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RETIREMENT SECURITY BONDS

50th Anniversary Speech by Nobel Laureate Robert C. Merton

December 1, 2023 CISDM, UMass Amherst

Introduction

Today, I will discuss a financial innovation, Retirement Security Bonds, and their role in addressing the global challenge of funding retirement. This talk is part of a larger celebration on the 50th Anniversary of the Black–Merton–Scholes Option pricing Model that started a month ago, and I am delighted to be here on this special occasion.

To provide some context, I will briefly discuss the option pricing model developed by Fischer Black and Myron Scholes, my contribution to it, and its impact on financial innovation. As in their other research in asset pricing, Black and Scholes employed the Sharpe Capital Asset Pricing Model (CAPM). Their key insight was to construct a portfolio consisting of the option, the underlying stock, and the risk-free asset, and adjust it dynamically according to a specified trading rule to keep the portfolio's systematic risk, *beta*, constant at zero. The CAPM dictates that a zero-beta portfolio's expected return must equal the risk-free rate. This approach led to a formula for equilibrium option prices. When Myron first shared their findings with me, I applied my continuous-time trading model framework[1] confirming that their formula was correct but also discovering it obtained for a more robust fundamental reason than a posited capital-market equilibrium model such as the CAPM. The continuous-time trading framework showed that following their trading rule not only eliminated the beta systematic risk in the hedge portfolio, but eliminated *all* its risk, leading to the concept of a *replicating portfolio.*

This replicating portfolio allows us to synthesize the payoff of an option precisely through continuous trading in the underlying stock and risk-free asset, a powerful result that has profoundly impacted finance.[2] Differences between

an option price and the cost of manufacturing it creates an arbitrage opportunity. The concept of no-arbitrage is a cornerstone principle of economic price theory – a necessary condition for equilibrium—ensuring that all equilibrium models must yield the same result.[3] Whenever a replicating portfolio exists, the no-arbitrage condition applies.

The option pricing model provides the production cost for its lowest-cost producer, akin to microeconomic principles. It gives the theoretical cost of manufacturing an option, though the market price may differ. Although derived originally for option pricing, the same replicating-portfolio principle applies robustly to pricing derivative securities in general[4].

This generalization and the practical applications of the option model have ensured its relevance even after 50 years. The 1970s saw the birth of financial engineering, where finance science was systematically applied to solve real-world problems. This period marked a major shift, bringing finance theory into mainstream practice, notably through innovations like the option pricing model[5]. Financial engineering, akin to any engineering discipline, involves creating tailored solutions to specific problems, often requiring the construction of financial products that did not yet exist.

This production theory, coupled with its trading rules, applied to derivatives in general, equips the financial engineer with a universal tool to derive the cost and trading prescription for implementation of custom-tailored solutions never seen before.

The robustness and adaptability of this model have ensured its continued use and relevance. Financial engineering has thrived by solving complex problems, leveraging the principles of the option pricing model.

Retirement Security Bonds

Now, turning to the core of my talk, I will discuss an example of financial engineering addressing a significant global challenge: funding retirement. This issue affects every country and requires innovative solutions. Our proposed solution is the introduction of Retirement Security Bonds (RSBs), offering a key transactional piece of a broader strategy to tackle this global challenge.[6] RSB aims to provide a secure and predictable income stream for retirees, addressing the uncertainties and risks associated with traditional retirement funding methods. These bonds are designed to offer stability and security, essential for ensuring that retirees can maintain their standard of living without undue financial stress.

The problem we are addressing is universal: provide the financial instruments needed for retirement preparation. This issue is particularly acute for those in the informal economic sectors, who typically lack access to pension plans or social security and thus, must fund retirement entirely from their personal savings. In some countries, this can represent half of the population. A viable retirement solution must include provisions for these individuals, who are outside the formal system but still need to prepare for retirement. The RSB was initially designed with this purpose in mind. As we shall see, its potential application is considerably broader.

Our goal was to create a financial product that users could understand and utilize without extensive education. Many financial products require users to learn complex concepts and strategies, often necessitating financial education programs. Instead, we aimed to design a product based on what users already know. Before solving the retirement funding problem, we must first define its goal–what constitutes a "good retirement."

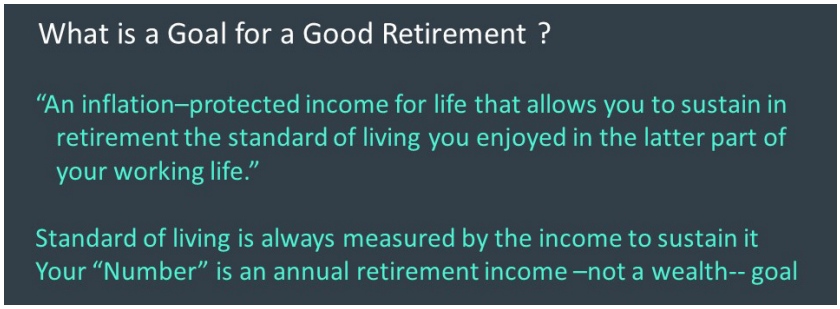

Figure 1

A good retirement ensures sufficient income for the rest of one's life to sustain the standard of living enjoyed at the end of one's working life. While everyone would like more, the primary goal is to avoid a decline in living standard post-retirement.[7]

Characteristics of the Retirement Security Bond

An RSB is a full faith and credit government bond, with identical credit-standing and treatment in the event of its owner's death. For instance, in the United States, it would be like the U.S. Treasury bond. The key difference lies in its payment structure, designed to mimic a pension-like payout pattern since that is the purpose of RSB. This structure deviates from traditional bonds, which typically offer regular coupon payments and a lump sum at maturity. Instead, the RSB provides no payments for a specific number of years after purchase. Then, at a specified future date, it begins to pay out a stream of level payments over a set period, such as 20 or 25 years, after which there are no further payments.

Some may assert that simply using traditional government bonds will provide a "good enough" approximation for the retirement saver and so no need for this refined innovation. Inspection of the payout pattern to a long-term traditional bond compared with the payout to RSB in Figure 2 show that is far from the case with considerable reinvestment risk as well as a large number more transactions with the traditional bond which would likely render it infeasible behaviorally in

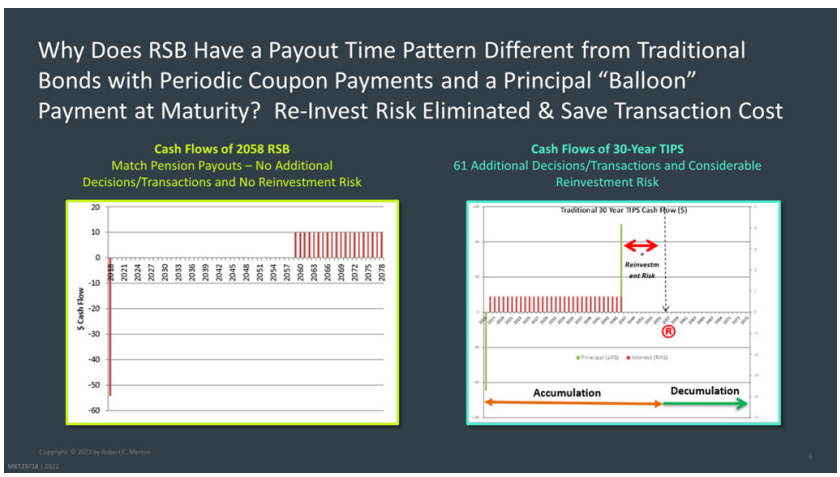

Figure 2

terms of time and effort, even without considering fees and spreads.

A second major difference between RSB and traditional government bonds is that RSB payments are indexed to aggregate per capita consumption, covering both inflation and real changes in living standards. This ensures that the standard of living improvements is reflected in the payouts, in addition to inflation.[8] Figures 3 and 4 illustrate how much standard of living can change and the potential shortfall from goal as the result of providing protection for inflation but not for standard-of-living changes, using as an example South Korea's history.

Practical Implementation

RSBs are issued identified by their starting dates for payments, not their maturity dates. The government will offer bonds with various starting dates, allowing individuals to choose based on their expected retirement year. For example, if you plan to retire in 2058, you will always purchase the bond with a starting date of 2058. This simplifies the process, as the same bond

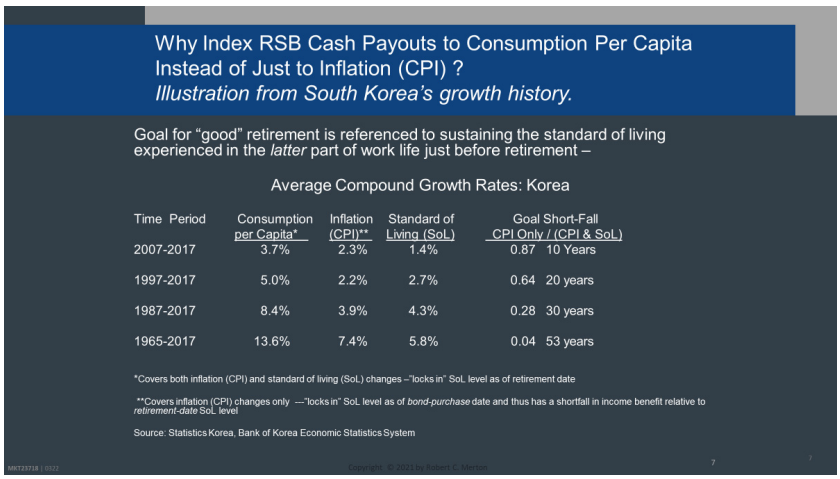

Figure 3

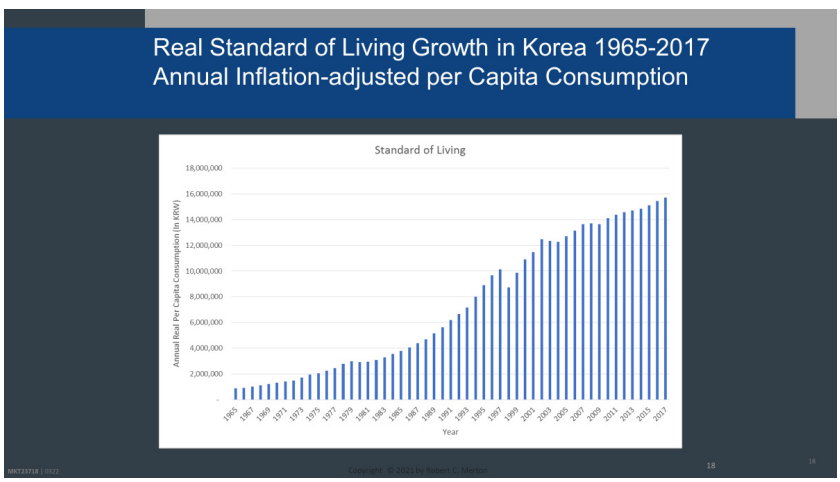

Figure 4

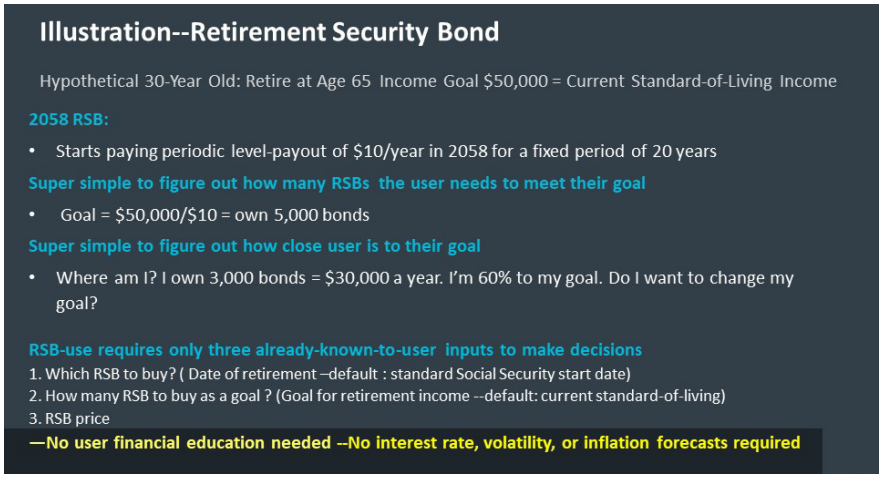

Figure 5

can be purchased now or in the future, ensuring consistent planning and simplified accumulation into a single bond issue. To illustrate, imagine that in 2024 a 31-year-old is planning to retire at 65 in 2058. If each bond pays $10 per year for 20 years, indexed to consumption, they will need to buy 5,000 bonds to achieve an annual retirement income of $50,000. This target is based on their current living standard because actual payments are adjusted for future improvements and inflation. The RSB is designed for individuals with minimal financial education. It requires knowing only three things: the retirement date, the desired retirement income and the current price of the RSB. This simplicity allows even those adults with a pre-high-school formal education to plan and implement saving for their retirement effectively.

As individuals accumulate RSBs, they can easily track their progress toward their retirement goal. For example, if they own 3,000 bonds and their goal is 5,000, they know they are 60% of the way there. This straightforward benchmarking helps individuals make informed decisions about their savings and investment strategies. Individuals can adjust their retirement plans based on changes in personal circumstances or preferences. Some may find that a lower income in retirement suffices due to lifestyle choices or reduced expenses, such as grown children no longer requiring support.

User Friendly

One of the key principles behind the RSB is to translate complex financial planning into understandable terms. Traditional financial planning tools often involve intricate projections and calculations, requiring users to understand interest rates and inflation forecasts, as well as rates of returns and risks of many asset classes. The RSB simplifies this by focusing on what users already know: their current living expenses and the price of the RSB, similar to how they might consider the cost of food or shoes. The RSB does not mention interest rates or rates of return and risks. Instead, users need only know the price of the bond and their retirement income goal. For instance, if someone needs $50,000 annually in retirement and each bond pays $10 annually, they will need to buy 5,000 RSBs during their work years. If their standard of living changes materially, they update their goal to that new level. This straightforward approach helps users plan based on their current income without needing extensive financial literacy.

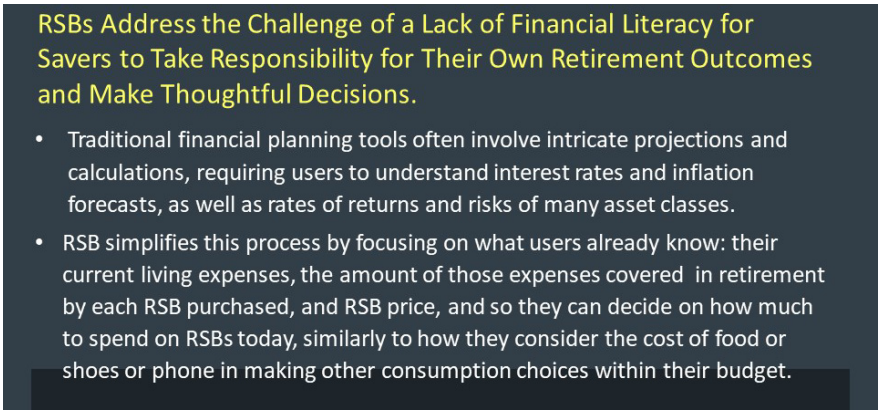

Figure 6

When designing financial solutions, it's crucial to avoid trying to solve too many problems at once. This increases both complexity and resistance. The RSB is designed to be a simple, non-controversial tool that individuals can use for their retirement savings without extensive financial education. Pricing RSB from auctions and secondary government bond market assures no hidden subsidies and no need to restrict RSB supply. This approach increases the likelihood of successful implementation and adoption. The RSB is designed for environments where people already think about retirement. It provides the means for individuals to plan and execute saving for retirement once they start considering it. In some regions, especially in developing countries, immediate economic survival needs may overshadow long-term planning. While the RSB does not directly address this issue, it offers a planning and execution tool for those who can and do think about their future.

Simplifying the Retirement Planning Process

Traditional retirement accounts often show the account value rather than the income it can generate, which can be misleading and is insufficient information to evaluate where one is currently relative to the retirement goal[9]. For example, the income from a $1 million account varies significantly depending on interest rates. Over the last 15 years, the annual coupon income from investing $1 million in the bellwether 10-year UST bond has ranged from $6,000 to $50,000! By focusing on income goals and bond quantities, the RSB provides clearer guidance for retirement planning. As individuals' circumstances change, they can adjust their retirement plans accordingly. For example, a person with 3,000 bonds knows they have secured $30,000 annually. If their goal is $50,000, they know they are 60% of the way there. This helps them make better informed decisions about future bond purchases.[10]

In a real-world scenario, governments can issue RSBs with various starting dates. Individuals choose the bond that matches their retirement year and purchase it as needed. This simplicity makes the RSB accessible to those with minimal financial education, ensuring it can be widely adopted. The core idea behind the RSB is to simplify the retirement planning process for individuals. Governments and the private sector can educate people on practical decisions about purchasing RSBs instead of on complex financial concepts like compound interest or market forecasts. This is akin to teaching someone to drive a car without

needing to understand the intricacies of an internal combustion engine to do so.

At retirement, individuals have a straightforward choice: either receive payments for life through an annuity or keep their RSBs, which will pay out for a fixed term (e.g., 27 years). This decision based on their health and life expectancy can be made at the time of retirement when they have the most relevant information to make an informed choice.

Addressing Longevity and Health Considerations

Individuals understand their health better than anyone else. Those who are ill or have a lower life expectancy might opt to keep their RSBs, while healthier individuals might prefer the lifetime annuity option or a mixture of the two. This approach acknowledges that people make the best decisions about their future when they have the most information, which is typically close to their retirement date.

Longevity Risk and Insurance Integration

As a bond, RSB itself does not address longevity risk (the risk of outliving one's savings). It can, however, be combined with life annuities from insurance companies. At retirement, individuals can exchange their RSBs for a life annuity, ensuring they receive payments for life rather than a fixed period. The key to making the decision easy is to set the RSB terms so that the payments remain the same, whether the individual chooses the fixed-term RSB or the life annuity.

Insurance companies can provide this protection because they can pool risk across many individuals, making longevity risk manageable. To cover the costs and profits of the insurance company, the RSB terms can include a few extra years of payments beyond the average life expectancy, ensuring the swap of RSB for annuity is cost-neutral for the retiree, simplifying the decision to annuitize or not.

Behavioral Economics and Framing

It's important to frame the benefits of annuities correctly. While some might fear losing their investment if they die early, the value of the annuity is in providing lifelong income for as long as they need money, even if they live to 120. The income only stops when they no longer need money. This perspective shifts the focus from the potential loss to the security of lifelong financial support. The RSB is designed based on what people already know. Users only need to understand

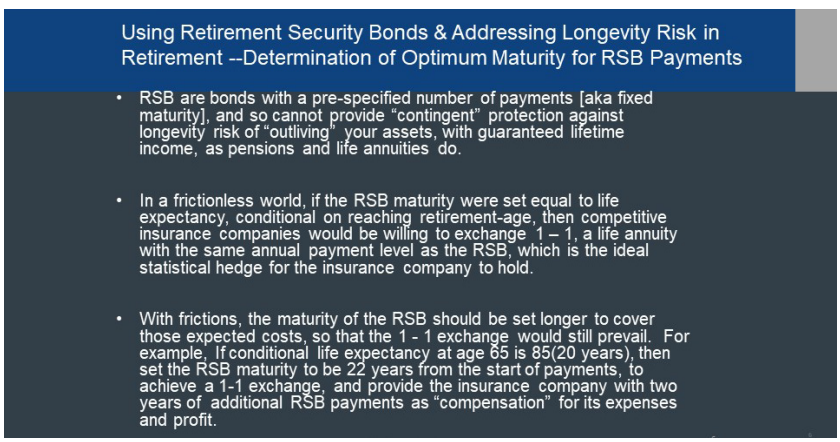

Figure 7

the price of the bond and how many they need to achieve their retirement income goal. This simplicity ensures that every adult, regardless of financial literacy, can make informed decisions. Consider automobiles, a large consumer product. The basic controls of a car, such as the accelerator, remain constant across decades in both location and how it feels to use, even as their underlying technology changes radically. This is purposeful so that using a new car is based on what the driver already knows how to do. Similarly, consumer electronics are designed to be intuitive, often usable straight out of the box without a manual. These examples illustrate the principle of designing products that align with users' existing knowledge and habits.

Broader Applications

While the RSB was initially motivated by the needs of the informal sector, it can benefit a far wider range of users in the entire economy. Social security and employer pensions generally provide only limited replacement income, necessitating additional personal savings for a good retirement. Individuals with 401(k)s are responsible to make their own investment decisions, and the RSB can simplify this process. Financial advisors can use RSBs to tailor and execute retirement and other income plans for their clients. Institutions, pension funds and insurance companies, will find RSBs effective for both valuing and hedging their long-term pension plan and annuity liabilities.

The Role of the Government

The decision to issue RSBs as government bonds rather than private-sector instruments is strategic for the design. Government bonds provide full faith and credit, ensuring the strongest payment reliability. If issued privately, RSB would require extensive risk disclosures and come with credit risk concerns. Government bonds leverage existing issuing infrastructure and avoids the need to create a new agency. Issuing RSBs can strengthen issuing government bond markets by encouraging long-term domestic holdings. For example, Italy pre-Euro, historically, had a robust market for domestic bonds held by Italians, even with a high debt-to-GDP ratio. Similarly, RSBs can enhance the stability and depth of a country's bond market. In countries with a VAT, which is essentially a consumption tax, the government has a natural asset that hedges RSB payment

Figure 8

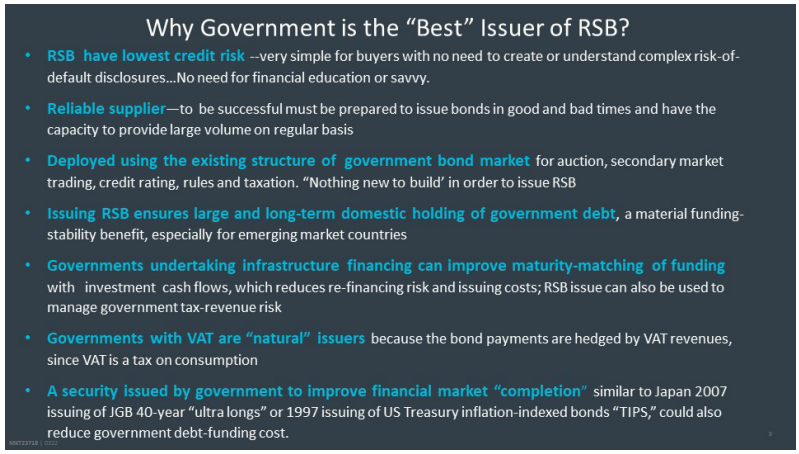

Figure 9

indexed to per capita consumption. This creates a perfect asset-liability match, reducing risk for the government and stabilizing the bond market.

Real-World Implementation

Brazil provided the first RSB implementation, having issued a simplified version of the RSB called RendA+ in January 2023. These bonds are full faith and credit, issued by the Brazilian Treasury. Individuals can buy or sell directly with Treasury in very small denominations (30 Real $\sim$ \$6 US). This approach ensures accessibility, prevents market disruptions, and avoids navigating the complexities of auctions or secondary markets. The very small transaction size facilitates opportunistic direct purchase whenever money to invest is received instead of storing it elsewhere until a threshold amount is accumulated before buying RSB. People are assured they are getting a fair market price because transactions are marked to the auction and secondary market prices for standard-size inflation-protected bonds. This also ensures no price subsidies.

An interesting observation from Brazil is that a disproportionate number of buyers of RendA+ bonds are women. While the reasons are not fully understood, it's notable that in many families,

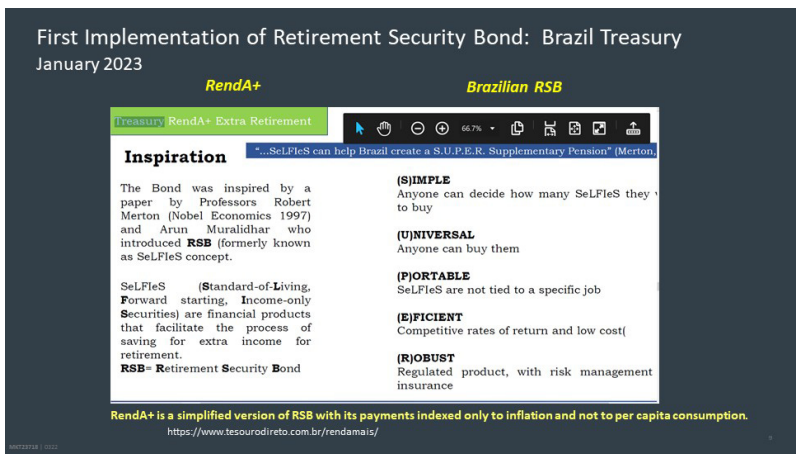

Figure 10

women are the financial decision-makers. But regardless of gender, the key point is that this approach has started well and offers valuable lessons. The success in Brazil did not hinge on direct external involvement. The idea resonated with the Treasury officials, and they pursued its development entirely internally, adapting it to local conditions and launching it during a significant political transition, which is rare. The outgoing president approved it, and the incoming president endorsed it, highlighting its bipartisan appeal.

The RSB is designed to be an enhancement, not a replacement, for social security and employer DB/401(k) plans. By avoiding subsidies and redistribution of funds, it sidesteps many contentious political issues, increasing its chances of acceptance and implementation.

Addressing Long-Term Debt Issuance and Market Stability

There are questions about the availability of long-term bonds. The U.S. government has not been issuing as many long-term bonds as needed, which limits intermediaries like insurance companies from creating similar products. However, if governments issue these bonds, it provides a secure foundation for retirement planning. A strong domestic bond market, particularly one with long-term holdings by local populations, enhances financial stability. This is evident from historical examples, such as Italy's bond market before the euro. Long-term, domestic holdings provide political and economic stability, which is crucial for the success of such initiatives.

Conclusion

The Retirement Security Bond (RSB) is a global-design financial product aimed to help address the global challenge of retirement security, RSB exemplifies the design principle to create products based on what their users already know. By simplifying both the planning and implementation process and leveraging existing government structures, it can provide a reliable, accessible solution for individuals as well as institutions. The adoption of this innovation in Brazil and the interest expressed from other countries is encouraging for its potential impact. The journey from concept to implementation is complex and requires the alignment of multiple stakeholders, but the potential benefits for global retirement security are significant.

Thank you for your time and attention. I hope this comprehensive overview has conveyed the importance and potential of the Retirement Security Bond in helping to address one of the most critical global financial challenges of our time.

Acknowledgments

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Endnote

1 Mathematically, the same pricing formula was derived in Samuelson (1965) if the expected return parameters for the option and stock in his model are set equal to the risk-free interest rate. But the Samuelson model was simply a parametric description of the formula without a theoretical foundation. See Merton (1973).

2 Merton (1969, 1970, 1971, 1975, 1992).

3 It has been long established that the pricing of forward and futures contracts can be derived from the no-arbitrage condition. Their replication portfolios involve a static one-time combination of the underlying asset and the risk-free asset held until the expiration of the contract because the relation between the contract and the underlying asset payoffs is linear. The relation between an option contract payoff and the underlying asset is non-linear. Thus, no static replicating portfolio, and a dynamic replicating strategy is required.

4 A well-known computational "trick" to determine the option price is to substitute the risk-free interest rate

for expected return on all assets and apply a standard discounted cash flow analysis of the option. Termed "risk-neutral" pricing because this would be the equilibrium price in a model where all traders have linear utility functions and are indifferent to risk. As with CAPM, it gives the "correct" price because all equilibrium models must agree with the no-arbitrage price.

[5] Merton (1977).

[6] Merton (2022).

[7] Merton (1983, 2012, 2014); Merton and Muralidhar (2020a, 2020b); Merton, Muralidhar, and Pinto-Ferreira (2019); Muralidhar, Ohashi, and Shin (2016).

[8] The SECURE Act of 2019 in U.S. requires that participants in ERISA-covered defined contribution retirement plans receive a lifetime income disclosure at least once a year. Implementation of this and similar income disclosures should help the process.

[9] Inflation-protection alone locks in the standard of living at time of RSB purchases resulting in a work-life weighted average standard of living benefit instead of the desired end-of-work-life one.

[10] Merton (2014).

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