

“RISK-FREE” GOAL FUNDING

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Investors commonly view cash, as represented by Treasury bills, as the *risk-free* asset. Treasury bills are perceived to have no default risk or interest rate risk, and thus little-to-no volatility. This asset is essentially risk-free over a single period (e.g. one year or less). But in the real world, investment time horizons are multi-period, as individuals and institutions seek to fund their goals and liabilities over many years. Over multi-year time horizons, Treasury bills are exposed to reinvestment risk (interest rate risk) and some inflation risk. They are not truly risk-free.

A *safe asset* is commonly used in practice as a surrogate for a theoretically risk-free asset. Pension funds use high-grade bonds to settle some or all of the multi-year liabilities owed to their beneficiaries. Goals-based approaches for private investors fund some or all high-priority goals with high-grade bonds. High-grade bond portfolios used in this way can retain some default, interest rate and inflation risks, depending on the character of the liability and the degree of alignment. Although relatively safe, they are not risk-free either.

A multi-year, risk-free asset is needed. The intertemporal capital asset pricing model (ICAPM) is an extension of modern portfolio theory (MPT). Unlike MPT, the ICAPM explicitly incorporates time and liabilities (goals). The risk-free asset is not defined as cash, but as an asset that is risk-free in relation to funding a multi-period liability.

As we discussed in our research article “Surplus Assets and Shortfall Risk,” Treasury Inflation-Protected Securities (TIPS) can be used as the multi-year risk-free asset. When the timing and magnitude of TIPS cash flows are perfectly aligned with the timing and magnitude of lifetime consumption flows, shortfall probability is reduced to 0% and the magnitude of potential shortfall goes to zero – forming a lifetime consumption hedge. Viewed from the perspective of funding the consumption goal, there is effectively no default risk, no interest rate risk and no inflation risk. Used in this way, TIPS are as close to risk-free as possible.

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Unfortunately, there are real-world implementation issues. TIPS are issued in limited maturities (5-, 10- and 30-year) and make interim interest payments, complicating the precise alignment of cash flows with goals. Additionally, circumstances often change as time passes. New goals emerge while old goals are modified or eliminated, and the portfolio should be able to adapt efficiently to new liability profiles. TIPS interest is also taxed as ordinary income, making it less appealing to taxable investors than the tax-free income of municipal bonds. As a result, most investors do not use TIPS as a risk-free asset.

Given the inflation-protected properties of TIPS and other inflation-protected bonds, a key question is how much TIPS should investors own if they do not use them as a risk-free asset but are still funding an inflation-sensitive (i.e. real), multi-year liability? Traditional approaches based on MPT may look to the minimum variance (minimum volatility) mix, or the maximum Sharpe (highest return-to-risk) mix of TIPS and investment-grade nominal bonds. But if risk-free in relation to the real liability is the ICAPM ideal for a risk-free asset, then minimum variance in relation to the real liability is next-best.

TIPS were introduced in 1997. We use 20 years of annual returns from 1998 to 2017 to capture the return and risk behaviors of TIPS relative to investment-grade nominal bonds (IG bonds).¹ TIPS, IG bonds and inflation are represented by the Bloomberg Barclays US Treasury US TIPS Index, the Bloomberg Barclays US Aggregate Bond Index and the IA SBBI US Inflation Index, respectively. Exhibit 1 shows the return and risk parameters of IG bonds and TIPS from 1998 to 2017.

EXHIBIT 1 – RETURN AND RISK PARAMETERS (1998-2017)

| | Mean Return | Standard Deviation | Correlation | |
|--------------------|-------------|--------------------|-------------|------|
| | | | IG Bonds | TIPS |
| IG Bonds (nominal) | 5.04% | 3.50% | 1.00 | 0.76 |
| TIPS | 5.65% | 6.11% | 0.76 | 1.00 |

SOURCE: Morningstar

The standard deviation of TIPS was 6.11% compared to 3.50% for IG bonds over this period. Despite having approximately similar average maturities, TIPS have been more volatile – more risky according to this standard definition of risk. This is because TIPS are sensitive to inflation, including negative inflation, or deflation.

Two common risk factors explain bond returns: the term factor represents returns from bearing interest rate (duration) risk; the default (or credit) factor represents returns from bearing equity-like default risk. Although nominal Treasury bond returns have no exposure to the default factor, TIPS returns show a low but statistically significant default beta even though the risk of actual default is close to zero. This is because deflation risk is correlated with default risk, which in turn is largely explained by market risk. Deflationary risks were elevated during the 2008-2009 financial crisis, when equity markets were distressed.

¹ We use the annual return frequency because it shows more inflation variation than the annualized monthly frequency, likely due to the appraisal-based nature of inflation reporting.

How much TIPS should investors own if they are funding an inflation-sensitive, multi-year liability?

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Based on the historical return and risk parameters in Exhibit 1, both the minimum variance and maximum Sharpe mixes show no allocation to TIPS. Nonetheless, TIPS represent about 5% of the market value of the entire U.S. investment-grade bond market.

Exhibit 2 shows three historical periods over which we measure inflation (annual frequency).

EXHIBIT 2 – INFLATION SCENARIOS

| | Mean Inflation | Standard Deviation |
|--------------|----------------|--------------------|
| 1926 to 2017 | 2.97% | 4.04% |
| 1970 to 2017 | 4.03% | 3.03% |
| 1998 to 2017 | 2.15% | 1.01% |

SOURCE: Morningstar

Among the three periods, average inflation was lowest and had the least variation over the 1998 to 2017 period, when TIPS were available to investors. Average inflation from 1926 to 2017 was about 3%, with a standard deviation of about 4% indicating much higher variation, or inflation uncertainty. We also include 1970 to 2017, which represents the beginning of an acute inflationary period.

Following from the ICAPM, we redefine risk as minimum variance in relation to funding a real multi-year liability. We build a model that combines optimization with Monte Carlo simulation, where the objective function is to find the mix of TIPS and IG bonds that funds a real (inflation-adjusted) liability with the least variation (uncertainty) in funding outcomes across 3,000 trials. The liability represents level, inflation-adjusted consumption over thirty years, which might be similar to a consumption goal in retirement.

In Test 1, we utilize the return and risk parameters in Exhibit 1 along with the inflation parameters over the 1998 to 2017 period from Exhibit 2. This period had relatively low inflation and low inflation variation. Based on our revised definition of risk (minimum variance in relation to funding a real liability), the model suggests an allocation of 0% to TIPS.

In Test 2, we hold all inputs constant but increase the inflation standard deviation from 1.01% to 3.03%, which represents inflation uncertainty over the 1970 to 2017 period. Importantly, we are still assuming average inflation of just 2.15%, like in Test 1. In this case, the model suggests a TIPS allocation of 13%.

In Test 3, we continue to hold all other inputs constant but increase the inflation standard deviation to 4.04%, which represents inflation uncertainty over the 1926 to 2017 period. The results of Test 3 suggest a TIPS allocation of 36%.

In aggregate, these results support higher allocations to TIPS with increasing inflation uncertainty. The average inflation was the same for all three tests. Only the inflation standard deviation changed, indicating increasing levels of inflation uncertainty produce higher TIPS allocations. In contrast, there is no material increase in TIPS if we increase average inflation but hold inflation standard deviation constant. This is an economically intuitive result. Inflation

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uncertainty is the key driver of holding more TIPS, not higher expected inflation, which would already be priced in. If expected inflation is low but uncertain, then a higher TIPS allocation is warranted.

EXHIBIT 3 – TIPS ALLOCATIONS WITH INFLATION UNCERTAINTY

| | Test 1 | Test 2 | Test 3 |
|--------------------|--------|--------|--------|
| IG Bonds (nominal) | 100% | 87% | 64% |
| TIPS | 0% | 13% | 36% |

SOURCE: Northern Trust Research

As previously noted, many taxable investors prefer municipal bonds because of their tax-free income. Therefore, we replace IG bonds with municipal bonds, as represented by the Bloomberg Barclays Municipal 1-15 Year Blend Index (which has about the same average maturity as the US Aggregate Bond Index, our proxy for IG bonds) and rerun the tests. Return and risk parameters for TIPS and municipal bonds over the 1998 to 2017 period are modified assuming a 37% income tax rate and 20% capital gains tax rate.

If taxable investors perceive after-tax returns and pre-tax risk, then the tests produce nearly identical TIPS allocations, as shown in Exhibit 3. Even though municipal bonds are far more tax-efficient than TIPS, when the objective is to fund an inflation-sensitive goal with minimal risk, then taxable TIPS play an important role alongside tax-free municipal bonds. Many taxable investors probably do indeed perceive after-tax returns and pre-tax risk. However, more sophisticated taxable investors perceive after-tax returns and after-tax risk. Under these conditions, the model suggests even higher allocations to TIPS because taxes reduce the volatility of after-tax returns.

The results of our tests indicate that bond allocations funding real multi-year goals (e.g. lifetime consumption) should have higher allocations to TIPS than traditional asset-only methods suggest. Higher inflation uncertainty – not higher expected inflation – is the key driver of higher TIPS allocations. If a true multi-year risk-free asset is impractical, then the asset mix that offers minimum variance in relation to funding an inflation-sensitive multi-year goal is the closest thing to “risk-free,” regardless of taxes.

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