TIAA Institute

The Foundation of Target-Date Funds and Annuities

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Abstract

Target-date funds, which represent age-dependent combinations of equity and bonds, span the asset allocation space absent annuitized investing. The "target-date funds" approach highlights the dependence of the optimal asset allocation between risky and riskless assets on the investor's age. In addition, under the assumptions underlying the Capital Asset Pricing Model (CAPM), all target-date funds are efficient investments and lie on the mean-variance efficient frontier. Target-date funds can be introduced into annuitized investing (variable and fixed annuities). An entity can own annuities whose value adjusts with market movements, so the insured entity can hedge financial market risk and fully insure idiosyncratic mortality risk. Financial/portfolio risks and mortality risks are independent and separable, leading to a "separation theorem." Then the structure of the holdings (including annuities) can capture completely both market risks and idiosyncratic mortality risk, rather than distorting the asset allocation in order to address more fully idiosyncratic mortality risk. The spanning and separation results can be interpreted as supporting the use of target-date fund products within annuitized vehicles. The optimal location of annuitized investing between retirement and taxable vehicles also is explored and asset location (where to locate equity and bonds) within such contexts is examined.

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1. Introduction

Target-date funds in which asset allocation changes over time based upon the investor's age or projected retirement date have become more important in individual investing, especially for retirement plans. While these target-date funds represent a combination of equity and fixed-income investments (or risky and riskless investments), these funds have a central role in asset allocation. The traditional view has been to suggest that the target-date fund for the investor's age guides his investment, but recognizes that the investor has a range of alternative allocations that he may wish to choose. Rather than viewing investment through the target-date fund for the investor's specific age as being narrowly prescriptive, we allow the investor flexibility in selecting the specific target-date funds and examine the foundational properties of these products.

We assume that the proportion of equity in the target-date fund decreases with the investor's age. As target-date funds reflect a unique combination of equity and bonds, we show that two target-date funds replicate all other target-date funds and span all equity-bond mixes. The target-date funds lie on the mean-variance frontier as they permit the investor to replicate any combination of the market basket and riskless asset. In effect, the Capital Asset Pricing Model (CAPM) is equivalent to the efficiency of target-date funds. These findings also are consistent with the use of target-date funds within annuitized products; the target-date fund achieves the desired financial risk exposure, while the annuitization structure insures the individual's mortality risk.

In Section 2 we discuss how target-date funds span the investment space and the efficiency of target-date funds under the CAPM. We extend our results on target-date funds to annuitization in Section 3. We discuss the impact of taxes on asset location with annuitization in Section 4. Section 5 concludes.

2. Target-date funds and efficient investing

In recent years attention to retirement fund investing has focused upon "target-date funds," which involve investing in a combination of mutual funds in which the investor's underlying asset allocation between equity and fixed-income is a function of an investor's age. The investor's choice among such target-date funds reflects a desired asset allocation and not the investor's actual age. The target-date fund can correspond to that for someone who has a different attained age. This itself can be adjusted over time. A target-date fund is a portfolio mix determined by a hypothetical age for the investor. The target-date funds are structured so that the proportion of equity declines with the investor's age.[1]

Assumption A: The proportion of the target-date fund invested in equity strictly declines with the investor's age.

This assumption, which is satisfied weakly by target-date fund programs, can be motivated in a number of ways. In a typical program in practice there is a discrete set of target-date fund options, so that the equity proportion is a non-increasing step function. However, by taking a convex combination of target-date funds at nearby ages, the equity proportion strictly declines over a continuous set of ages. For example, the shortening horizon of an investor as he ages, suggests declining risk-taking as the investor ages. Furthermore, there are important links to human capital over the life cycle. Human capital represents part of the individual's total wealth, but it is not included in standard measures of financial wealth.

While mutual fund organizations offer a limited set of target-date funds, conceptually there is a dense set of target-date funds, each corresponding to a unique proportion of equity and risk-free assets. The choice among target-date funds by the investor is equivalent to selecting an asset allocation. Two target-date funds composed of mixes of equity and risk-free bonds fully span the feasible asset allocations.[2] Two target-date funds held in appropriate proportions replicate any other target-date fund.

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[1] This is an aspect of how target-date funds are structured. A broader discussion of target-date funds is offered by Mitchell and Utkus (2012).

[2] This is similar to the idea that call (or equivalently put) options span the feasible payoffs. For example, every pure contingent claim (e.g., Arrow-Debreu security) that pays off in a single state can be replicated by a portfolio of options. Consequently, options can replicate all contingent claims (see the classic papers by Ross (1976) and Breeden and Litzenberger (1978)).

Proposition 1

A linear combination of two target-date funds spans the feasible allocations of bonds and equity and replicates any other target-date fund.

This result yields two-fund separation within the subspace of target-date funds. The separation idea emerges as a byproduct of defining target-date funds as a combination of equity and fixed-income portfolios. However, taking the conclusion in Proposition 1 together with underlying restrictions on preferences or the distribution of returns leads to the optimality of such portfolio combinations, as in the classic papers on two-fund separation under such assumptions as quadratic utility for preferences or normally distributed one-period returns.[3] In the presence of a risk-free asset and sufficient conditions for two-fund separation, the optimal composition of the risky portfolio is identical for all investors.[4]

The "separation theorem" implies that any efficient portfolio can be represented by a target-date fund, which we interpret as a combination of the risky and riskless assets, i.e., the market portfolio and riskless assets. The standard foundation of the Capital Asset Pricing Model (CAPM) implies that the CAPM is equivalent to the efficiency of the market portfolio, so the CAPM also is equivalent to any target-date fund being an efficient (mean-variance frontier) portfolio under our interpretation of the target-date fund.

Proposition 2

The CAPM is equivalent to the mean-variance efficiency of any target-date fund.

This offers a fundamental rationale for target-date funds, while not recommending particular target-date funds as maximizing expected utility to specific investors. At the same time, our analysis does not evaluate the choice of a specific product by the investors.

3. Annuitization and target-date funds

Annuities are an important asset category that is often not emphasized in traditional discussions of asset allocation (for "target-date funds" and even otherwise). These are defined on a different dimension than equity and bonds—annuities insure longevity. In its simplest form an annuity makes level payments over the life of the insured. In contrast, traditional asset allocation reflects choice among financial assets whose payoffs are defined over the state of the economy (or firm) rather than the specific mortality status of an individual (or a couple). However, one can hold such risky assets and the riskless asset inside (as well as outside) an "annuity wrapper." Inside the annuity the payoff would be determined by the state of the economy as well as whether the individual is alive. The "annuitization puzzle" represents a critique of the failure of many investors to hold annuities, even when they lack a strong bequest motive.[5] Indeed, this critique is that many individual investors do not annuitize at all, rather than that they do not fully annuitize.[6] Of course, the integration of annuities into the portfolio setting provides a mechanism to obtain additional consumption than can be achieved by investors owning only assets that do not provide insurance against longevity. By annuitizing and insuring his longevity, the consumer-investor obtains a larger return to fully utilize available resources during his lifetime. In contrast, without annuitization the consumer would obtain a lower effective return and die with assets in his name.[7] The insurance provided through annuitization allows such assets to be consumed during the investor's lifetime, rather than retaining resources at death that can only be used for bequests.

In contrast to the case with annuities, the traditional "target-date funds" framework without annuities did not allow investors without a bequest motive or only a modest bequest motive to maximize their expected utility. Incorporating annuities into the "target-date funds" framework would facilitate utility maximization. Interpretation

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3. The classic papers on two-fund separation more broadly are Tobin (1958), Cass and Stiglitz (1970) and Ross (1978).

4. Two-fund separation applies directly to after-tax payoffs in the presence of taxes under the assumption that all investors are taxed identically.

5. The annuitization puzzle was highlighted by Modigliani (1986) and more recently surveyed by Benartzi, Previtero and Thaler (2011). Milevsky and Young (2007) highlight that adverse selection can help explain the delay in purchasing annuities.

6. Individuals could be reluctant to fully annuitize because of a limited bequest motive or because of the desire to accommodate lumpy consumption demands and needs. A weakness of the interpretation that individuals do not partially annuitize is that Social Security in the United States, which is essentially universal, actually provides a real annuity.

7. This would be clearly inefficient without a bequest motive.

of the optimal solution in the presence of annuities would provide basic insight about how "target-date funds" could work with annuities.

In a standard asset allocation framework the employee's optimal asset allocation involves holdings of risky (the "market portfolio") and riskless assets. The "target-date funds" approach highlights the dependence of this asset allocation upon the investor's age. Of course, individuals face not only market risk that could be hedged through ownership of risky securities, but they also face idiosyncratic mortality risk that can be hedged by annuities.

Value can be reallocated among the assets in the annuity wrapper each period; the annuity structure can account potentially for both a fixed and variable annuity and allow redistribution of value between the two assets. The initial purchase of the annuity or deferred annuity can be a blend of a fixed and variable annuity—the mortality risk reflects the market value of the combined fixed and variable annuity. We assume that there is no correlation between the equity return and mortality realizations for the individual (the individual is small compared to the market; furthermore, except in extreme instances, individual mortality would not influence the equity return, and market returns do not typically influence individual or even aggregate mortality).

Assumption B: The realization of market risk and mortality risk are assumed to be independent.

For the most part this is a very reasonable assumption, as illustrated by the types of instances in which the assumption that individual mortality is independent of market returns would not be satisfied. For example, one could imagine that the death of a President of the United States or an extraordinary innovator (e.g., Steven Jobs) would be correlated with and influence market returns. Certainly at the level of an individual firm there could be such impacts (we've even seen positive responses at the firm level to rumors of the death of underperforming CEOs!). Under unusual circumstances, it also is possible that poor market returns leads to higher mortality rates.

Under the assumption of independence one can reallocate value each period between the assets within the annuity wrapper. Because the individual can own variable annuities whose notional value adjusts with market movements (along with fixed annuities, whose value would be invested in bonds), the individual can fully insure the relevant risks— both market risk and the idiosyncratic mortality risk to the extent that he desires to do so. In effect, there is an underlying "separation theorem" such that the structure of assets (including the annuities) can capture fully both market risk and idiosyncratic mortality risk, once these annuities are addressed. The import of this "separation theorem" is that the employee's optimal exposure to market risk (taking into account the implicit equity in any variable annuities that he holds) would be identical to his optimal holding of market risk absent the annuities. Therefore, the optimal annuitization decision and the asset allocation are separable.

Proposition 3

The optimal annuity purchase decision is separable from the optimal asset allocation under the assumption of independent financial returns and mortality realizations. Hence, the target-date funds offered inside the annuity wrapper should mirror those offered outside the annuity.[8]

4. Taxes and annuitization

An important friction is adjusting for differential tax treatment between taxable and retirement funds. As highlighted by Dammon, Spatt and Zhang (2004), the division of an investor's wealth between taxable and tax-deferred funds plays a crucial role with respect to asset location and allocation. For example, the optimal extent of holdings of equity is influenced by whether the marginal location for equity is in the taxable or retirement account. Similar logic would help pin down the indirect impact of taxes upon annuity holdings in a target-date funds context. In the traditional context with taxable and tax-deferred investing, Dammon, Spatt and Zhang (2004) point out that the taxation of bond returns and equity returns is neutral within the tax-deferred account, while equity has a considerable tax preference within a standard taxable account (favorable rates are applied to both dividends and capital gains and additionally, taxation of capital gains is deferred and the timing of realization is endogenous). This leads to their asset location conclusion that one should place his desired fixed-income exposure first in the retirement account and

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8.   This conclusion may be sensitive to the absence of adverse selection about mortality risk.

the desired equity first in the taxable account—the overall desired risk exposure interacts with the split of wealth in determining the asset location mix.

In contrast, equity and bonds are taxed identically within an annuitization context, whether in a qualified (tax-deferred or Roth) setting or non-qualified (taxable) context. This influences both the placement of equity vs. bonds within annuities compared to non-annuity contexts and the location of exposures across the various buckets. Of course, then the asset location (equity vs. bonds and indeed, specific target-date funds) is crucially linked to the allocation of wealth among the various contexts. The neutral treatment of bonds and equity in both tax-deferred settings and within annuities more generally point to non-annuitized, taxable funds being the first place to locate equity. The potential role of equity in taxable annuities (and whether they have a greater or lesser potential role than in tax-deferred annuities and tax-deferred annuities more generally) is ambiguous. On the one hand, the equity is subject to tax deferral until funds are withdrawn from the annuity for consumption (with an adjustment for principal),[9] but the preferential tax rate on equity returns is eliminated. Indeed, in the current environment (low time value of money, but a large differential between equity and bond taxation) we would anticipate that the value of the deferral is not as substantial as the large tax rate differential being foregone with equity investments.

The allocation of wealth to annuities is determined by the individual. One point to emphasize about that—investing in a tax-deferred retirement context (with or without annuitizing) dominates from a tax perspective investing in annuities in a taxable context as the former essentially does not tax the growth of the funds, while the latter subjects the growth to some taxation at the withdrawal of the annuity payments.[10] Hence, from a tax perspective annuitizing would be recommended in a taxable setting only when the limit on contributions to the tax-deferred account binds.

Of course, many individuals have some degree of annuitization, their Social Security. This is likely to have a substantial impact for those individuals for whom the bulk of their retirement income is in Social Security (individuals with relatively low income). Consequently, the greatest potential for annuitization would be for relatively higher income individuals.

5. Concluding comments

This paper provides perspective on the foundation of target-date fund investments both without and with the potential of the investor to annuitize. Target-date funds are convex combinations of equity and bond funds. Each target-date fund or asset allocation is a linear combination of risky equity and riskless bonds, which is spanned and can be replicated by two target-date funds. While investors won't necessarily find it optimal to choose the target-date fund corresponding to their particular age (they can select *any* target-date fund), the CAPM is equivalent to the efficiency of target-date fund investments. Additionally, the foundation and role of target-date funds to manage risks in one's financial account is robust to the presence of the opportunity to annuitize and does not distort the annuitization decision.

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9.   More detailed discussion and analysis of the tax treatment of the withdrawals from annuities (including allocation of payments to principal) is undertaken by Brown, Mitchell, Poterba and Warshawsky (1999) and Warshawsky (2015).

10. Dammon, Spatt and Zhang (2004) discuss why the growth of the retirement account is effectively not taxed (i.e., the original contribution was deductible, so the government has a claim on its portion of the account, reflected in the taxation of withdrawals). In contrast, the contribution to an annuity in a non-qualified (taxable) account is not deductible, but the growth would be taxed at withdrawal (this is somewhat analogous to an "after-tax" IRA; on the other hand, a Roth IRA provides no deduction up front and no tax of the withdrawals).

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