Vanguard

Financial Planning Perspectives

What to do with your next dollar: A quantitative framework

Our financial lives can quickly become complex. Various tools and account types are available to help us save for an uncertain future, including employer plans, IRAs, 529s, and HSAs. But in addition to managing their assets, most households are also juggling various 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) 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.

This paper introduces a 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**

  It is important to understand the costs, tax benefits, and rules of the investment opportunities available to you. We quantify the relative return potential of several types of accounts, showing the benefits of prioritizing tax-advantaged vehicles.

- **Debt: the other side of the balance sheet**

  What are the relative benefits and constraints of prioritizing debt prepayment over further investment? We show that prioritizing the prepayment of high-interest debt can lead to better outcomes and explore the behavioral, liquidity, and risk tolerance considerations involved in the trade-off.

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

  Finally, we analyze the cash allocation decision and suggest the following steps. First, prioritize matched savings and high-cost debt. Next, make sure you have adequate emergency savings. Last, select the highest-returning opportunities appropriate for your goals.

Understanding your opportunities

Many investors are not taking full advantage of the tools they can use to save for their future. Research conducted by Vanguard (Utkus and Young, 2019) revealed that approximately one in three participants is not contributing enough to a retirement plan to receive the full employer match. A study by Financial Engines (2015) found a similar result: One in four employees is not saving enough to receive the full employer match, leaving $24 billion in employer contributions unsaved annually nationwide.

In addition to undersaving, investors are often unaware of the accounts at their disposal. A report released by the Employee Benefit Research Institute (Fronstin, 2017) indicates that an estimated 7.3 million people enrolled in an eligible plan haven't opened an HSA. A survey by the College Savings Plans Network (2019) revealed that only one in five Americans knows what a 529 plan is for. If you don't know how to use these accounts to your advantage, you're leaving money on the table. The first step toward maximizing such resources is understanding how they work.

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

Tax advantages

Different account types have different tax benefits that can help maximize after-tax returns. But the cost of these benefits is generally a loss of flexibility in how the money can be spent. For example, HSAs provide a tax-advantaged way to save for health care, and IRAs a tax-advantaged way to save for retirement. **Figure 1** depicts the trade-offs for several widely used accounts. It can be helpful to structure your investing strategy by setting your financial goals and aligning them with the most suitable combination of accounts.

The key to making the most of tax advantages is to make your account selections with an eye on your need for liquidity.[1] 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 preferable tax treatment to maintain the liquidity necessary for emergency events or shorter-term goals. For example, even though the return achievable from investing in a tax-advantaged 401(k) may enable more spending in retirement, withdrawals are subject to penalties prior to age 59½, rendering the account unsuitable for a short-term, preretirement goal.[2]

Taxable accounts tend to be well-suited to a variety of investment goals as there are no limitations or penalties associated with withdrawals. Roth IRAs are a desirable choice for tax-advantaged growth while preserving some liquidity, because contributions can be withdrawn tax- and penalty-free.[3] HSAs can be a valuable option for retirement because they are accessible penalty-free once you reach age 65 even if you don't use them for health care expenses, an advantage similar to that of a traditional IRA. The ability to make withdrawals at any point for any qualifying expense incurred after opening the account adds to the HSA's flexibility.[4]

Notes on risk

All investing is subject to risk, including the possible loss of the money you invest. 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 educational purposes only and should not be considered tax advice. We recommend that you consult a tax or financial advisor about your individual situation.

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) include hardship withdrawals, which may be subject to an additional 10% income tax. See *IRS Publication 575* for more information.

3 Additionally, both traditional and Roth IRAs can be used for first-time home-buying up to $10,000 and for education purposes without incurring a 10% penalty for early withdrawal.

4 For more rules and information related to HSAs, see *IRS Publication 969*.

Figure 1. Some tax advantages come with constraints

More spending flexibility

Less spending flexibility

Account	Contributions	Investment growth	Withdrawals	Other considerations
General investment account (taxable)	Taxable	Taxable	Taxable gains	
Roth IRA or employer plan	Taxable	Tax-deferred	Tax-free	Most states follow federal rules for income taxes. Roth IRA contributions are available for withdrawal without penalty.
Health savings account	Pre-tax	Tax-deferred	Tax-free*	Receives favorable treatment from most states. Exempt from FICA taxes if contributions are made through payroll deductions.
Traditional IRA or employer plan	Pre-tax	Tax-deferred	Taxable	Most states follow federal rules for income taxes.
529 plan	Taxable	Tax-deferred	Tax-free*	Contributions are deductible from state income tax in most cases.

* Distributions must be offset by qualified expenses.

Notes: When taking withdrawals from a tax-deferred plan before age 59½, you may have to pay ordinary income tax plus a 10% federal penalty tax. This table does not address nondeductible contributions made to a traditional IRA or employer plan. The relative spending flexibility of each account is illustrative in nature and does not denote a specific ordinal ranking for all circumstances.

Source: Vanguard.

Hypothetical example

By taking full advantage of the accounts at their disposal, investors can 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 return assumptions.

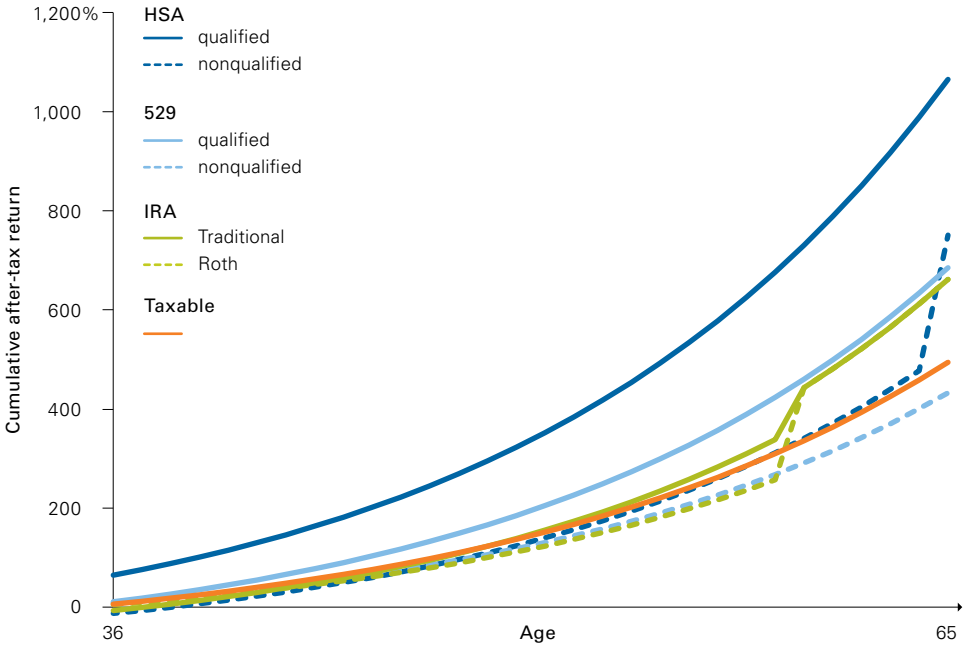
The lines on the chart represent returns after taxes and any applicable penalties are paid. The inflection points at age 59½ reflect the penalties associated with various retirement accounts prior to that age. "Qualified" and "nonqualified" indicate whether the account was used for a purpose that meets the IRS requirements and thus did not incur distribution taxes or penalties. HSA nonqualified shows what the return would be if the funds were spent for a non-health-care purpose, and 529 nonqualified shows the return if not used for a qualified education purpose.[5]

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

In this example, a dollar invested in a traditional or Roth IRA over 30 years would achieve approximately 170% more cumulative return than it would if invested in a taxable account. The return of the Roth or traditional IRA after age 59½ is equivalent assuming flat tax rates throughout the timeframe.

If different future tax rates are known or expected, projecting returns in this manner can indicate whether a tax-deferred (traditional IRA and 401(k)) or tax-exempt (Roth IRA and Roth 401(k)) account may be preferable, as well as the potential value of a Roth conversion. These decisions are largely a function of estimates of future tax rates and how decisions today might affect those rates (Dickson, Bruno, and Wong, 2018).

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 and 2% annual income returns. The assumed rate of return is not guaranteed. It is an illustrative example of a long-term average return. After-tax return assumes a complete liquidation of the account, including applicable taxes and penalties. 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. HSA contributions are assumed to be made through an employer plan and thus free from Social Security and Medicare taxation. Market returns are not constant and will fluctuate annually. 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 less. 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 further affect the comparison. Investors should consider their time horizon and current and expected future tax rates before making an investment decision.

Source: Vanguard.

5 For more information about 529s and what constitutes a qualified withdrawal, see *IRS Publication 970*.

Debt: the other side of the balance sheet

In addition to investing, you may wish to consider paying down the principal on one or more outstanding debts. In this context, payment of debt can be thought of as investing with a guaranteed return, as long as the debt carries a fixed rate. Paying down high-interest debt such as revolving credit card debt is typically one of the first places to direct cash flow, because an equivalent return in the market can be hard to achieve. The decision to prioritize the payment of debt versus investing can be complex, and investors should consider the following factors.

Behavioral considerations

When paying down debt, consumers often focus on accounts with the smallest balance first so that they can achieve a sense of tangible progress (Amar et al., 2011). Sometimes referred to as debt account aversion, this is typically not the best option from a wealth maximization standpoint. The highest-returning strategy is to pay down debt in order of descending interest rate. One technique that can help with this behavioral challenge is to consolidate debt into a single account. 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 in order to create wealth.

The elimination of high-interest debt should be a top priority.

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 will result in the complete loss of liquidity of any "invested" dollar.

The best option in this case is to pay down principal on the highest-interest-rate debt 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 either miss a short-term goal or take on more debt under uncertain or unfavorable terms.

Consider choosing between investing $5,000 for the near-term goal of making a house down-payment in the next two years or paying down principal on a student loan with a term of ten years and an interest rate of 5%. Given the short time horizon of the house-buying goal, we assume that the $5,000 investment will grow at a 1% rate with no 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. If you decided to invest instead of paying

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

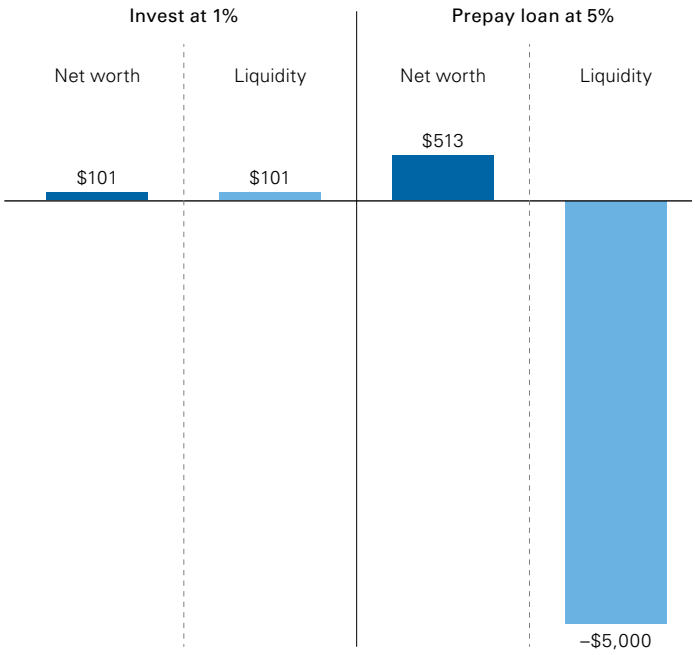
down the student loan, you would have access to $5,101 to buy the house. However, this would come at the cost of an additional $412 of potential net worth.

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

Increased wealth and liquidity are not always at odds when prepaying debt. If the loan can be fully paid off long 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 to both liquidity and net worth.

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



Source: Vanguard.

Risk tolerance

You should also consider the uncertainty associated with an investment's underlying asset allocation. Generally, risk-averse investors will be more drawn toward the guaranteed return of paying down debt than a less risk-averse investor would be. A utility function that incorporates aversion to risk provides a quantitative comparison:

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

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

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. For example, consider someone with access to an investment with an expected annualized return of 6% and standard deviation of 10%, as well as a long-term debt with a fixed interest rate of 4%. If this investor determines that his or her risk aversion parameter is 5, the risk-adjusted return for the investment will be 3.5% (6% – $0.5*5*10\%^2$). The 4% guaranteed return of the debt may be more suited to this individual's level of risk aversion than the investment would be.[6]

Balancing wealth maximization with other financial objectives

In some cases, long-term goals such as retirement may compete with shorter-term goals such as saving for a home or adequately preparing for a financial emergency. To resolve this conflict, investors can take the following steps:

1. Prioritize high-return opportunities such as matched employer plan contributions and paying down high interest-rate debts such as credit cards, which can spiral out of control if left untended.

2. Make sure to have adequate emergency savings to meet potential financial shocks (Kahler and Paradise, 2019). Without stable savings, an investor may be forced to take on additional debt under unfavorable conditions at inopportune times.

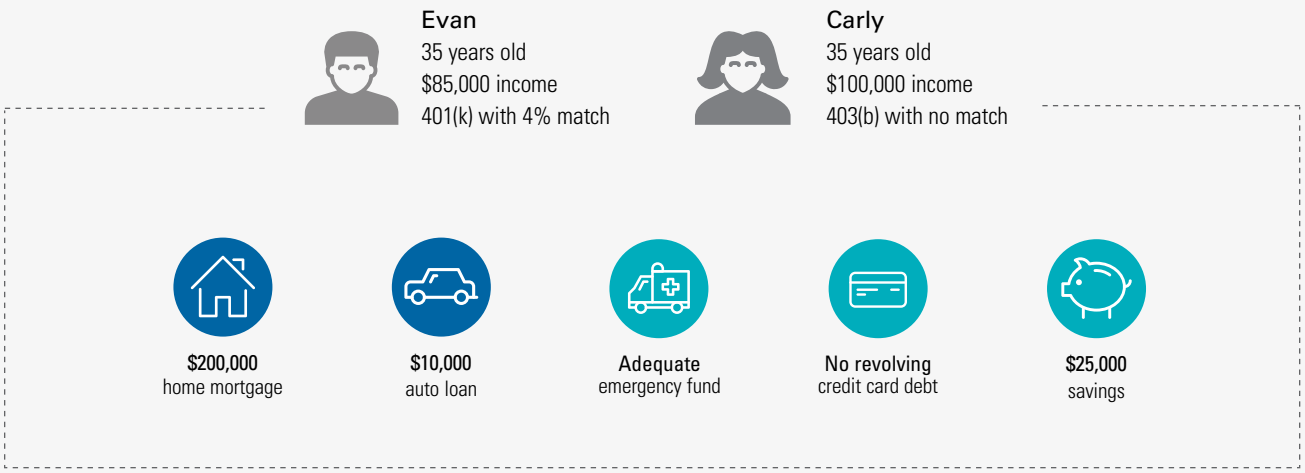
3. Prioritize remaining financial goals and determine applicable savings vehicles.

6 A risk aversion parameter of 0 would imply an indifference to risk and an assumption that the investor would always choose the option with the higher expected return. Note that no one formal, agreed-upon range exists for this type of quantitative risk measure; 1 through 10 can be a reasonable scale.

Case study

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

To illustrate the cash-flow prioritization framework, consider a household with the following characteristics.



Evan and Carly are saving to retire in 30 years. They are currently paying down two loans. The first is a fixed 4.5% home mortgage of $200,000; the second is an auto loan of $10,000 at a fixed rate of 5.5%.[7] They currently have adequate emergency savings and no revolving credit card debt. They are able to save $25,000 over the next year and are wondering how to allocate those savings.

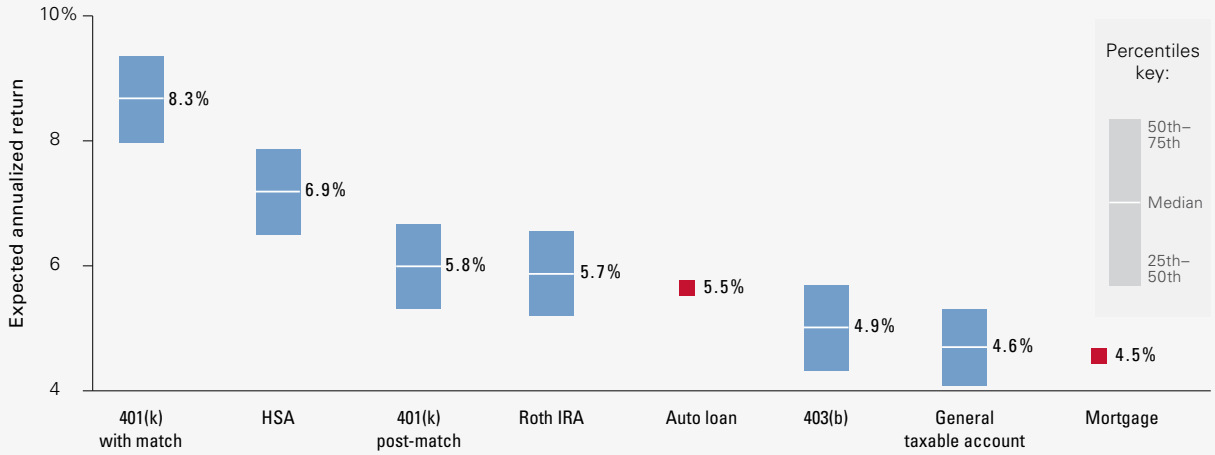
Calculate. We can calculate the expected annualized rate of return for all of their cash-flow opportunities, adjusting for costs, and then eliminate those not suited to their goal.

Most investment accounts are good options for saving for retirement, including HSAs (Kahler, Clarke, and Bruno, 2017). One exception is a 529 savings plan. Unless they are used for education purposes or transferred to another beneficiary, any 529 withdrawals will be subject to a 10% penalty as well as income taxes.

Figure 4 shows the expected annualized after-tax return of a one-time lump-sum investment in each suitable account or debt-payment opportunity.

7 If an investor is itemizing deductions instead of claiming the standard deduction, the prepayment of mortgage, student loan, or other interest-deductible debt can lower the future ability to deduct interest. This could affect the prepayment decision.

Figure 4. Align investments to your goals



Notes: Asset allocation is 60% stocks and 40% bonds for the entire time for each account. 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 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, 20 basis points.

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

IMPORTANT: The projections and other information generated by the 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 are as of December 31, 2018. Results from the model may vary with each use and over time. For more information, see the Appendix on page 11.

Prioritize. The next step is to determine how much of the expected $25,000 savings should be allocated to each opportunity. In the baseline scenario, Evan and Carly should first save $3,400 to the 401(k) to receive the full employer match. Next, they might prioritize saving $7,000 in an HSA. This will achieve a relatively high return if used for qualified expenses and a return similar to an IRA after age 65 if used for nonqualified expenses.

Evan and Carly will likely be able to use their HSA accounts for qualified purposes in retirement between Medicare premiums, copays, and deductibles. They might invest the remaining $14,600 in the 401(k) post-match. Depending on their aversion to risk, they may prioritize early principal repayment of their auto loan because of its guaranteed return nature.

Following the suggested allocation strategy, Evan and Carly might expect to achieve approximately 6.6% annualized returns after tax, as compared to a projected 4.6% after-tax annualized return for a general taxable account with the same asset allocation.[8] Over the course of 30 years, this can make a difference of more than $70,000 in additional wealth.

Projected **4.6%** after-tax annualized return for a general taxable account

Following the suggested allocation strategy, Evan and Carly might expect to achieve approximately **6.6%** annualized returns after tax

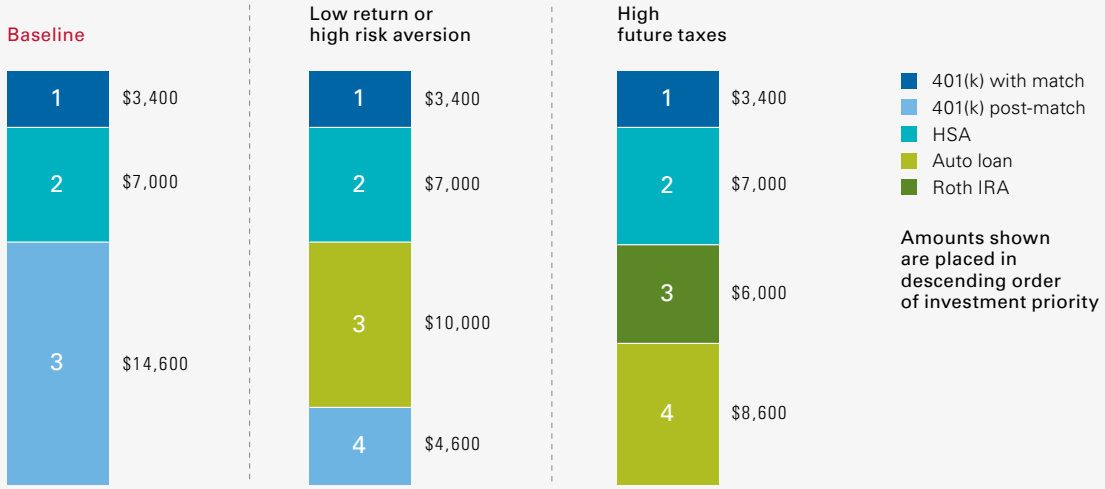
8 The expected weighted annualized return when investing in the 401(k) and HSA as described above is 6.6%. The HSA is assumed to be used for qualified medical expenses.

Alternative allocations. Under different circumstances, the ideal allocation may vary. **Figure 5** shows how we might invest differently depending on market and tax expectations.

If we believe the market will have lower future returns than the baseline projection shown in Figure 4, it would be prudent to allocate funds similarly. However, we should prioritize down-payment of the auto loan over investing in the 401(k) post-match, because the fixed return from debt repayment will not vary with market return.

If we expect exposure to higher tax rates in the future, whether from increasing income or legislation, we will likely prioritize first the Roth IRA and then the auto loan debt over the 401(k) post-match. Investments in a traditional 401(k) or IRA would be penalized relative to investments in a Roth account in such a scenario.

Figure 5. Some opportunities are more sensitive to changing tax rates and market conditions



Notes: Asset allocation is 60% stocks and 40% bonds for the entire time for each account. 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 be used for qualified medical expenses during retirement. "Low return" assumes a 25th-percentile annualized return from the baseline scenario as the new expected value. "High future taxes" assumes a 10% increase in federal income taxes after the initial investment. 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, 20 basis points.

Source: Vanguard calculations using the Vanguard Capital Markets Model (VCMM). Simulations are as of December 31, 2018.

Conclusion

When choosing among cash flow opportunities, from the prepayment of loan principal to various investments, investors may be best 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 limitations associated with various account types and debt options. Knowing the rules, we can then begin to model the possible future returns associated with each choice and visualize prospective wealth and liquidity levels. Finally, we can overlay these potential futures against a timeline of goals to begin making the most appropriate cash flow decisions for each 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(S38-S50): 11–11.

College Savings Plan Network, 2019. *Study Shows One in Five Know Purpose of a 529*, available at https://529forcollege.com/study-shows-one-in-five-know-purpose-of-a-529.

Dickson, Joel M., Maria A. Bruno, and Boris C. Wong, 2018. *A "BETR" Approach to Roth Conversions*. Valley Forge, Pa.: The Vanguard Group.

Financial Engines, 2015. *Missing Out: How Much Employer 401(k) Matching Contributions Do Employees Leave on the Table?* Available at https://financialengines.com/education-center/wp-content/uploads/2016/07/Financial-Engines-401k-Match-Report-050615.pdf.

Fronstin, Paul, 2017. *Trends in Health Savings Account Balances, Contributions, Distributions, and Investments, 2011–2016: Statistics From the EBRI HSA Database.* Employee Benefit Research Institute Issue Brief No. 434.

Kahler, Jonathan R., and Thomas Paradise, 2019. *Break Glass in Case of Emergency: Managing Household Liquidity.* Valley Forge, Pa.: The Vanguard Group.

Kahler, Jonathan R., Andrew Clarke, and Maria A. Bruno, 2017. *HSAs: An Off-Label Prescription for Retirement Saving.* Valley Forge, Pa.: The Vanguard Group.

Kitces, Michael, 2018. *The Hierarchy of Tax-Preferenced Savings Vehicles for High-Income Earners*, available at kitces.com/blog/hierarchy-tax-preference-savings-vehicle-roth-high-income.

Utkus, Stephen P., and Jean A. Young, 2019. *How America Saves.* Valley Forge, Pa.: The Vanguard Group.

Appendix. About the 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.

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.

The Vanguard Capital Markets Model® is a proprietary financial simulation tool developed and maintained by Vanguard's primary investment research and advice teams. 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 Vanguard Capital Markets Model 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 from as early as 1960. 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 time 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.

Connect with Vanguard® > vanguard.com

Vanguard research authors

Thomas Paradise
Jonathan R. Kahler, CFP®

Vanguard®

Vanguard Research

P.O. Box 2600
Valley Forge, PA 19482-2600

ISGWTDN 032020