Academic Roots & Practitioner Reach

Climate Change & Retirement Investing Conference JOIM & Santa Clara University – May 24, 2022

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

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Joint work with Vincent Milhau & Shahyar Safaee 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:

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

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

$$\max_{(w_{it},c_t))_{0 \le t \le T}} E_T \left(\int_T^\tau u(c_t) dt \right)$$

$$W_T; dW_t = W_t \left(\sum_{i=0}^N w_{it} \frac{dS_t^i}{S_t^i} \right) - c_t dt$$

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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.





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



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

EDHEC-RISK

Issuing versus Replicating Retirement Bonds

Le Monde

IDÉES | 7

LES SALARIÉS

SE TROUVENT DE PLUS

EN PLUS RESPONSABLES

DES DÉCISIONS

RELATIVES À LA

CONSTITUTION ET AU

PLACEMENT DE LEUR

ÉPARGNE-RETRAITE

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

LE CONTEXTE

ÉPARGNE Le ministre de l'éc Bruno Le Maire, a dévoilé le 28 mars lors du forum Entrep ses en action(s)! des mesure destinées à orienter l'épargne des Français vers les entrepris de tracejat vers tie ortenzijne og de overen tracegar od nos is bi Plan drukto pour la ortenzan e is trasformaties om at Ce nored de ministres om at Ce nored de ministres om at Ce parter betrasje og de de de de parter de avenues and ce parter de avenues and parter de avenues and de avenues and de avenues avenues and de avenues avenues and de avenues a entreprises. Pour certains économistes, il faut aller plus loin dans la reconstruction de l'offre de placements.

Par LIONEL MARTELLINI, tratse ROBERT C. MERTON et ARUN S. MURALIDHAR apital, ne permettent pas de sécuriser an montant minimal de revenu de nplacement à la retraite. un des objectifs du projet de loi La question de la pertinence des su un des objectits du projet de loi «plan d'action pour la crois-sance et la transformation des entreprises » (Pacte), qui devrait être présenté en conseil des ministres ports d'épargne longue se pose aujourd'hui avec d'autant plus d'acuité que l'équilibre de notre système public de retraite par répartition est menad de retraite par répartition est menacé par une crise sans précédent, caractéri-sée par l'allongement général de la du-rée de vie et la forte baisse du nombre d'actifs par retraité: ce ratio s'élève dé-sormais à 2,2, il est parmi les plus faibles des roue divendumés en mai, est de réorienter l'épargne long terme des Français pour la rendre non seulement plus productive pour le fi-nancement de l'économie, mais aussi plus efficace pour le financement de

Jeur retrain. Une grande partie de Tépargne des ménages est stéllisée dans des con-tents d'assurance-de, gai bénéficient d'un traitement fiscal avantageus mai-ne cont pardo trait adagtés aux becoin-de la préparation à la mitraile. L'objectif d'épargne d'un faitur retraité pout, en fait, se formules de maniéer auses claire: 11 égit de disposer d'un revenp claire. 11 égit de disposer d'un revenp d'arment de la permetante de la des pays développés. Dans la mesure où l'importance de régimes complémentaires, constituée du bloc AGIRC-ARRCQ reste relative du noc noncontrol rese realize-ment moders, les salaries se trouvent dans fobligation de recourir à des plans d'épargne individuels afin de complé-ter leur retraite publique et leur éven-tuelle retraite d'entreprise. Ils se trou-vent ainsi de facto de plus en plus re-ponsables des décisions relatives à la le remplaciment lui permettant de l' manore ses besoins de consommation constitution de leur épagne-retraite et pendant la retraite. Si le besoin est chir, le et pourtant mai couvert par les const pose un vérilable défi pour des indivi-rats existants. En fait, même les coro das rigard pas pour la plagrat l'exper-tiga, l'intérêt ou même le temps nécesil est pourtant mal couvert par les con-trats existants. En fait, même les con-

UNE PARTIE DE L'ÉPARGNE DES MÉNAGES EST STÉRILISÉE DANS DES CONTRATS D'ASSURANCE-VIE OUI NE SONT PAS ADAPTÉS AUX BESOINS DE LA PRÉPARATION À LA RETRAITE

tinuera à le percevoir pendant vingtans, soit jauqu'en 2028. Le mésa-nisme serait ains particulièrement aimple et transparent, ce qui faciliterait pour des individus ne disposant d'auxure experise en matière finan-chers ai l'on suppose un palement uni-tais de Sourage autorité finan-chers ai l'on suppose un palement uni-tais de Sourage autorité de la constru-tion de la construction de membri-las de la acettaje un revenue de remolàl'âge de la retraite un revenu de n ent de 10000 euros par an penvingtans. En France, ces obligations nourr tre particulièrement adaptées ouvelles formes de contrats en e ent adaptées à d définir dans le cadre de la loi Pacte afir

UNE MENACE TRÊS LOURDE

d'une éve

sions, à savoir la date de départ des paiements, leur durée et la possibilité

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our la dette publique, ou bien des o

pour la dette publique, ou bren des or ganismes publics ou parapublics béné ficiant de la garantie explicite ou impli-cite de l'Etat et ayant vocation à émettre des stocks importants de dette. En plus de leur utilité sociale, cer ablignitique patentie numerat émbr

En plus de leur utilité sociale, ces obligations retraite pevent égale ment présenter un intérêt pour l'émet-teur. Leur chènace différé les rend particulièrement bien adaptées au fi-nancement de grands projet s'i finfas-tunts dépenses konçul ils sont engu gés et ne produisent des revenus qu'une fois terminés. La crise des retraites en gestation fait poer une menace très builde au la co-

ment, ces oblij

une de ces ém

le indexation sur l'infla

d'encourager l'épargne longue. Dans l'ensemble de la zone euro, ces obliga-tions trouveraient naturellement leur tard à épargner pour leur retraite et ils ne sont que très rarement en situation place dans le cadre de programmes d'investissement mis en place par des individus ou par des fonds de pension. de prendre des décisions éclairées pou texte, la science et l'ingénierie : cial très fort en favoriser et l'ingeniere h-nancières peuvent avoir un impact so-cial très fort en favorisant l'émergence d'innovations simples et utiles pour les individus. L'introduction d'instru-ments financiere rhas generativente, der Golgations pournaient deglaments servir die base à l'élaboration de solutions d'épargne mêtant actions et obligations, et qui se-naient orientées vers la production d'un revenu de remplacement pendant la are-traite plutôt que vers la recherche de la performance sans réflexion sur la fina-lité de celle-ci. individus. L'introduction un ments financiers adaptés béné d'un cadre fiscal incitatif ne peut-être pas à résoudre la crise traites, mais elle contribuerait --timement à en changer la don hanger la de

Lionel Martellini est professe de finance à l'Edhec et directeu de l'Edhec-Risk Institute Robert C. Merton est professi de finance de Marcohumite

Arun S. Muralidhar est

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

aires à la mise en place d'un plan de r

traite adapté a leurs besons. Pour répondre à ce défi, nous préconi sons l'émission régulière d'«obliga tions retraite «, dont les deux caractéris tiques principales seraient d'une part un début des paiements différe, d'autre part des annuités constantes en valeur cominale vous une neurille ambientes

part des annuités constantes en valeur nominale (pave une possible revalorisa-tion tenant compte de l'inflation) ver-sées pendant une d'urée fixe de vingtans, qui correspond à peu pets à l'expérance de vis à metraite. Annsi un individu de 55 ans qui ach-tenait aujourd'autor de bigation d'échéance 2028 commencent à ten porcevoir le revenu annuel en 2028, quand l'individu alors lagé de 55 ans sut autor l'écheance d'annois de tours de com-tent l'écheance d'annois de tours de com-

raite adapté à leurs besoins

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before. Those parts of the industry that have 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 15 years ago but no longer do.

The lacklustre partial 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 \$20, well below the expected \$24-27. 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 x1, a Bermudabased property-and-casualty insurer.(

More serious still are demographic and insurance against disability or needpressures. As the rich world ages and reing long-term social care. Greg Galeaz of tires, total life insurance premiums are flat Fwc, a consultancy, notes that American or falling. In developed countries they fell peal to younger people, such as policies that allow withdrawals to pay off student by 0.5% in 2016 in real terms, according to Swiss Re, a reinsurer. Some countries have fallen off a cliff, including Australia (an Joans or support ageing parents. The indus-try could do more to appeal to the moder-18.2% drop in 2017 in nominal terms) and Japan (11.3%), where negative interest rates have savaged returns and prompted some ately affluent, who largely think of life insurers as providers of death benefits rather life insurers to stop selling lump-sum than savings and retirement products. death-benefit policies. The industry has

long been used to accumulating new as-sets, with old policies sold off to specialists (such as Phoenix). It will now have to adjust to "decumulation", says Henrik Nau joks of Bain & Company, a consultancy. One way out of this bind is to add bells

and whistles to their basic offerings. A sur vey by Bain suggested that customers like the idea of receiving advice during illnes or regular health check-ups as part of their life-insurance policy. That suggests they might welcome a blurring of the distin-tion between life and health insurance.

Another option is to expand into new markets. In emerging economies, life-in surance penetration ranges from 2.6% of GDP in China to just 0.4% in Russia. (South Africa, at 11%, is an outlier.) Total premium: grew by 16.9% in real terms in 2016. But com petition 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. Mos sales are still through agents and brokers. A third approach is to seek new kinds of customers. Though death benefits and an-

Award: On May 16th Callum Williams, our Britain economics correspondent, was named joint winner of the Young Financial Journalist of the Year at the Win 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. Antimo 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 insur ers 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. Govern ments 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 their freedom imprudently: 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 2015 abolished a requirement for retirees to purchase an annuity. Life insurers must somehow reinven themselves without losing sight of their core purpose: providing a way for their cus tomers to plan for a dignified old age without overburdening the state.

Pension bonds Will Selfies stick?

nuities are still the core business, life insur

ers are branching out into savings products

firms are crafting insurance products to ap-

An ingenious way to provide retirement income

When people stop working, they need a retirement income. Some are lucky enough to have an employerrovided 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

Lionel Martellini of EDHEC, a French siness school, and Robert Merton of the Massachusetts Institute of Technology (a Nobel laureate in economics) have come up with an alternative. Workers would buy government issued bonds while in employment; these would pay no interest until retirement. Over the next 20 years (the typical life expectancy on etirement) 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 Selfies (Standard of Living Indexed, Forwardstarting Income-only Securities

They would act somewhat like annu ities, though without protecting against the risk of living much longer than expected. One big advantage is that if hold-ers 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, work ers will still need a big pension pot to be able to retire comfortably. The median pension pot of an American aged 40-55 is \$14,500. That will not generate much income, whatever security it buys.



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 Cash-flows





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 <u>all scenarios & portfolios</u>.
- 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: $\lim_{\gamma \to \infty} c_t^* = \hat{c}_t$.



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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)

$$w_{t}^{*} = \frac{1}{\gamma} \underbrace{\sum_{tangency}^{-1} \mu_{t}}_{portfolio} + \frac{1}{\gamma H} \underbrace{\sum_{t}^{-1} c_{Y,t}}_{hedging} H_{Y} = \frac{1}{\gamma} \underbrace{\sum_{t}^{-1} \mu_{t}}_{tangency} + \underbrace{\sum_{t}^{-1} c_{Q,t}}_{hedging}_{portfolios}$$

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

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

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

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EDHEC-RISK

Efficiency Gains with Merton Rule (Constant Opportunity Set)

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



Certain equivalent wealth

Merton

- Option 2 generates a higher welfare compared to option 1 – actually the same welfare as consuming not \$5 but 1.5x5=\$7.5 every year.
- Investor could have saved \$7, or 7%, to achieve the same welfare.

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

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

Certain equivalent consumption





Optimal Decumulation Strategies with MM Rule

Optimal investment with maximally moderate withdrawal strategy:

$$\max_{(\mathbf{w}_t)_{T \le t \le \tau}} E_T \left(\int_T^\tau u(c_t) dt \right) \bigg|_{c_t = \hat{c}_t} = \max_{(\mathbf{w}_t)_{T \le t \le \tau}} E_T \left(\int_T^\tau u \left(\frac{W_t}{\beta_t} \right) dt \right)$$

Optimal investment strategy:

$$w_{t}^{*} = \frac{1}{\gamma} \underbrace{\sum_{tangency}}_{portfolio} + \left[1 - \frac{1}{\gamma}\right] \underbrace{\sum_{t}^{-1} c_{\beta,t}}_{retirement \ bond}_{hedging \ portfolio} + \frac{1}{\gamma G} \underbrace{\sum_{t}^{-1} c_{Y,t}}_{hedging \ portfolio} G_{Y}$$

• Optimal strategy for infinite risk-aversion: 100% in retirement bond (replicating portfolio); this is the <u>only</u> (*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).

Academic Roots & Practitioner Reach

EDHEC-RISK

Efficiency Gains with MM and Naïve Annuitization Rules

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



Certain equivalent wealth



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.



Retirement Bond
 US Aggregate

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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- 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.

