6</sup>

In Figure 2, a dollar invested in a traditional or Roth IRA over 30 years would achieve approximately 170% in additional cumulative return, compared with the same investment in a taxable account. The return of the Roth or traditional IRA after the investor turns age 59½ is equivalent in this example, assuming constant tax rates throughout the timeframe.

If different future tax rates are known or expected, projecting returns in this manner can help indicate whether a tax-deferred (traditional IRA and 401(k)) or a tax-exempt (Roth IRA and Roth 401(k)) account may be preferable, as well as the potential value of a conversion of a traditional IRA to a Roth IRA.<sup>7</sup> These decisions are largely a function of estimates of future tax rates and how decisions today, and in the future, might affect those rates (Wong and Dickson, 2022).

Investment goals should be aligned with relevant account type rules to avoid penalized distributions.

<sup>6</sup> For more information about 529s and what constitutes a qualified withdrawal, see IRS Publication 970. See **Appendix 2** on page 17 for other important information about 529 college savings plans.

<sup>7</sup> Each Roth conversion is subject to a five-calendar-year rule to avoid possible taxes and penalties. See IRS publication 590 for additional information.

## Evaluating debt-repayment opportunities

In addition to investing, you may wish to consider paying down additional principal on one or more outstanding debts. Debt repayment can be thought of as investing with a predetermined return, if the debt carries a fixed rate.<sup>8</sup> This return comes from lowering the remaining principal amount due, which results in less interest to be paid in the future. Paying down high-interest debt, such as revolving credit card debt, is typically one of the first places to direct disposable cash flow because an equivalent return in the market can be hard to consistently achieve. The decision to prioritize debt payments versus investing can be complex, and investors should consider the following factors.

Eliminating high-interest debt should be a top priority.

### Behavioral considerations

Consumers who are paying down debt often focus first on accounts with the smallest balance so they can achieve a sense of tangible progress (Amar et al., 2011). Sometimes referred to as debt account aversion, or a snowball paydown strategy, this is typically not the best approach for wealth maximization. The highest-returning strategy is to pay down debt in order of descending interest rate, otherwise known as the avalanche paydown approach. One technique that can help with this behavioral challenge is to consolidate debt into a single account.<sup>9</sup> This may also provide a way to refinance with a lower interest rate.

When deciding between the prepayment of debt and investing, investors should consider how they would use the extra cash flow from forgone loan interest. Will they increase their savings rate or their spending? If the prepayment of debt might result in higher consumption, they may wish to prioritize investing to create wealth.

<sup>8</sup> Investors may be able to save when repaying variable-rate debts, if the future rate is above zero, but because the future rate is unknown, the amount of savings cannot be determined.

<sup>9</sup> It's important to review all terms and conditions before acting, because certain loan consolidations may result in losing other protections or benefits (for instance, federal student loan protections).

## Liquidity preference

All else being equal, the ideal wealth-maximizing strategy is to prioritize paying down the debt with the highest interest rate or investing in the account with the highest expected return after tax. However, if the primary concern is near-term liquidity, prepayment of longer-term debt is potentially unsuitable because it would result in the complete loss of liquidity of any "invested" dollar.

The best option in this case is to pay down principal on debt with the highest interest rate or invest in the account with the highest potential return while maintaining the necessary liquidity or access to favorable credit when needed. Without this constraint, an investor may have to miss a short-term goal or else take on more debt under uncertain or unfavorable terms to fund the goal shortfall (for instance, by relying on credit cards).

Consider the choice between, on the one hand, investing \$5,000 for the near-term goal of making a house down payment in the next two years and, on the other hand, using the \$5,000 to pay down extra principal on a student loan with \$10,000 in principal remaining, a term of 10 years, and an interest rate of 5%.<sup>10</sup> Given the short time horizon of the house-buying goal, we assume that the \$5,000 investment in a bank savings account will grow at a 1% rate with little risk of losing principal, for a wealth increase of \$101 in two years. Paying down principal on the student loan would provide a higher riskless return, for a wealth increase of \$513 in two years.<sup>11</sup> If you had decided to invest instead of paying down the student loan, you would have access to \$5,101 to buy the house. However, this would come at the cost of an additional \$412 of potential net worth.

<sup>10</sup> Debt payments are assumed to be made annually in this hypothetical example, with \$1,295.05 minimum annual end-of-year payments continuing after the lump-sum payment is made. The lump-sum payment is assumed to be made at the beginning of the first period. Source: Vanguard calculations.

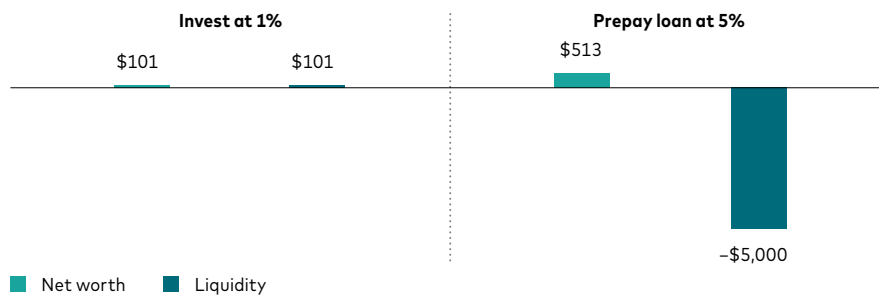
<sup>11</sup> Interest savings are \$250 in year 1 and \$262.50 in year 2 that instead go toward reducing principal and increasing net worth.

The best course of action depends on how much you value this liquidity. **Figure 3** illustrates the trade-off. Might the absence of this cash require delaying a purchase or incurring higher financing costs?

**FIGURE 3**

### The trade-off between wealth and liquidity

Potential change in net worth and liquidity after two years of either investing \$5,000 or using it to pay down a loan



**Note:** Values are rounded to the nearest dollar.

**Source:** Vanguard calculations.

Understand how debt prepayment will affect future cash flow and savings ability.

Increased wealth and liquidity are not always at odds with each other when you prepay debt. If the loan can be paid off far enough in advance of your goal, money that would have been spent on loan payments can be invested, potentially increasing the total invested amount—a net positive for both liquidity and net worth.

### Risk tolerance

You should also consider the uncertainty in an investment's underlying asset allocation and your personal risk preferences. Generally, a risk-averse investor will value the guaranteed return of paying down debt more highly than a less risk-averse investor will. A utility function that incorporates risk tolerance can help to provide a quantitative comparison:

$$\text{Risk-adjusted return} = \text{Expected risky return} - 0.5 * \left( \frac{\text{Risk-aversion estimate}}{\text{Investment standard deviation}} \right)^2$$

The savings from paying down debt can be thought of as a risk-free return when compared with investing.

Risk-aversion parameters vary in the literature—from as low as 0 and to 10 or higher—but the most accepted measures have a value ranging between 1 and 3, with 1 indicating less aversion and 3 indicating greater aversion (Gandelman and Hernández-Murillo, 2014).<sup>12</sup> This function can help determine whether the risk-free nature of paying down debt is worth the loss of additional potential return achievable by investing in risky assets.

<sup>12</sup> A risk-aversion parameter of 0 implies an indifference to risk and an assumption that the investor would always choose the option with the higher expected return. Note that no single formal, agreed-upon range exists for this type of quantitative risk measure.



A reasonable starting point may be choosing a risk-aversion parameter of 3 while considering an expected market return (+6.4%) and volatility (+9.4%) projections for a 60% equity/40% bond portfolio over the next 10 years (Davis et al., 2022). Combining these values with the function shown on page 8, the risk-adjusted return for this investment would be about 5% ( $6.4\% - 0.5 \cdot 3 \cdot 9.4\%^2$ ). That would mean that an investor with this portfolio and risk aversion should pay off any debt with a rate above 5% rather than invest the money.<sup>13</sup>

## Balancing wealth maximization with other financial objectives

Balancing multiple goals can be challenging and complex. Combined with the three pillars from *Vanguard's Guide to Financial Wellness* (Figure 4), this next-dollar framework helps guide investors in setting priorities, such as: Should I save more for retirement or pay down debt? Should I put money aside for emergencies or invest for other goals?

**FIGURE 4**  
**Vanguard's three pillars of financial wellness**



### Take control of your finances

Prioritize high-return opportunities such as matched employer plan contributions and paying down debts with high interest rates, such as credit cards.



### Prepare for the unexpected

Make sure to have adequate emergency savings to meet potential financial shocks.



### Make progress toward your goals

Prioritize remaining financial goals and determine applicable savings vehicles.

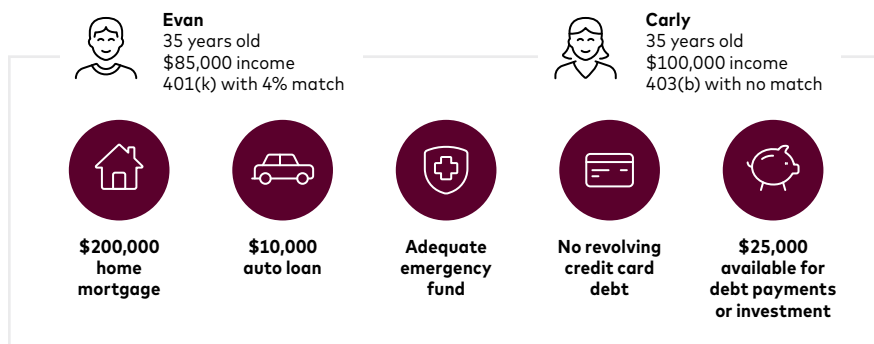
Source: Vanguard.

<sup>13</sup> The potential impact of taxes is not considered in this example.

## Case study

How should Evan and Carly allocate savings if they want to retire in 30 years?

To illustrate the prioritization framework, consider a household with the following characteristics:



Evan and Carly are currently paying down two loans and are comfortably able to meet the required minimum payments for these loans. The first loan is a fixed-rate 4.0% home mortgage of \$200,000; the second is an auto loan of \$10,000 at a fixed rate of 6.25%.<sup>14</sup> They currently have adequate emergency savings and no revolving credit card debt and have budgeted to meet their expected expenses for the year. They have determined that they can save \$25,000 over the next year and are wondering how they could allocate those savings to maximize their expected net worth. They need to:

**Calculate.** Their first step should be to calculate the expected annualized rate of return for all their opportunities, adjusting for costs, and then eliminate those not suited to their goal.

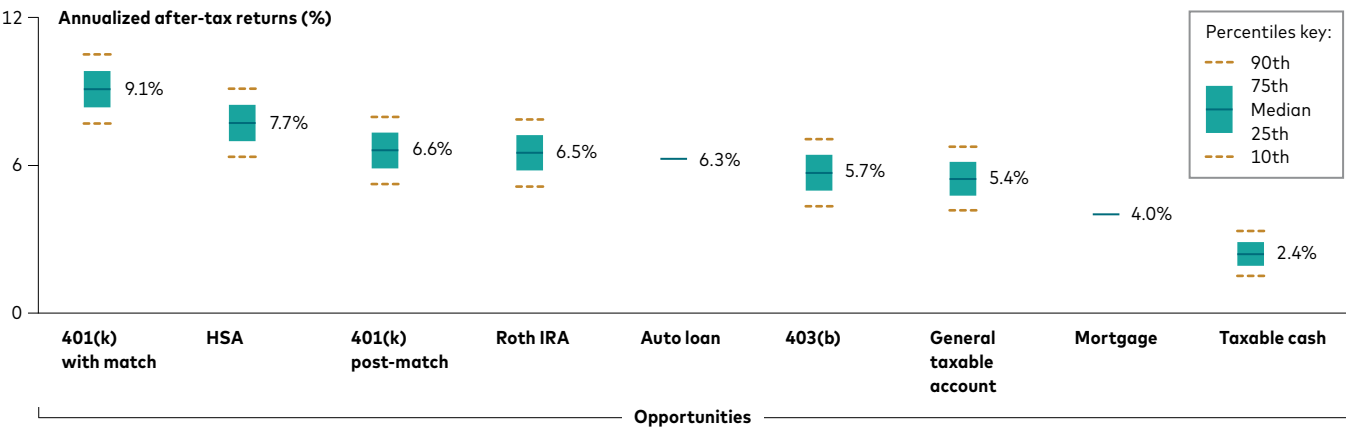
Most investment accounts are good options for saving for retirement, including HSAs (Kahler, Clarke, and Bruno, 2019). One exception is a 529 education savings plan. Unless these plans are used for education purposes or transferred to another eligible beneficiary, 529 withdrawals are generally subject to a 10% penalty as well as income taxes on earnings.<sup>15</sup>

<sup>14</sup> If an investor is itemizing deductions instead of claiming the standard deduction, the prepayment of mortgage or other interest-deductible debt can lower the future ability to deduct interest. Student loan interest deductions generally do not require itemization but are subject to income limitations. These deductions may affect the debt payoff decision.

<sup>15</sup> The passage of the SECURE 2.0 Act of 2022 may allow for future rollovers of excess 529 assets to the beneficiary's Roth IRA subject to additional conditions. This nuance is not considered here. For more information about 529s and what constitutes a qualified withdrawal, see IRS Publication 970.

**Figure 5** shows the expected annualized after-tax return of a one-time lump-sum investment in each suitable account or debt-payment opportunity. This highlights the dollar-for-dollar return comparisons against individual opportunities without considering various limits to each (such as match limit or debt balance).

**FIGURE 5**  
Align the highest-value opportunities to your goals



**Notes:** The asset allocation is 60% stocks and 40% bonds for the entire time for each account, except for debts and cash. Projections are over 30 years. Federal income taxes are assumed to be 24%, federal long-term capital gains taxes 15%, and state taxes 3% for both income and capital gains. The HSA is assumed to benefit from the FICA tax exemption for contributions and assumed to be used for qualified medical expenses during retirement. Tax rates are assumed to be static throughout the timeframe. The accounts modeled assume additional recordkeeping, investment, and other costs as follows: 401(k), 10 basis points; HSA, 50 basis points; Roth IRA, 20 basis points; 403(b), 100 basis points; and general taxable account and taxable cash, 20 basis points. One basis point is equal to one-hundredth of a percentage point. Mortgage interest is assumed to be nondeductible. Debt interest rates are hypothetical and do not represent a real cost of lending. Values are rounded to a tenth of 1% for presentation.

**Source:** Vanguard calculations, using the Vanguard Capital Markets Model® (VCMM).

**IMPORTANT:** The projections and other information generated by the Vanguard Capital Markets Model® (VCMM) regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from VCMM are derived from 10,000 simulations for each modeled asset class. Simulations as of December 31, 2022. Results from the model may vary with each use and over time. For more information, see Appendix 1 on page 16.

**Prioritize.** The next step is to determine how much of the expected \$25,000 savings should be allocated to each opportunity, considering contribution limits and remaining balances, then evaluate the trade-offs involved across the various allocation scenarios.

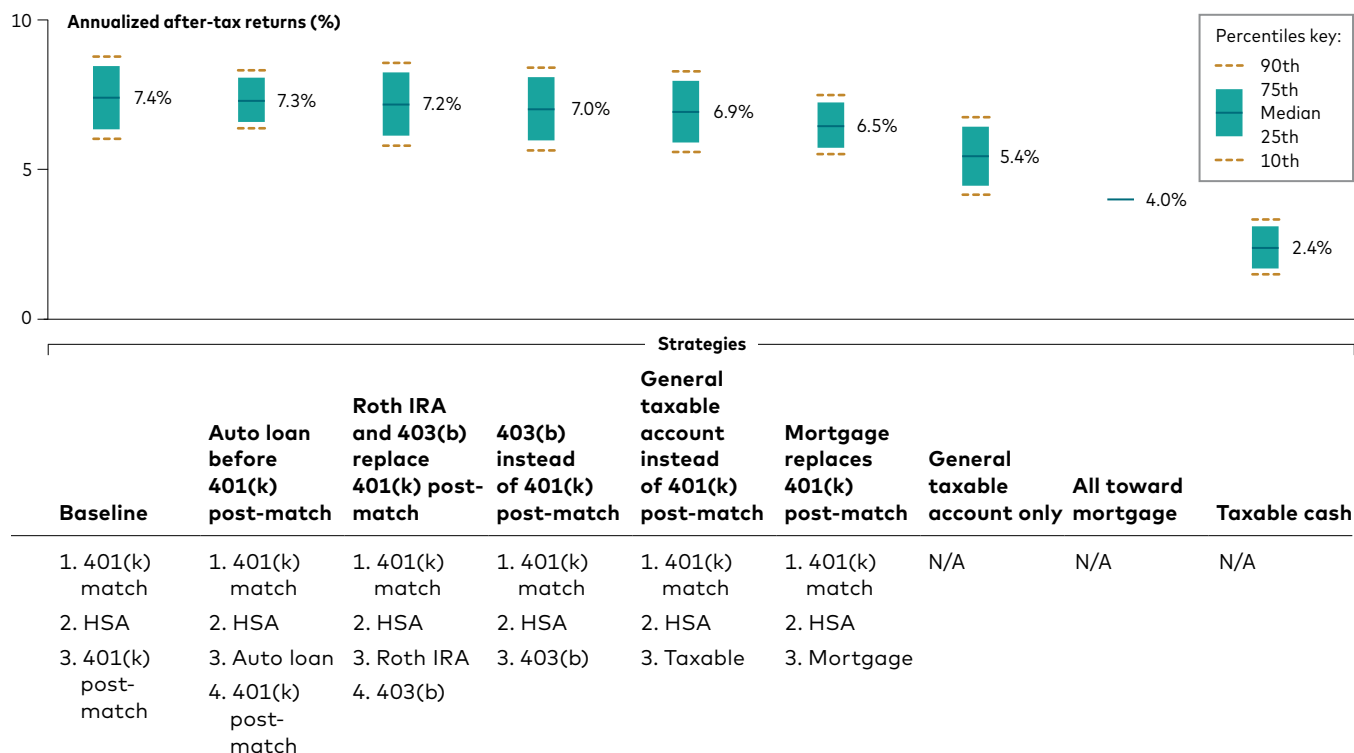
In the baseline scenario, Evan and Carly should first save \$3,400 annually in the 401(k) to receive the full employer match. Next, they might prioritize saving \$7,750 in an HSA. This will achieve a relatively high return if used for qualified expenses and a return after they turn 65 that is similar to that of an IRA if the HSA is used for nonqualified expenses.

Evan and Carly will likely be able to use their HSA accounts for qualified purposes in retirement for Medicare premiums, copays, and deductibles. They might invest the remaining \$13,850 in the 401(k) post-match.

As **Figure 6** shows, following this baseline strategy, Evan and Carly might expect to achieve approximately 7.4% annualized returns after tax, compared with a projected 5.4% after-tax annualized return for a general taxable account with the same asset allocation.<sup>16</sup> Over the course of 30 years, the baseline strategy could mean more than \$80,000 in additional wealth when compared with a general taxable account.

But what about other approaches? How much of a difference would there be between the ordering described above and an alternative ordering, in which, say, the auto loan was prioritized over post-match 401(k) contributions or the mortgage? Or what if all the money is placed in cash? Figure 6 illustrates some alternative strategies that may be considered.

**FIGURE 6**  
**Deviating from the baseline strategy results in lower expected after-tax returns**



**Notes:** Strategy-weighted annualized after-tax returns are shown. The asset allocation is 60% stocks and 40% bonds for the entire time for each account except for debts and cash. Projections are over 30 years. Federal income taxes are assumed to be at the 24% rate, federal long-term capital gains taxes at 15%, and state taxes at 3% for both income and capital gains. The HSA is assumed to benefit from the FICA tax exemption for contributions and assumed to be used for qualified medical expenses during retirement. Tax rates are assumed to be static throughout the period. The accounts modeled assume additional recordkeeping, investment, and other costs as follows: 401(k), 10 basis points; HSA, 50 basis points; Roth IRA, 20 basis points; 403(b), 100 basis points; and general taxable account and taxable cash, 20 basis points. One basis point is equal to one-hundredth of a percentage point. Mortgage interest is assumed to be nondeductible. Debt interest rates are hypothetical and do not represent a real cost of lending. Values are rounded to a tenth of 1% for presentation.

**Source:** Vanguard calculations, using the VCMM. Simulations are as of December 31, 2022.

<sup>16</sup> The expected weighted median annualized return when investing in the 401(k) (match and post-match) and HSA as described above is 7.4%. The HSA is assumed to be used for qualified medical expenses. Source: Vanguard calculations, using the VCMM.

Differences may be nominal when investors swap between higher-returning opportunities. Investing only in cash, however, or putting all money toward the mortgage results in expected returns (+4%) of about 3 percentage points less per year than in the baseline (+7.4%) scenario.

Depending on Evan and Carly's aversion to risk, they may prioritize early principal repayment of their auto loan because of its guaranteed return. This would result in a slightly lower return, but with less expected volatility, than the baseline recommendation. When investors decide on alternative actions, whether because of personal preferences or other reasons, they should consider and understand the trade-offs appropriately before acting.

What else might vary the suggested strategy?

**Alternative allocations.** The ideal allocation also may vary by circumstance. **Figure 7** shows how one might invest \$25,000 differently depending on market conditions, risk tolerance, or tax expectations.

**FIGURE 7**  
**Some opportunities are more sensitive to changing tax rates and market conditions**

*Amounts shown are placed in order of investment priority from top to bottom.*



**Notes:** The asset allocation is 60% stocks and 40% bonds for the entire time for each account. Projections are over 30 years. Rates for federal income taxes are assumed to be 24%, federal long-term capital gains taxes 15%, and state taxes 3% for both income and capital gains. The HSA is assumed to be used for qualified medical expenses during retirement. "Lower return or higher risk aversion" assumes a 25th-percentile annualized return from the baseline scenario as the new expected value. "Higher future taxes" assumes a 10% increase in federal income taxes upon future withdrawal. The accounts modeled assume additional recordkeeping, investment, and other costs as follows: 401(k), 10 basis points; HSA, 50 basis points; Roth IRA, 20 basis points; and 403(b), 100 basis points. One basis point is equal to one-hundredth of a percentage point. Contributions to a Roth IRA are subject to income limitations; see IRS publication 590-A for additional information.

**Source:** Vanguard calculations, using the VCMM. Simulations are as of December 31, 2022.

If we believe the market's future returns will be lower than the projections shown in Figure 5, it would be prudent to allocate funds accordingly. However, we should prioritize paying down the auto loan over investing in the 401(k) post-match because the return from debt repayment will not vary with market return.

If we expect higher tax rates in the future, when withdrawals may be made, we will likely prioritize first the Roth IRA and then paying down the auto loan debt over the 401(k) post-match. Investments in a traditional 401(k) or IRA would be less favorable relative to investments in a Roth account in such a scenario.

## **Conclusion**

When choosing how to allocate discretionary income, from the prepayment of loan principal to various investment accounts, investors may best be served by following a quantitative framework to maximize future returns while considering the funding and timing needs of their goals. Any strategy must balance generating greater potential returns with an investor's behavior, risk tolerance, and liquidity needs over time.

The process begins with understanding the potential and the limitations of various account types and debt options. Knowing the rules, investors can then begin to model the possible future returns for each choice and visualize prospective wealth and liquidity levels. Finally, investors can overlay these potential futures against a timeline of goals to begin making the most appropriate decisions for their household.

## References

- Amar, Moty, Dan Ariely, Shahar Ayal, Cynthia Cryder, and Scott Rick, 2011. Winning the Battle but Losing the War: The Psychology of Debt Management. *Journal of Marketing Research* 48(SPL).
- Clark, Jeffrey W., 2022. *How America Saves 2022*. Valley Forge, Pa.: The Vanguard Group.
- Costa, Paulo, and Clifford S. Felton, 2022. *Vanguard's Guide to Financial Wellness*. Valley Forge, Pa.: The Vanguard Group.
- Davis, Joseph, Roger A. Aliaga-Díaz, Jumana Saleheen, Qian Wang, Andrew J. Patterson, Kevin DiCiurcio, Alexis Gray, Asawari Sathe, Joshua M. Hirt, and Shaan Raithatha, 2022. *Vanguard Economic and Market Outlook for 2023: Beating Back Inflation*. Valley Forge, Pa.: The Vanguard Group.
- Gandelman, Néstor, and Rubén Hernández-Murillo, 2014. *Risk Aversion at the Country Level*. St. Louis, Mo.: Federal Reserve Bank of St. Louis.
- Kahler, Jonathan R., Andrew Clarke, and Maria A. Bruno, 2019. *HSA's: An Off-Label Prescription for Retirement Saving*. Valley Forge, Pa.: The Vanguard Group.
- Kullgren, Jeffrey T., Elizabeth Q. Cliff, Christopher Krenz, Brady T. West, Helen Levy, Mark Fendrick, and Angela Fagerlin, 2020. Use of Health Savings Accounts Among US Adults Enrolled in High-Deductible Health Plans. *JAMA Network Open* 3(7):e2011014.
- Nebraska State Treasurer's Office, 2020. *Study: 71% of Americans Have Never Contributed to a 529 Plan*; available at <https://treasurer.nebraska.gov/news/default.aspx?story=552>.
- Wong, Boris C., and Joel M. Dickson, 2022. *A "BETR" Approach to Roth Conversions*. Valley Forge, Pa.: The Vanguard Group.

## Appendix 1

### Vanguard Capital Markets Model

**IMPORTANT:** The projections and other information generated by the Vanguard Capital Markets Model regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM results will vary with each use and over time. VCMM results presented are as of December 31, 2022.

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More important, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based. Our simulations of market returns assume investors invest 60% of their equity sub-asset allocation to U.S. equities and 40% to non-U.S. equities. For bonds, our simulations assume sub-asset allocations of 70% to U.S. bonds and 30% to non-U.S. bonds.

The VCMM is a proprietary financial simulation tool developed and maintained by Vanguard's Investment Strategy Group. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include U.S. and international equity markets, several maturities of the U.S. Treasury and corporate fixed income markets, international fixed income markets, U.S. money markets, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the VCMM is that the returns of various asset classes reflect the compensation investors require for bearing different types of systematic risk (beta).

At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several simulation horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results produced by the tool will vary with each use and over time.



## **Appendix 2**

### **529 college savings plans**

For more information about any 529 savings plan, contact the plan provider to obtain a Program Description, which includes investment objectives, risks, charges, expenses, and other information; read and consider it carefully before investing. If you are not a taxpayer of the state offering the plan, consider before investing whether your or the designated beneficiary's home state offers any state tax or other benefits that are only available for investments in such state's qualified tuition program. Other state benefits may include financial aid, scholarship funds, and protection from creditors. Vanguard Marketing Corporation serves as distributor for some 529 plans.

## Authors



Clifford S. Felton,  
CFP®, CFA



Thomas Paradise,  
CFA

**Acknowledgments:** This paper is a revision of Vanguard research published in 2020 under the same title, written by Thomas Paradise and Jonathan R. Kahler.

## Connect with Vanguard®

[vanguard.com](https://vanguard.com)

All investing is subject to risk, including possible loss of principal. Be aware that fluctuations in the financial markets and other factors may cause declines in the value of your account. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income.

This information is for general guidance only and does not take into consideration your personal circumstances or other factors that may be important in making investment decisions. We recommend that you consult a financial or tax advisor about your individual situation before investing.

CFA® is a registered trademark owned by CFA Institute.

Certified Financial Planner Board of Standards Inc. owns the certification marks CFP®, CERTIFIED FINANCIAL PLANNER™, in the U.S., which it awards to individuals who successfully complete CFP Board's initial and ongoing certification requirements.

**Vanguard®**

© 2024 The Vanguard Group, Inc.  
All rights reserved.

ISGNDA 022024