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Report to the Chairman, Subcommittee on Transportation, Treasury, and Independent Agencies, Committee on Appropriations, House of Representatives

June 2003

SAVINGS BONDS

Actions Needed to Increase the Reliability of Cost-effectiveness Measures

GAO-03-513

June 2003

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Highlights

Highlights of GAO-03-513, a report to the Chairman, Subcommittee on Transportation, Treasury, and Independent Agencies, Committee on Appropriations, House of Representatives

SAVINGS BONDS

Actions Needed to Increase the Reliability of Cost-effectiveness Measures

Why GAO Did This Study

While the Treasury generally pays lower interest rates on U.S. Savings Bonds than it does on other forms of borrowing from the public, it also incurs substantially higher administrative costs to issue and redeem the paper savings bond certificates. To determine whether these higher administrative costs exceed its interest rate savings, Treasury's Bureau of the Public Debt uses a spreadsheet model to compare the costs of issuing Series EE and Series I savings bonds with those of issuing marketable Treasury securities. GAO was asked to review this model to judge its reliability in measuring the relative costs of Treasury's borrowing alternatives.

What GAO Recommends

GAO is recommending that the Bureau of the Public Debt revise the cost-effectiveness model so that it provides reliable information on the costs of the savings bond program. As part of that revision, the bureau should consider updating some of the key data on the performance of the savings bond program, particularly on savings bond redemption patterns.

What GAO Found

Treasury has several alternative vehicles for issuing debt to the public. A substantial majority of that debt is issued in the form of marketable Treasury securities. U.S. Savings Bonds today account for about 3 percent of total Treasury securities outstanding. A majority of these bonds have lower minimum denominations or face amounts than marketable Treasury securities and generally pay lower interest rates as well, but provide the same assurance of the full faith and credit of the United States, making them an alternative for investors unable or unwilling to pay the minimum denominations of marketable Treasury securities. Savings bonds continue to be issued as paper certificates, rather than in the format of the "book entry" system for marketable Treasury securities; however, this increases the administrative costs of issuing, servicing, and redeeming savings bonds, relative to the marketable securities.

The cost-effectiveness of the savings bond program depends on whether Treasury's savings—in terms of the generally lower interest payments on savings bonds relative to marketable Treasury securities—exceed the costs that Treasury incurs with processing the paper savings bond certificates. The question is complicated by the fact that the interest savings occur over the life of a savings bond, and that Treasury pays costs upfront at issuance and in the future when the savings bond is redeemed.

As prescribed by the Office of Management and Budget and common financial practice, in dealing with savings or costs over time, the value of future savings or costs must be discounted to present value. Treasury has reported that its cost-effectiveness model does calculate the present values of the relative costs of savings bonds and marketable Treasury securities. However, because of flaws in the design and implementation of the spreadsheet used to calculate these present values, the cost-effectiveness model's results do not provide the Bureau of the Public Debt, Treasury, or Congress with accurate information that is needed to assess the relative costs of issuing debt through savings bonds or marketable Treasury securities, or to manage the savings bond program. Further, the bureau has not updated some key data elements in the cost-effectiveness model. In particular, citing budget considerations, the bureau uses data on the redemption patterns for savings bonds that date back to 1993, which do not reflect the effects of the wide variety of financial instruments now available to investors.

www.gao.gov/cgi-bin/getrpt?GAO-03-513.

To view the full report, including the scope and methodology, click on the link above. For more information, contact Thomas J. McCool at (202) 512-8678 or McCoolT@gao.gov.

Contents

Letter

1

Results in Brief 2
Background 3
Conceptual Design for Estimating Savings Bond Cost-effectiveness Is Appropriate, but Model Calculations Contain Errors 8
Key Model Parameters and Components May Not Be Reliable 15
Conclusions 20
Recommendations 21
Agency Comments and Our Evaluation 22

Appendixes

Appendix I: Objectives, Scope, and Methodology 26

Appendix II: Present Value Theory and Model Calculations 27

Appendix III: Future Value Examples for Series EE and Series I Savings Bonds for Bonds 5 Years and Older 30

Appendix IV: Model Calculations Detail 32

Appendix V: Comments from the Bureau of the Public Debt 35
GAO Comments 43

Appendix VI: GAO Contacts and Staff Acknowledgments 44
GAO Contacts 44
Acknowledgments 44

Tables

Table 1: Savings Bonds and Selected Treasury Securities 4
Table 2: Key Parameters of the Savings Bond Cost-effectiveness Model 7
Table 3: Redemption Value Calculation for Series EE and Series I Savings Bonds 5 Years and Older 12
Table 4: BPD Changes to Savings Bond Cost-effectiveness Model Parameters since 1995 16

Figure

Figure 1: Conceptual Design of the Savings Bond Cost-effectiveness Model 9

Abbreviations

BPD	Bureau of the Public Debt
CMT	constant maturity Treasury
FV	future value
OMB	Office of Management and Budget
PV	present value

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Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

June 16, 2003

The Honorable Ernest J. Istook, Jr.
Chairman, Subcommittee on Transportation, Treasury,
and Independent Agencies
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

Savings bonds, which offer low-risk, affordable investment opportunities to many Americans, represent almost 3 percent of the total Department of the Treasury (Treasury) securities outstanding but nearly 6 percent of the total nonmarketable Treasury securities outstanding.[1] While savings bonds generally pay lower interest rates than marketable Treasury securities, Treasury incurs higher administrative costs to produce, market, service, and redeem savings bond certificates. Concerns have been raised regarding whether, and to what extent, savings bonds are cost effective for Treasury—whether Treasury's administrative and tax deferral costs on savings bonds are more than offset by lower interest payments. To address these concerns, in 1985, Treasury introduced the savings bond cost-effectiveness model that measures, according to model documentation, the difference between the projected costs for raising funds through the issuance of $1 billion of new savings bonds and the estimated costs for comparable borrowing through marketable securities. In 1995, Treasury's Bureau of the Public Debt (BPD) assumed responsibility for the model. BPD believes the model shows that over time savings bonds are a more cost-effective means of raising funds in that the administrative and tax deferral costs of issuing savings bonds are offset by the lower interest payments on savings bonds.

This report responds to your July 16, 2002, request that we assess the effectiveness of BPD's cost-effectiveness model. As agreed with your staff, this report presents our assessment of (1) the appropriateness of the model's design to compare the costs associated with savings bonds with those of other Treasury debt and (2) the reliability of certain key parameters and components of the model.

[1]Treasury Department, Bureau of the Public Debt, *Monthly Statement of the Public Debt of the United States* (April 30, 2003). Available from www.publicdebt.treas.gov.

To address these objectives, we reviewed an electronic copy of the model, related hard-copy documentation, and savings bond program regulations. We did not assess the overall savings bond program or the accuracy or completeness of all data used in the model. As a result, we do not know what effect such data had on the model's cost-effectiveness calculation. Appendix I contains a more detailed description of our scope and methodology.

We conducted our work in Washington, D.C., from September 2002 through April 2003 in accordance with generally accepted government auditing standards.

Results in Brief

Treasury has presented the savings bond cost-effectiveness model as a way to measure the cost-effectiveness of savings bonds over time, one that is based on a present value approach—calculating the value today of future costs and revenues in order to provide a common basis for comparison between savings bonds and marketable Treasury securities. The conceptual design underlying the savings bond cost-effectiveness model reflects Office of Management and Budget (OMB) guidance and common financial economics practice. According to OMB Circular A-94, such analysis is appropriate when the benefits of competing alternatives—alternative debt instruments in this case that provide equal funds to Treasury—are the same. A program is cost effective if, on the basis of appropriately measuring the costs of competing alternatives over time, it has the lowest costs, expressed in present value terms, for a given amount of benefits. For savings bonds, the question is whether, over time, savings bonds cost less than marketable Treasury securities. However, the model as constructed does not provide Treasury with the information it needs to determine whether savings bonds are cost effective because of errors in several steps in the model. In particular, we found that the model does not accurately calculate the present value of either alternative and thus does not provide a valid comparison.

BPD has changed several parameters in the model in an effort to better reflect changes in the savings bond program. However, despite these enhancements, some of the data used to adjust the model's parameters have not been updated and do not incorporate historical experience. In particular, data on savings bond redemptions do not reflect the most recent experience, possibly affecting the validity of the model's cost-effectiveness estimates. In addition, the model contains other inaccuracies that could affect its reliability and accuracy. Finally, the model has not been subject to

ongoing and periodic reviews by independent external reviewers, a common practice endorsed by OMB.

This report includes recommendations to the Secretary of the Treasury that are designed to increase the reliability of the savings bond cost-effectiveness model. We obtained comments on a draft of this report from BPD. BPD disagreed with our description of the savings bond cost-effectiveness model and our conclusion that the model's comparisons were invalid, but agreed in general with our recommendations. However, BPD noted that the goal of moving to an electronic environment for savings bonds would make it appropriate to "shelve" the current model. BPD's comments are discussed in the Agency Comments and Our Evaluation section, and its written comments are reprinted in appendix V.

Background

Savings bonds offer investors the ability to purchase securities with lower minimum denominations than those for marketable Treasury securities. In response to concerns raised regarding the cost-effectiveness of the savings bond program as a funding mechanism for federal government operations, Treasury created a cost-effectiveness model that is now used and maintained by BPD. The model was intended to compare the projected costs for $1 billion of new savings bond borrowing and comparable borrowing through marketable Treasury securities. The model is based on the characteristics of the Series EE and Series I savings bonds and is intended to compare these costs on a present value basis.

Savings Bond Program

Treasury is authorized to borrow money on the credit of the United States to fund federal government operations. Within Treasury, BPD is responsible for prescribing the debt instruments, limiting and restricting the amount and composition of the debt, paying interest to investors, and accounting for the resulting debt. However, Treasury sets the financial terms and conditions of savings bonds and marketable Treasury securities, including denomination and pricing changes.[2]

[2]Treasury securities are marketable bills, notes, and bonds issued at various schedules throughout the year. These instruments are negotiable debt obligations of the U.S. government secured by its full faith and credit. Treasury bills are short-term obligations issued with a term of 1 year or less. Treasury notes have a term of more than 1 year, but not more than 10 years. Treasury bonds are long-term obligations issued with a term of more than 10 years.

Savings bonds are an alternative for investors unable or unwilling to pay the minimum denomination of marketable Treasury securities. Table 1 describes several principal differences between Series EE and Series I savings bonds and selected marketable Treasury securities.

Table 1: Savings Bonds and Selected Treasury Securities

	Savings bonds		Marketable Treasury securities	
	Series EE	**Series I**	**Fixed-principal notes**	**Inflation-indexed notes[a]**
General features	Nonmarketable. Sold at 50 percent of face value in denominations as low as $50.	Nonmarketable. Sold at face value in denominations as low as $50.	Marketable. Sold at auction with a minimum face value of $1,000.	Marketable. Sold at auction with a minimum face value of $1,000.
Interest rate	Calculated as 90 percent of 6-month averages of 5-year Treasury securities yields.	Calculated to provide a fixed rate plus a semiannual inflation adjustment.	Rate is determined at auction.	Rate is determined at auction. The fixed rate of interest is applied to the inflation-adjusted principal.
Earnings	Interest is paid when the bond is redeemed; value increases monthly with accrued interest.	Interest is paid when the bond is redeemed; generally increases in value monthly, but may remain unchanged in times of deflation.	Interest is paid semiannually. (Interest payment is commonly called the note's "coupon").	Interest is paid semiannually based on the inflation-adjusted principal value of the note; in the event of deflation, interest payments will decrease.
	Earn interest for up to 30 years.	Earn interest for up to 30 years.	Interest paid until the note matures; more than 1 year but not more than 10 years.	Interest paid until the note matures; more than 1 year but not more than 10 years.
Redemption and cashing options	Can be redeemed after first 12 months.[b] A 3-month interest penalty applies to bonds redeemed during the first 5 years.	Can be redeemed after first 12 months. A 3-month interest penalty applies to bonds redeemed during the first 5 years.	Marketable, can be sold at any time prior to maturity date.	Marketable, can be sold at any time prior to maturity date.

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	Savings bonds		Marketable Treasury securities	
	Series EE	**Series I**	**Fixed-principal notes**	**Inflation-indexed notes[a]**
Special federal tax treatment	Federal income tax on earnings may be deferred until redemption; all or part of earnings may be excluded from federal income tax if used for qualified education expenses.	Federal income tax on earnings may be deferred until redemption; all or part of earnings may be excluded from federal income tax if used for qualified education expenses.	Interest income is subject to federal income tax, which is generally reported in the year paid.	Interest income is subject to federal income tax, which is generally reported in the year paid. Inflation adjustments must be reported in the year earned.

Sources: BPD and the Internal Revenue Service.

Note: Table data taken from the following publications of the Treasury Department, Bureau of the Public Debt: *FAQs Regarding Treasury Bills, Notes, and Bonds, The U.S. Savings Bonds Owner's Manual* (June 2002), *Minimum Holding Period For Savings Bonds Extended to 12 Months* (press release: January 15, 2003), available from www.publicdebt.treas.gov; and Internal Revenue Service, *Investment Income and Expenses for 2002 Returns*, Publication 550, available from www.irs.gov.

[a]Treasury notes and bonds for which the interest and redemption payments are tied to inflation. Treasury bills are not offered in inflation indexed form.

[b]The 12-month period, referred to as the minimum holding period, is the length of time from the issue date that a bond must be held before it is eligible for redemption. On January 15, 2003, Treasury announced that the minimum holding period that applies to U.S. Savings Bonds would be extended from 6 to 12 months, effective for bonds issued on and after February 1, 2003. Series EE and Series I savings bonds bearing issue dates prior to February 2003 retain the 6-month minimum holding period in effect when they were issued.

In March 2002 the Treasury Assistant Secretary for Financial Markets testified before the House Appropriations Committee, Subcommittee on Treasury, Postal Service, and General Government that Treasury believes that the availability of a savings vehicle with the full faith and credit of the United States should not be limited to those who can afford the minimum $1,000 denominations available in auctions of marketable Treasury securities. The official also said that even though savings bonds are not the most efficient form of borrowing in operational terms, Treasury would continue to offer them to the public.[3]

[3]In March 2002, the Commissioner of the Public Debt testified before the Subcommittee on Treasury, Postal Service, and General Government, House Committee on Appropriations that savings bonds are the only security sold to the public in the form of paper certificates.

Treasury is seeking to reduce the operational costs of savings bonds by offering the securities in paperless form. Treasury has started to offer savings bonds that are held in direct Treasury accounts instead of issuing paper certificates for the bonds. The Series EE and Series I savings bonds are available through the new TreasuryDirect system.[4] A BPD planning document describes BPD's objective as enabling Treasury to stop issuing paper savings bonds and thus begin to realize the long-term cost reductions expected from additional automation and more efficient processing.

Savings Bond Cost-effectiveness Model

In response to concerns raised regarding the cost-effectiveness of the savings bond program as a funding mechanism for federal government operations, Treasury created a cost-effectiveness model. According to a Treasury report to the House Committee on Appropriations and Committee on Financial Services, the savings bond cost-effectiveness model has been used to assess potential changes in the financial terms and conditions for Series EE and Series I savings bonds.[5] According to model documentation, BPD also uses model results to project and trace annual costs and recoveries for distinct cost centers over the life of a savings bond loan.

What is collectively referred to as the savings bond cost-effectiveness model comprises two submodels, Series EE and Series I, with the differences between the two reflecting differences between the two series of savings bonds. The results of each submodel are averaged to estimate the overall cost-effectiveness of the savings bond program. According to a BPD official, the model calculates the value of a single savings bond and its costs to Treasury, and extends this to the total savings bond population in a given year. Subsequently, the model attempts to quantify the differences between the savings bonds and marketable Treasury securities (noted in table 1).[6]

[4]The original TreasuryDirect system was a Web-based system for marketable Treasury securities that is now called Electronic Services for Treasury Bills, Notes, and Bonds. The new TreasuryDirect is a Web-based system that allows investors to establish accounts to purchase, hold, and conduct transactions for Series EE and Series I savings bonds on-line.

[5]Department of the Treasury, *Report to the Committee on Appropriations and the Committee on Financial Services*, *United States House of Representatives: On Federal Debt Financing and the Role of United States Savings Bonds* (Washington, D.C.: July 1, 2002).

[6]Treasury has not issued bonds of any maturity since its decision in October 2001 to suspend issuance of the 30-year bond.

The model was intended to compare the projected costs for $1 billion of new savings bond borrowing and those for $1 billion in marketable Treasury securities on a present value basis, that is, discounting the costs over time to permit a valid comparison. The savings bond cost-effectiveness model utilizes seven key parameters: administrative costs, historic redemption patterns, sales volume, savings bond yields, maturity period, equivalent marketable yield, and tax recovery. Table 2 describes the key parameters of the model in detail.

Table 2: Key Parameters of the Savings Bond Cost-effectiveness Model

Key parameters	Description
Administrative costs	Includes all federal government costs for marketing/issuing, servicing, and redeeming savings bonds.[a] Issue cost comprises marketing/issuing costs plus one-half of servicing costs. Redemption cost comprises cost of redemption plus one-half of servicing costs. Each of these total costs is then divided by its respective transactions during the prior fiscal year budget activity to return unit cost to issue per bond and unit cost to redeem per bond. Unit costs per bond are the same across all denominations.
Historic redemption patterns	A probability distribution of the number of bonds redeemed by denomination and period outstanding. The data were derived from the redemption patterns from 1957 through 1993. Monthly rates of redemption in the first 3 years outstanding are expressed as the quotient of the total bonds redeemed at a given age by the total bonds of that age outstanding. Annual rates of redemption for bonds that remain outstanding for 3 years or longer were similarly derived. The annual rates are prorated to allocate bond redemptions equally among the 12 months in a year. The model applies the redemption probabilities of Series EE bonds to similarly priced Series I bonds (that is, the probabilities for a $100 Series EE bond and a $50 Series I bond are equal).
Sales volume	The number of bonds issued by denomination in the prior fiscal year.
Savings bond yields	Series EE – 90 percent of 6-month averages of 5-year Treasury securities yields. Series I - a fixed rate of return and a semiannual inflation rate.
Maturity period	Series EE and Series I bonds earn interest for 30 years. The model incorporates an additional 20 years of redemption patterns beyond final maturity.

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Key parameters	Description
Equivalent marketable yield	An estimate of the comparable borrowing costs for marketable Treasury securities based on the constant maturity yield curve.
Tax recovery	An estimate of taxes paid by an investor upon redeeming the bond. [b]

Source: BPD model documentation.

[a]According to model documentation, since BPD's administrative costs for marketable Treasury securities are negligible to the total amount financed, they are not built into the model.

[b]The tax recovery rate is provided by Treasury's Office of Tax Policy, which, among other functions, provides the official estimates of all government receipts for Treasury cash management decisions.

Conceptual Design for Estimating Savings Bond Cost-effectiveness Is Appropriate, but Model Calculations Contain Errors

OMB guidelines state that a cost-effectiveness analysis is appropriate to use in an analysis of government programs when the benefits of competing alternatives are the same or where a policy decision has been made that the benefits of a program must be provided.[7] A program is cost effective if, on the basis of life cycle cost analysis of competing alternatives, it is determined to have the lowest costs expressed in present value terms for a given amount of benefits.[8] The conceptual design underlying the savings bond cost-effectiveness model reflects this OMB guidance. However, the present value calculations in the model contain errors. As a result, the model's estimated "present values" do not follow OMB guidance and common financial economics practice, and the model does not provide Treasury with the information it needs to determine whether savings bonds are cost-effective.

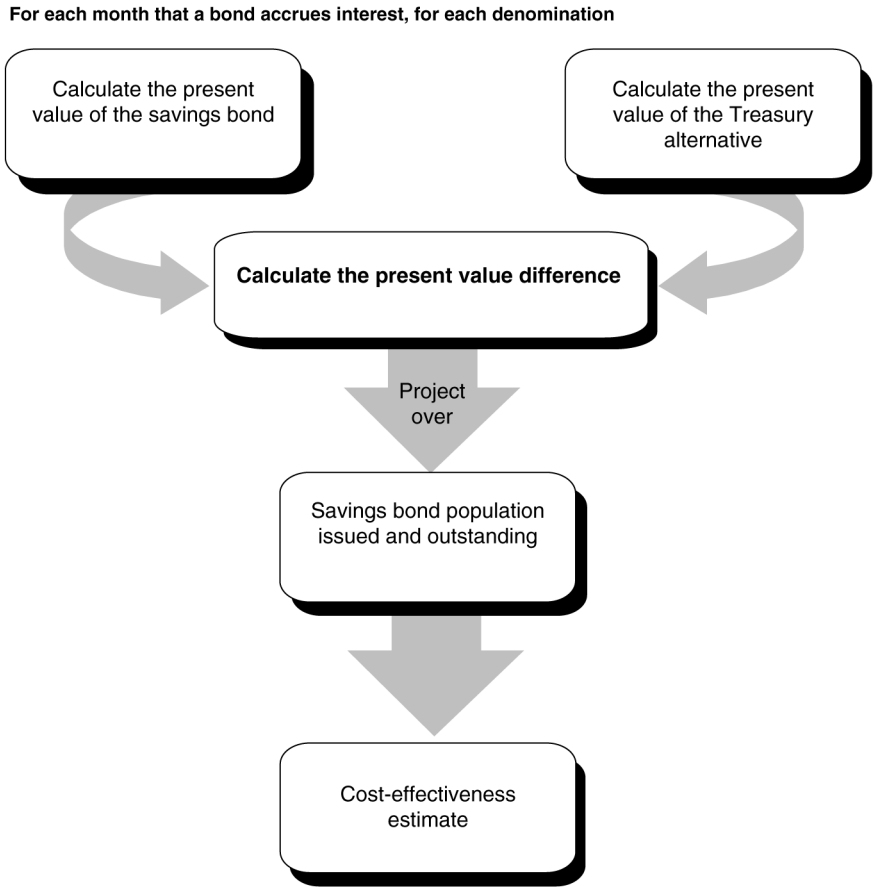
Model's Conceptual Design Follows OMB Guidelines

The model's conceptual design follows OMB guidelines for cost-effectiveness analysis. Figure 1 shows the conceptual design of the model.

[7]Office of Management and Budget, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Circular A-94 (Washington, D.C.: October 29, 1992). This circular provides general guidance for conducting benefit-cost and cost-effectiveness analyses and serves as a checklist of whether an agency has considered and properly dealt with all the elements for sound benefit-cost and cost-effectiveness analyses.

[8]OMB states that life cycle cost represents the overall estimated cost for a particular program alternative over the time period corresponding to the life of the program, including direct and indirect initial costs plus any periodic or continuing costs of operation and maintenance.

Figure 1: Conceptual Design of the Savings Bond Cost-effectiveness Model



Source: GAO analysis of BPD's savings bond cost-effectiveness model theory.

OMB Circular A-94, which is applicable to executive branch agencies, provides that the standard criterion for deciding whether a government program is cost-effective is net present value—a comparison of the discounted monetized value of the expected life cycle costs of alternative means of achieving the same stream of benefits. However, in its comments on this report BPD asserted that the model's approach follows an alternative OMB method to determine cost-effectiveness. BPD stated that the model measures cost-effectiveness as the "relative financial benefit from two borrowing options whose overall costs are identical. Treasury's benefit from each alternative is the amount of financing realized at the time

borrowing occurs." We have addressed this comment in the Agency Comments and Our Evaluation section.

A key concept in finance is recognizing that the value associated with funds received or paid at different points changes over time. Funds have a time value because of the opportunity to invest them at different interest rates and in different financial alternatives. Investors demand some compensation for making funds available today in return for future repayment. For example, the interest paid on a loan is a measure of this compensation.

Essentially, a present value calculation measures the value today that would be equivalent to a future payment, or stream of payments, by discounting the future payments (using an appropriate discount rate).[9] For Treasury, this is the value today of the future payments to investors of securities offered for sale which, in the context of the model, is the redemption value of Series EE and Series I savings bonds and the repayment stream of the alternative marketable Treasury security (that is, any coupons plus maturity value). Calculating the present value for each alternative takes the monetary value of costs over time and discounts them at an appropriate discount rate. Discounting transforms costs occurring in different time periods to a common unit of measurement (app. II describes this in greater detail).

As table 1 notes, there are several distinctions between savings bonds and marketable Treasury securities; several of these are relevant to the model. Most notably, the interest rates and the timing of the interest payments are different. Accurate implementation of the conceptual design requires that the model address these issues in order to construct comparable present values for the costs of savings bonds and marketable Treasury securities. The model attempts to address these distinctions by (1) creating an after-tax present value discount factor for the marketable Treasury security from a 6-month average of the constant maturity yield curve, commonly referred to as the "constant maturity Treasury," or CMT),[10] and (2) reducing the

[9]The interest rate used in calculating the present value of expected future benefits and costs.

[10]The Federal Reserve Bank of New York collects prices for all actively traded U.S. Treasury securities. Treasury takes this information and calculates a yield curve. The curve is known as the constant maturity yield curve because it gives an estimate of the yield on Treasury securities at the maturities shown even if no current Treasury security has a remaining maturity exactly equal to one of those points.

present value of the marketable Treasury security by subtracting its estimated (that is, not paid) "discounted" coupons.

Model Creates Cost-effectiveness Ratio Based on Calculated "Present Values" for Both Alternatives

In general, the model is conceptually designed to create a marketable Treasury security comparable to a savings bond such that the repayment stream (that is, any coupons plus maturity value) to an investor is equal to that of a savings bond's net cost to Treasury (that is, redemption value adjusted for administrative unit costs and tax revenue implications). The repayment stream of the created marketable Treasury security and the adjusted redemption value of the savings bonds represent costs to Treasury from offering these securities for sale. From this point, the model is intended to compare the costs of these two financing alternatives on a present value basis.

According to model documentation, the present value of the marketable Treasury security is constructed by discounting the savings bond's redemption value, adjusted for Treasury's unit cost of redemption and tax revenue implications, at an equivalent after-tax rate for marketable Treasury securities of the same maturity.[11] The model's calculation of the redemption value of the Series EE and Series I savings bond is similar; changes are due to the different structures of the two series. Table 3 provides additional detail on the redemption value calculation and variables for both the Series EE and Series I savings bond. Appendix III provides examples of redemption value calculations for both the Series EE and Series I savings bond.

[11]According to model documentation, the model assumes that the tax recovery for the marketable Treasury security occurs simultaneously with each interest payment.

Table 3: Redemption Value Calculation for Series EE and Series I Savings Bonds 5 Years and Older

Series EE, $FV = PV * \{[1+(i/2)]^{(m/6)}\}$, where	Series I, $FV = PV * \{[1+(CR/2)]^{(m/6)}\}$, where
FV (future value) = redemption value on redemption (accrual) date rounded to the nearest cent	FV (future value) = redemption value on redemption (accrual) date rounded to the nearest cent
PV (present value) = redemption value at the beginning of the semiannual rate period	PV (present value) = redemption value at the beginning of the semiannual rate period
i = savings bond rate	CR (composite rate) = fixed rate of return plus the semiannual inflation rate
m = number of full calendar months elapsed during the semiannual rate period	m = number of full calendar months elapsed during the semiannual rate period

Sources: Series EE: 31C.F.R. § 351.2-(k)(4)(ii)(A); Series I: 31C.F.R. § 359.2-(e)(4)(ii)(A).

Note: Bonds are subject to a 12-month holding period and those redeemed before 5 years are subject to a 3-month interest penalty. All calculations of interest are based on a hypothetical savings bond with a denomination of $25.

The tax revenue implications are reflected in the model as a tax recovery rate. The model assumes that all savings bond tax recoveries are deferred until redemption.[12] Tax recovery—the taxes collected on savings bond earnings that had been deferred until redemption—increases the revenues to Treasury. The model calculates the effect of tax recovery, in terms of life cycle costs for the model, by reducing the amount Treasury pays to an investor at redemption. However, the tax recovery rate is reduced in the model to reflect the education bond program. In general, as shown in table 1, savings bonds are eligible for tax benefits upon redemption when used for qualified education expenses.

[12]An investor may choose to use the accrual method of accounting, where increases in the redemption value are reported as interest each year, or the cash method of accounting, where reporting of interest earned is postponed until the earlier of the year in which the bond is cashed or disposed of or the year in which the bond matures.

The administrative unit cost to Treasury from redeeming savings bonds reduces the revenues to Treasury. The model calculates the effect of administrative unit redemption cost, in terms of life cycle costs for the model, by increasing the amount Treasury pays to an investor at redemption. The model constructs an after-tax "discount factor" based on a 6-month average of the CMT.[13] At the time of our review, the window was the 6-month period ending October 31, 2001.

According to BPD officials, the model is intended to perform an additional step to calculate the "present value" of the marketable Treasury security. This additional step, according to model documentation, is intended to reflect the difference between savings bonds, which do not pay periodic interest, and marketable Treasury securities that do pay such interest in the form of coupons. The model treats the coupon payments that the marketable Treasury security would pay as a separate security in which the tax recovery is simultaneous with the payment. First, the estimated coupons are created based on the savings bond's redemption value, adjusted for Treasury's unit cost of redemption and tax revenue estimates. Second, these coupons are "discounted" by an after-tax "discount factor" based on a 6-month average of the CMT.

BPD believes that these coupons would reduce the benefit of the initial marketable Treasury security and therefore its "present value." According to model documentation, these are subtracted from the "discounted" savings bond final payout, adjusted for Treasury's unit cost of redemption and tax revenue implications. The model calculations for the "present value" of the marketable Treasury security, however, do not follow model documentation in that the savings bond final payout is not discounted. BPD officials confirmed that the model calculations actually construct the "present value" of the marketable Treasury security as equal to the redemption value of the savings bond, adjusted for Treasury's unit cost of redemption and tax revenue implications, net of estimated "discounted" coupons.

According to model documentation, the "present value" of the savings bond is its issue price less the unit cost to issue. The model's calculation returns a value that is equal to Treasury receipts from a savings bond, net of the administrative unit cost of issuance.

[13]The tax rate applied to the 6-month average of the CMT is the unadjusted tax recovery rate provided by Treasury's Office of Tax Policy.

As previously mentioned, the model is intended to compare a savings bond and a marketable Treasury security on a present value basis. The difference, according to a BPD official, is then translated to the total savings bond population in a given year and converted to a ratio of millions of dollars in cost per $1 billion borrowed. The model calculation takes the difference between the two "present values" described above, projects the difference across the sales volume for the prior fiscal year, and then converts the difference to a ratio that measures cost savings in millions per $1 billion borrowed. Appendix IV provides a more detailed discussion of the model calculations.

BPD's Definition of Present Value Does Not Follow OMB Guidance

Although Treasury has presented the model as measuring cost-effectiveness on a present value basis, most notably in a July 2002 report to Congress, the model does not construct a present value comparison in accordance with OMB guidance. Our review indicates that the model does not accurately incorporate all the life cycle costs in the present value calculations for either alternative, does not calculate and apply a true economic discount factor needed to derive present value that would be relevant to the time periods, and ultimately compares values that are not equivalent based on the time value of money. The result is that the model's calculation of a cost-effectiveness ratio does not provide an accurate present value assessment of the alternatives.

As previously discussed, to create comparable borrowing between the two alternatives, the model is intended to set the repayment stream (that is, any coupons plus maturity value) of the marketable Treasury security equal to that of a savings bond's net cost to Treasury (that is, redemption value adjusted for administrative unit costs and tax revenue implications). However, the model calculation does not incorporate all the life cycle costs of the savings bond into the marketable Treasury security's "present value" calculation — the initial administrative cost of issuing the savings bond (that is, unit cost to issue) is not included. In addition, the model calculation does not incorporate all the life cycle costs of the savings bond into the saving bond's "present value" calculation — the redemption value paid to an investor and the final administrative cost of the savings bond (that is, unit cost to redeem) is not included.

The present value of a bond (or bond price) is equal to the present value of its expected cash flows (that is, any coupons plus maturity value). As noted previously, BPD officials confirmed that the model measures what it terms the "present value" of the marketable Treasury security as equal to the

redemption value of the savings bond, adjusted for Treasury's unit cost of redemption and tax revenue implications, net of estimated "discounted" coupons. However, this calculation implicitly values current and future funds as the same. In addition, as previously discussed, the model treats coupons as if they reduce the benefit of the marketable Treasury security and therefore its "present value." However, since the CMT already reflects the value of the coupons that Treasury is obligated to pay, reducing the benefit to Treasury essentially counts the coupons twice. Additionally, the construction of the discount factor in the model departs from OMB guidance since the model's "discount factor" does not create an appropriate time value.

Further, the model treats Treasury receipts from a savings bond, net of the administrative unit cost of issuance, as the "present value" of the savings bond. However, the model does not include or discount over time the savings bond's redemption value in this calculation, and therefore the model does not reflect a time value associated with these funds, or present value as the term is used in OMB guidance or in general finance usage.

Key Model Parameters and Components May Not Be Reliable

The savings bond cost-effectiveness model utilizes seven key parameters: administrative costs, historic redemption patterns, sales volume, savings bond yields, maturity period, equivalent marketable yield, and tax recovery. Since 1995, when BPD assumed responsibility for the model, it has made four model enhancements in an effort to better reflect changes in the savings bond program, three of which directly affect these parameters.[14] Table 4 presents BPD's changes to the three key model parameters since 1995. However, despite these enhancements, some of the data used to adjust the model's parameters have not been updated and do not incorporate historical experience. In addition, the model contains other inaccuracies that could affect its reliability and accuracy. Finally, the model has not been subject to ongoing and periodic reviews by independent external reviewers, a common practice endorsed by OMB.

[14]The fourth change, building cost centers, does not directly affect the model parameters.

Table 4: BPD Changes to Savings Bond Cost-effectiveness Model Parameters since 1995

Parameters	BPD changes
Redemption probabilities	The model originally based bond redemption projections on current snapshots of redemption activity. To limit the model's exposure to short-term market swings, BPD developed redemption patterns based on longer-term historical data (1957-93).
Activity beyond maturity	Series EE and Series I bonds earn interest for 30 years. However, not all bonds are redeemed before or at this final maturity; some owners choose to hold them even though they are no longer earning interest. For this reason, BPD refined the model to incorporate redemption patterns for 20 years beyond final maturity.
Tax recovery	Savings bonds have an education bond feature that is a tax benefit to investors; participation does not occur until investors actually redeem their bonds. According to BPD, while the full effects of the program are not known, BPD estimates the program's effect in the model by reducing savings bond tax recovery by 10 percent, an estimate it believes to be at or above the maximum reduction in tax recovery.

Source: BPD model documentation.

Despite Enhancements, Model Results May Not Be Accurate

The first enhancement affects a key calculation in the savings bond cost-effectiveness model: the redemption value, or future value, of the savings bond over time. These values form the basis for constructing a marketable Treasury security that is the alternative to savings bonds. The earlier bonds are redeemed, the less administrative costs are offset. Therefore, the accuracy of the model's cost-effectiveness calculation depends heavily on the accuracy of predicted early redemptions.

The key driver for the redemption values in the model is probability of redemption. The model accounts for redemption probabilities differently than in the original model transferred to BPD in 1995. According to BPD officials, the original model estimated redemption probabilities with the most recent 13 months of Series EE redemption data. When BPD assumed responsibility for the model, staff began estimating redemption probabilities for each denomination of Series EE savings bonds back to 1957. The current model continues to incorporate the historical redemption patterns from 1957 to 1993. However, citing cost concerns, BPD has not updated the probabilities to reflect redemption patterns of the most recent 10 years. Since then, however, a wide variety of financial instruments have

become available to investors, which could affect the patterns of redemption. Further, the redemptions do not reflect current interest rates.

As previously discussed, the model also applies the redemption probabilities of Series EE bonds to similarly priced Series I bonds (that is, the redemption probabilities for a $100 Series EE bond and a $50 Series I bond are equal). BPD has not estimated the redemption probabilities of Series I bonds, introduced in 1998, therefore the redemption probabilities applied in the Series I submodel have no direct relation to the Series I bond redemption patterns since 1998.

The second model enhancement deals with the maturity period. The original model assumed the stated maturity date for both securities of 30 years. BPD adjusted the current model to include an additional 20-year horizon beyond the stated maturities of savings bonds and marketable Treasury securities to account for those investors who hold on to the securities past the maturity date. However, according to a statement made by Treasury, the regulations governing savings bonds provide that bonds for which no claims have been filed within 10 years of the maturity date will be presumed to have been properly paid. The 20-year horizon enhancement appears to be inconsistent with this Treasury statement. Further, adding the 20 years appears to be inconsistent with OMB guidance for the alternatives to be compared over their stated life cycles, which for both alternatives should be the 30-year maturity period.

Finally, the third enhancement to the model adjusts the tax recovery rate for savings bonds by 10 percent to account for the education bond program. The 10 percent adjustment was an estimate since there was no program experience to guide the adjustment. The education bond benefit, which allows for the exclusion of interest earned subject to certain rules and limits, applies only to savings bonds. Adjusting the tax recovery rate for savings bonds to reflect this program is appropriate. However, the education bond program was introduced in 1990, providing program experience of at least 12 years. BPD has not analyzed whether the historical experience is consistent with the 10 percent adjustment and thus does not know whether the adjustment improves the model's accuracy.

Discontinuance of 30-Year Marketable Treasury Bonds Directly Affects the Marketable Yield Model Parameter

A BPD official told us that the equivalent marketable yield, or CMT, has the strongest impact on model results. The CMT is the basis for BPD's "discount factor" used to derive the "present value" of the alternative marketable Treasury security. Treasury discontinued the issuance of the 30-year Treasury bond in October 2001, however, directly affecting how the discount rate is calculated.

Beginning on February 18, 2002, Treasury ceased publication of the 30-year constant maturity series. Instead, Treasury publishes a Long-Term Average Rate and a linear extrapolation factor that can be added to the Long-Term Average Rate to allow interested parties to compute an estimated 30-year rate.[15] BPD staff told us that BPD is still considering how to reflect this change in the model's "discount factor."

Other Model Features Could Affect the Reliability of Model Results

The model coding contains additional inaccuracies that, in comparison to the present value inaccuracy, appear to have a minor impact. Also, the model's use of older software and lack of controls over changes may allow additional errors to remain undetected.

A coding error in the *bonds redeemed* calculation occurs in some denominations for both submodels. From the time of issuance through 4 months outstanding, the formula uses the probability of redemption for the month following the correct month. BPD staff told us this error occurred during model maintenance by BPD staff. Additionally, BPD staff told us that this error would be corrected (app. IV describes the correction for this calculation).

Another inaccuracy involves the redemption value calculation in the Series I submodel. The calculation there does not match the savings bond regulations since the redemption value does not reflect the accrued value at the beginning of each semiannual period.

[15]The Long-Term Average Rate is the arithmetic average of the bid yields on all outstanding fixed-coupon securities (i.e., excludes inflation-indexed securities) with 25 years or more remaining to maturity. This series first appeared on February 19, 2002, following discontinuation of the 30-year Treasury constant maturity series.

In addition, the savings bond cost-effectiveness model is maintained in older software.[16] Use of the older software can be appropriate, but does increase the difficulty in maintaining and updating the model without introducing errors. As noted above, BPD acknowledged one such error. BPD staff told us that they have not moved the model into current software because of concerns that the software's features used to calculate the scenario effects of program changes will not function properly.

During the course of our review, we also found that the model contained unlabeled and undocumented data fields. BPD staff told us that these fields were remnants of scenarios that staff had run on the model in the past, which were accidentally left in the model when it was sent to us for review. One aspect of an effective general control and application environment is the protection of data, files, and programs from unauthorized access, modification, and destruction. BPD staff could, by saving scenario data in the master model file, inadvertently add, alter, or delete sensitive data or coding.

BPD Has Not Requested an Independent External Review of the Model

While OMB guidance calls for an independent external review of cost-effectiveness models, as well as assessments of their accuracy and reliability, BPD has not commissioned such analysis. As a result, BPD cannot assess the accuracy and reliability of the model.

OMB guidelines provide elements for a cost-effectiveness analysis and promote subjecting such analyses to independent external reviews. Verification and explicit assumptions are two of the four elements OMB identified for a cost-effectiveness analysis. OMB states that verification through retrospective studies to determine whether anticipated benefits and costs have been realized are potentially valuable. Such studies can be used to determine necessary corrections in existing programs, and to improve future estimates of benefits and costs in these programs. Agencies should have a plan for periodic, results-oriented evaluation of program effectiveness. OMB adds that a cost-effectiveness analysis should be explicit about the underlying assumptions used to arrive at estimates of future benefits and costs and include a statement of the assumptions, the rationale behind them, and a review of their strengths and weaknesses. Key

[16]The model is maintained in version 5 of a spreadsheet program that is currently marketed in version 9.

data and results should be reported to promote independent analysis and review.

OMB guidance also acknowledges that estimates are typically uncertain because of imprecision in both underlying data and modeling assumptions and states that analyses should attempt to characterize the sources and nature of uncertainty. In analyzing uncertain data, objective estimates of probabilities, such as those derived from market data, should be used whenever possible. Any limitations of the analysis because of uncertainty or biases surrounding the data or assumptions should be discussed. In addition, major assumptions should be varied and net present value and other outcomes recomputed to determine how sensitive outcomes are to changes in the assumptions. In general, sensitivity analysis should be considered for estimates of benefits and costs, the discount rate, the general inflation rate, and distributional assumptions of probabilities. Models used in the analysis should be well documented and, where possible, available to facilitate independent review.

BPD has not independently verified the cost-effectiveness model. According to BPD officials, a survey and investigations team from the House Committee on Appropriations, which visited BPD's Parkersburg, West Virginia, location in 1996, conducted the only review of the savings bond cost-effectiveness model. Since the team did not initiate further inquiry, BPD officials said they assumed that the team had found no issues requiring further review and discussion. Although BPD and Treasury officials have maintained in congressional testimonies and in a recent report that the model results are accurate, to date neither BPD nor Treasury has requested an independent external review to validate the savings bond cost-effectiveness model. Further, while BPD has used the model to estimate the potential effects of changes in the savings bond program, it has not sought to conduct any sensitivity analysis that could reveal the model's limitations.

Conclusions

Our review of BPD's savings bond cost-effectiveness model indicates that the model's results do not provide BPD, Treasury, OMB, or Congress appropriate information to assess the relative costs of the savings bond program versus marketable Treasury securities as a source of raising funds. Although the model was intended to compare savings bonds and marketable Treasury securities on a present value basis, the model's comparison is not based on present values and thus does not follow OMB guidance and common financial economics practice. As previously

discussed, a discount factor brings future costs and revenues into present value terms to permit comparisons. While the model calculates a value that BPD terms a "discount factor," the calculation is incorrect and, as a result, the model does not correctly calculate the present value of the alternatives. In addition, this calculated value is not applied consistent with the model's conceptual design and OMB guidance. Therefore the cost-effectiveness ratio that the model creates does not provide BPD with the information it needs to assess the relative costs of the savings bond program and marketable Treasury securities to determine which financing approach offers a greater financial benefit to Treasury.

The model also uses data that may not be reliable. In particular, the probabilities of redemption for the Series EE bond are 10 years out of date and BPD has not estimated any probabilities of redemption that have any direct relation to the Series I bond redemption patterns since 1998 when these bonds were first introduced. The model also incorporates a time horizon that extends beyond the life cycles of either security and distorts the cost-effectiveness analysis, allowing a longer time period for the administrative costs of savings bonds to be offset. Finally, the reduction in the tax recovery rate to reflect the education bond program is not based on actual program experience and may be over- or underestimating the financial impact of the program to Treasury.

Given that the model uses data that may not be reliable and BPD has not decided how to reflect the discontinuance of the 30-year constant maturity series in the model's "discount factor," we did not make corrections to the model. As a result, we do not know to what degree the present value errors and these data affect the model's cost-effectiveness ratio.

BPD's ability to assess the impact of policy changes to the savings bond program, project cost centers for the savings bond program, and determine cost-effectiveness in relation to marketable Treasury securities is hampered by fundamental errors in the present value calculations. When combined with model data that may not be reliable, the need for independent reviews of cost-effectiveness and sensitivity analyses, which are called for in OMB Circular A-94, becomes particularly important.

Recommendations

Because of the importance of measuring the cost-effectiveness of financing mechanisms used to fund the operations of the federal government, we recommend that the Secretary of the Treasury direct that the Commissioner of the Public Debt in conjunction with Treasury's Office of

Domestic Finance revise the savings bond cost-effectiveness model to estimate the relative (or net) present value of the life cycle costs of issuing savings bonds versus marketable Treasury securities.

As part of that revision, the Commissioner should do the following:

- Update the Series EE probabilities of redemption to capture any changes in redemption patterns caused by the proliferation of financial products or interest rate changes in the last 10 years. At a minimum, Treasury and BPD should collect data for a sample of the more recent time period to test the validity of the 1957-93 data.
- Base Series I bond redemption patterns on actual experience with those bonds.
- Validate the cost estimate of education bond program participation based on the historical, 12-year data to date.
- Replace the 30-year equivalent marketable rate.
- Update the software used for the model to enhance BPD's ability to maintain the model and protect against unauthorized modification.
- Put in place a process for ongoing verification, sensitivity analysis, and independent external review of the model.

Agency Comments and Our Evaluation

In a June 4, 2003, letter commenting on a draft of this report, the Commissioner of the Public Debt wrote that the cost-effectiveness model conformed to OMB Circular A-94, sec. 5b, since it "measures Treasury's relative financial benefit from two borrowing options whose overall costs are identical. Treasury's benefit from each alternative is the amount of financing realized at the time borrowing occurs." Noting that the model "is not intended to be a classic present value exercise," the Commissioner explained that the model "compares the present value of a projected stream of payments associated with the sale of savings bonds with the amount realized from the sale." BPD suspects it may have inadvertently misused the terms "discount factor" and "present value" in internal Treasury discussions. Further, BPD said that we did not understand the model's life-cycle duration, the minimum holding period, and the Series I redemption values.

The Commissioner noted that while BPD disagreed with our conclusion that the model's comparisons were invalid, BPD generally agreed with our recommendations for updating the model. However, the Commissioner also noted that, with Treasury's goal of moving toward a totally electronic environment for the savings bond program, "we think it's appropriate for us to shelve the existing model, which is based on paper bonds, and focus our attention on the transition to a fully electronic program."

We disagree with the Commissioner's portrayal of the cost-effectiveness model as measuring "…Treasury's relative financial benefit from two borrowing options whose overall costs are identical." Neither the model documentation nor BPD's public statements are consistent with this explanation. BPD's model documentation explained that the savings bond cost-effectiveness model compares the projected costs for $1 billion of new savings bond borrowing and those for $1 billion in marketable Treasury securities on a present value basis. In March 2002 testimony before the House Appropriations Subcommittee on Treasury, Postal Service, and General Government, the Commissioner described the model as one that "…measures the cost-effectiveness of savings bonds vis-à-vis borrowing equivalent amounts of money with marketable issues. …Our latest calculations indicate that every $1 billion borrowed through Series EE and Series I savings bonds is $35 million less expensive than borrowing with marketable securities." Additionally, the July 2002 report to the House Committees on Appropriations and Financial Services explained the savings bond cost-effectiveness model as one based on a present value analysis:

> The model compares the amount of funds raised by selling a given amount of Series EE and I bonds in various denominations and the present value of the future costs to Treasury in connection with issuing the bonds. If the amount raised is greater than the present value of the future costs associated with the bonds, taking into account administrative costs and tax benefits, then the program is deemed to be cost-effective.

While we agree that an approach comparing the benefits of two approaches having identical costs would be a valid alternative to the present value approach that we described in our report, the model's calculations do not support this analysis. Marketable Treasury securities and savings bonds can be compared by either comparing the costs of raising identical sums using two alternative debt instruments or by comparing the funds raised when the costs of the two instruments are identical. However, if BPD were to base the cost-effectiveness model on a comparison of the "financial benefit from two borrowing options whose overall costs are identical," the key issue that this approach would have to address is that marketable

Treasury securities and savings bonds do not necessarily have identical overall costs.

The challenge of this modeling approach would be to appropriately measure costs over time of the two options in a way that would permit treating the costs as identical. Since the costs vary over time, accurately calculating the present value of the costs of the two options would be an essential step. However, we did not find, for reasons noted in the report, that the model accurately or reliably calculates the present value of the stream of costs associated with the sale of savings bonds. In particular, the report explains that the discount rate used to calculate the present value of the projected stream of costs is inappropriate.

We have changed the report to recognize that BPD allocates a small number of redemptions prior to 6 months to reflect hardship waivers; these waivers are not discussed in BPD's model documentation. We have not, however, changed the report in response to the Commissioner's statements regarding life cycle costs and Series I redemption values. As the report notes, the 20-year extension on the life cycle appears to be inconsistent with regulations that provide that bonds for which no claims have been filed within 10 years of the maturity date are presumed to have been properly paid. Our analysis of the Series I savings bond redemption value found that the formula does not correctly recognize the savings bond's accrued value at the beginning of each semiannual period.

The Commissioner's letter noted that BPD generally agrees with the recommendations for updating the model, but that BPD believes it appropriate to "shelve" the existing model and focus on the transition to a fully electronic retail securities program. We agree that the importance of many administrative costs will decline if BPD successfully transforms the current paper-based savings bond program to an electronic environment. Further, there may be changes in investors' purchases and redemptions of savings bonds in an electronic environment.

However, important differences will continue to exist between the costs of savings bonds and marketable Treasury securities, particularly the payment of coupons and the tax treatment of the two debt instruments. A model that accurately recognizes these differences will continue to be as crucial to understanding the relative cost-effectiveness of the two debt instruments as it is in the current paper-based environment. That model, furthermore, will have to be updated regularly to reflect the effect of any changes in investor preferences and behavior on the savings bond program

as it moves into this new electronic environment. Our recommendations will remain appropriate for assessing the cost-effectiveness of the savings bond program managed in an electronic environment.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its date. At that time, we will send copies to the Secretary of the Treasury, the Treasury Under Secretary for Domestic Finance, and the Commissioner of the Public Debt. Copies will be made available to others upon request. In addition, this report is also available at no charge on GAO's Web site at http://www.gao.gov.

If you have any further questions, please call me at (202) 512-8678 or mccoolt@gao.gov or James M. McDermott, Assistant Director, at (202) 512-5373 or mcdermottjm@gao.gov.

Sincerely yours,

Thomas J. McCool
Managing Director, Financial Markets
and Community Investment

Objectives, Scope, and Methodology

To assess the savings bond cost-effectiveness model, we obtained an electronic copy of the model as of fiscal year 2001 in addition to hard-copy background and supporting documentation. Given that the model is maintained in older software, Lotus 1-2-3 version 5, we reviewed the model using the same program and version to avoid corruption or translation errors. We then identified and reviewed the various regulations regarding the Series EE and Series I savings bond structure on which the cost-effectiveness model is based. In addition, we reviewed relevant portions of Internal Revenue Service publications regarding the tax implications of the savings bond program. We compared these information sources with the model coding to verify that the calculations reflect the structure of the savings bond program.

To determine if the model constructed a present value comparison, we analyzed the model coding and supplied documentation to determine if (1) the model's design matched Office of Management and Budget and conventional approaches and (2) the model's calculations accurately implement the model's design to arrive at a present value comparison.

Given that the model calculations did not result in a present value comparison, we did not assess the accuracy or completeness of the data input used in the various model parameters and assumptions. As a result, we do not know what effect such data had on the model's cost-effectiveness calculation.

We conducted our work in Washington, D.C., from September 2002 through April 2003 in accordance with generally accepted government auditing standards.

Present Value Theory and Model Calculations

The present value of a bond (or, bond price) is equal to the present value of its expected cash flows (any coupons plus maturity value). Each cash flow must be discounted at the relevant rate for the time period.

t		0	1	2	3	...	n-1	n	n+1	...
discount rate			$r_{0,1}$	$r_{1,2}$	$r_{2,3}$	...	$r_{n-2,n-1}$	$r_{n-1,n}$	$r_{n,n+1}$	...
cash flows										
	coupon	0	C_1	C_2	C_3	...	C_{n-1}	C_n	0	...
	face	0	0	0	0	...	0	M	0	...

Here, t represents time, where $t = 0$ represents the present moment, $t = 1$ represents the end of the first period, $t = 2$ represents the end of the second period, and so on. A given cash flow is specified to occur at the end of the given period. The discount rate, $r_{s-1,s}$, is the appropriate one-period discount rate from $s - 1$ to s, at $t = s$ (for $s = 1, \ldots, n$).[1] The appropriate one-period discount factor (or deflator) is as follows:

$$\frac{1}{(1 + r_{s-1,s})}$$

For example, to determine the value of C_1 at $t = 0$, the appropriate discount rate is $r_{0,1}$ and the appropriate one-period discount factor is as follows:[2]

$\frac{1}{(1 + r_{0,1})}$; thus the present value at $t = 0$ of C_1 received at $t = 1$ is: $\frac{C_1}{(1 + r_{0,1})}$

For the cash flows specified in the above table, which are designed to mimic the cash flows of an n-period bond paying coupon C_s at $t = s$ (for $s = 1, \ldots, n$) and M at maturity, $t = n$, the present value at $t = 0$ is as follows:

[1]In many explanations of present value, the discount rate is held constant, removing the need for $r_{s-1,s}$ to vary over time.

[2]The factor that translates expected benefits or costs in any given future year into present value terms.

$$PV_{t=0}\,(\text{coupon} + \text{face}) = \sum_{t=1}^{\eta} \left[\frac{C_t}{\prod_{s=1}^{t} (1 + r_{s-1,s})} \right] + \frac{M}{\prod_{t=1}^{\eta} (1 + r_{t-1,t})}$$, in which

$$\prod_{s=1}^{t} (1 + r_{s-1,s}) = (1 + r_{0,1})*(1 + r_{1,2})*...*(1 + r_{t-1,t})$$ for some t >2, for example.

Based on the above table, the following illustrations assume that the periods correspond to years (for example t = 1 represents the end of the first year).

The present value of a one-period (that is 1-year) bond is as follows:

$$PV = \frac{C_1}{(1 + r_{0,1})} + \frac{M}{(1 + r_{0,1})}$$

The present value of a two-period bond is as follows:

$$PV = \frac{C_1}{(1 + r_{0,1})} + \frac{C_2}{(1 + r_{0,1})(1 + r_{1,2})} + \frac{M}{(1 + r_{0,1})(1 + r_{1,2})}$$

Note that if r is identical through all time periods, such that $r = r_{0,1} = r_{1,2}$, the above two-time period present value is equivalent to the following:

$$PV = \frac{C_1}{(1 + r)} + \frac{C_2}{(1 + r)^2} + \frac{M}{(1 + r)^2}$$

The present value of a three-period bond is as follows:

$$PV = \frac{C_1}{(1 + r_{0,1})} + \frac{C_2}{(1 + r_{0,1})(1 + r_{1,2})} + \frac{C_3}{(1 + r_{0,1})(1 + r_{1,2})(1 + r_{2,3})} + \frac{M}{(1 + r_{0,1})(1 + r_{1,2})(1 + r_{2,3})}$$

In the illustrations above, the rate or rates used to discount each component is relevant to the time period.

Model Calculation for the "Present Value" of the Marketable Treasury Alternative

Based on model documentation, the coupon payments are subtracted to reflect that the coupon payments on the Treasury alternative would reduce the benefit Treasury would receive from the initial security.

Redemption Value_n substituted for M in the prior equation, where n = months outstanding

Redemption $\text{Value}_n * r_n$ substituted for C in the prior equation, where n = months outstanding
r_n = Monthly after-tax "discount rate" (derived from CMT), where n = months outstanding

The "present value" of a 1-month marketable alternative is calculated as follows:

$$PV = \text{Redemption Value}_1 - \frac{\text{Redemption Value}_1 * r_1}{(1 + r_1)}$$

However, the "present value" of a 2-month marketable alternative is calculated as follows:

$$PV = \text{Redemption Value}_2 - \left[\frac{\text{Redemption Value}_2 * r_2}{(1 + r_2)} + \frac{\text{Redemption Value}_2 * r_2}{(1 + r_2)(1 + r_1)}\right]$$

Further, the "present value" of a 3-month marketable alternative is calculated as follows:

$$PV = \text{Redemption Value}_3 - \left[\frac{\text{Redemption Value}_3 * r_3}{(1 + r_3)} + \frac{\text{Redemption Value}_3 * r_3}{(1 + r_3)(1 + r_2)} + \frac{\text{Redemption Value}_3 * r_3}{(1 + r_3)(1 + r_2)(1 + r_1)}\right]$$

The discounting is incorrect in the model, and is carried through for periods two and greater. Appendix IV provides a more detailed discussion of the model calculations, including the monthly after-tax "discount rate" mentioned above.

Future Value Examples for Series EE and Series I Savings Bonds for Bonds 5 Years and Older

All calculations of interest are based on a hypothetical savings bond with a denomination of $25,[1] such that for the following:

Series EE, $FV = PV * \{[1+(i/2)]^{(m/6)}\}$

Example: An EE savings bond rate of 5.07 percent will result in a newly purchased hypothetical $25 bond increasing in value after 6 months to $12.82, when rounded to the nearest cent.

At the beginning of the first semiannual rate period, the present value (PV) is equal to $12.50 such that

Month 1: $FV = 12.50 * \{[1 + (.0507/2)]^{(1/6)} = 12.55$
Month 2: $FV = 12.50 * \{[1 + (.0507/2)]^{(2/6)} = 12.60$
Month 3: $FV = 12.50 * \{[1 + (.0507/2)]^{(3/6)} = 12.66$
Month 4: $FV = 12.50 * \{[1 + (.0507/2)]^{(4/6)} = 12.71$
Month 5: $FV = 12.50 * \{[1 + (.0507/2)]^{(5/6)} = 12.76$
Month 6: $FV = 12.50 * \{[1 + (.0507/2)]^{(6/6)} = 12.82$

Thus, a $5,000 bond purchased at the same time as the hypothetical $25 bond will be worth $2,564 after 6 months ([$5,000 ÷ $25] x $12.82 = $2,564).

The PV variable changes in months 7 through 12 such that the PV is equal to the redemption value at the beginning of the semiannual rate period, which in the above example is equal to month 6 future value (FV) such that

Month 7: $FV = 12.82 * \{[1 + (.0507/2)]^{(1/6)} = 12.87$
Month 8: $FV = 12.82 * \{[1 + (.0507/2)]^{(2/6)} = 12.93$
Month 9: $FV = 12.82 * \{[1 + (.0507/2)]^{(3/6)} = 12.98$
Month 10: $FV = 12.82 * \{[1 + (.0507/2)]^{(4/6)} = 13.04$
Month 11: $FV = 12.82 * \{[1 + (.0507/2)]^{(5/6)} = 13.09$
Month 12: $FV = 12.82 * \{[1 + (.0507/2)]^{(6/6)} = 13.14$

The PV variable changes in months 13 through 18 such that the PV is equal to the redemption value at the beginning of the semiannual rate period, which in the above example is equal to month 12 FV, and so on.

Sources: 31C.F.R. § 351.2-(k)(4)(ii)(A), U.S. Savings Bond Series EE Information Statement for bonds issued May 1997 or later, and GAO analysis.

Note: Savings bonds are subject to a 12-month holding period and those redeemed before 5 years are subject to a 3-month interest penalty.

[1]Series EE - 31C.F.R. §351.2-(k)(1)(iii); Series I – 31C.F.R. § 359.2-(e)(1)(vi).

Series I, $FV = PV * \{[1+(CR/2)]^{(m/6)}\}$

Example: An I composite rate of 5.07 percent will result in a newly purchased hypothetical $25 bond increasing in value after 6 months to $25.63, when rounded to the nearest cent.

At the beginning of the first semiannual rate period, the PV is equal to $25 such that

Month 1: $FV = 25 * \{[1 + (.0507/2)]^{(1/6)} = 25.10$
Month 2: $FV = 25 * \{[1 + (.0507/2)]^{(2/6)} = 25.21$
Month 3: $FV = 25 * \{[1 + (.0507/2)]^{(3/6)} = 25.31$
Month 4: $FV = 25 * \{[1 + (.0507/2)]^{(4/6)} = 25.42$
Month 5: $FV = 25 * \{[1 + (.0507/2)]^{(5/6)} = 25.53$
Month 6: $FV = 25 * \{[1 + (.0507/2)]^{(6/6)} = 25.63$

Thus, a $5,000 bond purchased at the same time as the hypothetical $25 bond will be worth $5,126 after 6 months ([$5,000 ÷ $25] x $25.63 = $5,126).

The PV variable changes in months 7 through 12 such that the PV is equal to the redemption value at the beginning of the semiannual rate period, which in the above example is equal to month 6 FV such that

Month 7: $FV = 25.63 * \{[1 + (.0507/2)]^{(1/6)} = 25.74$
Month 8: $FV = 25.63 * \{[1 + (.0507/2)]^{(2/6)} = 25.84$
Month 9: $FV = 25.63 * \{[1 + (.0507/2)]^{(3/6)} = 25.95$
Month 10: $FV = 25.63 * \{[1 + (.0507/2)]^{(4/6)} = 26.06$
Month 11: $FV = 25.63 * \{[1 + (.0507/2)]^{(5/6)} = 26.17$
Month 12: $FV = 25.63 * \{[1 + (.0507/2)]^{(6/6)} = 26.28$

The PV variable changes in months 13 through 18 such that the PV is equal to the redemption value at the beginning of the semiannual rate period, which in the above example is equal to month 12 FV, and so on.

Sources: 31C.F.R. § 359.2-(e)(4)(ii)(A), U.S. Savings Bond Series I Information Statement, and GAO analysis.

Note: Savings bonds are subject to a 12-month holding period and those redeemed before 5 years are subject to a 3-month interest penalty.

Model Calculations Detail

The cost-effectiveness calculations in the Series EE and Series I submodels, as well as preceding steps, are similar; coding changes are due to the different structures of the two series, as noted in table 3, and modeling errors, as previously discussed. Though not shown here, both submodel calculations for savings bond redemption value incorporate the 3-month interest penalty for bonds redeemed before 5 years from issue.

Calculations for Marketable Treasury "Present Value" — Five Steps

Where n = months outstanding

Step 1: Savings bond redemption $value_n$ respective to denomination (as previously shown in table 3).

Step 2: Savings bond redemption $value_n$ after unit cost to redeem and tax revenue implications = Adjusted Redemption $Value_n$:
Redemption $Value_n$ – ((Redemption $Value_n$ – savings bond issue price) * savings bond tax recovery rate) + unit cost to redeem[1]

Step 3: Algebraic after-tax "present value discount factor"$_n$ (comprising several component calculations):

3a. after-tax semiannual CMT_n = (6-month average of $CMT_n/2$) * (1 – tax recovery rate)

3b. after-tax semiannual CMT_n expressed as a monthly rate = Y_n = ((after-tax semiannual CMT_n + 1) ^ $^{(1/6)}$) – 1

3c. Y_n algebraic conversion leading to after-tax "present value discount factor":

3c.1. $S_n = 1/(1 + Y_n)$

3.c.2 Month 1 FAC (that is, FAC_1) = S_1; for all other n, $FAC_n = S_n * (FAC_{n-1} + 1)$

3d. After-tax "present value discount factor"$_n$ = $FACT_n = 1 – (Y_n * FAC_n)$

Step 4: Algebraic after-tax "present value discount factor"$_n$ expressed as a monthly rate: Ie_n = (((1/$FACT_n$) ^ $^{(1/n)}$) – 1)

[1]Adjusted for the education bond program such that savings bond tax recovery = tax recovery rate provided by the Treasury's Office of Tax Policy * (1 - .10).

Step 5: Treasury "present value"$_n$: Adjusted Redemption Value$_n$ / (1 + Ie$_n$) ^ ^{n}

The resulting marketable Treasury "present value"$_n$ = Adjusted Redemption Value$_n$ * FACT$_n$, which returns the following:

Month 1 marketable Treasury "present value" = Adjusted Redemption Value$_1$ - Adjusted Redemption Value$_1$ * Y_1 / (1 + Y_1)

Month 2 marketable Treasury "present value" = Adjusted Redemption Value$_2$ – [Adjusted Redemption Value$_2$ * Y_2 / (1 + Y_2) + Adjusted Redemption Value$_2$ * Y_2 / (1 + Y_2)(1 + Y_1)], and so on.

Calculation for Savings Bond "Present Value" — One Step

Savings bond issue price respective to denomination – savings bond unit cost to issue

Calculations for Cost-effectiveness Ratio — Six Steps

Where n = months outstanding

Step 1: "present value" difference$_n$
Savings bond "present value" - marketable Treasury "present value"$_n$

Step 2: Bonds redeemed$_n$:
Month 0 bonds redeemed = probability of redemption$_0$ * savings bond sales volume respective to denomination

Month 1 bonds redeemed = probability of redemption$_1$ * (savings bond sales volume respective to denomination – bonds redeemed$_0$); for all other bonds redeemed$_n$ = probability of redemption$_n$ * (savings bond sales volume respective to denomination – bonds redeemed$_{0..n}$)

Step 3: Projected "present value" difference$_n$:
"present value" difference$_n$ * bonds redeemed$_n$

Step 4: Cumulative projected "present value" difference:
Month 0 cumulative projected "present value" difference = projected "present value" difference$_0$; for all other cumulative projected "present value" difference$_n$ = projected "present value" difference$_n$ + cumulative projected "present value" difference$_{n-1}$

Step 5: Bonds outstanding$_n$:
Month 0 bonds outstanding = sales volume respective to denomination – bonds redeemed$_0$; for all other bonds outstanding$_n$ = bonds outstanding$_{n-1}$ - bonds redeemed$_n$

Step 6: Cost-effectiveness ratio for each denomination (comprising several component calculations):

6a. (cumulative projected "present value" difference$_{50\ years}$ – pieces outstanding$_{50\ years}$ * savings bond unit cost to issue)

6b. (sales volume respective to denomination * savings bond issue price)

6c. (result of 6a. / results of 6b.) * 1,000

The resulting cost-effectiveness calculation returns a ratio of millions saved per $1 billion borrowed.

Additional Calculations That Are Not Relevant to the Model's Cost-effectiveness Calculation

Though not detailed above, the model includes five calculations that do not produce output relevant to the cost-effectiveness calculation.

In addition, the model performs an additional step in the after-tax "present value discount factor" calculation that is not necessary. The model creates an after-tax "present value discount factor" expressed as a monthly rate, shown above as step 4 in the calculations for the marketable Treasury "present value." Step 5, as shown above in the calculations for the marketable Treasury "present value," reverses this calculation through the 30-year life cycle of the marketable Treasury alternative.

Comments from the Bureau of the Public Debt

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DEPARTMENT OF THE TREASURY
BUREAU OF THE PUBLIC DEBT
WASHINGTON, DC 20239-0001

June 4, 2003

Thomas J. McCool, Managing Director,
Financial Markets and Community Investment
General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Mr. McCool:

Thank you for the opportunity to review and comment on your draft report GAO-03-513, *SAVINGS BONDS: Actions Needed to Increase The Reliability of Cost-effectiveness Measures*. Although we have comments on a number of points in the draft report, we'll focus first on the overall concept of the model.

As we understand it, the draft report's primary finding is that our analysis doesn't accurately calculate the present value of our financing options; as a result, our comparisons are not valid. The draft report implies there is a single standard established in government guidelines for analysis of this type. We see this differently and would like to clarify our approach.

The draft report suggests we compare the relative costs of two financing alternatives that achieve the same benefit to Treasury. It states that, in accordance with OMB Circular A-94, we should identify all costs for the two options and discount them to present value. Cost-effectiveness would be expressed as the difference between these discounted costs. The draft report indicates that, absent this approach, the model's results are insufficient to assess the relative costs of savings bonds and marketable Treasury securities.

Our analysis, however, uses another approach that is itself accepted under OMB's guidelines (Circular A-94, Section 5b). Rather than define cost-effectiveness as a measure of costs between alternatives, the model measures Treasury's relative financial benefit from two borrowing options whose overall costs are identical. Treasury's benefit from each alternative is the amount of financing realized at the time borrowing occurs.

We believe this critical difference between the model's design and your expectations may have fostered further misunderstanding about the time value of our estimates. The draft report indicates that our estimates of present value depart from accepted discounting practice. The model, however, is not intended to be a classic present value exercise. It is designed to compare Treasury's current benefit from each of two borrowing options. The comparable benefits are the amount of current financing realized from borrowing decisions in two distinct instruments that result in identical payout at some point in the future. Since the financing is realized immediately and not in the future, our approach does not require discounting of the benefit estimates. Another way of looking at the model is that it compares the present value of a projected stream of payments associated with the sale of savings bonds with the amount realized from the sale.

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The present value of the payments can be viewed as the amount realized from the sale of a basket of zero-coupon securities whose maturing values match the projected savings bond payments.

Perhaps we've inadvertently contributed to this misinterpretation through use of the terms, *discount factor* and *present value*. We agree that our analytical mechanics don't match up with classic definitions of these expressions. This has never been a problem during internal discussions within Treasury — use of these shorthand terms has been understood within the context of the model's workings. In conversations outside of Treasury, we've added another potential source of confusion by referring to savings bonds as something that "costs less" rather than something that "benefits more." We suspect that our informal use of otherwise precise terms may detract from a clear picture of the model's design. For a fuller explanation of the model's intent, please see the attached discussion.

Beyond the basic concepts, we'd like to note a few other aspects of the model that appear to have been misunderstood. (These points are also covered more fully in the attached discussion.)

- Life cycle costs. The draft report expresses concerns about the model's savings bond life cycle duration and whether we incorporate all costs into our analysis. We use a 50-year duration that is consistent with actual investor behavior and our policy to pay all bonds properly presented, even if they're years beyond maturity. Also, we believe the model captures all program costs to the government, including administrative costs, interest costs, and deferred taxes.
- Minimum holding period. The draft report suggests that our analysis incorrectly reflects our minimum holding requirements for savings bonds. The model that we shared with you reflects the 6-month minimum holding period in effect prior to February 2003 and provides for bonds redeemed early under hardship waivers.
- Series I redemption values. The draft report suggests that the model's Series I redemption values do not reflect the security's accrual feature. The model appropriately recognizes a bond's accrued value at the start of each semiannual period as the basis of interest accrual. We accomplish this through a compound interest formula that calculates from issue date to redemption date, compounding semiannually.

Although we disagree with the draft report's conclusion that the model's comparisons are not valid, we generally agree with the draft report's recommendations for updating the model's parameters:

- Update redemption probabilities. We see the benefit of updating our redemption probabilities to incorporate our experience over the past decade.
- Redemption patterns for Series I bonds. While it may be difficult to extrapolate a 30-year pattern from 5 years of experience, we agree it's time to incorporate what we know about I bond redemptions into our analysis.
- Validate education bond participation. Education bond is a tax benefit feature that is still maturing; participation doesn't occur until investors actually redeem their bonds. Since the feature probably won't reach its full participation level for several more years, we use a participation rate (10% of all interest) that we believe overstates the cost of the savings

2

bond program. But we agree that it's time to review this estimate against current experience.

- Replace the 30-year constant maturity yield. We recognize the need to replace the discontinued 30-year yield among the Treasury yields we use to price the marketable alternative.
- Update software. We remain confident in our ability to maintain and control the model in its current software. But we agree that we should upgrade to current software in the future.
- Verification, sensitivity analysis, and independent review. We agree that our analysis would benefit from the support measures provided by verification, sensitivity analysis, and independent review. We will look into ways to incorporate these elements into our process.

Finally, we'd like to share our thoughts about the future utility of the savings bond cost-effectiveness model. We recently publicized our goal to move away from paper securities and toward an all-electronic environment for our retail securities programs. The significant business changes brought about by an all-electronic environment should greatly improve the savings bond program's efficiency. Given our strategic direction, we think it's appropriate for us to shelve the existing model, which is based on paper bonds, and focus our attention on the transition to a fully electronic program. As the transition unfolds, it may be appropriate to develop a cost-effectiveness model for this new environment at some point in the future. If for some reason, however, it becomes necessary for us to reexamine the cost-effectiveness of paper savings bonds, we'll incorporate your recommendations into our current model.

We hope that our comments will shed more light on the model's conceptual design, the mechanics to implement it, and its compliance with OMB's guidelines for this type of analysis. We stand ready to address any additional questions you or your staff may have.

Sincerely,

Van Zeck
Commissioner

Enclosure

3

See comment 1.

Savings Bond Cost-Effectiveness Model

In draft report GAO-03-513, *SAVINGS BONDS: Actions Needed to Increase The Reliability of Cost-effectiveness Measures*, the General Accounting Office's primary finding appears to be that savings bond cost-effectiveness analysis doesn't accurately calculate the present value of Treasury's financing options; as a result, our comparisons are not valid. The draft report implies there is a single standard established in government guidelines for analysis of this type. We see this differently and would like to clarify our approach.

Expected analysis. The draft report suggests we compare the relative costs of two financing alternatives that achieve the same benefit to Treasury. It states that, in accordance with OMB Circular A-94, we should identify all costs for the two options and discount them to present value. Cost-effectiveness would be expressed as the difference between these discounted costs. The draft report indicates that, absent this approach, the model's results are insufficient to assess the relative costs of savings bonds and marketable Treasury securities.

Savings bond cost-effectiveness model's intent. Our analysis, however, uses another approach that is itself accepted under OMB's guidelines (Circular A-94, Section 5b). Rather than define cost-effectiveness as a measure of costs between alternatives, the model measures Treasury's relative *benefit* from two borrowing options whose overall costs are identical. Treasury's benefit from each alternative is the amount of financing realized at the time borrowing occurs.

Savings bond benefit. Treasury's benefit from a savings bond is its issue price — *i.e.*, the amount of financing realized at the point of sale. Since the benefit is realized immediately, there is no need to discount it to present value. The model accounts for administrative cost to issue a bond as a reduction to this benefit. (See the discussion of life cycle costs for a fuller explanation of administrative costs.)

Marketable security benefit. The model's challenge is to determine the benefit that Treasury realizes from a marketable borrowing with overall costs identical to those projected for a given savings bond. Since savings bonds and marketable Treasury securities pay out interest in different ways, some work must be done to construct a marketable payment stream that is identical to that of a savings bond. The model constructs an identical cost alternative with a series of borrowing offsets. The resulting benefit is the composite price for a series of securities.

The analysis begins with the projected net payout of a savings bond at redemption. (Again, see the discussion of life cycle costs for a fuller explanation of this net payout). The goal is to determine the benefit from a marketable security whose maturity and final payout are identical to that of a savings bond. This benefit is the price paid at issue. Here's how we find that price:

1

1) Assume the final payout is comprised of the security's par value plus its final coupon payment.
2) Define the security's coupon rate as equal to its yield.
3) Divide the final payout by (1 + Yield) to determine the security's par value, which is also its price when the security's coupon rate equals its yield.

This analysis gives us the principal amount (price) of a marketable security with a payout at some date in the future that is identical to that of a savings bond. However, we can't yet say that these two securities have identical life cycle costs — the marketable security also has coupon payments prior to maturity. To establish equivalent costs between these two options, the model reduces Treasury's current benefit for marketable securities to account for the fact that marketable securities pay periodic coupons and savings bonds do not. The model effectively offsets each of these coupon payments by assuming that Treasury forgoes another borrowing. Each forgone borrowing reduces the overall benefit that Treasury would otherwise receive from the initial marketable security.

Here's a simple example (illustrated in the table below) to demonstrate this offset arrangement. The example assumes:

- A savings bond issued today will be worth $1,000 (principal plus interest) when it's cashed four years from now. Its interest rate is 3.00%, compounded annually.
- A marketable security yielding 4.00% and paying $1,000 (par value plus final coupon) at its four-year maturity provides a time-equivalent and cost-equivalent alternative. The security pays coupons annually.
- To establish equivalent costs between these two options, Treasury would have to forgo other borrowing (one "security" for each intervening coupon) to offset the coupon payments due prior to maturity.
- Each of these forgone borrowings reduces the overall benefit that Treasury would otherwise receive from the initial security.
- A forgone three-year security yielding 3.00% offsets the third coupon as well as a portion of the first two.
- A forgone two-year security yielding 2.00% offsets most of the second coupon and a portion of the first.
- A forgone one-year security yielding 1.00% offsets most of the first coupon.

Security Description				Security Payout at The End of Year...			
Type	Maturity	Yield	Principal	1	2	3	4
Savings bond	4	3.00%	888.49	0.00	0.00	0.00	1,000.00
Marketable security	4	4.00%	961.54	38.46	38.46	38.46	1,000.00
Forgone security #1	3	3.00%	-37.34	-1.12	-1.12	-38.46	0.00
Forgone security #2	2	2.00%	-36.61	-0.73	-37.34	0.00	0.00
Forgone security #3	1	1.00%	-36.25	-36.61	0.00	0.00	0.00
Total Marketable securities			851.34	0.00	0.00	0.00	1,000.00

	Savings Bond	Marketable Securities	Net
Treasury's current benefit	888.49	851.34	37.15

2

The four-year security, together with three forgone securities, provides a repayment stream that exactly matches the savings bond. Each forgone security's payout is designed to offset the intervening coupons. For example, the first forgone security must offset $38.46 at three years. At a yield of 3.00%, it can do this with $37.34 in par value plus $1.12 as a final coupon. This security completely offsets the original security's third coupon; it also offsets a portion ($1.12) of each of the first two coupons.

Treasury's benefit from this series of marketable securities is $851.34 — the price of a security that would actually be issued minus the combined prices of securities Treasury would forgo to establish overall costs equal to those of the savings bond alternative. In this example, Treasury would benefit $37.15 more from a savings bond than it would from a marketable borrowing with an identical payment stream. We define this net benefit as the savings bond's cost-effectiveness.

In practical application, this methodology is identical to using theoretical zero-coupon rates to discount projected future savings bond payments to the present. The zero-coupon rates are derived from the Treasury yield curve, under the assumption that each security is sold at par with a coupon rate equal to its yield. The sum of the discounted values of all future payments from the sale of the savings bonds is their present value. To measure the current benefit (or cost) to the Treasury from the sale of savings bonds, the model takes the difference between the amount realized from the sale of the savings bonds and the present value of the projected payments those bonds will generate.

The model and OMB guidance. The savings bond cost-effectiveness model was developed in 1985, seven years before OMB issued cost-effectiveness analysis guidelines in its 1992 revision of Circular A-94. Nonetheless, the model's design complies with OMB's guidance, specifically the circular's Section 5b acceptance of "[c]ost-effectiveness analysis [that] compare[s] programs *with identical costs but differing benefits.*" The model's comparison of borrowing realized from two identical-cost financing options follows this prescription.

Present value and the model's estimates. OMB provides specific guidelines to discount future costs and benefits to present value. The draft report indicates that our estimates of present value fall short of these guidelines. But as we've mentioned, the model is not intended to be a classic present value exercise. It is designed to compare Treasury's current benefit from each of two borrowing options. The comparable benefits are the amount of current financing realized from borrowing decisions in two distinct instruments that result in identical payout at some point in the future. Since the financing is realized immediately and not in the future, our approach does not require discounting these estimates to present value.

Terminology. The model calculates a ratio that is used to derive a composite bond price that estimates Treasury's overall current benefit from marketable borrowing. In the earlier example, this ratio would be 0.85134 (851.34 ÷ 1,000.00). The model calculates this ratio based on the constant maturity yield curve up to and including the payout date. The calculation simulates the series of issued and forgone securities demonstrated in the

3

example. We use the resulting ratio to determine the composite price of an alternative marketable borrowing arrangement.

Since we apply this ratio in similar fashion, we've come to commonly refer to it as a "discount factor" and to the composite price as the "present value." Perhaps our informal usage of these otherwise precise terms has contributed to confusion about the model's intent. This has never been a problem during internal discussions within Treasury — use of these shorthand terms has been understood within the context of the model's workings. In conversations outside of Treasury, we've added another potential source of confusion by referring to savings bonds as something that "costs less" rather than something that "benefits more."

See comment 2.

Life cycle costs. The draft report expresses concern about the model's savings bond life cycle duration. Although a savings bond matures in 30 years, its life cycle continues until the bond is redeemed. Some owners choose to hold bonds longer than 30 years, even though they pass maturity and no longer earn interest. For this reason, the model incorporates redemptions for 20 years beyond final maturity. This treatment mirrors the reality that some payouts do not occur until after bonds mature.

The draft report suggests 20 years is too long to extend the life cycle. The suggestion is based on a perceived contradiction with our policy that honors claims up to 10 years after maturity. But there's a distinct difference between our policy for redemptions and our policy for claims against redemptions. A bond properly presented for payment after maturity will always be honored, regardless of how long ago it matured. On the other hand, we will not investigate a claim to the validity of a paid bond if the claim is filed 10 years or more after the paid bond would otherwise have matured.

The draft report also indicates that we don't incorporate all costs into our analysis. The model includes all federal government costs for issuing, servicing, and redeeming savings bonds. Nothing is excluded. The administrative cost to issue a bond is realized immediately. The model treats it as an immediate offset to the immediate benefit. The cost to redeem a bond is realized at redemption. These costs, therefore, are treated as an addition to the total payout Treasury makes at redemption. Servicing costs (those that occur between issue and redemption) are evenly split between the two events. Finally, the model assumes that all savings bond taxes are deferred until redemption and treats these taxes as an offset to the payout at redemption.

Compared to the amount of borrowing, the appropriated costs for marketable securities are insignificant. The model, therefore, assumes that none exist. Its marketable security cost stream includes principal and interest costs (less taxes) that add up to the total of savings bond principal, interest (less taxes), and administrative costs paid at redemption. The key factor remains that Treasury's overall costs are identical for the two financing options.

See comment 3.

Minimum holding period. The draft report suggests that our analysis incorrectly reflects the savings bond minimum holding requirement. The model, however, is based on a 6-

4

month period in effect at the time we shared it last fall. Beyond that, in cases of personal hardship or in areas of natural disaster, we sometimes waive the holding period and allow early redemptions. The model correctly reflects this reality by allocating a small number of redemptions prior to six months.

The draft report also suggests that the model should account for a 12-month minimum holding period — our policy since February 2003. Unfortunately, this policy wasn't even introduced until after we shared the model last fall. Therefore, it's not possible for us to have accounted for this longer period in the version of the model that was reviewed.

See comment 4.

I bond redemption values. The draft report also states that the model's Series I redemption values do not reflect the accrued value at the beginning of each semiannual period. We disagree. The model recognizes an I bond's accrued value at the start of each semiannual period through the use of a compound interest formula. The model calculates each redemption value from a bond's issue date to its redemption date. The calculation provides semiannual compounding. During each semiannual earning period, therefore, a bond earns interest on its original principal plus interest that accrued through the start of the semiannual period.

June 2003

5

GAO Comments

The following are GAO's comments on the Bureau of the Public Debt's (BPD) letter dated June 4, 2003.

1. As we note in this report's Agency Comments and Our Evaluation section, the approach that BPD outlines here would be an appropriate alternative to the cost-effectiveness model based on a present value analysis described in the report. The description in this report is based on documentation for the cost-effectiveness model that BPD provided in an October 16, 2002, meeting; on a July 2002 report that BPD prepared for the House Committees on Appropriations and on Financial Services; and on March 2002 testimony by the Commissioner of the Public Debt before the House Appropriations Subcommittee on Treasury, Postal Service, and General Government.

2. As we note in the report, the 20-year extension is not consistent with a statement previously made by the Department of the Treasury regarding the presumption of payment 10 years beyond the maturity date.

   We agree that all administrative costs are included in the model. As the report notes, however, the model calculation does not accurately incorporate these costs in computing the present value of the marketable Treasury security and the savings bond.

3. Based on BPD's explanation that redemptions within 6 months of a savings bond's issuance are sometimes granted in hardship cases, we have deleted discussion of their inclusion in the model from the report.

4. As we note in the report, the model's compound interest formula for the Series I bonds does not recognize the bond's accrued value at the beginning of each semiannual period. When calculated out over 30 years, the difference between the formula in the regulation and the model's calculation is minor but still exists.

GAO Contacts and Staff Acknowledgments

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