Funding the Search for Extraterrestrial Intelligence with a Lottery Bond

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Abstract

I propose the establishment of a SETI Lottery Bond to provide a continued source of funding for the search for extraterrestrial intelligence (SETI). The SETI Lottery Bond is a fixed rate perpetual bond with a lottery at maturity, where maturity occurs only upon discovery and confirmation of extraterrestrial intelligent life. Investors in the SETI Lottery Bond purchase shares that yield a fixed rate of interest that continues indefinitely until SETI succeeds—at which point a random subset of shares will be awarded a prize from a lottery pool. SETI Lottery Bond shares also are transferable, so that investors can benefit their shares to kin or trade them in secondary markets. The total capital raised this way will provide a fund to be managed by a financial institution, with annual payments from this fund to support SETI research, pay investor interest, and contribute to the lottery fund. Such a plan could generate several to tens of millions of dollars for SETI research each year, which would help to revitalize and expand facilities such as the Allen Telescope Array. The SETI Lottery Bond is a savings product that only can be offered by a financial institution with authorization to engage in banking and gaming activities. I therefore suggest that one or more banks offer a lottery-linked savings product in support of SETI research, with the added benefit of promoting personal savings and intergenerational wealth building among individuals.

1 Introduction

Finding sources of funding for the Search for Extraterrestrial Intelligence (SETI) has proven to be almost elusive as ETI themselves, and the lack of adequate funding is perhaps the greatest obstacle to the SETI program’s success. Evidence of ETI in the galaxy could take the form of radio signals from other star systems [1], interstellar spacecraft sent to our Solar System [2, 3], or infrared excesses generated by space faring super-civilizations [4], but the limited number of searches for any such phenomenon so far has produced null results [5]. From Senator William Proxmire’s issuance of the “golden fleece award” for NASA’s sponsorship of SETI research in 1978, to the financial shortfall that put the Allen Telescope Array into hibernation in 2011, the SETI research community has suffered from lack of funding since its inception—and for the obvious reasons that SETI represents a game in which both risk and rewards are unknown.

Most funding for SETI research takes the form of grants and donations, often scant in supply and limited in duration. For SETI to succeed, astronomers must scan the sky in search of directed or accidental transmissions that indicate extraterrestrial intelligent life. To avoid missing any such signals, the SETI program ideally requires a total sky survey at all radio frequencies and at all
times of day—a feat that could take anywhere from a few years to a few thousand or more. As a step toward this goal, Microsoft’s co-founder Paul Allen has donated over $30 million toward the construction of the Allen Telescope Array (ATA), a radio interferometer designed especially for SETI, but this flagship facility is only partially operational and still incomplete due to the lack of donors interested in funding its continual operation. Likewise, few federal and private granting agencies show interest in funding SETI research or supporting the ATA, while any grants that do succeed only last a few months to a few years. The SETI community has been relatively unsuccessful at attracting investment capital, due in part to the SETI program’s inability to promise a return on investment to prospective investors. The discovery of ETI could be one of the most philosophically provocative and socially stimulating discoveries of human history [6, 7, 8], yet this discovery itself will do little to refill the pockets of investors who provide long-term venture capital. As charitable research funding becomes increasingly limited, novel sources of financing are needed to ensure a sustainable future for the SETI program.

Here I propose to attract long-term investors in SETI research by creating a “SETI Lottery Bond” (SLB) savings product that reaches maturity only upon the first discovery and confirmation of ETI. Savings products with a randomized return historically have been issued to finance projects with low investor zeal, and contemporary examples of such products include the U.K. Premium Bond program [9, 10, 11] and lottery-linked/prize-linked deposit accounts used in a variety of nations [12, 13]. The SLB is a product issued by a financial institution, and the funds collected from the SLB are managed to provide a fixed rate of return to the investor, a steady stream of funding to support SETI research, and a contribution to a long-term lottery prize. Investors in the SLB purchase bonds at a fixed price in exchange for a guaranteed rate of interest for the lifetime of the bond and are allowed to continue purchasing bonds until the first discovery (and subsequent confirmation) of ETI. After this initial discovery of ETI, SLB shares will be redeemed, thereby repaying the initial investment and closing any secondary markets for trading SLB shares. In addition, a lottery prize will be awarded randomly to a subset of SLB shares upon discovery of ETI as an incentive to encourage long-term investment and promote public enthusiasm for SETI. The SLB in effect acts as a perpetual bond (such as a Consol) that yields interest as income but is unlikely to be redeemed at any time in the near future. Such a savings product may appeal to a wide range of investors and would provide a financial backbone to sustain the long-term efforts required for the SETI program’s first success.

This proposal may seem provocative to some, but bonds and lotteries have been successful means of financing otherwise unattractive investments, and I suggest that SETI research could benefit from such an approach. I begin in Section 2 by defining the concepts of bonds, perpetual bonds, lotteries, and lottery bonds that are required for describing the SLB. In Section 3 I present a proposal for the SLB as a fixed rate perpetual bond with a lottery at maturity and show that such a fund could generate several to tens of millions of dollars for SETI research each year. I then discuss some of the ethical considerations involved in funding research with such a product in Section 4 and conclude with prospects for future implementation.

2 Bonds and Lotteries

The SETI Lottery Bond incorporates elements of perpetual bonds, a savings product that never reaches maturation, and lotteries, a form of gaming that involves the random selection of prizes to a subset population. This section defines basic concepts of bonds, perpetual bonds, lotteries, and lottery bonds in order to establish a framework for discussing the SLB.

A bond is a debt security that obligates the issuer to pay a certain amount of interest to the holder at regular intervals with a promise to repay the principal (the net purchase price of the bond) at some point in the future. The time between a bond’s issuance and its redemption is known as the bond duration, at which point the bond is said to have reached maturity. Bonds are often offered by national governments to finance otherwise unattractive investments (such as large construction
projects or military operations), usually with a bond duration on the order of years to decades. Many bonds can also be bought and sold as commodities in a secondary market that facilitates trading, although some bonds prohibit transfer of ownership. Bonds are attractive savings products to investors because they offer a relatively predictable return on investment over a known duration of time.

While most bonds are issued with a fixed and known duration, perpetual bonds offer regular payments of interest that continue forever but with no promise of ever repaying the principal investment. A true perpetual bond therefore acts as an annuity that guarantees the purchaser a fixed stream of income for life or longer. A Consol is a famous example of a perpetual bond that was first issued by the British government in 1751 as an attempt to consolidate its outstanding debt. Originally offering a 3.5% return to investors, this interest rate has declined through several subsequent conversions, and Consols today in the U.K. offer a lower rate of 2.5%. The duration of a Consol bond is unknown and taken to be infinite by many investors. Technically, Consols can be redeemed at any point in the future by an Act of Parliament, but such an Act seems improbable in the current economic climate. Barring such an unlikely Act, Consols represent one of the few examples of perpetual bonds and provide a financial product similar to annuities. Because a Consol is unlikely to ever be redeemed, an investor never will be repaid their principal investment, but they will continue to receive interest payments on their investment for life—and often these bonds can be benefacted to kin or charity. Perpetual bonds are attractive savings products for long-term investors seeking a regular stream of income from their principal.

A lottery is a form of gaming that provides a way to allocate prizes or resources to a large population, usually by random selection of a subset population. Lotteries are usually self-funded, in that the value of the prize pool is determined by the number of lottery tickets sold. A typical lottery will sell tickets at a fixed price for a known duration of time, after which ticket sales are suspended and winners randomly chosen. Lotteries also have been suggested as a fair way of distributing scarce resources, such as selecting patients to receive an organ transplant [14, 15]. Many state governments in the U.S. operate lotteries to support social programs such as public education, economic development, ecological preservation, and addiction treatment, although some evidence suggests that individuals who purchase state lottery tickets are less likely to receive direct benefits from lottery funds [16, 17]. Lotteries tend to attract a disproportionate number of low- to middle-income households [16, 17] and appeal to optimistic and adventurous investors who hope to achieve a large return on their investment.

A lottery bond is a savings product that combines elements of bonds and lotteries. Lottery bonds offer repayment of the principal investment like a conventional bond, but they also include a lottery prize that is awarded to a subset of shares periodically or when the bond reaches maturity. Investors in a lottery bond opt for a lower rate of interest (compared to a conventional bond) in exchange for a chance at winning a much larger prize. However, unlike a conventional lottery, investors in a lottery bond do not risk loss of their principal investment; lottery bonds instead represent a savings product that incorporates a randomized rate of return. Lottery bonds have substantial historical precedent and have been issued in the past and present by many European nations [18, 19]. The U.K. Premium Bond program is a contemporary example of a government-issued lottery bond that provides monthly drawings for cash prizes, with an investor’s chances of winning proportional to the number of bonds owned [9, 10, 11]. Other examples of similar financial products include lottery-linked deposit accounts [12] and prize-linked savings accounts [13], both of which provide depositors a low rate of interest on their account balance along with a periodic chance at winning a much larger prize. Prize-linked and lottery-linked savings products are used in a variety of developing and industrialized nations and have shown some success at encouraging fiscal responsibility among individuals otherwise likely to gamble [12, 13, 20]. Lottery bonds are attractive savings products to adventurous investors who seek a large rate of return but also want to retain their principal investment.
3 SETI Lottery Bond

The purpose of the SETI Lottery Bond is to generate a source of revenue that can sustain the SETI program until the first discovery of extraterrestrial intelligent life. By combining elements of perpetual bonds and lotteries, the SETI Lottery Bond is a unique savings product that also supports scientific research.

Most conventional sources of funding stipulate a finite duration of time for a project to reach completeness; however, it is nearly impossible to calculate the probability of success for SETI, which creates great difficulty in predicting the expected amount of time required for SETI to succeed. A conventional bond therefore is an inadequate device for funding SETI because bonds require the lender to repay the principal at a specified future time—even a thousand year duration for a bond might be insufficient time for SETI to succeed. Perpetual bonds provide a better mechanism for funding SETI because the duration of a perpetual bond essentially is unlimited: a perpetual bond linked to the outcome of SETI would pay investors a fixed rate of interest and only return the principal investment upon the first success of SETI. In principle, such a perpetual bond might be sufficient to attract long-term investments in SETI; but in practice, such a savings product would have few advantages over other similar products already offered by savings institutions, such as annuities and existing perpetual bonds. Thus, in order to incentivise a perpetual bond while simultaneously promoting awareness of SETI research, I propose the creation of a “SETI Lottery Bond” that acts as a perpetual bond but with a lottery prize awarded to a random subset of investors upon SETI’s first discovery.

The SETI Lottery Bond is defined as a fixed rate bond with a lottery at maturation, where maturation occurs upon the discovery of extraterrestrial intelligent life. Let \( r_c \) be the fixed rate of return on investment offered by the SLB (also known as the coupon rate), let \( P \) be the price at which each share in the SLB is sold, and let \( N \) be the total number of SLB shares sold. The total capital raised is therefore \( NP \) and the amount owed to investors each year is \( r_c NP \). Additionally, the SLB pays a yearly contribution \( r_l \) toward the lottery fund along with a yearly contribution \( r_s \) toward SETI research, which amounts to \( (r_l + r_s)NP \) each year. Assuming a constant rate of inflation \( r_i \) and annual compounding, the future value \( V_{\text{future}} \) of each share of the SLB can be expressed as

\[
V_{\text{future}} = P \left( \frac{1 + r_c}{1 + r_i} \right)^t.
\]  

If the rate of inflation is greater than the bond coupon rate \( (r_i > r_c) \), which is likely the case for a lottery-linked product, then the future value \( V_{\text{future}} \) should decrease with time. However, the expected value \( V_{\text{expected}} \) of each share takes into account the possibility of winning a lottery prize when the bond matures. The expected value can be expressed as

\[
V_{\text{expected}} = V_{\text{future}} + r_l Pt,
\]  

which increases with time as the lottery prize fund grows. An example of SLB prices is shown in Table 1, which assumes \( N = 10^6 \) as the number of shares sold, \( P = $100 \) as the price per share, \( r_c = 2\% \) as the bond coupon rate, \( r_l = 0.75\% \) as the contribution toward the prize fund, and \( r_i = 3\% \) as the rate of inflation. Calculations in Table 1 assume that the lottery prize fund is managed so as to keep pace with inflation. Although the future value of each share decreases with time, the expected value exceeds the purchase price after about sixty years. During the first ten years of the SLB, an investor will see a modest decrease in future value but may remain hopeful of winning a modest prize if SETI succeeds. After about fifty to one hundred years, an investor’s share will decrease notably in future value due to inflation, but the expected value of the share is now much greater, and SLB shares may therefore be valuable heirlooms that are passed to kin or benefacted to charity. On even longer timescales that span generations, SLB shares would have very low future value, due to inflation, but would have a very large expected value if SETI succeeds and the lottery...
Table 1 – Prize fund total \((r_lNP_t)\), future value per share \((V_{future})\), and expected value per share \((V_{expected})\) for the SETI Lottery Bond, assuming \(N = 10^6\) as the number of shares sold, \(P = $100\) as the price per share, \(r_c = 2\%\) as the bond coupon rate, and \(r_l = 0.75\%\) as the contribution toward the prize fund. Future values are adjusted for inflation according to Eq. (1), assuming an inflation rate of \(r_i = 3\%.\) The prize fund is assumed to grow at a constant rate equal to the rate of inflation. Under these assumptions, the future value falls with time because its growth is less than inflation, but the expected value of each share rises with time as the prize fund grows according to Eq. (2). Note that the expected value of a share exceeds its purchase price after about sixty years.

| Time [yr] | Prize Fund | Future Value | Expected Value |
|-----------|-------------|--------------|----------------|
| 1         | $0.75M      | $99.03       | $99.78         |
| 3         | $2.25M      | $97.12       | $99.37         |
| 6         | $4.50M      | $94.31       | $98.81         |
| 10        | $7.50M      | $90.70       | $98.20         |
| 30        | $22.5M      | $74.63       | $97.13         |
| 60        | $45.0M      | $55.69       | $100.69        |
| 100       | $75.0M      | $37.70       | $112.70        |
| 300       | $225M       | $5.36        | $230.36        |
| 600       | $450M       | $0.29        | $450.29        |
| 1,000     | $750M       | $0.01        | $750.01        |
| 3,000     | $2250M      | $0.00        | $2250.00       |
| 6,000     | $4500M      | $0.00        | $4500.00       |
| 10,000    | $7500M      | $0.00        | $7500.00       |

The lottery commences. If SETI takes hundreds or even thousands of years to succeed, then SLB shares may become treasures that are cherished and guarded by families and charities, both as a relic from the past and a hope for a prosperous financial future.

In order to remain viable, the growth of the SLB fund must be sufficient to satisfy obligations to investors, the SETI community, and the lottery prize fund. Additionally, the total value of the fund must always be at least equal to the principal investment \(NP\), while the lottery fund and the annual SETI contribution must grow to keep pace with inflation. Letting \(t\) represent time, and assuming annual compounding, this can be expressed as

\[
NP \left( \frac{1 + R}{1 + r_i} \right)^t \geq NP + r_cNP_t + (r_l + r_s)(1 + r_l)^t NP_t,
\]

where \(R\) is the required growth rate of the SLB fund. Solving for \(R\) yields the equation

\[
R \geq \exp \left\{ \frac{1}{t} \ln \left[ 1 + t \left( r_c + (r_l + r_s)(1 + r_l)^t \right) \right] \right\} (1 + r_l) - 1,
\]

that must be evaluated numerically. Table 2 shows values for this fund growth rate \(R\) under three scenarios labeled “conservative”, “moderate”, and “aggressive”, which illustrate configurations of the SLB that respectively yield $2.5 million, $10 million, or $30 million per year for SETI research. Upon reaching maturation, the SLB lottery would commence by randomly selecting a fraction of shares that each win a portion of the prize fund. The fraction of shares that win a prize should be small enough that individual prizes are desirable but large enough that investors are attracted by the chances of winning. Even if one out of every ten thousand shares were selected for a prize, this would produce several winners who each make a handsome profit compared to their initial investment. The SLB thus serves as a long-term savings product with a continually growing lottery prize in anticipation of the first discovery of ETI.
The values in Tables 1 and 2 are calculated out to ten thousand years, but no currency has a legacy anywhere near this length. Within a few hundred years, the U.S. dollar may be surpassed by the euro or yuan as the world “reserve currency” [21, 22], while in a few thousand years, none of these units of currency may be in use. Concepts of economics and value may even change so drastically over thousand-year time scales that savings products such as bonds or lotteries are no longer offered or wildly different in form. Without the ability to predict how future economics will develop on thousand-year timescales, the very long-term prices and rates shown in Tables 1 and 2 should be considered illustrative at best.

Creation of the SLB will require cooperation with a financial institution that has the legal authority to engage in banking and gaming activities. Banking and gaming are regulated industries in most nations, with about two thirds of lotteries operated by private or government-owned corporations and the remaining third directly by government agencies [9]. Financial institutions such as banks or large investment corporations can also manage a large pool of funds to yield a profit, for example by creating loans or engaging in other risky investments. In order to succeed, the SLB fund must exhibit steady growth in order to satisfy its obligations; financial institutions can generate this steady growth of the principal investment and also can absorb any losses that may occur during the fund’s inception. Note that each of the three scenarios in Table 2 requires a relatively high growth rate during the first ten to one hundred years but a much lower rate after. While it might be difficult for an individual investor to achieve this sort of performance, a large and viable financial institution reasonably could manage the SLB fund to reach these goals. A financial institution would be motivated to issue such a product because any performance of the fund above expectations would yield profit for the fund’s managing institution (although any below-expected performance would result in a loss for the financial institution), which would provide a novel form of revenue from a new group of investors. I therefore propose that the SLB should be a savings product issued by a financial institution (such as a bank or a government treasury department) and managed for the benefit of investors and the SETI community.

### Table 2

| Time [yr] | Conservative | Moderate | Aggressive |
|-----------|--------------|----------|------------|
|           | \( R_{\text{q}} \) | \( r_{\text{s}} \) | \( R_{\text{q}} \) |
| 1         | 8.51%        | 16.5%    | 37.7%      |
| 3         | 8.43%        | 15.6%    | 31.2%      |
| 6         | 8.32%        | 14.5%    | 25.8%      |
| 10        | 8.20%        | 13.5%    | 21.8%      |
| 30        | 7.84%        | 11.0%    | 14.5%      |
| 60        | 7.59%        | 9.54%    | 11.4%      |
| 100       | 7.40%        | 8.66%    | 9.79%      |
| 300       | 6.90%        | 7.33%    | 7.70%      |
| 600       | 6.62%        | 6.83%    | 7.01%      |
| 1,000     | 6.46%        | 6.59%    | 6.70%      |
| 3,000     | 6.25%        | 6.29%    | 6.33%      |
| 6,000     | 6.18%        | 6.20%    | 6.22%      |
| 10,000    | 6.15%        | 6.16%    | 6.17%      |

Table 2 – Required growth rates (\( R \)) and annual contribution to SETI research (\( r_{\text{s}}NP \)) for the SETI Lottery Bond, assuming \( N = 10^6 \) as the number of shares sold, \( P = \$100 \) as the price per share, \( r_c = 2\% \) as the bond coupon rate, and \( r_l = 0.75\% \) as the contribution toward the prize fund. Growth rates are adjusted for inflation according to Eq. (4), assuming an inflation rate of \( r_i = 3\% \). The annual contribution toward SETI is also adjusted for inflation according to Eq. (3). Any of these three growth scenarios would provide a stream of income, similar to an endowment, to support SETI research.
SLB shares are also transferable, meaning that they can change ownership and be passed from one generation to another. This leads to the creation of a secondary market for trading SLB shares, and it seems likely that many investors will buy or sell their SLB shares in such a market well in advance of the discovery of ETI. In fact, the market value of SLB shares may even ebb and flow with current events, such as the discovery of new habitable planets or budget shortfalls that leave important missions unfunded. This secondary market may help to maintain interest in the SLB by providing new means for clever traders to reap a profit. The transferability of SLB shares also makes them attractive intergenerational investments for families or organizations that want to provide a fixed stream of income for the future.

The SLB will generate a regular stream of income for the SETI community that can be distributed to institutions and individuals to pursue the search for extraterrestrial intelligent life. The specific means of distribution of these funds likely will be a contentious issue but ultimately will remain the decision of the financial institution providing the SLB product. One possibility is direct endowment to an existing SETI research facility, such as the SETI Institute in Mountain View, California. The SETI Institute has been struggling to support the Allen Telescope Array (ATA)—a radio interferometer designed specifically for SETI—which requires about $2.5 million per year for its operations and science campaign, while a larger budget would allow planned expansion of the ATA to continue. Any of the three scenarios in Table 2 provide sufficient capital for SETI to revitalize the ATA, so direct endowment to existing SETI organizations may be prudent. The sponsoring financial institution could also solicit SETI researchers for grant proposals as a way of distributing some of the funds, which may encourage new SETI research groups to form in universities across the world. Banks and other financial institutions may lack the expertise to conduct scientific review panels, so partnerships with scientific organizations and foundations may be prudent for the evaluation of proposals and dispersal of funds. By supporting existing research efforts, revitalizing existing technology, and providing new funding opportunities for investigators, the SLB could provide tremendous opportunity to further SETI research.

Shares of the SLB can be purchased any time until the first discovery of ETI, culminating in the lottery and repayment of the principal investment. Because the first discovery of ETI will likely be contentious and require a series of attempts at confirmation, I propose that an independent scientific governance board should be tasked with determining when the discovery and confirmation of extraterrestrial intelligent life has occurred. The scientific governance board has the authority to suspend the sale of SLB shares, including a freeze on trades in any secondary markets, in order to evaluate a potential SETI discovery for its authenticity. Once potential claims have been evaluated, the scientific governance board can then decide to re-open the market (due to a false positive) or close the market and begin the lottery (due to the discovery of ETI). The scientific governance board should include global representation of scientists in the SETI and astrobiology communities as well as scholars from other academic disciplines, all of whom are financially independent of the SLB. Some representation from other experts also may be prudent; however, the purpose of the governance board is solely to evaluate whether or not enough information exists to say that the discovery of extraterrestrial intelligent life has occurred. Presumably, any reported discovery of ETI will be thoroughly vetted by the scientific community, and it is not the job of the scientific governance board to conduct follow-up observations. Instead, the scientific governance board serves as a mechanism to regulate the closing of the SLB market when the discovery of ETI eventually occurs.

In summary, the SETI Lottery Bond is a savings product issued by a financial institution that provides a fixed rate of return to the investor, a fixed rate of return to support SETI research, and a chance at winning a prize through lottery when the bond matures due to the discovery of ETI.
4 Ethical Considerations

The SETI Lottery Bond is a savings product issued by a financial institution that provides continuous funding for SETI research. This product involves a conflation of investment and scientific goals, which raises several ethical issues that are worth addressing in advance.

First, if the SLB has a duration that lasts until the first discovery of ETI, then what, exactly, constitutes a “discovery of extraterrestrial intelligent life”? Direct contact between humans and ETI seems unlikely—and SETI efforts are unlikely to alter this probability, anyhow. Any evidence of ETI will therefore be subject to some analysis and interpretation, which may cause a lengthy period of discussion within the scientific community, probably followed by an even longer period of debate within public, political, and religious circles. For the purposes of the SLB, evidence of ETI could take the form of narrow-band radio signals emanating from an ETI civilization that show patterns or encoded information [1], functional or defunct technological artifacts sent to the Solar System by ETI that may be drifting nearby [2, 3], or large excesses of infrared radiation from stars, clusters, or galaxies that indicate macro-engineering feats of an ETI empire [4]. Any of these discoveries would provide extraordinary evidence for ETI and would become targets for further exploration or attempts at communication. Authenticating the signal or artifact will be an arduous process that may take years or decades before scientific consensus. For this reason, the SLB stipulates a scientific governance board with the authority to suspend transactions if the authenticity of an ETI discovery is under scrutiny. Any discovery of ETI must broadly be considered as scientific consensus in order to constitute the first “discovery of extraterrestrial intelligent life” that would bring the SLB to maturity.

Many nations have explicit laws prohibiting insider trading of public securities, and the SLB should be no different. In particular, the SLB provides financial support for SETI research, which will directly benefit a small number of scientists worldwide. This creates the potential for insider trading activities because SETI scientists may have access to privileged information, which may provide an unfair advantage when trading SLB shares in a secondary market. Therefore, a provision against insider trading should also include a restriction that anyone who receives funding directly from the SLB is prohibited from personally investing in the fund.

Another consideration is that a long-term fund like the SLB might be assumed to be a sort of Ponzi scheme or other fraudulent investment. In a Ponzi scheme, returns to investors are paid either from preexisting coffers or from the contributions of future investors, which requires a continuous supply of revenue and almost always fails in collapse. Ponzi schemes are not true savings products because they falsely advertise a rate of return that cannot be honored for all investors. The SLB, contrary to any fraudulent investment scheme, is a legitimate financial savings product, issued by an authorized financial institution, that promises a fixed rate of return to investors as well as the return of principal upon reaching maturity. Because maturity occurs upon the discovery of ETI, likely to be a long time from the bond’s inception, the SLB fund managers must be careful to maintain the principal investment balance for when maturity occurs—otherwise, a shortage of funds upon the discovery of ETI would result in a failure to meet investor obligations. Managed properly by an authorized financial institution, the SLB would act as a novel savings product with a very long expected duration.

The inclusion of a lottery prize in the SLB raises the issue of whether or not a savings product should include random elements. In particular, lotteries and other games of chance seem to reinforce gambling behavior patterns, even when used to fund programs for community development [16, 17]. However, products such as lottery-linked deposit accounts or prize-linked savings accounts appear to successfully attract individuals otherwise likely to gamble by providing a product that allows savings to build but with a randomized rate of return that captures the “thrill” of a lottery [9, 10, 12, 13]. Lottery bonds and lottery-linked/prize-linked accounts are primarily a marketing device to appeal to investors who enjoy purchasing products with unknown rates of return, and they are potentially more attractive than conventional gaming products because they promise a full return of...
the principal investment. Although a lottery bond does include elements of gaming, such a product incorporates a “clear savings element” [11] with “entertainment value” [9] that distinguishes itself from conventional gaming products.

It is impossible to predict the demographics of SLB investors, but I suspect that the SLB would appeal to a wide range of socioeconomic classes, perhaps wider than most existing lottery or lottery-linked products. With the SLB, the “thrill” of investment is the knowledge that an investor is helping to further scientific progress in SETI and the anticipation of a lottery prize if the search succeeds. This type of marketing may appeal to science enthusiasts, altruists, futurists, and “ethical investors” who seek to help SETI but are uninterested in purely charitable donations [9]. Furthermore, if SLB shares are offered at a relatively affordable price (such as $100 per share as assumed in Table 1), then individuals of nearly any economic class will have the option of participating—and if the SLB shows any similarity to existing lottery-linked products [12, 13, 20], then it may be helpful to discourage gambling and encourage long-term savings. Analysis by [20] suggests that more than half of individuals in the U.S. would consider purchasing a lottery-linked product, with primary interest among individuals without savings habits. The SLB may represent an opportunity for financial institutions to draw consumers from an otherwise untapped market.

Lottery-linked savings products could be useful in funding a variety of research or causes, and it is reasonable to question why this proposal calls for SETI lottery bonds in particular, rather than any other charitable cause. While a device like the SLB certainly could be used to finance a variety of research projects (such as nuclear fusion development, or the construction of large particle accelerators, or applied medical research), three aspects of SETI in particular make it a prime candidate for associating with a lottery-linked product. First, SETI represents a search with no known duration: it could take ten years, a hundred years, or a thousand or more before SETI finds signs of ETI, and calculating the expected amount of time before SETI’s success is a challenging task to say the least. Compared to most other areas of research, SETI is one of the few where the amount of time required for success is probably on the order of generations. The SLB is constructed so that the date of maturity is likewise unknown, allowing investors to participate in the uncertainty that accompanies SETI. Second, SETI is a long-term effort that requires a continuous stream of funding if it is ever to succeed. Appealing to individual donors time after time, each of whom may lose interest after a few decades of null results, has proven to be an ineffective strategy in sustaining SETI, so a perpetual bond is an option for providing a sustained source of revenue. Third, SETI efforts are admittedly optimistic and sometimes described as a gamble with unknown odds; in a way, the thrill of winning a lottery prize in the SLB allows investors to share in SETI scientists’ hopes of eventually discovering ETI—if and when this momentous occasion occurs, scientists and the world will celebrate, but SLB investors will also partake finally in their long overdue lottery. Other communities certainly could implement lottery-linked products tailored to their research; the SLB represents an example of such a product designed for SETI in particular.

A final objection, perhaps mostly from the scientific community, is that this fundamentally is not the way science should be financed. For most of history, scientists have relied upon the goodwill of wealthy patrons and governments to pursue basic research, which has caused funding to ebb and flow with the tides of politics. Today, the vast majority of science funding takes the form of competitive grants offered by various government organizations, while private organizations offering support for science remain a much smaller contributor. Some research by for-profit corporations also leads to new basic scientific knowledge, but these results are not always published in peer-reviewed journals and are sometimes even guarded as trade secrets. Many scientists in academia tend to frown upon linking basic research with any profit motive, believing that science should be guided only by motives such as curiosity or passion. Indeed, the profit motive introduced by the SLB might increase the likelihood of a false positive discovery of ETI—perhaps because any investors in the SLB will have a personal attachment to the outcome of SETI. This highlights the need for a scientific governance board to accompany any implementation of the SLB and be particularly wary of false positives that might arise early on. Nevertheless, ideological objections to the SLB remain a valid point of
contention, and many researchers will likely avoid any funding linked to a financial product. Even so, some scientists—either out of necessity, invention, or out of frustration with the current grant-based system—may find the SLB to be an appealing source of funding, one that allows investors (instead of just donors) to engage in science. I do not suggest that this should be the dominant model for funding in science, nor do I argue that this model is better (or worse) than current models of funding. My goal in crafting this proposal is to suggest a way that SETI in particular could harness the capital it needs to sustain the long-term search for our extraterrestrial neighbors. If grants and donations cannot achieve this goal, then why not try a SETI Lottery Bond?

5 Conclusion

I have outlined a proposal for the SETI Lottery Bond as a fixed rate perpetual bond with a lottery at maturation that can serve as a continuous source of funding to sustain the search for extraterrestrial intelligent life. The SLB is a savings product issued by a financial institution and would appeal to people interested in assisting SETI though investment, rather than donation. Because SETI is a long-term endeavor, one that will likely continue to span generations, the SLB is a long-term savings product that will likewise span generations, which may encourage intergenerational wealth building among individuals without savings habits. Regular payments from the SLB will sustain SETI research until the first discovery of ETI by providing several to tens of million dollars in funding annually. Funding at this level will allow SETI surveys, such as the Allan Telescope Array, to remain dedicated to SETI and expand their capabilities as necessary, which is a necessary first step to find evidence of ETI.

Bringing the SLB into reality presents a challenge of convincing a financial institution to seek authorization to offer such a lottery bond as a product. Many European nations and developing nations offer lottery bonds or lottery-linked savings accounts [10, 11, 12, 13], and evidence suggests that consumers in the U.S. are interested in lottery-linked products [20]. A bank in the U.S., for example, would be required to secure federal and state approval before it could begin issuing lottery bonds, such as the SLB, as such a product includes elements of both banking and gaming. While securing this approval might be a tedious process, the SLB might ultimately be approved as a savings product because the primary goal of the SLB is to capture investor zeal to raise capital for SETI research. Savings products offered by banks are usually not linked to altruistic objectives, and almost never linked to unknown-risk outcomes such as SETI, so the SLB represents a unique product that could be offered by any stable financial institute willing to offer a long-term perpetual bond that lasts until SETI succeeds. Perhaps offering such a product would also help financial institutions to improve their perception among consumers.

SETI is a global endeavor, and the SLB may be most successful at a global scale. Analysis by [9] discusses the possibility of implementing a global lottery bond and claims that such a product is “best provided by a single organization selling and administering the bonds worldwide”. A single global bank, group of international banks, multinational investment corporation, or consortium of international governments would therefore be among the best options for offering the SLB worldwide. Products like the SLB could widen the range of savings products available in developing nations [9], and organizations like the World Bank or the International Monetary Fund (IMF) might even partner with the SLB managers in order to make the product available to nations with few available savings options.

Given that federal budgets are uncertain and already saturated, I propose that one or more international financial institutions obtain authorization to offer lottery-linked savings products in support of SETI research. Even if SETI takes a very long time to succeed—or if it never succeeds—this plan still will help to promote personal savings and intergenerational wealth building along with astrobiology education. In the best case, SETI succeeds; but even in the worst case, if SETI finds nothing, then it will at least have taught us how to think more seriously about our financial future.
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