The Cost of Risk to the Government and Its Implications for Federal Budgeting

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I. Introduction

The idea of "state prices" -- that the value today of a dollar in future purchasing power depends on the future state of nature -- dates back to the classic work of Arrow and Debreu (1954) and Debreu (1959), and is the basis for most neo-classical theories of asset valuation used today. It offers an explanation for why some securities, such as common stocks and risky loans, earn an expected return in excess of the risk-free rate: These securities tend to have high payoffs when the economy is strong and low payoffs when the economy is weak. Since dollars received in good times are worth less in utility terms than in bad times (a result of decreasing marginal utility of wealth), the price of a risky security is less than its expected payoff discounted at the risk-free rate. Equivalently, its expected return is higher than the risk-free rate; there is a market risk premium.

While its widely accepted that investors require a market risk premium, it is less well established that risk should be treated as a cost to the federal government. Furthermore, the price of risk is almost entirely absent from federal budgeting. This practice makes federal credit and some insurance programs appear to cost less than their market value, thereby favoring such assistance over alternatives that are accounted for at market prices. It also gives federal investments in risky securities financed with Treasury debt the appearance of generating free money for the government.

In this paper we revisit the question of the cost of risk to the federal government and its implications, both conceptual and practical, for federal budgeting. We begin in Section 2 with a brief review of the academic literature that speaks directly to the cost. We then

review the economic case for treating market risk as a legitimate cost, and consider how this conclusion is affected by considerations such as the government's ability to improve risk-sharing, transfer wealth across generations, and in general reduce credit market imperfections.

In Section 3, after briefly describing the current budget treatment of credit, insurance, and investments in private securities, we present the budgetary case for including the cost of market risk in budget estimates. An important but often overlooked observation is that the budgetary case for including the cost of risk is related to, but distinct from, the economic case for treating risk as a cost to the government. That is, the question of whether it is socially optimal for the government to make a particular investment may not have the same answer as the question of whether including the market cost of risk in the federal budget makes for more or less level comparisons between different types of expenditures. We conclude that considerations of consistency and transparency favor using market values as budget costs. Alternatives for measuring and accounting for market risk, and some of the practical difficulties involved, are also discussed.

Even if in principle market risk should be included in budget estimates, whether it is worthwhile to modify budgeting practice depends on whether the potential improvements are material. A series of papers by the Congressional Budget Office, and a number of academic studies including several in this volume, provide some evidence on the magnitudes involved. Those findings, reviewed in Section 4, suggests that in some cases the distortion is considerable.

2. Cost of Risk to the Government

2.1 Early Literature

The question of the cost of risk to the government received considerable attention in the mid to late 1960s and early 1970s, but much less has been written on the topic since then.[1] Academic interest during that period arose naturally from recent advances in general equilibrium theory, particularly the contributions of Arrow and Debreu (1954) and Debreu (1959). Those developments allowed more general welfare analyses of policy, underscored both the benefits of risk-sharing and the aggregate limit on risk-sharing, and clarified the role of market prices in aggregating the risk preferences of society. In this vein, Diamond (1967) analyzed an economy with technology risk and a stock market. His conclusions regarding government investment can be paraphrased by saying that if markets are sufficiently complete for stock prices to reflect the social cost of risk, then those prices are also relevant to the government in evaluating its investment policy. In other words, the private cost of capital is a reasonable proxy for the social cost of capital, and the right metric for evaluating government investment decisions. Hirshleifer (1964 and 1966) reached similar conclusions, and argued forcefully for the use of market prices.

[1] A notable exception is Bazelon and Smetters (1999), which also survey some of the earlier literature, and addresses many of the same issues as does this paper.

A distinctly different view of the cost of risk to the government was put forth by other leading economists of the time. In Jorgenson et. al. (1964), Samuelson and Vickrey argue that because of the large and diversified portfolio held by the government, the marginal return from public investment overall is virtually risk-free, and hence should be evaluated at the risk-free rate rather than the higher market rate demanded by less diversified individuals. In a very influential paper, Arrow and Lind (1970) formalize this argument. Specifically, they study a model with complete contingent claims (i.e., complete insurance markets) and no aggregate uncertainty. They conclude that in this setting, the social and private discount rate is equated at the risk-free rate. They further show that even when markets are incomplete, the cost of risk-bearing to taxpayers goes to zero as the number of taxpayers becomes large and the share of risk borne by each diminishes.

Arrow and Lind acknowledge that these conclusions depend on the assumption that government investment entails no aggregate risk: "The results…depend on returns from a given public investment being independent of other components of national income." They defend this assumption as plausible, asserting that correlated risk is likely to be insignificant for many government investments. This is also noted by Sandmo (1972), who writes that the Hirshleifer view can be reconciled with Arrow and Lind's conclusions only by recognizing that:

> "the two sets of arguments are based on entirely different assumptions concerning the relationship between private and public investment with respect to risk. Arrow and Lind assume that the returns on private and public investment are

> uncorrelated; indeed this assumption is crucial for their main result. The Hirshleifer view, however, is clearly based on the assumption that for each type of public investment it is possible to find a private industry such that the returns are highly correlated."

Sandmo goes on to suggest that for the modern economies of Europe and the U.S., Hirshleifer's view is likely the more plausible. Interestingly, he observes that the contributions of Sharpe (1964), Lintner (1965), and Modigliani and Miller (1958) – a body of work that forms the cornerstone of modern financial economics -- are highly relevant to this debate, but rarely cited in the context of public investment.

A closely related question to the relevance of market risk to the government is whether there is a well-defined social (risk-free) discount rate, and whether it can be gleaned from market prices? As for the price of risk, the rate of time preference reflected in capital market prices can lead to suboptimal government investment decisions when markets are incomplete. A lively discussion of this issue was also occurring at that time (see Sandmo and Dreze (1971) and references therein). The broad conclusion was that in the presence of distorting taxes and various other sources of market incompleteness, there is not a unique rate of time preference appropriate for evaluating all pubic investments. As for market risk, the difficult question is then how to determine a better rule for choosing a discount rate.

2.2 The Economic Case

In this section we revisit the arguments for using market prices to evaluate risky government investment opportunities, and consider some more recent evidence that bears on the question. The basic logic, as emphasized by Hirshleifer (1964 and 1966) and Diamond (1967), remains that if markets are reasonably complete, private value – which is reflected in market prices – is a close approximation of social value.

In evaluating the information in financial market prices, economic theory distinguishes between two broad categories of risk – non-diversifiable or market risk, and diversifiable or idiosyncratic risk. Market risk arises from fluctuations in aggregate output, which by definition include the effects of government policy and cannot be undone by government intervention. Idiosyncratic risk, on the other hand, can in principle be avoided through insurance and other contractual risk-sharing arrangements, and by portfolio diversification. When markets are complete, individual optimization eliminates idiosyncratic risk, and in equilibrium only market risk is priced.

As discussed above, Arrow and Lind (1970) cast doubt on the relevance to the government of the market risk premium by observing that markets are not complete; individuals bear a significant amount of diversifiable risk. They conjecture that the reason for the observed market risk premium is mainly due to these diversifiable risks rather than to market risk. If government investment more effectively diversifies risk than does the private sector, using a discount rate that includes compensation for diversifiable risk would result in systematic undervaluation of government investments.

Since that time, numerous empirical studies have tested for whether diversifiable risk is priced in financial markets. Most cross-sectional evidence on asset returns suggests that this risk is not priced. In particular, tests of the Sharpe and Lintner Capital Asset Pricing Model (CAPM), which decomposes asset returns into a market and idiosyncratic component, show that idiosyncratic risk has little or no explanatory power for the cross-section of stock returns (citations TBA). The CAPM has been criticized for its low explanatory power, but tests of better-performing alternatives also provide little support for the idea that differences in idiosyncratic risk explain the cross-section of returns (citations TBA). These findings are consistent with the observation that even small investors can diversify financial risk quite inexpensively, for instance through mutual funds, and that most large investors diversify. This evidence weighs against the argument of Arrow and Lind that market prices overstate the cost of risk to the government because they put excessive weight on diversifiable risk.[2]

Some observers have also interpreted the equity premium puzzle – the inability of parameterized versions of standard neoclassical general equilibrium models to account for the historically high average spreads between risky securities and short-term Treasury rates – as evidence of capital market imperfections. Attempts to explain the equity premium puzzle by appealing to individual risk exposure, however, have been largely unsuccessful (e.g., Heaton and Lucas (1996)). In fact, economic theory puts very few

[2] Some have pointed to the difficulty of calibrated, highly parameterized, neo-classical models to account for the magnitude of the market risk premium in time series data -- the "equity premium puzzle" -- as evidence of the effect of market imperfections on asset prices. Models that incorporate such imperfections, however, also cannot account for the equity premium. Hence we view this literature as offering little insight into whether market prices deviate from social values.

quantitative restrictions on price levels or returns, suggesting that the observed equity premium is difficult to interpret as evidence for or against the price efficiency of financial markets.

Some (mostly non-academic) observers have further suggested that market risk is not costly to the government because the government can borrow at a risk-free Treasury rate. The problem with this reasoning is that even though the government raises funds to finance investments by selling safe Treasury securities, the risk from the levered investment is shifted onto current and future taxpayers and other federal stake holders. Imagine, for instance, that the government finances an investment in common stock through the sale of Treasury securities. The expected return on the stock exceeds the Treasury rate, but taxpayers are liable for repayment of the Treasury debt regardless of whether the stock gains or loses value. If taxpayers accepted the same risk in a private financial transaction, they would expect compensation equal to the levered market risk premium to participate. This argument is an application to public finance of the well-known Modigliani-Miller theorem (Modigliani and Miller, 1958), which establishes that in the absence of market imperfections, the cost of risk depends on an investment's own risk characteristics, but not on the choice of financial securities used to finance it.

2.3 Implications of Incomplete Markets

Notwithstanding the preceding arguments for the relevance of market prices, there are clearly situations arising from market incompleteness in which the social costs and

benefits of a risky government investment cannot be evaluated so simply.[3] A classic example arises in credit markets, where informational asymmetries combined with weak enforcement mechanisms can cause markets to break down. For instance, Stiglitz and Weiss (1981) consider a credit market with borrowers of mixed quality, where lenders cannot distinguish between borrower types. If lenders attempt to increase interest rates to make up for expected losses on bad credits, good borrowers are driven out of the market. In the extreme, there is no interest rate that clears the market at a non-negative profit to lenders, and private credit is rationed. In such cases, it can be optimal for the government to intervene by making credit available, although it does so at an expected loss. The federal student loan program, which provides credit for students who have little or no credit history and might not be able to obtain loans on their own, is an example of a government intervention thought to reduce such credit rationing.

Imperfect credit markets are a useful context in which to consider the relevance of market prices, and in particular the price of risk, to the government. When markets fail, or when government credit crowds out private credit,[4] there may be no obvious market price to use for valuation. Further, the benefit to the credit recipient need not equal the cost of providing credit, since marginal utilities are not equated. The benefits could exceed the costs, as in cases of information-induced credit rationing. The benefits could also be less than the costs, for instance when the government provides highly subsidized credit that

[3] Bohn (2003), for instance, examines the welfare effects of alternative fiscal policies when market incompleteness is generated by imperfect risk-sharing across generations.

[4] Gale (1991) observes that when government credit simply substitutes for credit that would have otherwise been privately extended, and hence has little effect on real resource allocations, government provision has little effect on social welfare.

induces more borrowing than is socially desirable. Since marginal utilities are unobservable and likely to vary across constrained borrowers, it seems that the evaluation of benefits will always include a large subjective element.

In determining the cost of providing government credit, however, modern finance theory offers more guidance. The cost, in terms of what markets (and presumably taxpayers) would demand for receiving the same state contingent payoffs, can be found by projecting those payoffs on securities that are traded in financial markets. For instance, one can infer the value of government student loans from market prices for unsecured consumer credit; and government credit guarantees to small businesses can be valued using information on similar, non-guaranteed bank loans. Notice that the absence of a market price does not preclude the existence of a similar private credit arrangement, nor does it suggest that a government program is exceptionally risky; rather it reflects the absence of a profitable private lending opportunity. With regard to market risk, the prescription of projecting payoffs from government credit programs onto traded securities to evaluate cost identifies the amount of market risk embedded in the transaction. It also incorporates the price of market risk into the estimated cost for the government. (In Section 3.3 we discuss the practical alternatives for accomplishing this.)

The discussion of the effect of incomplete markets also pertains to costs. To the extent that taxpayers are not diversified and marginal utilities are not equated to market prices, they may assess the cost of government risk-taking on their behalf to be greater than, or less than, its identifiable market value.

The government's ability to affect inter-generational transfers has also been suggested as a reason for the government to put less weight on market prices. Future generations are not directly represented in current market transactions, and some believe that too little weight is placed on their welfare when future costs and benefits are discounted at market rates. This objection pertains as much to the risk-free rate as to risk-adjusted rates, and leaves open the question of how to determine appropriate adjustments for these effects. To the extent that program costs are primarily borne by now-living taxpayers, the reasoning in the previous paragraph seems to apply in this situation as well.

3. The Cost of Risk and the Federal Budget[5]

To evaluate the pros and cons of including the cost of risk in federal budget estimates, it is first necessary to understand the basic principles that govern budgetary accounting, and specifically the rules related to credit, insurance, and investments in private securities. It is also important to understand how Congress uses these estimates in making resource allocation decisions.

3.1 Federal Budget Accounting

The federal budget primarily relies on cash accounting, which records federal activity in terms of net cash outlays in the year in which it occurs. It also includes projected outlays

[5] Much of the discussion in this section is based on CBO (2007a), which also includes a more detailed description of current and historical accounting practices.

over a budget period of up to 10 years. The out-year projections receive less attention, however, because they do not affect the current budget deficit or surplus.

For certain long-lived contractual obligations such as capital leases, interest on Treasury securities, and federal credit assistance, the budget has moved gradually away from pure cash accounting in favor of up-front or capitalized accrual accounting.[6] That treatment recognizes all payments associated with the obligation, even if some cash flows will occur outside the budget period. It also introduces discounting into budget calculations.

3.1.1 Loans and Loan Guarantees

Before 1990, the budget cost for federal credit activity was similar to that for most other programs – the net cash outflows for the program in the fiscal year. The mix of cash flows included in the budget account made net outlays for existing programs difficult to interpret. An increase in net outlays could result from increases in new lending, higher defaults on outstanding guarantees, legislated increases in debt forgiveness, or other factors. The cost reported for new programs was not comprehensive, and hence also hard to evaluate. For a new direct loan program the cost included projected net outlays in the budget period, but no offset for expected repayments outside the budget window and no adjustment for time value. New guarantee programs were scored with few if any cash

[6] The fact that the budget is primarily on a cash rather than accrual basis can distort resource allocation decisions, for instance by making rental appear less costly than capital investment, even when in present value terms the capital investment is cheaper and the facility will be used indefinitely. Accruals, however, require more assumptions about uncertain future cash flows, making them easier to manipulate. Assessing the pros and cons of cash versus accrual budgeting is beyond the scope of this analysis; we take the cash treatment of most expenditures as given. The main conclusions, however, would likely be similar were the accruals more widely used in the budget.

outflows in the year the program began because defaults usually occur a year or more after the loan is disbursed. In fact, new guarantees often had a negative cost because of the inflow of guarantee fees early on. This accounting favored new guarantee programs over almost all alternative policies, including new direct loan programs.

The Federal Credit Reform Act of 1990 (FCRA) effectively put credit on an accrual basis, with cost measured as the net present value of current and future period cash flows from budget period transactions. Its stated objectives were to: measure the cost of federal credit programs more accurately; place the cost of credit programs on a budgetary basis equivalent to other federal spending; encourage the delivery of benefits in the form most appropriate to the needs of beneficiaries; and improve the allocation of resources among credit programs and between credit and other spending programs.

Although the FCRA was partially successful in meeting its objectives, it fell short of measuring cost in terms completely equivalent to cash spending. The largest discrepancy arises from the mandated use of interest rates on maturity-matched U.S. Treasury securities for discounting, rather than a market-based cost of capital that includes the cost of market risk.[7] The understatement of cost is most evident in those programs that report a gain to the government, while delivering credit at rates that are below those charged for credit of similar risk in competitive markets. In those cases, the budget creates a bias in favor of federal credit programs compared with non-credit assistance, and encourages expansion of federal credit services that can crowd out private provision of credit.

[7] The treatment of administrative costs, floating rate loans, and re-estimates is also problematic (CBO, 2006b), but those issues are beyond the scope of this paper.

3.1.2 Insurance

Insurance programs generally are budgeted for on a cash basis. For property casualty coverage such as federal flood or crop insurance, this approach is consistent with the annual coverage period that is standard in the private sector. For such insurance programs, market risk is unlikely to represent a major cost. Programs such as deposit and pension insurance, however, also can be viewed as credit guarantees, although they are not covered by the FCRA. Deposit and pension insurance is distinguished from the types of transactions covered by FCRA by their lack of a fixed maturity date. Nevertheless, the market risk associated with these programs is not currently treated as a cost.

3.1.3 Investments in Private Securities

Despite their similarity to federal loans, investments in private securities (e.g., stocks, corporate bonds, mortgages, foreign securities) are not covered by FCRA. Rather, such investments are generally are accounted for under OMB Circular A-11, which directs agencies to account for investments in private equities on a cash basis. That is, such investments are reported as outlays when made, despite the offsetting receipt of a security of equal value.

Scoring financial investments as outlays tends to discourage such activity, and until recently federal investments in private securities have been quite limited. The possibility

of booking a profit, however, has influenced several proposals to increase federal investments in private securities, usually in the context of Social Security reform. The passage of the 2001 Amendments to the Railroad Retirement Act was a notable step in this direction.

The Railroad Retirement System, which pre-dates Social Security, provides two tiers of benefits to retired railroad workers and their dependents. The first approximates benefits payable under Social Security. The second is specified in the Railroad Retirement Act and is based on years of railroad employment. Both tiers are financed by payroll taxes levied on employees and the railroads. The 2001 Amendments authorized a newly-created National Railroad Retirement Investment Trust (NRRIT) to invest in a diversified portfolio of risky securities. Further, the legislation specified that the purchase and sale of private securities by the Trust be treated in the budget as having no effect on budget outlays or the deficit. Only capital gains and losses and were to be treated as affecting outlays.

The Railroad Retirement Act posed new challenges to the Congressional Budget Office (CBO) and the Office of Management and Budget (OMB). There was general agreement that booking the market risk premium as expected profit offsetting program expenses should be avoided. Otherwise, the appearance of an arbitrage opportunity from selling Treasury securities and buying risky securities would reward increased risk-taking and perhaps encourage increased spending from illusory resources.[8] Consistent with the

[8] For example, the Railroad Retirement Act allows benefits to be increased with investment gains, while limiting the risk exposure of beneficiaries to the investment outcomes.

legislation, it was agreed the outlay of cash for securities would be treated as an equal value exchange. Gains and losses would be recognized in budget net outlays (gains as negatives) only as incurred. Notably, Treasury rates of return were adopted for projecting baseline income for the Railroad Retirement System; future gains were risk-adjusted, avoiding the appearance of a free lunch in budget projections.

3.2. Risk as a Budgetary Cost

The main purpose of budgeting is to allow trade-offs to be made among competing uses of resources. For the Congress, the budget resolution limits the budget costs that authorizing and appropriations committees can incur during a fiscal year. Those constraints create an incentive for the committees to choose policies that provide the greatest benefit from the limited budget resources available. To make comparisons between policy alternatives meaningful, it is important that cost is recorded on a consistent basis.

The principle of consistency suggests the use of market prices in budgeting for federal financial commitments. The reason is that almost all non-credit transactions -- including grants, purchases of goods, and the direct provision of services – appear in the budget at market prices. For instance, to increase access to higher education, policy alternatives include outright grants, direct loans, and loan guarantees. The omission of the cost of risk on the loan or loan guarantee artificially favors credit assistance for education over funding for grants.

As discussed in Section 2, when markets are incomplete, the value of government services to beneficiaries need not equal the cost to taxpayers of providing them. Since this is true of non-credit as well as credit programs, the observation does not justify selectively deviating from market prices in the case of budgeting for credit. Further, the budget is intended to measure costs, not benefits. From the perspective of the typical taxpayer, cost seems most naturally measured in terms of market prices.

Many government-provided financial services do not have a direct market counterpart, complicating the assessment of market value. In considering alternative approaches, an important conceptual question is how broadly to define cost? A broad view of opportunity cost suggests using a comprehensive measure of private production costs, including not only of the market risk premium, but also taxes, liquidity, marketing expenses, etc.. That is, the cost is what it would cost to contract for the same service in the private market. The alternative is to focus on government production costs. Private sector prices can exceed government production costs because of the liquidity advantage of the Treasury market, the exemption of Treasury debt from state and local taxes, and the fact that the government often avoids the higher marketing and service costs typically incurred by private providers.[9]

The question of whether to use private sector or government production costs in estimating market values is not resolved by the principle of consistency -- the budget

[9] The higher private sector administrative costs reflect generally higher service levels, and hence a different product than would be offered by the government.

generally records narrowly measured production costs for services the government produces, but it also records the full price of privately produced goods and services it purchases. In practice it is difficult to separate out the various components of the market price of financial transactions. Hence, estimates based on comparable market prices are likely to reflect a broad measure of opportunity cost, even when adjustments are made for identifiable differences such as in administrative cost.

3.3 Alternative Valuation Methods

Three basic approaches can be used to incorporate market risk in the pricing of federal financial transactions: comparable market prices, risk-adjusted discount rates, and options or derivative pricing. Although all methods should provide similar answers if correctly implemented,[10] the preferred approach will vary with the transaction under consideration.

3.3.1 Comparable Market Prices

The most straightforward estimate of market cost is obtained in those instances when comparable products are offered by competitive private financial institutions. Clearly government purchases of publicly traded stocks, bonds and other financial securities fall

[10] It is well-established in financial theory that for options such as loan guarantees, there is generally no single discount rate that can be applied to projected cash flows to obtain a correct answer. This complication is avoided using an options pricing approach, which implicitly incorporates the appropriate, potentially time-varying, discount rate. Standard implementations of options pricing methods often yield cost estimates that are lower than those based on risk-adjusted rates. Nevertheless, all of the approaches yield estimates closer to market value than the current practice of omitting all risk adjustment.

into this category. Several federal credit offerings also have direct market counterparts, although favorable government terms can crowd out private provision. FHA and VA mortgages, for instance, are similar in terms of size and borrower credit risk to some segments of the private market, where prices are readily observable. Still, adjustments must be made to account for differences in borrower and product characteristics.

3.3.2 Risk-adjusted Spreads

For direct loan programs and sometimes for loan guarantees, risk-adjusting discount rates is often the most straightforward approach to estimating market value. Risk-adjusted discount rates are higher than comparable maturity Treasury rates because they include a premium or spread that compensates investors for risk-bearing and other costs of extending credit. An advantage of this method is that for direct loans, it allows budget analysts to follow procedures similar to those currently used under FCRA, where projected future cash flows are discounted to present values using rates on Treasury securities of the same maturity. The method of risk-adjusted discount rates also involves projecting future cash flows and discounting them to the present at a maturity-matched rate, but the rate is risk-adjusted.

The risk-adjusted spread often can be inferred from comparable market rates. For loans to rated corporations, loan maturity and credit rating provide guidance in identifying the expected return. For unrated companies such as the small businesses served by the SBA, bank rates on small business loans serves as a useful starting point. Estimated spreads

can be further refined by taking into account attributes such as whether the loan is collateralized, whether there are other debt obligations, etc.. For consumer credit such as student loans and mortgage insurance, the private market provides useful reference rates that can be further refined with information on credit scores, collateral value, etc.. Even for loans that do not have a close market analog, it is possible to glean information from market rates. For instance, a loan to a young company developing new energy technologies could be valued with reference to spreads on high-yield bonds, or yields on venture capital investments in energy.

A number of caveats apply to the estimation and application of risk-adjusted rates. Rarely can market spreads be applied directly, and the required adjustments can be subtle. First, the market spread must be adjusted for expected losses to avoid double counting. This is because rate spreads reflect not only a market risk premium, but also expected losses. The current approach of estimating expected cash flows already adjusts for expected losses in the numerator of present value calculations. To avoid double counting by using too high a discount rate, expected losses must be subtracted from the reference market spread. For example, if the reference spread were based on BB bond yields, the spread could be adjusted by subtracting out the average realized losses on BB bonds of similar maturity.

Identifying the cost of risk from primary market spreads -- those based on loan terms at origination – generally requires further adjustments for administrative costs. The interest rate charged to borrowers often includes compensation for origination expenses,

servicing, and collection costs, but the degree to which this is the case varies (sometimes fees cover these expenses instead). Secondary market prices, when available, largely avoid this complication. However, secondary market prices may be affected by subordination structures and other mechanisms to redistribute risk that also must be recognized and adjusted for.

Finally, adjustments must be made for the value of prepayment options embedded in many federal loans and guarantees, and also for prepayment options affecting the reference market spreads.

Once market spreads are adjusted down for expected losses, administrative costs and prepayment options, the remaining spread represents compensation for market risk, but also for liquidity and tax differentials. As mentioned earlier, from a broad opportunity cost perspective, liquidity and tax differentials can also be considered legitimate elements of government expense. Under a narrower interpretation of cost, the size of tax and liquidity effects must also be estimated and subtracted to isolate the cost of market risk.

Perhaps the most important caveat regarding risk-adjusted spreads is that the method can be difficult to properly apply them to valuing loan guarantees. On a direct loan, the spread over Treasury rates results in a lower present value of loan payments: the loan is worth less because of market risk. For a loan guarantee, using higher risk-adjusted rates to discount expected losses to the guarantor incorrectly implies that market risk reduces the value of the guarantee. In fact, it increases guarantee value because the guarantor

assumes the market risk. Calculating the present value of guarantee payments effectively requires using a discount rate that is lower than the risk-free rate. This follows logically from the identity that the value of a loan with credit risk, plus the value of a 100 percent credit guarantee, equals the value of a risk-free loan. The risky loan is worth less than if cash flows were discounted at a risk-free rate, and the guarantee is worth more. This relation suggests loan guarantees can be valued by taking the difference between the value of a risk-free loan with equivalent cash flows and the estimated market value of the underlying risky loan. However, several complications often make it difficult to implement this approach, such as the fact that most guarantees are for less than 100 percent of loan value. Further, the value of a guarantee can interact with other loan features such as the prepayment option. For many loan guarantees, a conceptually and operationally more appealing approach is to rely on derivative pricing methods.

3.3.3 Derivative Pricing

A loan guarantee is equivalent to a put option, a derivative security that can be valued using well-established methods employed by private financial institutions. The equivalence arises because the lender has the option to put the loan to the guarantor – the writer of the put option -- at a strike price equal to the face value of the loan. In the event of default, it is optimal for the lender to exercise the option, leaving the guarantor with a loss equal to the difference between the loan's face value and the amount collected in default.

Derivatives pricing methods are often used by financial analysts to value loan guarantees to commercial enterprises. They are also relatively straightforward to apply to valuing insurance products that entail significant market risk, such as pension and deposit insurance. The method is rarely applied to credit extended to individuals, however, because critical model inputs, such as the underlying asset value or the conditions triggering default, cannot be identified precisely enough. In such cases, risk-adjusted rates are likely to be a more reliable starting point for estimation. The choice of valuation methods used in the examples described in Section 4 below are consistent with these observations.

3.4 Additional Considerations

The costs of modifying budget practice -- including drafting and passing new legislation, re-training analysts, and revamping methods and models -- pose serious impediments to the adoption of risk-adjusted pricing for federal budgeting. The added complexity could also make it harder to explain budget estimates to non-specialists. An approach that would partially mitigate some of these problems would be to concentrate analytical efforts on developing standard models and relatively simple guidelines for valuation at CBO and OMB. The results would then disseminated to the relevant credit agencies. A precedent for this approach occurred with the passage of FCRA, which also added significantly to agencies' reporting and analytical requirements. The task of developing standard tools is made more feasible by the fact that only a few programs provide most assisted credit (see Table 1).

4. Evidence

Whether it is worthwhile to incur the costs of budget reform depends on how serious the distortions are from ignoring the price of risk. A series of recent studies quantify effects in a variety of contexts. They also illustrate the potential and challenges of estimating the cost of risk for federal financial transactions.

4.1 Loans and Loan Guarantees

Strikingly, some of the government's large credit programs -- including mortgage insurance, small business 7(a) loan guarantees, rural utilities loans, and some student loan programs -- appear to cost nothing or to make money for the government (see Table 2). Extending the budget measure of subsidy cost to include the market cost of risk and other excluded factors seems likely to raise estimated subsidy costs and eliminate most zero and negative subsides. This is because opportunities to extend credit on terms that more than cover cost tend to be taken by private lenders without taxpayer assistance. A growing body of evidence is consistent with this expectation.

4.1.1 Corporate Debt Guarantees

CBO (2004a) was the first CBO study to apply a derivatives pricing approach to valuing loan guarantees, and to compare the results with and without the inclusion of a market

risk premium. The study looks at two similarly structured loan guarantees to distressed corporations: $1.5 billion to Chrysler in 1980, and $380 million to America West Airlines (AWA) in 2002. In exchange, the government received guarantee fees and 10-year warrants granting the right to purchase shares at a fixed strike price.

For both Chrysler and AWA ex ante, the net cost to the government is the cost of the guarantee less the value of warrants and guarantee fees. Uncertainty about default, prepayment, and future asset and stock values affects each cost component. Following a standard binomial modeling approach (see CBO (2004b) for technical details), the stochastic evolution of asset value is based on expected returns and historical volatility of assets, estimated from historical stock return and industry data. Default is triggered when asset value falls below the value of maturing debt and current liabilities. Similarly, prepayment is triggered when assets exceed liabilities, since recovery would likely allow a switch to lower fee, non-government financing. The distribution of cash flows to the government fans out over time, with large gains in states of the world where the firm recovers and the warrants become very valuable, and large losses in states where the firm defaults and the warrants are worthless.[11]

The same statistical models for estimating the distribution of future cash flows are used for both the FCRA-style and market value estimates, ensuring that the underlying cash flows are the same for both. Only the discount rates differ between implementations. The FCRA estimates are discounted using a contemporaneous Treasury rate, whereas the

[11] Both firms recovered, yielding the government large gains ex post.

market value estimates incorporate the price of risk implicitly through the binomial options pricing approach.

These highly risky corporate guarantees are an example where the inclusion of the price of market risk has a large effect, for AWA changing the net value from a gain of 9.8 percent of loan value to a loss of 11.5 percent. For Chrysler the net loss increases from 7.2 percent to 15.9 percent. Table 3 shows the results for each firm, broken down into guarantee, fee and warrant components. Risk adjustment increases the value of loan guarantees because defaults tend to occur in bad aggregate states. Conversely, it decreases the value of warrants, which tend to be most valuable in good aggregate states. Two offsetting effects on fee value make the net effect of risk adjustment small: prepayments reduce fees in good times, but defaults reduce fees in bad times.

4.1.2 FHA Mortgage Guarantees

FHA operates the Mutual Mortgage Insurance program (MMI), which provides access to home ownership to individuals who lack the savings, credit history, or income to qualify for a conventional mortgage. Under this program, FHA provides credit guarantees on 15 and 30-year fixed and adjustable rate, amortizing mortgages. FHA charges borrowers both an up-front and annual fee for this service. To target the program to low- and moderate-income borrowers, FHA sets limits on the dollar value insured.

Conveniently for valuation, the MMI program has a close counterpart in the private sector, and market prices are readily available. In fact the FHA share of the mortgage guarantee business has declined sharply in recent years, as private competitors have attracted an increasing portion of relatively low-risk borrowers by selectively pricing below the FHA.

In a recent analysis of proposed changes in the MMI program, CBO (2006a) includes a calculation of the effect of market risk on program cost. Although comparable market prices are available, in estimating government cost adjustments had to be made for differences in loan-to-value ratios (the FHA is more lenient), the government's lower marketing costs, and differences in the distribution of credit scores for FHA-insured versus privately-insured borrowers.

As for the AWA and Chrysler loan guarantee, the effect of market risk is considerable. After adjusting the above-mentioned factors, CBO estimates FHA's subsidy cost for the MMI program is 56 basis points per year, versus a 33 basis point cost without risk adjustment.

4.1.2 Student Loans

Two of the largest federal credit programs are the Federal Family Education Loan (FFEL) program and the Federal Direct Student Loan (FDSL) program. FFEL guaranteed loans are originated and serviced by private lenders but guaranteed against credit risk by the federal government. Private lenders are also assured of a gross return

that is a spread over the commercial paper rate through payments from the federal government that make up the difference between the student loan rate and the guaranteed rate. The direct loan program provides funds directly from the federal government to students without the use of a private financial intermediary. The terms on guaranteed and direct loans are approximately the same for students, and generally more favorable than available to consumers on non-federal unsecured loans.

As is the case with federal mortgage insurance, a private market has developed with the federal student loan program, mostly to provide funds to students who have reached the federal borrowing limit. Using a combination of data from private and federal lenders, Lucas and Moore (2007) have estimated that market risk adds 1 to 2 percent per year to the rate charged on private student loans. Using this estimate to calculate the cost of federal student loans adds about 8 percentage points to the subsidy rate for both guaranteed and direct loans.

4.1.3 SBA 7(a) Loans

To promote access to loan capital for small businesses, SBA offers loan guarantees covering 50 percent to 85 percent of principal. In fiscal 2005, new guarantees issued by the agency totaled about $14 billion. The interest rate paid by borrowers on those loans is negotiated with the lender and appears to be about 5 percent over short term Treasury rates (a premium that is hard to reconcile with historically low default rates and the substantial credit guarantee). Borrowers also pay guarantee fees to SBA.

By applying an options pricing model to SBA's cash flow data, CBO has estimated that taking account of market risk doubles the cost of 7(a) guarantees from 1.1 percent of the loan amount to 2.2 percent.

4.2 Insurance Programs

Recall that unlike credit, insurance is budgeted for on a cash rather than accrual basis. Nevertheless, multi-year analyses suggest that the cost of risk is significant for some of these programs.

4.2.1 PBGC Insurance

The cost of federal insurance for defined benefit pension plans provided by the Pension Benefit Guaranty Corporation (PBGC) increases with the frequency of insolvency of plan sponsors, and with the shortfall between plan assets and plan liabilities. Both of these factors contribute to higher payouts by the PBGC in bad aggregate states: Insolvency rates increase in downturns, and the value of plan assets, which are heavily invested in equities, falls relative to the more stable value of liabilities. Consequently, the cost of market risk is a large component of the market price of this insurance.

CBO (2005) evaluates the market value cost of insurance using an options pricing framework, and compares it to an estimate based on identical cash flows but risk-free

discounting.[12] The market value of federal pension insurance net of premiums for single-employer plans over the next 10 years is estimated to be $86.7 billion. That sum includes $23.3 billion for plans that have already been terminated and $63.4 billion for insured claims projected to be put to PBGC during the period. For the forward looking component of cost, discounting new projected PBGC claims at Treasury rates results in a present value cost estimate of $32.4 billion, or just over half the market value of $63.4 when the cost of market risk is incorporated.

4.2.2 Deposit Insurance

Recent estimates of the cost of federal deposit insurance also indicate a significant contribution from market risk. For example, Falkenheim and Pennacchi (2003) develop an options pricing model for deposit insurance to banks and thrifts. To differentiate the market cost of deposit insurance from the expected cost discounted at risk free rates, they report and compare the risk-adjusted, or "risk neutral" cumulative 10-year probabilities of bank insolvency with the cumulative actual or "physical" probabilities of insolvency. Their results show markedly higher cumulative risk neutral probabilities of default than actual probabilities. For example, the average cumulative 10-year probability of insolvency for a large sample of private banks was 11.19 percent (risk neutral) and 4.5

[12] The compound nature of the option is accommodated using a risk-neutral Monte Carlo simulation approach. The model is used to evaluate the joint probability distribution of insolvency and the shortfall in plan assets for each covered firm. The total discounted cost is then a sum over all covered firms for which data is available. Pennacchi and Lewis (1999) examine a related pricing model.

percent (actual). For the publicly traded sample, the respective probabilities were 12.13 percent (risk neutral) and 4.98 percent (actual).[13]

4.3 Investments in Private Securities

When investments in private securities are explicitly or implicitly treated similarly to credit under FCRA, an apparent arbitrage opportunity arises.[14] Imagine issuing $100 billion in Treasury bonds yielding 5 percent, and investing the money in private equities. Clearly in market value terms this is a neutral transaction for the government -- equal value is paid and received. Projecting cash flows from the equity investment into the future, the investment is expected to earn an equity premium, conservatively, 4 percent more than the risk-free rate. At the end of 10 years, the accumulated value of the equity is then expected to be $\$100(1.09)^{10} = \$237$ billion. Discounting at the Treasury rate of 5 percent, the present value of the equity investment is $145 billion. Under FCRA-type accounting the transaction appears to make $45 billion for the government (the $145 equity value less the $100 in Treasury securities issued).

Failing to take into account market risk can also distort the perception of the magnitude of liabilities, as discussed in Geanakoplos and Zeldes (2007) in the context of social security. Further, an even larger discrepancy between market value and estimated cost

[13] The difference between actual and risk-neutral probabilities over this horizon does not map directly into a cost differential because it neglects time value, but nevertheless is indicative of the relative magnitude of costs with and without risk adjustment.

[14] Recall that at present, private investments are accounted for as cash outlays in the budget under Circular A-11.

can arise in for benefit guarantees, such as those contemplated in some proposals to supplement social security with investments in private securities (CBO (2006b), other citations TBA). Such guarantees provide a floor on benefits protecting against poor investment returns. Like credit guarantees, benefit guarantees are a type of put option, conferring the right to sell an asset for a predetermined price should it lose value. Benefit guarantees are particularly susceptible to market risk, however, because of the leveraged exposure to stock market risk.

Many observers inside and outside the government have emphasized the importance of avoiding the temptation to treat the risk premium as an arbitrage opportunity in these situations. For instance, in describing the budget treatment of the private investments in the Railroad Retirement Fund discussed in section 2.1.3, OMB writes that,[15]

> ""Equities and private bonds earn a higher return on average than the Treasury rate, but that return is subject to greater uncertainty. Sound budgeting principles require that estimates of future [Railroad Retirement] trust fund balances reflect both the average return and the cost of risk associated with the uncertainty of that return. .... [T]he difference between the expected return of a risky liquid asset and the Treasury rate is equal to the cost of the asset's additional risk as priced by the market. Following through on this insight, the best way to project the rate of return on the Fund's balances is to use a Treasury rate. This will mean that assets with equal economic value as measured by market prices will be treated

[15] "The Budget System and Concepts," Chapter 26, *Analytical Perspectives*, FY 2007, Budget of the U.S. Government, p. 392. Available at www.budget.gov/budget

equivalently, avoiding the appearance that the budget could benefit if the government bought private sector assets."

The 1999 Social Security Technical Advisory Panel[16] similarly warns against presentations "…that tend to show that "financial arbitrage"—borrowing to purchase equities with a higher expected rate of return—creates some sort of free lunch. Nevertheless, agreement has yet to be reached on how the risk premium should be treated in the budget or in other types of government financial reports.

[16] 1999 Technical Advisory Panel on Assumptions and Methods, *Report to the Social Security Advisory Board*, available at http://www.ssab.gov/1999TechnicalPanelRept.pdf

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Table 1:
New Federal Direct Loans and Guarantees by Program, 2005
(billions of dollars and percent of total)

Stafford & Plus Student Loans*	$12.9	52.4%
Rural Electric Telecom	4.8	19.5
Rural Community Facilities	1.7	6.9
Rural Housing Insurance Fund	1.3	5.3
SBA Disaster Loans	1.3	5.3
Other	2.6	10.6%
Total Direct Loans	$24.6	
Guaranteed Loans:		
Stafford & Plus Student Loans*	$43.3	22.6
FHA Mutual Mortgage Insurance	58	30.3
FHA General and Special risk	19.7	10.3
VA Housing	22.5	11.8
SBA General Business	19.9	10.4
Other	27.9	14.6
Total Guaranteed Loans	$191.3	

*excludes consolidation loans totaling $???
Source: OMB, Analytical Perspectives, FY 2007, pp.89-90.

Table 2: Selected Loan and Loan Guarantee Subsidy Rates

Direct Loans Obligations:	Subsidy Rate (%)
Rural Housing Insurance Fund	14.70
SBA Disaster Loans	12.86
Agricultural Credit Insurance Fund	7.38
Rural Community Advancement	6.81
Student Loans	3.32
Rural Electric and Telecom	- 0.96
Guaranteed loan commitments:	
Student Loans	11.09
CCC Export	5.07
Export-Import Bank	1.09
Agricultural Credit Insurance Fund	3.27
SBA 7(a)	0(?)
FHA, MMI	- 1.80
FHA, S&G	- 0.85
VA Housing	- 0.32

Source, OMB, Analytical Perspectives, 2007, pp.89-90.

Table 3: Comparing Subsidy Rates, Credit Reform Versus Market Values (Percentages)				
	Credit Reform AWA	**Mkt. Value AWA**	**Credit Reform Chrysler**	**Mkt. Value Chrysler**
Warrants	(21.2)	(13.2)	(7.9)	(5.4)
Guarantee Fees Paid	(13.8)	(14.9)	(1.93)	(1.86)
Loan Guarantee	25.2	39.6	17.0	23.2
Net Government Subsidy	(9.8)	11.5	7.2	15.9