

Climate Change & Retirement Investing Conference

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Introducing the Retirement Bond – The New Risk-Free Asset in Decumulation Investing

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Research conducted with the support of Bank of America

Outline

- The Decumulation Investing Problem
- Retirement Bonds in Retirement Planning
- Retirement Bonds in Retirement Investing
- Puzzles in Decumulation Investing

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The Decumulation Problem

- **Accumulation problem** – Efficiently turning *income (contribution)* into wealth:

$$\left\{ \begin{array}{l} \max_{(w_{it})_{0 \leq t \leq T}} E_0(u(W_T)) \\ W_0; dW_t = W_t \left(\sum_{i=0}^N w_{it} \frac{dS_t^i}{S_t^i} \right) + c_t dt \end{array} \right.$$

- **Decumulation problem** – Efficiently turning wealth back into *income (consumption)*:

$$\left\{ \begin{array}{l} \max_{(w_{it}, c_t)_{0 \leq t \leq T}} E_T \left(\int_T^\tau u(c_t) dt \right) \\ W_T; dW_t = W_t \left(\sum_{i=0}^N w_{it} \frac{dS_t^i}{S_t^i} \right) - c_t dt \end{array} \right.$$

An Important and Complex Problem

“The only way to avoid a catastrophe is for plan participants, professionals and regulators to **shift the mindset and metrics from asset value to income.”**

Bob Merton (recipient of the 1997 Nobel prize in economics)
The Crisis in Retirement Planning – Harvard Business Review – July/August 2014

“Decumulation is the **nastiest, hardest problem in finance.”**

Bill Sharpe (recipient of the 1990 Nobel prize in economics)
Tackling the 'Nastiest, Hardest Problem in Finance' – Bloomberg Opinion – June 5, 2017

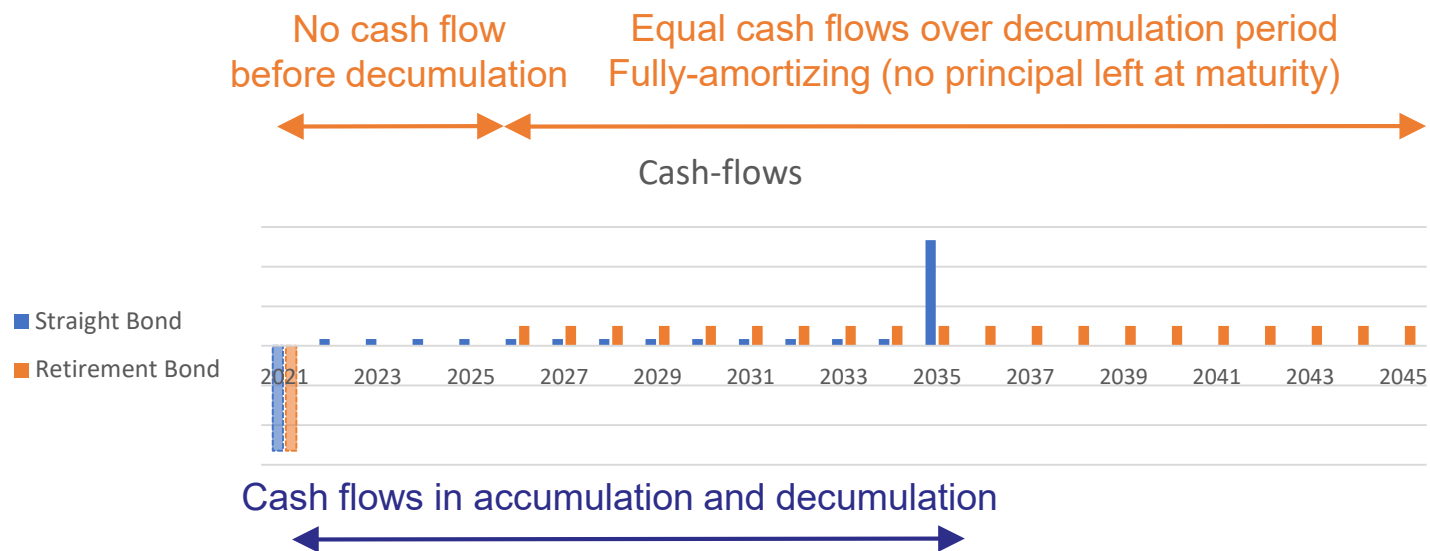
A Conundrum

- **Academic insights** (starting with Merton (1969)) about **optimal** investment & income strategies (w_t^*, c_t^*) are **not actionable**:
 - c_t^* function of unobservable parameters (risk-aversion, expected returns)
- **Industry best practices** about **heuristic** investment & income strategies (w_t, c_t) are **not efficient**:
 - c_t given by ad-hoc rule (e.g., 4% rule) violating basic *efficiency* axioms
- Fixed x% spending rules inevitably lead to spending too much (**bankruptcy**) or too little (**opportunity cost**).
- Our approach: **simplify the problem** via a focus on (1) *first 20Y* versus *whole retirement* and (2) *efficiency* versus *optimality*.

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 - Retirement Bonds in Retirement Investing
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The Retirement Bond

- One key ingredient is the retirement bond, a **fully amortizing fixed-income security** paying constant (or COLA) cash-flows for first 20 years in retirement.



- Price β_t gives **purchasing power of wealth in income units**: W_t / β_t .

Issuing versus Replicating Retirement Bonds

Le Monde
SAMEDI 7 AVRIL 2012

Pour la création « d'obligations retraite »

Trois professeurs de finance, Lionel Martellini, Robert C. Merton et Arun S. Muralidhar, suggèrent l'émission d'obligations dont l'échéance et la durée correspondraient aux âges de départ et d'espérance de vie à la retraite

Par LIONEL MARTELLINI,
ROBERT C. MERTON ET
ARUN S. MURALIDHAR

LE CONTEXTE

ÉPARGNE

La mesure de l'économie, dit-on Le Maire, a dévoilé le 28 mars lors du forum Entrepren- en action) des mesures destinées à orienter l'épargne vers les entreprises, qui devraient être encouragées, et qui devraient figurer dans le Plan d'action pour la croissance et la transformation des entreprises (Pacti) que devrait être présenté en conseil des ministres en mai, est de réorienter l'épargne long terme des Français pour la rendre non seulement plus productive pour le financement de l'économie, mais aussi plus efficace pour le financement de leur retraite.

Une grande partie de l'épargne des ménages est stérilisée dans des contrats d'assurance-vie, qui bénéficient d'un traitement fiscal avantageux mais ne sont pas du tout adaptés aux besoins de la préparation à la retraite. L'objectif d'épargne d'un futur retraité, pour lui, se formule de manière assez claire : il s'agit de disposer d'un revenu de remplacement lui permettant de financer ses besoins de consommation pendant la retraite. Si le besoin est clair, il est pourtant mal couvert par les contrats existants. En fait, même les con-

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trats en euros, réputés non risqués dans la mesure où ils offrent une garantie en capital, ne permettent pas de sécuriser un montant minimal de revenu de remplacement à la retraite.

La question de la pertinence des supports d'épargne longue se pose aujourd'hui avec d'autant plus d'acuité que l'allongement général de la durée de vie et la forte baisse du nombre d'actifs par retraité (ce ratio s'élevait de 2,2 en 1980 à 1,2 en 2008) ont entraîné une baisse des dépenses de retraite.

Dans la mesure où l'importance des régimes complémentaires, constitués du New AGIRC-ARRCO, reste relativement modeste, les salariés se trouvent dans l'obligation de recourir à des plans d'épargne individuels afin de compléter leur retraite publique et, en plus, de constituer un complément de leur revenu ainsi de facto de plus en plus élevé. Finistère ou même le temps raccourci de leur retraite, et donc de leur consommation pendant la retraite.

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LES SALARIÉS SE TROUVENT DE PLUS EN PLUS RESPONSABLES DES DÉCISIONS RELATIVES À LA CONSTITUTION ET AU PLACEMENT DE LEUR ÉPARGNE-RETRAITE

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before. Those parts of the industry that were not evolved fast enough, says Clive Bannister, the head of Phoenix Group, a "closed" life insurer that buys and manages old policies but issues no new ones, have experienced a "demolition". He lists half a dozen British life insurers that existed 35 years ago but no longer do.

The lull is partly spin-off on May 10th of the American life-insurance unit of AXA, a French insurer, is just the latest sign of worries about the industry's prospects. Shares were priced at \$30, well below the expected \$22. Among its woes are low interest rates, which make it hard to fulfil promises of guaranteed returns on some products, and costly new regulations. Since 2016 Europe has required much more capital to be held against long-term liabilities, like those of life insurers. That has prompted some to seek to rebalance their businesses. AXA has not only listed its American life arm this year but also announced the purchase of XL, a Bermuda-based property and casualty insurer.

More serious still are demographic pressures. As the rich world ages and retirees, total life insurance premiums are flat or falling. In developed countries they fell by 0.5% in 2015 in real terms, according to Swiss Re, a reinsurer. Some countries have fallen off a cliff, including Australia (an 18.2% drop in 2015 in nominal terms) and Japan (2.3%), where negative interest rates have savaged returns and prompted some life insurers to stop selling lump-sum death-benefit policies. The industry has long been used to accumulating new assets, with old policies sold off to specialists (such as Phoenix). It will now have to adjust to "decumulating assets as part of their life-insurance policy. That suggests they might welcome a blurring of the distinction between life and health insurance.

Another option is to expand into new markets. In emerging economies, life insurance penetration ranges from 2.6% of GDP in China to just 0.4% in Russia. (South Africa, at 11%, is an outlier.) Total premiums grew by 16.9% in real terms in 2016. But competition from domestic incumbents is fierce, particularly in China. And attracting new customers or providing new services, whether at home or abroad, will be hard for an industry that is saddled with high costs and has been slow to go digital. Most sales are still through agents and brokers.

A third approach is to seek new kinds of customers. Though death benefits and an-

Annals: On May 16th Cathal Williams, an British economics correspondent, was named joint winner of the Young Financial Journalist of the Year at the Wincor Awards, an annual set of prizes for British journalists.

The Economist May 19th 2018



Insurers' single most popular strategy has been to diversify into investment-like products—an index-tracker bundled with a guarantee that the principal will be returned, for example. But since these resemble the offerings of asset managers, they are also the least distinctive. Animo Perretta of AXA echoes many of his peers when he says that risk-averse customers have much to gain from the smoothing of returns an insurer can provide. Life insurers also argue they give access to a broader range of asset classes (including, say, exposure to private equity) than asset managers do. And they point to the attractive tax treatment in most jurisdictions of savings products with a life-insurance element.

But that is to reverse the logic. Governments tax life insurance lightly because of the social value of protecting people from underestimating their life expectancy and retirement needs. Australia used to offer retiring workers incentives to purchase annuities when it stopped these in 2007, the annuities market shrivelled away. Many elderly Australians have used that freedom immoderately: around half have emptied their pension pot by the age of 70. Mr Bannister fears a repeat on a grander scale in Britain, which in 2016 abolished a requirement for retirees to purchase an annuity. Life insurers must somehow reinvent themselves without losing sight of their core purpose: providing a way for their customers to plan for a dignified old age without overburdening the state.

Pension bonds

Will Selfies stick?

An ingenious way to provide retirement income

WHEN people stop working, they need a retirement income. Some are lucky enough to have an employer-provided pension linked to their salary. Everyone else faces a difficult choice. Some keep their pension pot in cash and watch as it is eroded by inflation. Others use savings products with high fees and risk being hurt by a stockmarket downturn. A third option is an annuity, which guarantees a lifelong income but vanishes at death, even if that is a week after retirement.

Lionel Martellini of EDHEC, a French business school, and Robert C. Merton of the Massachusetts Institute of Technology (a Nobel laureate in economics) have come up with an alternative. Workers would buy government-issued bonds when in employment; these would pay no interest until retirement. Over the next 20 years (the typical life expectancy on retirement) bondholders would receive payments comprising interest plus the

return of the capital. These would be linked to inflation, or another measure such as average consumption. So a worker born in 1970, say, would buy a bond that made payments from 2035 until 2055. Every financial innovation needs an acronym, and these are called selfras (Standard of Living Indexed, Forward-starting Income-only Securities).

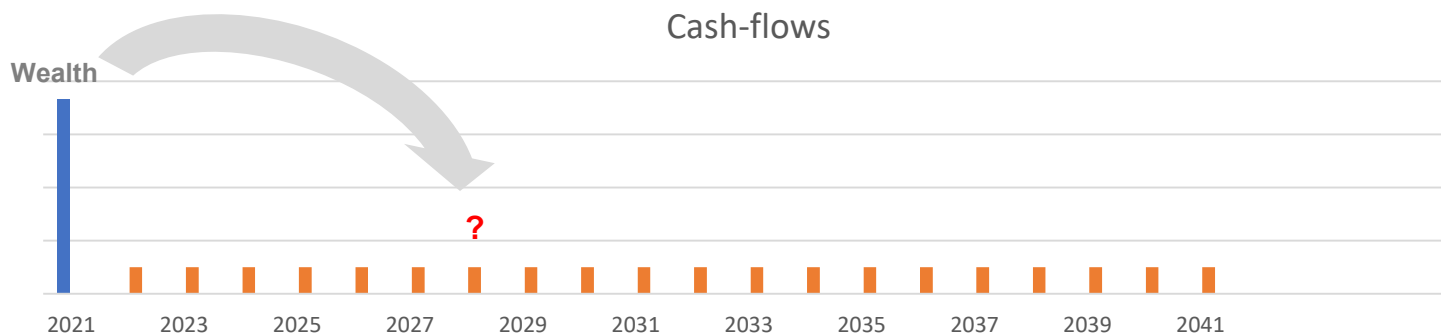
They would act somewhat like annuities, though without protecting against the risk of living much longer than expected. One big advantage is that if holders die before the maturity date, the capital would be passed to their heirs. They could also be attractive to corporate pension funds and institutions such as sovereign-wealth funds. But if bond yields stay as low as they are now, workers will still need a big pension pot to be able to retire comfortably. The median pension pot of an American aged 40-55 is \$4,500. That will not generate much income, whatever security it buys.

Retirement bonds (like Merton & Muralidhar's SELFIES, which do not exist but (unlike SELFIES, which are indexed with respect to per capita consumption) they can be replicated (Martellini et al. (2022)).

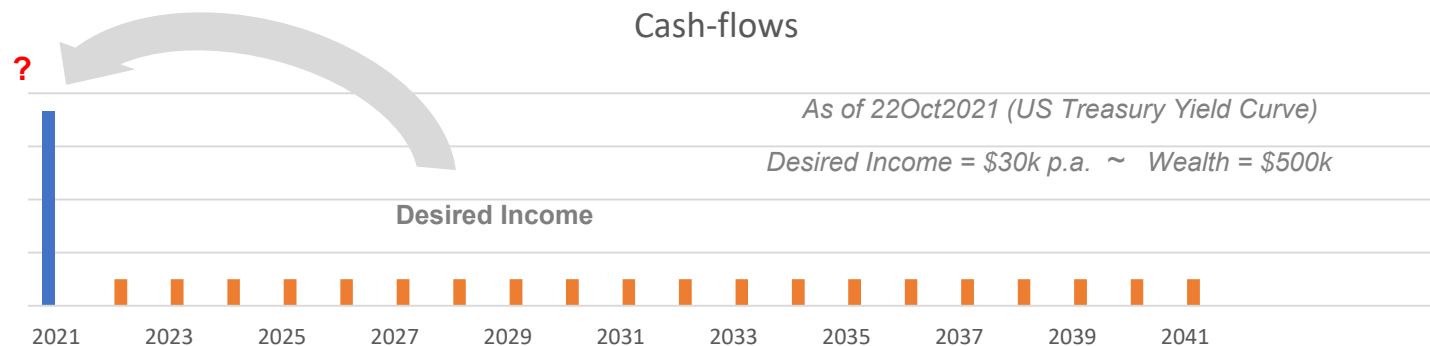
RB as a Numeraire for Turning Wealth into Income

The Retirement Bond price β_t gives **purchasing power of wealth in income units** W_t/β_t and thus allows us to...

- ... Estimate the **income that a given wealth level can secure**



- ... Estimate the **wealth needed to secure a desired income level**



Benefits of Retirement Bonds for Efficient Spending

- The retirement bond price can also be used to define a new spending rule, the **maximally moderate (MM) rule**:
 - Income withdrawal defined as: $\hat{c}_t = W_{t-} / \beta_{t-}$ (moderation).
 - Implies **strict** maintain of purchasing power: $W_t / \beta_t = W_{t-} / \beta_{t-}$.
 - Final deficit/surplus is zero for all scenarios & portfolios.
- The MM rule ...
 - ... is purely based on observable parameters (the yield curve);
 - ... generalizes the “naïve annuity” rule: $c_t = W_t / (\tau - t)$;
 - ... is reminiscent of Siegel and Waring (2015) “annually recalculated virtual annuity” rule (based on an average real yield as discount rate);
 - ... coincides with the solution to Merton’s (1969, 1973) problem with infinite risk-aversion: $\lim_{\gamma \rightarrow \infty} c_t^* = \hat{c}_t$.

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Optimal Decumulation Strategies with Merton Rule

- Reminder on optimal investment and consumption decisions:

$$\max_{(c_t, w_t)_{T \leq t \leq \tau}} E_T \left(\int_T^\tau u(c_t) dt \right)$$

- Optimal portfolio: Merton (1973), Munk and Sorensen (2004)

$$w_t^* = \frac{1}{\gamma} \underbrace{\Sigma_t^{-1} \mu_t}_{\text{tangency portfolio}} + \frac{1}{\gamma H} \underbrace{\Sigma_t^{-1} c_{Y,t}}_{\text{hedging portfolios}} H_Y = \frac{1}{\gamma} \underbrace{\Sigma_t^{-1} \mu_t}_{\text{tangency portfolio}} + \underbrace{\Sigma_t^{-1} c_{Q,t}}_{\text{hedging portfolios}}$$

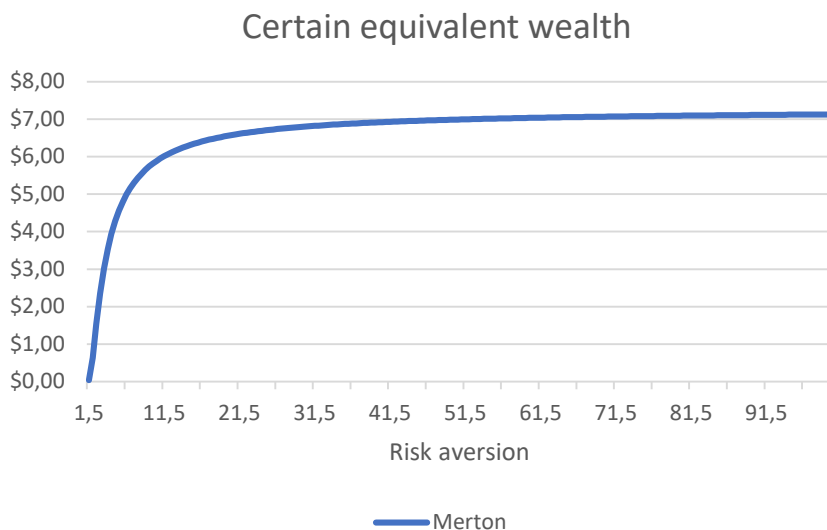
- Optimal spending (complex time- and state-dependent rule):

$$c_t^* = \frac{W_t}{Q_t}$$

$$\text{with } Q_t = \int_t^\tau E_t \left[\left[\frac{M_s}{M_t} \right]^{1-\frac{1}{\gamma}} \right] ds \xrightarrow{\gamma \rightarrow \infty} \beta_t = \int_t^\tau b_{t,s} ds$$

Efficiency Gains with Merton Rule (Constant Opportunity Set)

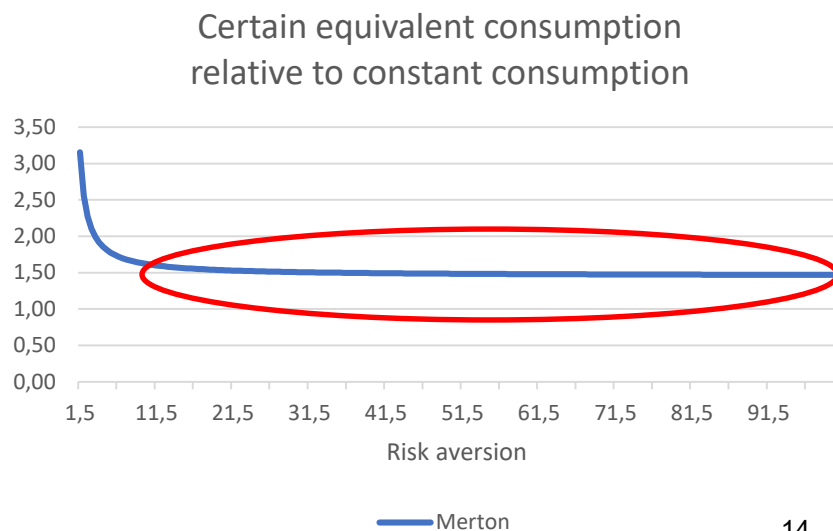
- $r = 4\%$; $\lambda_{MSR} = 0.5$; $\tau - T = 20$ years; $W_T = \$100$.



- Option 2 generates a higher welfare compared to option 1 – actually the same welfare as consuming not \$5 but $1.5 \times 5 = \$7.5$ every year.
- Investor could have saved \$7, or 7%, to achieve the same welfare.

Consider large gamma values (say $\gamma > 20$) and give the following options to the investor:

- Option 1: Do not invest and consume $W_T / (\tau - T) = \$5$ every year for 20 years;
- Option 2: Invest and consume following Merton optimal prescriptions for 20 years.



Optimal Decumulation Strategies with MM Rule

- Optimal investment with maximally moderate withdrawal strategy:

$$\max_{(w_t)_{T \leq t \leq \tau}} E_T \left(\int_T^\tau u(c_t) dt \right) \Big|_{c_t = \hat{c}_t} = \max_{(w_t)_{T \leq t \leq \tau}} E_T \left(\int_T^\tau u \left(\frac{W_t}{\beta_t} \right) dt \right)$$

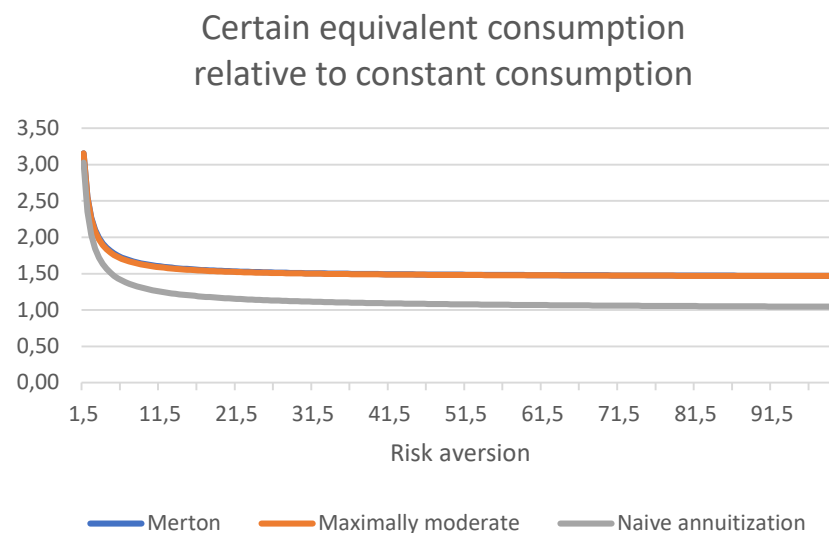
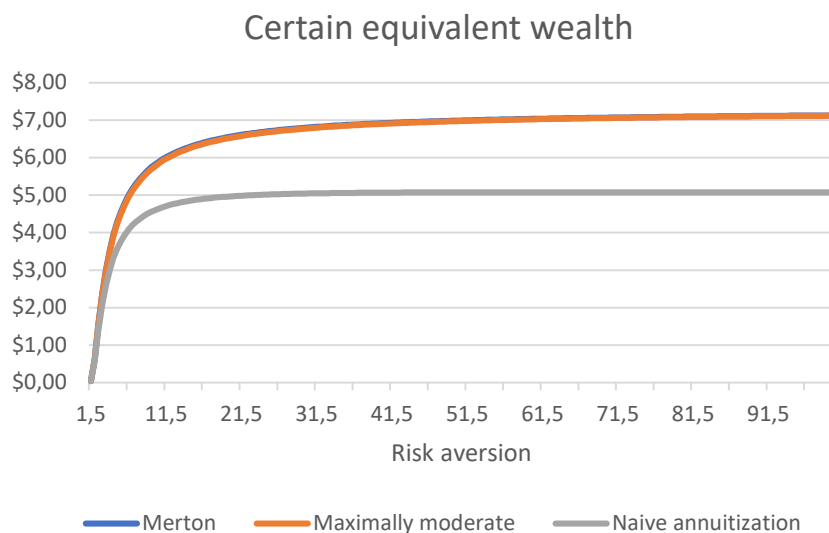
- Optimal investment strategy:

$$w_t^* = \frac{1}{\gamma} \underbrace{\Sigma_t^{-1} \mu_t}_{\text{tangency portfolio}} + \left[1 - \frac{1}{\gamma} \right] \underbrace{\Sigma_t^{-1} c_{\beta,t}}_{\text{retirement bond hedging portfolio}} + \frac{1}{\gamma G} \underbrace{\Sigma_t^{-1} c_{Y,t}}_{\text{hedging portfolios}} G_Y$$

- Optimal strategy for infinite risk-aversion: 100% in retirement bond (replicating portfolio); this is the only (*non trivial*) decumulation strategy (i.e., joint (w_t, c_t) decision) allowing investors to enjoy constant withdrawals (obviously *not investing and spending* $\frac{W_T}{\tau - T}$ would also work).

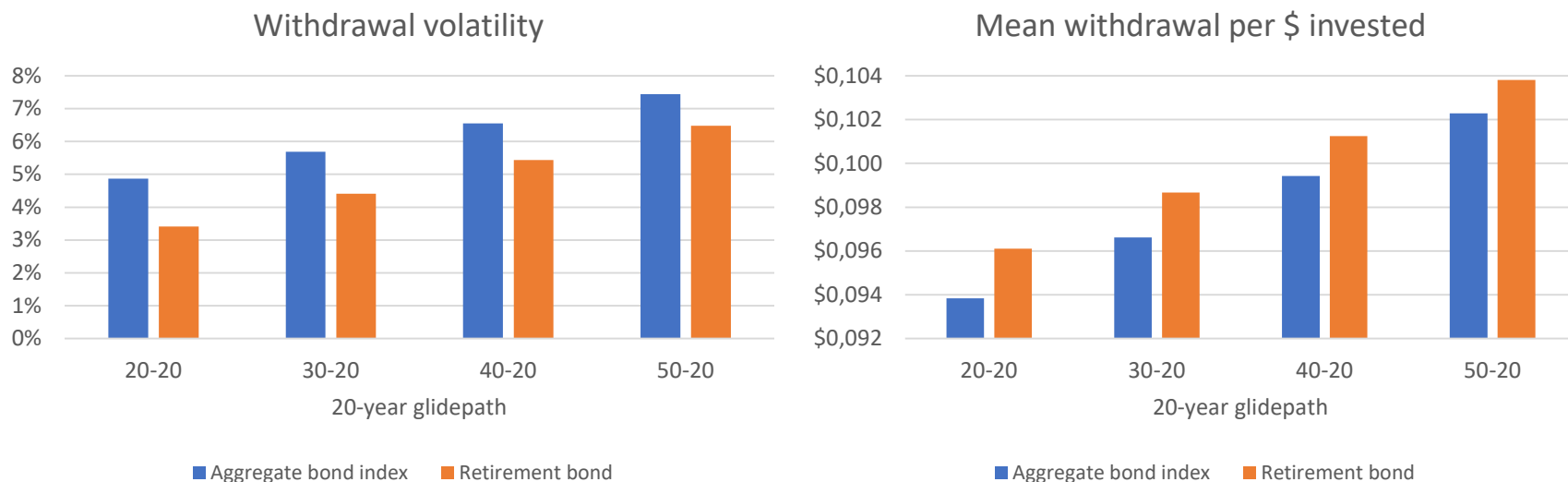
Efficiency Gains with MM and Naïve Annuitization Rules

- $r = 4\%$; $\lambda_{\text{MSR}} = 0.5$; $\tau - T = 20$ years; $W_T = \$100$.



Practical Implication – Improvement of Target Date Funds

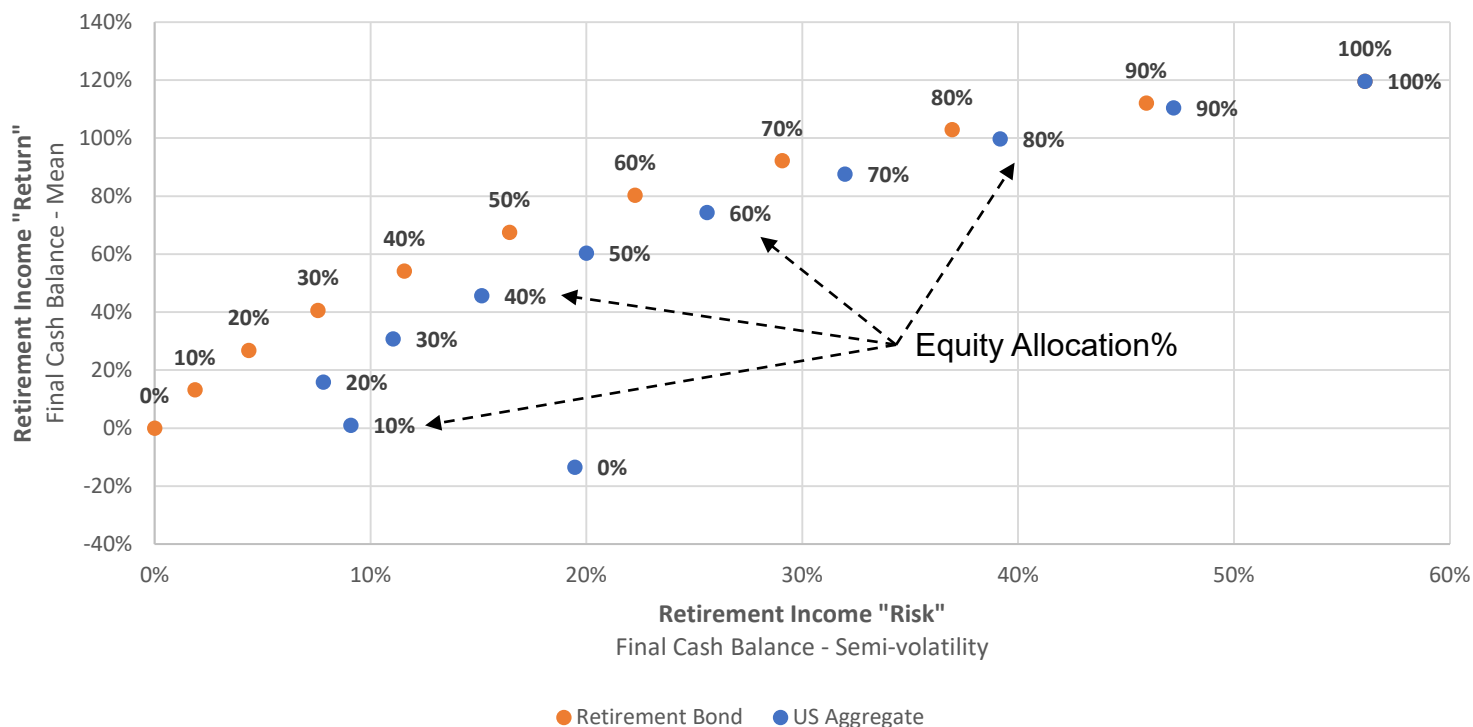
- Using the retirement bond as the fixed-income asset allows for both higher average withdrawals and lower withdrawal uncertainty.



Withdrawal volatility and the mean withdrawal are calculated over each 20-year decumulation period, beginning each month end from Jul. 1981 to Dec. 2020. Volatility is averaged over the 462 periods with at least two withdrawals recorded to date (periods beginning until Dec. 2019), and the mean withdrawal is averaged over the 474 periods with at least one withdrawal.

Practical Implications – Improvement of Efficient Frontiers

Using the Retirement Bond as the fixed-income building block **enhances “risk-adjusted returns”** with respect to retirement income.



The retirement bond allows for a more efficient spending of retirement income risk budget: higher equity allocation for the same risk budget.

(*) Mean and Semi-volatility of Final Cash Balance are based on historical outcomes of overlapping 20y-windows starting every month. There are 234 outcomes. The first window is July1981-July2001, the last window is Dec2000-Dec2020.

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Puzzles in Retirement Investing

- We have identified **an efficient** (if not optimal) **decumulation strategy**.
- It relies on the retirement bond as a key ingredient:
 - Used as a **numeraire for spending decisions**;
 - Used as a building block **for investment decisions**.
- The retirement bond is a safe asset for decumulation that can serve as a useful complement or substitute for:
 - Annuities (cf. the **annuity puzzle**, Modigliani (1986));
 - Bond funds (cf. the **duration puzzle**, van Bilsten et al. (2020)).
- The retirement bond can also be used in **dynamic strategies aiming at securing minimum income levels** while allowing for upside potential.