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Credit policy as fiscal policy

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1. Introduction

With the notable exception of Gale (1991), federal credit policies have been largely overlooked in analyses of the macroeconomic effects of fiscal policies. In this paper I make the case that the amount of fiscal stimulus to the U.S. economy has in recent times been seriously underestimated because of this omission. In general, the error is likely to be particularly severe during downturns that are accompanied by major disruptions in private credit markets, as occurred during the Great Recession of 2007-9 and in its aftermath. The estimates here for 2010 suggest that the stimulus effects of federal credit programs were likely to have been similar in magnitude to those of the American Recovery and Reinvestment Act of 2009 (ARRA), which provided about $392 billion of additional spending and tax cuts that year (CBO, 2011). I also find that federal credit subsidies had a big "bang-for-the-buck"—a large amount of stimulus per dollar of taxpayer cost. Furthermore, government credit programs acted as automatic stabilizers because participation rates and loan amounts could increase during the downturn without legislative action.

The finding of large stimulus effects in 2010 reflects the size and reach of U.S. federal credit support activities, as well as the apparent unwillingness of private lenders to extend credit to certain borrowers and market segments during that period. Through its traditional credit programs, the government routinely provides direct loans and loan guarantees for housing, education, agriculture, small businesses, energy, trade and other private activities via over 150 separate programs that appear in the federal budget. New loans originated under those programs in 2010 totaled $584 billion.[1] Federal credit-related activities also include implicitly or explicitly guaranteeing the obligations of government sponsored enterprises such as Fannie Mae and Freddie

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[1] Elliot (2011) provides a history and more complete discussion of federal credit programs.

Mac, the Federal Home Loan Banks and the Farm Credit System; and insuring bank deposits and defined benefit pension plans. Notably, Fannie Mae and Freddie Mac, which had received explicit government backing by that time, guaranteed over $1 trillion in newly originated mortgages in 2010.

To understand how in principle how such a surprisingly large amount of stimulus could be attributed to incremental loan volume arising from federal credit programs, it is necessary to first consider the ways in which government credit subsidies can affect lending volumes. There are two distinct channels: (1) a traditional elasticity channel (intensive margin), whereby the demand for loans increases when the costs of borrowing falls; and (2) a credit rationing channel (extensive margin), whereby individuals who are unable to obtain the desired amount of credit at any rate from fully private lenders (for instance because of asymmetric information about borrower quality) are able to borrow when a direct government loan or a government loan guarantee is made available. A simple model in the spirit of Rothschild and Stiglitz (1976) and related analyses shows that the second channel can be highly non-linear, and that it can be the more important of the two when both are operative. The model also shows why credit rationing can be alleviated with quite small credit subsidies in some instances.

Having established that credit subsidies can generate large increases in loan volume in principle, the next step in making the case for a potentially large stimulus effect is to link increased loan volumes to increased aggregate output. That connection is made using a fiscal multiplier approach, following a large literature that includes Auerbach and Gorodnichenko (2012), CBO (2011 and 2015), and references therein. Because traditional multiplier analysis focuses on tax and expenditure policies, adjustments to that approach are required in order to apply existing estimates

of fiscal multipliers to credit subsidies. Specifically, the multipliers suggested by the literature are applied to the estimates of incremental loan value rather than directly to the credit subsidy amounts.

Estimates of the subsidies associated with the government's major credit programs are needed to do bang-for-the-buck calculations and to predict increases in borrowing along the intensive margin for each program. For most non-credit fiscal policies, the standard way to assess subsidy cost is as the net cash outflow in a given year, which corresponds to the budgetary cost. Credit subsidies are more complicated because loans and loan guarantees involve uncertain cash flows that extend over many years. For traditional credit programs, federal budgetary estimates of credit subsidies involve projecting cash flows over the life of the loan and discounting them to the date of origination at Treasury rates to produce a lifetime or accrual cost of the loan. Most administrative costs are omitted from those subsidy estimates (but accounted for elsewhere in the budget on a cash basis). The practice of discounting at Treasury rates and omitting administrative costs causes budgetary estimates of credit subsidies to understate the full economic cost to taxpayers of credit assistance (Lucas and Phaup, 2010 and CBO, 2011). The cost estimates used here are fair value estimates derived from pricing models that my colleagues at the Congressional Budget Office (CBO) and I have developed to provide fair value estimates for most major federal credit programs. Conceptually, the fair value subsidy cost is the lump payment at origination that the government would have to make to private lenders in a well-functioning market to induce them to extend credit at the same terms to the same people as under the government program. Those fair value estimates often significantly exceed reported budgetary costs, but nevertheless represent a modest fraction of loan principal for most programs.

Extensions in loan volume at the extensive margin are a quantitatively important driver of the stimulus effects of credit programs. Unfortunately, the estimates of increased borrowing along the extensive margin are by necessity subjective because data is not available to rigorously measure those effects. However, the estimates are informed by the programs' histories and observed market behavior by private lenders, and the conclusion of a large stimulus effect is robust to fairly conservative assumptions about the size of those margins.

For a variety of reasons explained below, different multipliers are applied to the increase in loan volume attributed to different credit programs. Borrowing generally involves significant effort and cost, which suggests that most borrowed funds will be spent rather than saved. However, money borrowed to repay outstanding debt or to purchase existing houses is unlikely to contribute as much to aggregate demand as money borrowed for education or for investment by small businesses. The ranges for the multipliers assumed are loosely mapped into the categories used by CBO (2011) for ARRA programs in 2010.

Federal credit support has many other important economic consequences, and it is beyond the scope of this analysis to attempt to quantify its net effect on social welfare. To undertake a welfare analysis, the salutary effects of credit programs during severe downturns that are highlighted here would have to be weighed against the inefficiencies that government credit policies tend to cause during more normal times. Those have been written about extensively (e.g., Gale, 1991, Lucas 2012 and 2014, and La Porta et. al., 2002): Credit subsidies tend to be target inefficient; they are opaque; they can distort the allocation of capital and crowd out more productive private investment; they encourage excessive levels of household and business debt; and they create incentives for excessive risk-taking that have systemic consequences. Furthermore,

some observers have suggested that overly liberal credit policies of Fannie Mae and Freddie Mac were an underlying cause of the 2007 financial crisis. A further caveat to this analysis is that credit policy includes a panoply of regulations that are likely to have fiscal effects but that are not considered here.

The remainder of the paper is organized as follows. Section 2 lays out a model that illustrates the channels through which federal credit programs can provide economic stimulus. Section 3 provides context for the analysis by providing an overview of federal credit support activities. Section 4 explains the calibration of inputs into the model including subsidy rates for each major program, elasticities, extensive margin effects, and multipliers. Section 5 presents estimates of the stimulus provided by federal credit assistance in 2010 under the base case assumptions and for a range of alternative assumptions. Section 6 concludes.

2. Theoretical underpinnings

To understand how government credit programs might be expected to affect aggregate borrowing and ultimately aggregate demand, this section lays out a stylized model of credit markets that illustrates the channels through which federal credit subsidies affect loan volumes and pricing. The model is in the spirit of Rothschild and Stiglitz (1976) and other analyses that emphasize the effects of asymmetric information or costly state verification on insurance or credit market outcomes and the potential effects of government intervention.[2] The conceptual linkages between incremental loan demand and aggregate demand that are quantified in Section 3 to estimate the stimulus effects of federal credit programs in 2010.

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[2] Related theoretical analyses include Jaffe and Russell (1976), Stiglitz and Weiss (1981), Smith (1983), Smith and Stutzer (1989), Gale (1990), Lacker (1993), and Williamson (1994).

2.1 Government credit as a fiscal policy tool

We assume that the credit market consists of large numbers of two types of borrowers, Type A and Type B, and many of competitive lenders. Loans last one period, and utility is realized at time 1 when the loan is repaid.[3] The population share of Type A borrowers is μ_A. Type A borrowers always repay their loans in full. Type B borrowers default and repay a fraction ρ_B of the promised amount. Both know their own types, and have the same utility function that depends on fixed parameters v and γ, and on the amount borrowed, L, net of the expected amount repaid inclusive of interest, RL:

$$U(L) = \frac{vL^{(1-\gamma)}}{1-\gamma} - RL \quad \text{for } L \geq 1 \text{ or for } L = 0 \tag{1}$$

Setting a minimum loan size reflects that the activities financed may have a minimum required investment amount, and also the presence of fixed costs in loan origination. The desired amount of borrowing is found from rearranging the first order condition that comes from maximizing (1) with respect to the choice of L:

$$L_i^* = \left(\frac{R_i}{v}\right)^{-1/\gamma} \quad \text{for } i = \text{A, B} \tag{2}$$

Competitive lenders offer borrowers a contractual interest rate and loan size that satisfy a zero profit condition. The supply of loans is assumed to be infinitely elastic at those equilibrium rates. Lenders cannot identify the type of an individual borrower directly, but they know the population shares and can infer whether a borrower of each type will accept the loan terms ($L(\theta)$,

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[3] This assumption economizes on notation and is without loss of generality.

$r(\theta)$ offered, where $r(\theta)$ is the contractual rate on the loan and θ is the lender's information set. Thus the lender anticipate whether there is a pooling equilibrium or a separating equilibrium and will choose an offer consistent with that inference and with the zero profit condition. The offered rate, $r(\theta)$, reflects that the gross expected return to lenders, $(1+r_m(\theta))$, includes a premium for the systematic risk in risky loan returns and any other priced risks. That market rate schedule is an equilibrium outcome that is taken as known and as exogenously given for this partial equilibrium analysis.

The model admits both pooling and separating equilibria (and possibly both) depending on the selected parameter values. In a separating equilibrium, Type A borrowers are offered the risk-free rate r_f and a loan amount that is the lesser of the optimal loan amount implied by equation (2) with $R_A = 1+r_f$, and a loan amount that is the maximum that is small enough to deter Type B borrowers from mimicking Type A borrowers. Type B borrowers are offered a contract with a gross promised return $(1+r_m(\theta))/\rho_B$, an expected gross repayment $R_B = 1+r_m(\theta)$, and a loan amount that satisfies equation (2). Because the minimum loan size is 1, it is possible that depending on parameter values, one or both types will choose not to borrow anything.

In a pooling equilibrium where the offered rate is a population-weighted average of the two separating rates, Type B's would like to borrow more than Type A's. However, to maintain pooling Type B's can only borrow L_A^*, the optimal level of borrowing for Type A's at the offered rate. The offered rate, $r(\theta)$ solves the zero profit condition:

$$1 + r_m(\theta) = \mu_A(1 + r(\theta)) + (1 - \mu_A)\rho_B(1 + r(\theta)) \tag{3}$$

Rearranging implies:

$$1 + r(\theta) = \frac{(1 + r_m(\theta))}{\mu_A + (1 - \mu_A)\rho_B} \tag{4}$$

It follows immediately that as the proportion of Type B's becomes large, and as their expected repayment becomes small, there will be no pooling equilibrium because the required return goes to infinity. There may be a separating equilibrium in which only B types borrow.

The model is easily extended to include government credit guarantees. We'll see that the introduction of guarantees can significantly change equilibrium quantities and rates offered by private lenders, and that large increases in borrowing may be achieved at a low subsidy cost to the government. The government guarantees a portion, g, of the promised repayment R. For the guarantee to affect outcomes, $g > \rho_B$. With the guarantee, the offered rate in the pooling equilibrium falls to:

$$1 + r(\theta) = \frac{(1 + r_m(\theta))}{\mu_A + (1 - \mu_A)g} \tag{5}$$

The offered rate in a separating equilibrium where only Type B's borrow is also given by equation (5) with $\mu_A = 0$. Note that in all cases g is in the information set θ and affects the equilibrium expected return (e.g., with a 100% credit guarantee the expected return is the risk-free rate).

The subsidy rate, s, is defined as the cost to the government of providing the guarantee per dollar of loan principal:

$$s = (g - \rho_B)(1 - \mu_A) \tag{6}$$

Result 1: If there is a pooling equilibrium in the private market, the introduction of a guarantee lowers the offered rate and increases loan demand through an elasticity effect. The elasticity effect operates at the intensive margin.

Result 2: If there is an equilibrium in the private market with no borrowing or with only Type B's borrowing, then there exists a $g \leq 1$ such that a pooling equilibrium exists. This creates an expansion of lending on the extensive and intensive margins.

The potential for large increases on the extensive margin induced by the availability of government guarantees is the mechanism by which federal credit programs can have large stimulus effects. The link from borrowing to stimulus also involves assumption about how the borrowed funds are used, as discussed in the next section. Clearly, similar conclusions about the stimulus effects of government credit follow from direct lending programs. A more general specification, e.g., as in Stiglitz and Weiss (1981), would allow for the probability of default and the expected recovery rate to also depend on the interest rate for Type B borrowers. That possibility was assumed away for simplicity, but Results 1 and 2 would still be expected to obtain in that more general setting. In that case, the introduction of a government guarantee would have the additional effect of mitigating default losses by making the loans more affordable.

Simulation of a parameterized version of the model illustrates the possibility of generating large increases in lending volume at a modest subsidy cost, primarily through the extensive margin. It also highlights the potentially high costs for government credit programs that fail to impose lending limits that prevent excessive borrowing by risky borrowers. This is the narrative that motivates the main calibration exercise in Section 5.

Figure 1 shows the equilibrium lending volume, the full information loan volume, and the

cost to the government as a function of the government guarantee rate. The guarantee rate is varied

between 0 and 1, but the guarantee only affects outcomes when $g > \rho_B$. In this example parameters

are fixed at $v = 1.1$, $r_f = .01$, r_m(B only) $= .04$, $\mu_A = .75$, $\rho_B = .6$, and $\gamma = 2$.

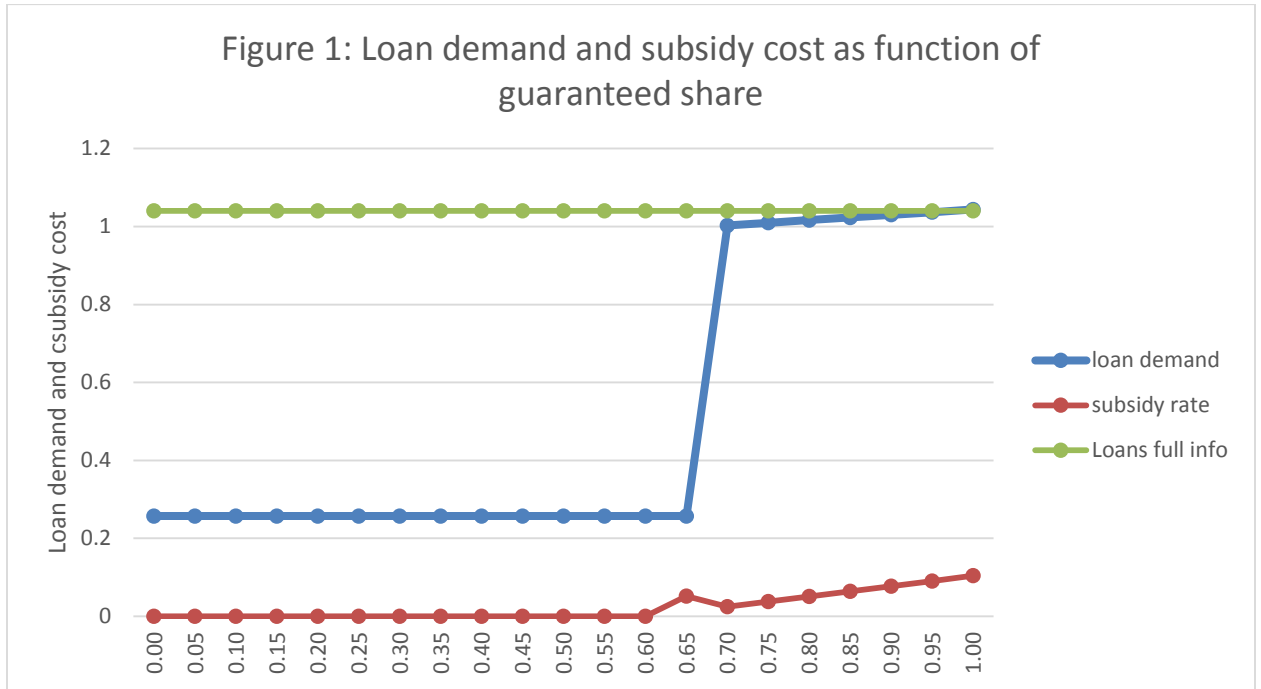Figure 1: Loan demand and subsidy cost as function of guaranteed share

Figure 1 shows that for guarantee levels below about 70 percent, the pooling interest rate

is too high for Type A's to participate. Hence there is a separating equilibrium in which Type B's

borrow at a fair rate and Type A's do not borrow. When the guarantee is sufficiently high, the

offered rate under the pooling equilibrium falls to a level where both types borrow. Total loan

volume roughly quadruples because of the entry of the safe borrowers. For guarantee rates in

excess of the entry level for Type A's, aggregate borrowing increases in the guarantee rate through

the extensive margin. However, those extensive margin increases are relative small. Notice also

that the subsidy rate, which is the cost to the government per dollar of loan guaranteed, is only 2%

at the guarantee level that causes loan demand to quadruple. This demonstrates that credit subsidies can have a large bang-for-the-buck because of the non-linear effects of the subsidies. Increasing the guarantee to 100% has a small incremental volume effect, but increases the subsidy rate to 10%.

The model also has lessons for the efficient structuring of federal credit programs. The upward blip observed in the subsidy rate at $g = .65$ is a reminder that if the guarantee protects lenders against some of the risk of bad borrowers but is insufficiently high to attract good borrowers into the market, it provides an inefficient subsidy to low quality borrowers who would have borrowed anyway. In such cases, setting a high enough guarantee rate to attract new good borrowers lowers the subsidy rate by increasing average pool quality. The model further suggests that it is important for the government to impose quantity limits in its direct loan programs or in guarantee programs where the government fixes the borrowing rate, in order to avoid excessive borrowing by bad borrowers. Recall that in the pooling equilibrium with private lenders making rate and quantity offers, both types are limited to loan amounts that maximize Type A's utility at a zero profit interest rate. If there were no constraint on quantities, Type B's would borrow more than Type A's and the subsidy rate would increase. For example, for the Figure 1 parameters, faced with the pooling equilibrium interest rates, unconstrained Type B's would borrow about 30% more. That would increase the average subsidy rate by degrading the quality of the borrower pool, and the total subsidy cost would increase by a corresponding 30%.

A natural question is whether the large discrete changes in loan volume induced by modest credit subsidies could occur in a setting with a large number of borrower types or under other information structures. I believe that the basic intuition is robust and that similar results would be

found in more general settings, but it remains for future research to establish more general conditions under which these effects are present.

2.2 From loan demand to aggregate output

To translate estimates of the increase in the availability of credit and reductions in its cost into an estimate of increased aggregate output requires several steps. The first is to calculate how much incremental borrowing is induced by the credit programs through both the intensive and extensive margins, adjusting for the offsetting effect of any crowding out of existing private sector loan supply. The second step is to take into account multiplier effects that could cause the amount of incremental borrowing to differ from its ultimate effect on aggregate output.

Incremental aggregate borrowing, ΔB, attributable to federal credit assistance net of crowding out can be written as:

$$\Delta B = dA + S(dB/dS) - C \tag{7}$$

where dA is incremental borrowing along the extensive margin, $S(dB/dS)$ is incremental borrowing along the intensive margin induced by the subsidy S, and C is the amount by which private lending is crowded out in aggregate.

This reduced form represents the net effect of supply and demand factors on volume. No distinction is made between guaranteed and direct lending because, as discussed below, in both cases the subsidy mechanisms that induce incremental demand—reduced interest rates and fees, and a decrease in credit rationing—are the same. That incremental demand puts upward pressure on interest rates that may crowd out other lending. The size of the crowding out effect depends on the elasticity of credit supply.

Incremental borrowing along the intensive margin, $S(dB/dS)$, represents the sum of subsidy effects across individual credit programs. It can be approximated using estimates of the demand elasticities and estimated subsidies for each type of credit program. Specifically, the present value of subsidies associated with all new loans made in a given year, S, is multiplied by the corresponding demand elasticity, dB/dS. Hence, both previously constrained and unconstrained borrowers contribute to increased demand at the intensive margin.

Similarly, total borrowing along the extensive margin, dA, is a sum across individual program effects. As in Gale (1991) and fundamentally by necessity, those estimates are largely judgmental, although they are informed by observations about credit programs and markets. Note also that the *ex post* observed amount of federally-backed borrowing includes the incremental borrowing induced by the credit programs.

A fiscal multiplier approach is used to translate incremental amounts borrowed into changes in aggregate output. Let Δb_i denote total incremental loan volume in program i (the sum of the intensive and extensive margin effects) and μ_i denote the corresponding output multiplier. Then the net stimulus effect of federal credit programs, ΔY, is:

$$\Delta Y = \sum_i \Delta b_i \mu_i - C \mu_c \tag{8}$$

While traditional multiplier analyses focus on tax and expenditure policies, there are additional considerations in applying them to credit policies. Importantly, although existing multiplier estimates can provide guidance on the relation between incremental amounts borrowed and increases in output, it does not make sense to apply them directly to credit subsidies. To the extent that traditional stimulus policies influence aggregate demand primarily because they

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provide additional spending capacity to hand-to-mouth or liquidity-constrained consumers, access to a dollar of additional borrowing can be expected to have similar effects to a dollar received from a grant program. However, the relation between the cost of a credit subsidy and its effect on aggregate demand would be poorly measured by directly applying the multiplier estimates in the literature. One source of the problem is that credit subsidies are measured on an accrual basis, and from the perspective of the borrower have a wealth effect rather than an income effect.[4] Furthermore, the value of credit subsidies cannot be converted to cash and therefore the subsidies in themselves do not relax liquidity constraints. Nevertheless, an important question is how much stimulus is generated for dollar of cost to taxpayers. To provide an answer, multipliers are applied to the incremental borrowing amount and the resulting increase in output is divided by the subsidy cost.

Other attributes of credit are also relevant in assessing the appropriate mapping to existing multiplier estimates for different types of policies. Because borrowers incur significant costs to take out and carry a loan, borrowed funds are likely to be disbursed fairly quickly. However, not all of the money will be used for consumption or new investment. Particularly with mortgages, a large fraction of new borrowing goes toward refinancing existing debt or buying a home that is part of the existing housing stock. Another consideration with credit is that over longer horizons its stimulus effects could be reversed as the loans come due.

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[4] In a frictionless market a subsidized borrower could turn around and sell the loan for an amount equal to the credit subsidy, but in practice it is prohibitively costly for borrowers to monetize the subsidy.

3. Background on Federal Credit Programs

This section provides some background information on the size and nature of federal credit activities in order to provide a broader context for the analysis of their fiscal stimulus effects and for the assumptions made in calibrating the model. Federal credit activities can be subdivided between programs classified in the budget as credit programs, which are referred to here as "traditional credit programs," and other programs that provide credit support but are not classified in the budget as credit programs, such as Fannie Mae and Freddie Mac, deposit insurance, private pension guarantees, and certain tax credits and exemptions. For the purposes of estimating stimulus effects in 2010, the main focus is on the traditional credit programs plus Fannie Mae and Freddie Mac.

3.1 Stock measures of federally-backed credit

The large footprint of federally backed credit in the U.S. financial markets can be clearly seen by comparing the stock of government-backed credit balances with those of different types of private credit outstanding. (However, the flow measures presented later on are more directly related to the potential size of stimulus those activities provide in a given year.)

The outstanding balances for federal direct loan and loan guarantee programs for the period 1970 to 2015 are shown in Figure 2, which shows the historically unprecedented expansion in those programs in the aftermath of the financial crisis of 2007. In reporting on traditional federal credit programs, it is standard to combine direct loans (loans originated and funded by the government) and government loan guarantees because all else equal the two forms of assistance are roughly economically equivalent in terms of the credit support provided and the subsidy cost to the government and ultimately to taxpayers.

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The 2010 Credit Supplement to the Federal Budget lists over 150 credit programs that are administered by various federal agencies and bureaus. Figure 3 groups the outstanding balances of federal direct loans and loan guarantees into major loan types--housing, education, agriculture, business or other--over the period 1998 to 2010.[5] Housing is the single largest category in all years, while federal student loans underwent the most rapid growth. The total amount of federal guaranteed and direct loans outstanding roughly doubled over the period, reaching about $2.3 trillion in 2010.

The volume of explicitly government-backed credit increased dramatically with the 2008 federal takeover of Fannie Mae and Freddie Mac. That action converted those two government-sponsored enterprises (GSEs) from private companies with implicit government guarantees to entities that are fully owned by the government and whose losses the government has a legal obligation to absorb. Figure 4 shows the totals for federal credit programs that include the credit obligations of Fannie Mae and Freddie Mac, and also some of the emergency programs of the FDIC and the Federal Reserve. Including those activities brings total federally-backed credit outstanding to over $8 trillion in 2010.

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[5] This excludes programs classified as emergency lending associated with the financial crisis.

Figure 2: Nominal Face Value of Federal Credit Outstanding
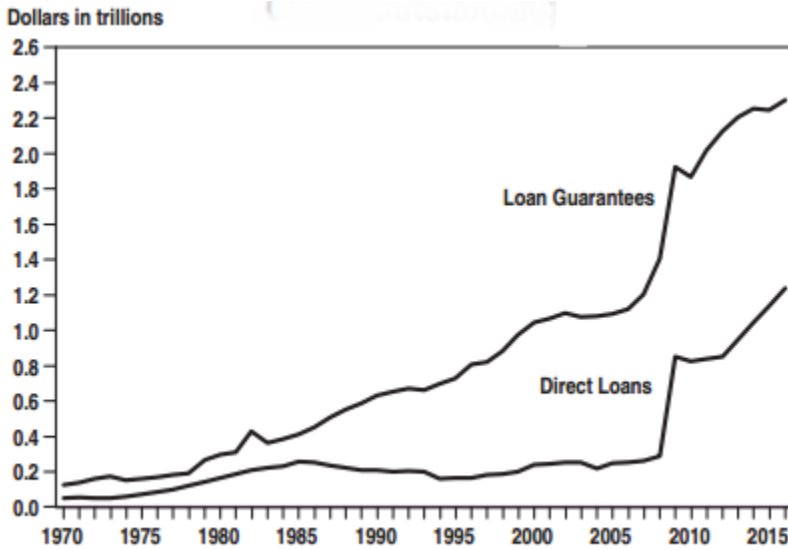
Source: Analytical Perspectives 2016, Office of Management and Budget

Figure 3: Total Non-Emergency Federal Loans Outstanding by Category (Direct and Guaranteed), 1998-2010

Source: Budget of the U.S. Government, Analytical Perspectives, FY2001-2012, as reported in Uncle Sam in Pinstripes, by Doiuglas Elliott.
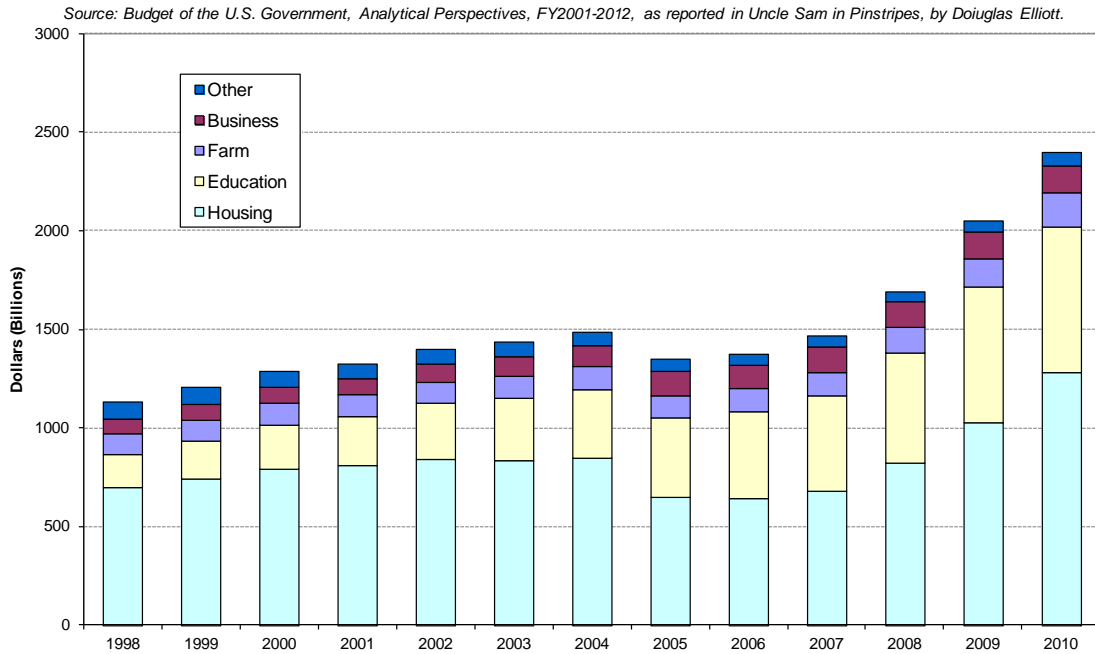
Figure 4:
Total Federal Loans (Direct and Guaranteed) and GSE Obligations Outstanding
1998-2010

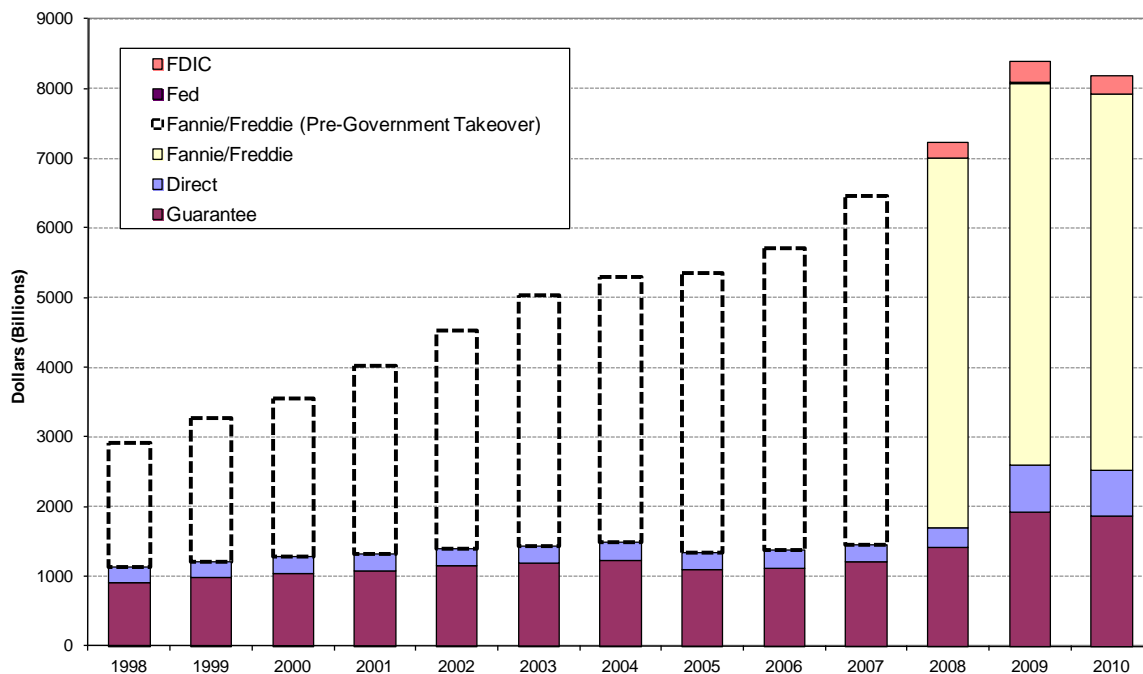*Source: Budget of the U.S. Government, Analytical Perspectives, FY2001-2012, as presented in Bankers in Pinstripes by D. Elliott.*

The programs included in Figures 3 and 4 are ones in which the federal government has a fairly direct role in determining eligibility and underwriting standards for the credit it backs, and those are the focus of the stimulus estimates here. (These figures may be extended through 2014 in the next draft.)

The government provides credit subsidies through other programs as well, and some of those may also provide fiscal stimulus under some market conditions. Those credit-related activities include: (1) *federal deposit insurance* covering $6.2 trillion of deposits in 2010; (2) *pension guarantees of private defined benefit pension plans* through the government's Pension Benefit Guarantee Corporation (PBGC) that had an estimated $2.8 trillion in covered liabilities in 2007

according to Munnell et. al. (2008); (3) *implicit guarantees to the Federal Home Loan Banks and the Farm Credit System*, which lower those institutions' funding costs. In 2010 the liabilities of the FHLBs totaled over $800 billion, and those of the FCS totaled about $200 billion; (4) support to financial institutions through the *Troubled Asset Relief Program (TARP)*, including purchases of preferred stock that peaked at about $540 billion in 2009 but subsequently declined; and (5) The *Federal Reserve* is a large participant in debt markets and its actions affect market prices, but most of its activities do not involve direct subsidies. The portion of the Fed's assets that are potentially relevant for subsidy calculations here are its loans to financial institutions and Maiden Lane holdings, which stood at $140 billion in 2010.

In sum, outstanding balances in the government's traditional direct loan and loan guarantee programs plus the mortgages held or guaranteed by Fannie Mae and Freddie Mac totaled about $8 trillion in 2010. Including credit-related activities such as deposit insurance, private defined-benefit pension insurance, implicit guarantees to the FHLBs and FCS, TARP, and the Federal Reserve's non-traditional programs increases the sum of federally-backed obligations to about $18 trillion.

By comparison, flow-of-funds data for 2010 indicate that home mortgage debt outstanding of $10.0 trillion, other consumer credit of $2.4 trillion, and business (corporate and non-corporate) debt of $10.8 trillion. These aggregates suggest that a large fraction of mortgages and consumer credit in the U.S. is federally-backed whereas most business debt is not. Governments are also large borrowers: state and local government debt in 2010 stood at $2.8 trillion, and federal debt

held by the public totaled $9.4 trillion.[6] As noted by Gale (1991), the behavior of users of state and local debt is also affected by the associated federal credit subsidies.

3.2 Federal credit extension over time and over the business cycle

The pattern of disbursements (i.e., new loans originated) of federally-backed credit over time in its traditional credit programs as a share of GDP from 1992 to 2011 is shown in Figure 5, with shaded areas indicating the peak to trough of business cycles as dated by the NBER.[7] Until 2009 disbursements volumes were fairly steady as a share of economic activity, fluctuating between about 2 and 3 percent of GDP. Disbursement activity peaked in 2009 at 10.8 percent of GDP, and in 2010 stood at 4.9 percent, still about twice as high as the historical average. The time series is not long enough to discern whether disbursements were countercyclical in the past, but clearly demand for federally-backed credit increased dramatically in response to the financial crisis and recession that began in late 2007. Data in Gale (2001) for 1980-87 suggests little cyclical variation during that timeframe, although disbursements in traditional credit programs were somewhat higher in the recessionary period of the early 1980s than later that decade.

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[6] U.S. Census, State and Local Government Finances by Level of Government: 2010.

[7] The series starts in 1992 because of the difficulty of obtaining comprehensive credit program information prior to that time, but I will extend the graph forward and hopefully also backwards in the next draft.

Figure 5:   Disbursements from Traditional Federal Credit Programs as a Percentage of GDP 1992 to 2010
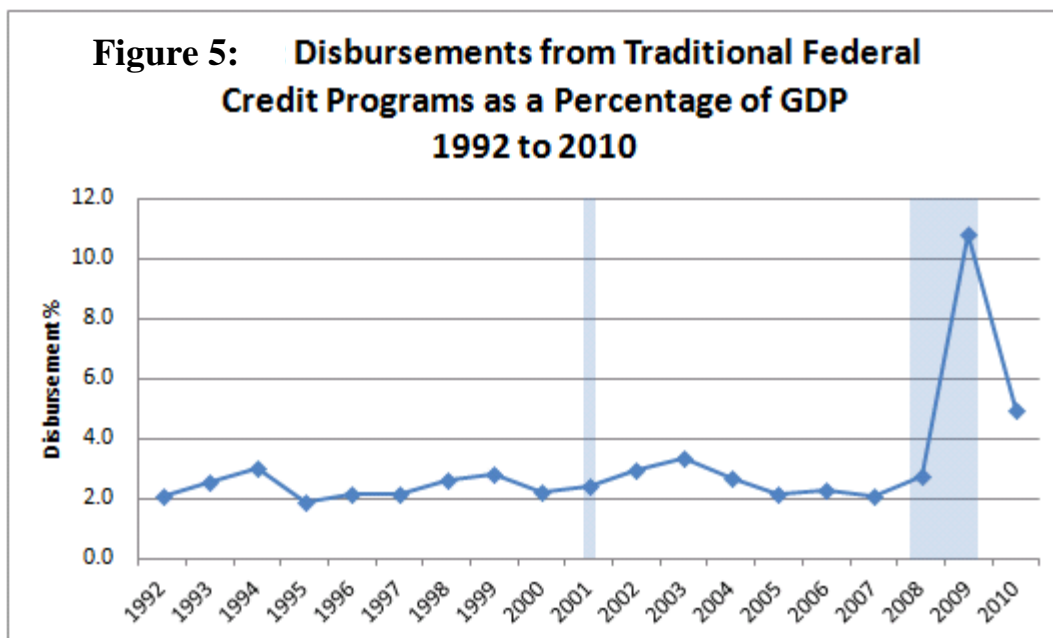
4. Model Calibration

The inputs used to calibrate the model include estimates of subsidy rates for each major credit program, demand and supply elasticities, program disbursements, expansions on the extensive margin, and multipliers.

4. 1 Program-specific subsidy rates and disbursement amounts

Estimates of the credit subsidies received by borrowers in 2010 are important inputs into the calculations of incremental borrowing along the intensive margin and of the bang-for-the-buck of credit program stimulus. Most non-credit federal subsidies are measured on a cash basis, and for the purposes of measuring stimulus their size and costs are generally equated to the annual cash outflows that are reported in the federal budget. Measuring and interpreting credit subsidy costs is more complicated because credit involves risky cash flows over long horizons. To capture the effects of time and risk, the credit subsidy calculations used in this paper are computed on a fair

value basis. Taking a fair value approach arguably provides the best measure of the economic cost to taxpayers of credit support extended in a given year, and hence it is the logical basis for fiscal multiplier calculations. However, those estimates differ from the credit subsidy estimates that are reported in the federal budget. (See the Appendix for additional discussion of methods and issues.) The fair-value estimates of subsidy costs used here are based on a series of analyses undertaken at CBO and in a number of academic studies that were aimed at improving cost measurement for select programs, and on extrapolations from those analyses to cover the larger set of programs considered here. It is convenient to refer to subsidy costs in terms of a "subsidy rate," which is defined as the fair value subsidy per dollar of loan principal.

4.1.1 Mortgage Programs

Since the 2007 financial crisis, the federal government has absorbed the credit risk on most new home mortgages. In 2010, Fannie Mae and Freddie Mac provided financing for 63 percent of new mortgages.[8] Adding to that the 23 percent of home loans insured by federal agencies such as FHA, VA and RHS (which are securitized by Ginnie Mae), about 86 percent of new mortgages originated that year carried a federal guarantee.

4.1.1.1 Fannie Mae and Freddie Mac

In 2010, the principal value of mortgages purchased by Fannie Mae and Freddie Mac was $1,011 billion ($625 billion by Fannie and $386 billion by Freddie). Most of the purchases were

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[8] The volumes that are relevant to the subsidy calculations include refinanced loans even if the previous mortgage also carried a federal guarantee. That is because the models used to predict guarantee costs treat refinancing events as precluding further defaults.
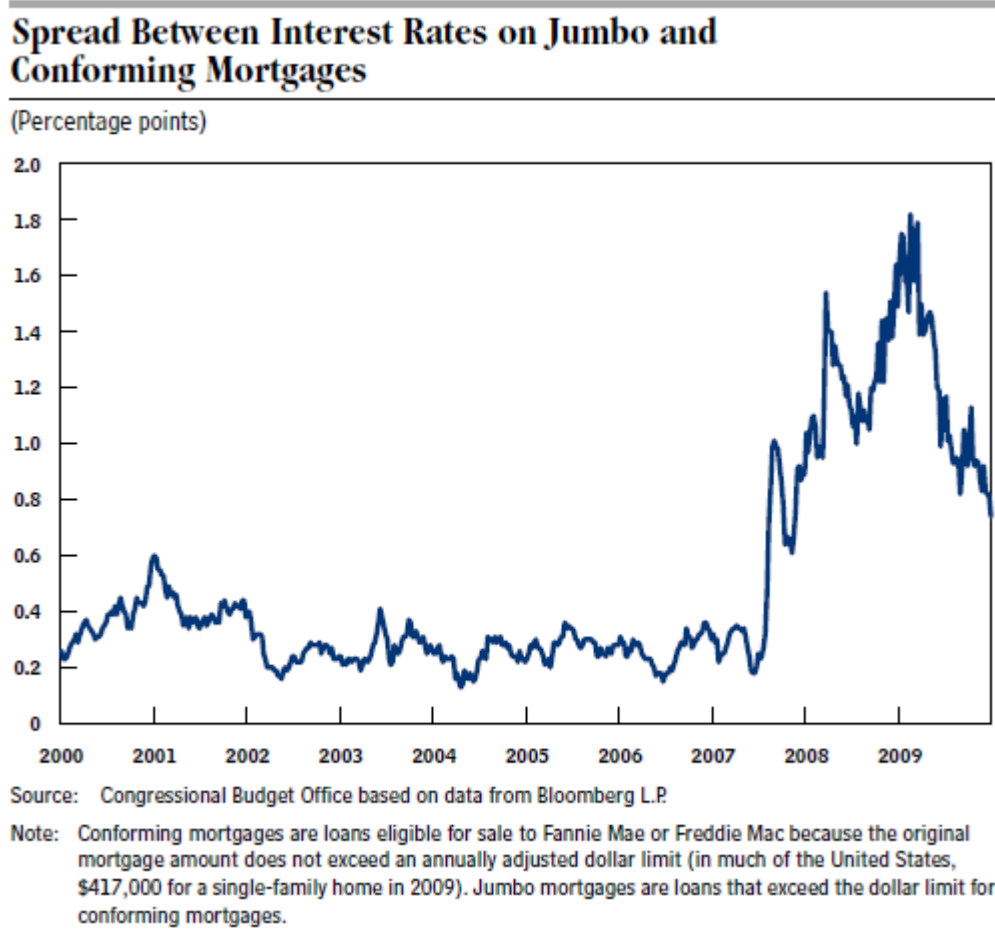
of fixed rate conforming mortgages on single-family homes. Based on estimates reported in CBO (2010a), the subsidy rate on the guarantee of those mortgages is taken to be 4.05 percent.

CBO provides an estimate of the annual fair value subsidy on new mortgages guaranteed by Fannie Mae and Freddie Mac in its baseline estimates of federal spending. Those estimates correspond to the concept of subsidy value used here: The annual estimate covers only the current year's new book of business; it does not reflect losses on mortgages guaranteed or purchased in the past, nor on expected future guarantees. The reported 2010 fair value subsidy cost was $41 billion, which represents about a 4 percent subsidy rate dividing by the principal amount of originations.

CBO (2010b) explains that its subsidy estimates are based on a model of expected future loss and prepayment rates, and a cost of capital based on the jumbo-conforming spread. The jumbo-conforming spread is often taken as an indicator of the difference between the private cost of insuring mortgage credit risk and what the government charges for it. The spread also reflects other differences between jumbo and conforming mortgages. CBO does not state the precise portion of the jumbo-conforming spread that they attribute to other factors, but other studies have suggested it was approximately half of the spread in the pre-crisis period. Figure 6 shows that the spread had fallen from its peak levels by 2010, but it still remained substantially elevated above pre-crisis levels at about 80 bps at the beginning of 2010. The 4 percent subsidy rate reported by CBO and used here can be understood as being roughly consistent with a 40 basis point annual subsidy over a 10-year average life of a mortgage.

Figure 6:

Spread Between Interest Rates on Jumbo and Conforming Mortgages

(Percentage points)

Source: Congressional Budget Office based on data from Bloomberg L.P.

Note: Conforming mortgages are loans eligible for sale to Fannie Mae or Freddie Mac because the original mortgage amount does not exceed an annually adjusted dollar limit (in much of the United States, $417,000 for a single-family home in 2009). Jumbo mortgages are loans that exceed the dollar limit for conforming mortgages.

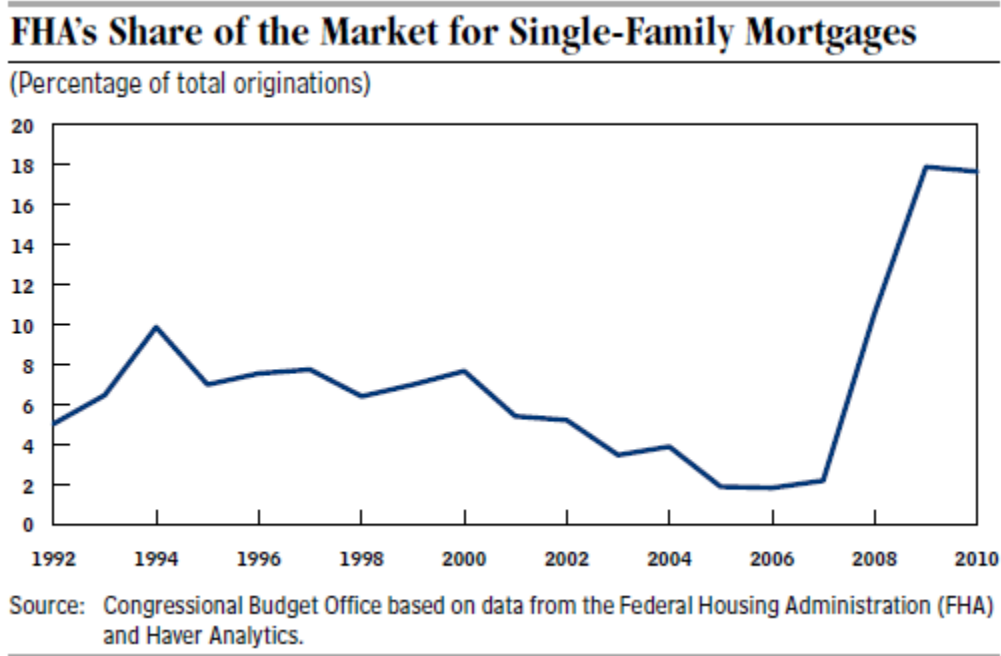## 4.1.1.2 Federal Housing Administration (FHA)

In 2010, FHA guaranteed about $319 billion of new mortgage loans, which represents about 17 percent of single-family mortgages originated that year (see Figure 7). The fair value subsidy rate assumed here of 2.25 percent is based on the rate reported in CBO (2011a) for 2012, adjusted upward to account for the higher credit spreads and lower fees prevailing in 2010.

Figure 7:

FHA's Share of the Market for Single-Family Mortgages
(Percentage of total originations)

Source: Congressional Budget Office based on data from the Federal Housing Administration (FHA) and Haver Analytics.

FHA's largest program is its single family guarantee program, which was designed to provide access to home ownership to people who lack the savings, credit history, or income to qualify for a conventional (GSE-eligible) mortgage. Guarantees are available to qualifying borrowers with down payments as low as 3.5 percent of a property's appraised value. The maximum amounts that can be borrowed are the same as on conforming mortgages insured by the GSEs. FHA charges borrowers an up-front fee and annual premiums.

Valuing FHA guarantees made in the wake of the financial crisis is complicated by the lack of private subprime mortgage originations that would normally provide reference prices. However, the key insight in CBO (2011a) is that information about the market price of mortgage credit risk was available at that time from the private mortgage insurance (PMI) market. Fannie and Freddie require borrowers with less than a 20 percent down payment to purchase PMI. Controlling for borrower and other loan characteristics, the present value of fees charged for PMI plus the fair

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value of a GSE guarantee approximates the fair value of the guarantee provided by the FHA. The difference between that imputed value of the guarantee, and of the fees that FHA is expected to collect, approximates FHA's subsidy at fair value.[9]

CBO's analysis yielded a projected subsidy rate of 1.5 percent for FHA guarantees expected to be made in 2012. Two factors suggest assigning a higher subsidy rate to 2010 originations: FHA's upfront fees were 50 basis points lower prior to April 2010, and credit spreads were wider in 2010 than in 2012. The subsidy rate used here for 2010 of 2.5 percent is lower than the 4 percent rate used for Fannie Mae and Freddie Mac. Although it may seem surprising that the subsidy rate on much riskier FHA loans is lower than for loans purchased by the GSEs, the difference can be explained by higher FHA fees that more than offset the higher default losses. It appears that most borrowers who qualify for GSE financing choose it over the FHA, which is consistent with the finding of a higher subsidy rate on GSE-backed mortgages.

4.1.1.3 Veteran's Administration and Rural Housing Service

Like FHA, the VA and RHS offer mortgages guarantees at more favorable terms to borrowers than are available privately. For example, the VA offers guarantees on mortgages, usually with no down payment, to active duty military personnel and veterans. RHS loans are means-tested and offered to relatively low-income rural residents. The subsidy rates for those programs are likely to differ from FHA's because of differences in fee structures, product mix, and

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[9] The valuation exercise employed a Monte Carlo model of mortgage cash flows, together with the prices of PMI guarantees, GSE guarantees, and of MBSs, to infer risk-neutral prices that could then be used to value FHA guarantees.

the borrower populations. The subsidy rates used here are 3.2 percent for the VA, which insured $63 billion of mortgage principal in 2010, and 4.4 percent for the RHS, which insured $17 billion.

Detailed estimates of fair value subsidies have not been published for VA, RHS, or other smaller housing programs. Rough estimates can be constructed by starting with the official subsidy rates published in the federal budget, and adjusting them for a market risk charge based on the risk charge inferred for FHA. That is, the budgetary subsidy estimates give the present value of projected losses discounted at Treasury rates. The budget calculations take into account differences in expected default and recovery rates across programs. The difference between the fair value subsidy and FCRA subsidy is the market risk charge for a program (see the Appendix). For FHA, the subsidy rate reported in the budget for 2010 was -0.84 percent whereas the fair value rate is estimated as described above to be 2.5 percent.[10] The fair value subsidy rate is therefore 3.34 percentage points higher than the FCRA subsidy rate. The assumption that the capitalized market risk charge is similar for all of these mortgage guarantee programs can be justified by the many similarities between them--the most of the loans are long-term, fixed rate, and highly levered, and they are exposed to aggregate risk primarily through shocks to the housing market. In 2010, the FCRA subsidy rates for the VA and RHS are -0.16 percent and 1.21 percent respectively. Adding a 3.34 percent risk charge implies a fair value subsidy rate of 3.2 percent for the VA and 4.4 percent for the RHS.

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[10] All FCRA estimates are from OMB's Analytical Perspectives, 2012.

4.1.2 Student Loans

The federal government makes financing for higher education widely available through its student loan programs. Since July, 2010 all new student loans have been made through the direct loan program administered by the Department of Education (ED), but prior to that time the majority of federal student loans were made through ED's guaranteed loan program.[11] The programs offer long-term fixed rate loans with a variety of terms.

The subsidy rates used for loans originated in 2010 are 13 percent for direct loans and 16 percent for guaranteed loans, following Lucas and Moore (2010) and CBO (2010d). The higher subsidy cost of the guaranteed program can be attributed to the statutory fees paid to private lenders that exceed the government's cost of administering the direct loan program. Collectively, the student loan programs disbursed $105 billion of new student loans in 2010.

Lucas and Moore (2010) and CBO (2010d) develop fair value subsidy estimates for the direct and guaranteed student loan programs at that time. The subsidies reported here are based on the subsidy rates reported in Table 3 of the CBO study.[12] Cash flows on student loans are modeled using historical loan-level data from the Department of Education on performance, and risk-adjusted discount rates are derived from the spreads over Treasury rates charged on private student loans prior to the financial crisis. (During the crisis the spreads widened enormously and private lending volumes fell sharply.) The loans have multiple embedded options including prepayment and deferral options that were also taken into account in the pricing model. Because the interest

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[11] During that time the government also purchased guaranteed loans from lenders. Those purchases do not create new credit subsidies for borrowers and those loans are excluded from the reported subsidy estimates.

[12] The methodology was similar in both analyses, but the reported subsidy rates are somewhat different, in part because of the time periods considered. However, the subsidy rates reported by CBO are more applicable to this analysis because it takes into account the mix of loan types and interest rate conditions in 2010.

rates on the private student loans are primary rather than secondary market rates, adjustments had to be made to subtract out an estimate of the fees that were included in the quoted rates. (Lucas and Moore, 2010, has a complete description of the valuation model.)

The subsidy rates used for student loans are much higher than for the mortgage guarantee programs. The higher rates reflect that student loans are long-term unsecured consumer debt, which is considerably riskier than even highly levered mortgages which are protected by the collateral value of the house.

4.1.3 Small Business Administration (SBA)

The SBA assists qualifying small businesses in obtaining access to bank credit by guaranteeing a portion of their loans through its largest program, its 7(a) loan guarantee program. That program had modest default rates in the years leading up to the 2007 financial crisis, but post-crisis loss rates increased dramatically (and in earlier years loss rates had also been high). Based on the analysis in CBO (2007), the fair value subsidy rate used here is 6.5 percent for the $17 billion of small business loans guaranteed in 2010.

CBO estimated the market value of SBA's subsidy on guaranteed loans originated in 2006 using an options pricing model that is described in CBO (2007).[13] CBO reports a market value subsidy rate for 2006 of 1 percent, versus a FCRA subsidy estimate of 0 percent. The report also concludes that under less benign market conditions (with 20 percent higher default rates and 50 percent lower recovery rates) the market value subsidy would increase to 2.7 percent for 2006. For 2010, OMB reports a FCRA subsidy rate for the SBA of 3.53 percent. The subsidy for 2010 is

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[13] The estimate is referred to in the report as a market value estimate, but it is conceptually equivalent to what is described as a fair value estimate in later CBO publications.

approximated by adding a market risk charge of 3 percent to the 2010 FCRA subsidy rate, which roughly corresponds to assuming a market risk premium of 50 bps annually over an average 7-year loan life.

4.1.4 Other Traditional Credit Programs

The programs discussed above account for over 88 percent of traditional credit program disbursement volume in 2010. The fair value subsidy rate used for the $64 billion of loans covered by these other programs is 6 percent.

The larger programs in the "other" category provide credit assistance for agriculture and international trade. While a few of those larger programs exceeded $5 billion in 2010 lending volume, most were much smaller. Fair value subsidy estimates have not been published for those programs. However, OMB provides summary data that include interest rates and fees, lifetime default and recovery rates, loans originated, and the FCRA subsidy rates.[14] From that information it is possible to back out estimates of a risk charge using a simple model of the annual expected cash flows on the underlying loans. That is, given an assumed prepayment rate, the lifetime default rate is converted into an annual default rate. Cash flows on the underlying loan are based on the borrower rate, the annual default rate, the prepayment rate, and the recovery rate conditional on default.[15] Discounting expected cash flows for each program at a risk-adjusted rate yields an estimate of their fair value. Then the subsidy (either for a direct loan or a loan guarantee) is the difference between the loan principal and the present value of loan payments and fees. FCRA

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[14] The data, which is reported by the federal agency running the program, is of mixed quality and in some cases clearly incorrect. In those cases the risk charge added to the FCRA subsidy rate is the average of the risk charges across all of the smaller programs.

[15] The present value of fees is assumed to be unaffected by the discount rate, which is only correct for upfront fees. However, the data on periodic fees is not reliable, which is why the effect of differential risk adjustment for fees is not calculated. Neglecting the difference is likely to have a very small effect on the total subsidy estimates.

values are approximated the same way except that Treasury rates are used for discounting.[16] The difference between the fair value and FCRA estimates is the market risk charge, which is added to the official FCRA estimate for each program to produce a fair value subsidy estimate.[17]

To risk-adjust the discount rates, the spread over Treasury rates is set at 1.15 percent, which corresponds to the historical risk premium on BBB bonds (Hull et. al., 2005). The weighted average risk charge is 6 percent, and the weighted average official FCRA subsidy rate is close to zero. Hence the fair value subsidy rate for the $64 billion of loans covered by other programs in 2010 is taken to be 6 percent.

4.2 Credit supply and demand elasticities

The elasticity of credit supply affects the extent to which additional borrowing in government credit programs is offset by reductions in private borrowing. For the 1980s, Gale considers supply elasticity of 0.5 and 5.0 to span the range of plausible values. The high levels of reserves in the banking system and loose monetary policy in 2010 suggest a high elasticity of supply in 2010. Therefore I do not include an aggregate crowding out effect. However, in assessing the increase on the extensive margin attributable to credit programs below, I take into account the likely share of borrowers who could have obtained credit for the same purpose from the private sector but chose not to because of the more favorable terms offered by the government.

Demand elasticities are an input to the estimated expansion of borrowing at the intensive margin. For the main results reported, I follow Gale (1991) by using elasticities with respect to the dollar subsidy amounts of 1.8 for housing, 0.65 for student loans, and 0.8 for business and other.

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[16] CBO (2011b) provides a detailed example of this approach for nuclear construction loan guarantees.
[17] The risk charge plus OMB's FCRA estimate is used instead of the rough fair value estimates because the FCRA estimates are generally based on more complete information about cash flows and their timing.

A more recent estimate of mortgage demand elasticity from DeFusco and Paciorek (2014) finds a reduction in total mortgage debt of between 1.5 and 2 percent per percentage point increase in the interest rate. To compare that flow estimate to the stock elasticity of 1.8 requires an assumption about the life of a mortgage and the appropriate discount rate. Very roughly, assuming 7 years of a 1 percent rate reduction provides about a 5 percent of the principal value in reduced cost, and the implied elasticity is .5. More generally, the literature is inconclusive on demand elasticities for credit, with more recent studies finding a mix of large and small values in different instances. This motivates using a fairly wide elasticity band for all types of borrowing in sensitivity analysis.

4.3 Increases in borrowing on the extensive margin

As the model in Section 2 illustrates, if credit rationing effects are important then the increased availability of credit to previously constrained households from federal credit programs could significantly increase borrowing volumes. The size of those volume increases may be largely unrelated to the cost of the associated credit subsidies; in some instances a small subsidy may lower the equilibrium interest rate enough to attract both low- and high-risk borrowers in situations where no private loans could be offered without lenders taking a loss. However, in other circumstances large subsidies may have little incremental effect on loan volume.

The evaluation of extensive margin effects for each program is informed by observations about the programs and related markets, but by necessity is largely judgmental because the counterfactuals would be extremely difficult to estimate. [18] Nevertheless, to the extent that the assumptions are plausible they are worth taking seriously, precisely because the implied stimulus

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[18] An exception is Jeske et. al. (2011), which proposes a structural model to assess the effects of the GSEs.

effects are so large. Alternative assumptions considered in the sensitivity analysis provide some assurance that the effects are large although they cannot be precisely measured.

The approach used here broadly follows Gale (1991). However, the goals of the two analyses are different and hence different choices are made. Gale considers two scenarios for the world without credit subsidies in order to provide upper and lower bounds for his calculations of the effects of policy on the allocation and quantity of credit under normal market conditions. The first is that all markets would clear. The second is that tax-exempt and mortgage markets would clear, but farmers, students, and small businesses would be "redlined," meaning that credit would not be available even at very high interest rates.

Here I consider two different scenarios for the effects of federal credit assistance on the availability of credit. The first scenario is for normal economic conditions; the second is for periods of recession and financial market distress. In calibrating the model for 2010, the question is which scenario more closely reflects conditions at that time, or did they lie somewhere in between? Financial markets had begun to normalize by 2010 and the recovery had officially started, but credit was still tight and unemployment remained elevated. Reflecting that the economy was neither normal nor high distressed, the reported stimulus effects are based on an equally weighted average of the outcomes in each of those scenarios.

4.3.1 Housing

Real estate serves as high quality collateral, making it relatively easy for firms and households to borrow against it. Perhaps for that reason, Gale assumes that the mortgage market would clear in the absence of federal housing programs. However, because house prices are volatile, there are limits to leverage. Government programs can increase the availability of

mortgage credit by permitting higher loan-to-value ratios than a private financial institution would accept. FHA, VA and RHS all allow borrowers to make very small or no down payments. A larger down payment requirement would discourage some people from purchasing a home at all and cause others to buy a less expensive home. To take into account that those programs loosen collateral constraints even during normal times, the constrained share of borrowing for the FHA, VA and RHS is set to 10 percent (i.e., 10 percent of the funds borrowed through those programs would not be available at any price without government assistance). By contrast, the GSEs require 20 percent down or private mortgage insurance and also impose payment-to-income limits. Those requirements appear to be at least as rigorous as those on non-conforming mortgages from private lenders. Hence it seems unlikely that the GSEs have much effect on the availability of mortgage credit in normal times and I assume they have no impact.[19]

Federal backing is likely to have a much larger effect on the availability of mortgage credit during periods of severe financial stress. However, the shift from private label mortgages to government-backed mortgages following the 2007 financial crisis is not necessarily indicative of the size of that effect because the government also attracts additional borrowers at such times because its pricing is particularly favorable. I assume that 90 percent of FHA borrowing is incremental during distress periods because the program is specifically designed for borrowers with no credit history, low savings, and low incomes, and because the down payments allowed are so low.[20] For the VA and RHS, I set the constrained share to 50 percent because some VA

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[19] Indirect support for this assumption comes from the finding that GSE pricing is only slightly more favorable than that on comparable private label mortgages (Passmore, Sherlund and Burgess, 2005).

[20] To the extent that this may overstate the extent to which FHA borrowers would be constrained during a crisis, note that FHA lending is shown below to add only $67 billion in stimulus, and that shading that number down would not change the main conclusions.

borrowers are more likely to be in a position to obtain some credit privately than are FHA borrowers. For the GSEs, even during periods of stress most conforming borrowers probably would be able to obtain credit from private lenders, albeit at higher interest rates. I assume that 25 percent of the volume of GSE credit is incremental during distress periods.

4.3.2 Student Loans

The federal student loan programs make unsecured, long-term credit available to borrowers most of whom have no credit history and little in the way of income or assets. Such loans are generally not offered by private financial institutions. For those reasons, the student loan program is thought to greatly increase the availability of funds for higher education.

I assume that during normal times, 75 percent of student loan volume observed would not have been available without federal support. The presumption that a quarter of the loans could have been obtained anyway is supported by the fairly sizable private student loan market that had emerged prior to the financial crisis. Also, some student loans are made to parents of students who are more likely to be able to obtain credit privately.

During the financial crisis many private lenders withdrew from the student loan market, and the ones that remained sharply raised their underwriting standards and rates. I assume that during times of market stress 95 percent of federal student loans represent incremental borrowing volume. That estimate may be on the high side if some families could use home equity or other forms of collateral to borrow funds to finance education when student loans are not available, or if they would have relied more on savings to cover educational expenses had government loans not been available. However, contributing also to incremental borrowing was that some students

probably took out loans that were used by their families for other purposes because of the unusual difficulty of obtaining credit elsewhere.

4.3.3 Small Businesses and Other Traditional Credit Programs

The SBA 7(a) program is explicitly aimed at increasing access to credit by businesses that would be unable to obtain loans on their own. The pricing that small businesses obtain through that program does not appear to be particularly favorable, and the volume of SBA loans did not increase much following the onset of the financial crisis.[21] I assume that the constrained share of those loans is 75 percent in normal times and 85 percent in stress periods. The relatively small difference between the normal and distressed share of constrained borrowers reflects the view that the program is relatively unattractive in good times for unconstrained borrowers. As a result, the level of constrained borrowers in good times is assumed to be higher than for most other federal credit programs.

Other traditional credit programs are a mix of support for agriculture, trade, energy, and other activities. The constrained share is set to 50% in normal times and 75% in periods of stress.

4.4 Fiscal multipliers

CBO (2011c) defines a fiscal multiplier as the change in a nation's economic output generated by each dollar of the budgetary cost of a change in fiscal policy. It reports a range of fiscal multipliers, reproduced in Table 1, for various types of expenditures authorized under the ARRA. The wide range reflects the conflicting evidence in the literature on their size. Auerbach

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[21] de Andrade and Lucas (2009) find that SBA subsidies may benefit banks more than small businesses.

and Gorodnichenko (2012) show that some of the size variation is a function of the business cycle, with much larger multipliers in downturns that are at the high end of the range reported by CBO.

Table 1. Ranges for U.S. Fiscal Multipliers

Type of Activity	Estimated Multipliers	
	Low Estimate	High Estimate
Purchases of Goods and Services by the Federal Government	0.5	2.5
Transfer Payments to State and Local Governments for Infrastructure	0.4	2.2
Transfer Payments to State and Local Governments for Other Purposes	0.4	1.8
Transfer Payments to Individuals	0.4	2.1
One-Time Payments to Retirees	0.2	1.0
Two-Year Tax Cuts for Lower- and Middle-Income People	0.3	1.5
One-Year Tax Cut for Higher-Income People	0.1	0.6
Extension of First-Time Homebuyer Credit	0.2	0.8
Corporate Tax Provisions Primarily Affecting Cash Flow	0	0.4

Source: Congressional Budget Office (CBO, 2011c).

As discussed in Section 2.2, under the interpretation that stimulus affects aggregate demand largely through the spending of hand-to-mouth consumers or liquidity-constrained households, these multipliers apply more naturally to incremental borrowing than to credit subsidies. However, how to map the different credit programs into the listed categories is not obvious. Student loans, small business loans, and other loans probably correspond most closely to "transfer payments to individuals" in that they put money directly into people's hands that is likely to be spent fairly quickly. Mortgages are most closely related to the extension of a first-time homebuyer credit, although the terms of that program are quite different than that of on mortgages, and many mortgage borrowers are not first-time borrowers.

To capture the cyclical variation in multipliers at different phases of the business cycle suggested by Auerbach and Gorodichenko (2012), higher multipliers are applied in the distress scenarios than for normal times. For the distress scenario multipliers are set to 2.0 for student loans, business loans and other loans. That choice of multipliers is towards the high end of CBO's range for transfers to individuals. For normal conditions the multipliers for those programs are set to 0.5. For Fannie Mae and Freddie Mac, I assume a much smaller multiplier of 0.3 under distress conditions and 0.2 under normal conditions. For the other mortgage programs the multipliers are set to 0.4 and 0.3 respectively. Those numbers fall in the low to middle range that CBO reports for the first-time homeowner credit. The choice of small multipliers for mortgage programs reflects the fact that refinancing accounted for about 73 percent of U.S. mortgage originations in 2010 according to Freddie Mac's 2010 Annual Report. Refinancing frees up cash for borrowing-constrained households because it lowers monthly mortgage payments (both through a lower interest rate and because principal is re-amortized), but the increase in free cash flow is much less than the principal amount refinanced. Most purchase mortgages also can be expected to have a limited stimulus effect because the money is spent on existing structures that are not part of output. The effects of larger and smaller multiplier are considered in the sensitivity analysis.

5. Stimulus Estimates and Sensitivity Analysis

Recall from Section 2.2 that incremental borrowing, ΔB, attributable to federal credit assistance net of crowding out is: $\Delta B = dA + S(dB/dS) - C$. The first two terms are incremental borrowing on the extensive and intensive margins, which can be easily quantified based on the assumptions made in Section 4. Crowding out, C, is set to zero due to the slack in the financial system in 2010. Applying the multipliers to ΔB for each program and summing up the results yields

the estimate of fiscal stimulus. Dividing the fiscal stimulus by the sum of credit subsidies quantifies the bang-for-the-buck of credit subsidies.

5.1 Subsidy totals and borrowing increases along the intensive margin

Table 2 summarizes the assumed subsidy rates and the estimates of incremental demand along the intensive margin, $S(dB/dS)$. Multiplying the loan disbursements by the subsidy rates gives a subsidy cost for traditional credit programs of $29.8 billion.[22] The GSE subsidies add to that $40.9 billion, bringing total estimated subsidies for 2010 to $70.8 billion.

	Table 2: Summary of Fair Value Subsidy Estimates for Federally-Assisted Credit in 2010				
	Category	Agency	Disbursements /Purchases ($ billions)	Fair Value Subsidy Rate (%)	Fair Value Subsidy ($ billions)
	Housing	Federal Housing Administration	319	2.5	8.0
	Housing	Department of Veteran's Affairs	63	3.2	2.0
	Housing	Rural Housing Service	17	4.4	0.7
	Student Loans (guaranteed)	Department of Education	20	16.0	3.1
	Student Loans (direct)	Department of Education	85	13.0	11.0
	Business	Small Business Administration	17	6.5	1.1
	Other Traditional	Various	64	6.0	3.8
Subtotal[*]			**584**		**29.8**
	Housing	Fannie Mae and Freddie Mac	1,011	4.1	40.9
Total			**1,595**		**70.8**
*The sum of disbursements is lower than the total in OMB's Analytical Perspectives because Treasury TARP and MBS transactions and ED purchases of seasoned student loans are excluded.					

The construction of the estimates of incremental borrowing for each program on the intensive margin are shown in Table 3, using the demand elasticities, disbursements, and subsidy

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[22] By contrast, a total subsidy cost of -$11.7 billion (i.e., savings) was reported in the Federal Budget.

rates described for each program in Section 4. In total, $107 billion of additional borrowing is attributed to this channel, mostly from the housing programs.

Table 3: Calculation of incremental borrowing on intensive margin						
	Category	Agency	2010 Volume ($ billions)	Elasticity	Subsidy Rate	Incremental borrowing ($ billions)
	Housing	FHA	319	1.8	2.5	14.3
	Housing	VA and RHS	80	1.8	3.5	5.0
	Student Loans	ED	105	0.65	14.0	9.6
	Business	SBA	17	0.8	6.2	0.8
	Other Traditional	Various	64	0.8	6.0	3.1
Subtotal*			584			33
	Housing	Fannie & Freddie	1,011	1.8	4.1	74.6
Total			1,595			107

Note that in an economy without credit market frictions, federal credit subsidies of this magnitude would be expected to have modest effects on economic aggregates: $70.8 billion is only about 11 percent of the $666 billion in non-defense discretionary spending, and 0.5 percent of GDP. Without credit market frictions those subsidies would cause some redistribution of wealth from taxpayers to borrowers. Demand would increase for subsidized loans, and there would be some crowding out of unsubsidized loans. Because eligibility for subsidies is linked to specific investments and increases the demand for them, some or all of the subsidy would be absorbed in higher relative factor prices (e.g., subsidized mortgages encourage more housing purchases, putting upward pressure on house prices).

5.2 Borrowing on the extensive margin and aggregate stimulus effects

The computations of borrowing for each program on the extensive margin and the computation of aggregate stimulus effects under the normal and stress scenarios are shown in

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Table 4. Incremental borrowing on the extensive margin is found by multiplying the assumed share of incremental loan demand for each program by the actual disbursement amounts. The sum of incremental loan demand on the extensive and intensive margins for each program is multiplied by corresponding fiscal multiplier to estimate incremental output.

Table 4 Panel A: Incremental Output in a Normal Period

Category	Agency	2010 loan volume ($ billions)	Constrained share	Incremental loan volume extensive margin	Incremental loan volume intensive margin	Multiplier	Incremental Output
Housing	FHA	319	0.10	31.9	14.3	0.3	13.9
Housing	VA and RHS	80	0.10	8.0	5.0	0.3	3.9
Student Loans	ED	105	0.75	78.8	9.6	0.5	44.2
Business	SBA	17	0.75	12.5	0.8	0.5	6.6
Other Traditional	Various	64	0.50	31.9	3.1	0.5	17.5
Subtotal		**584**		**163**	**33**		**86**
Housing	Fannie & Freddie	1,011	0.00	0.0	74.6	0.2	15
Total		**1,595**		**163**	**107**		**101**

Table 4 Panel B: Incremental Output in a Distressed Period

Category	Agency	2010 loan volume ($ billions)	Constrained share	Incremental loan volume extensive margin	Incremental loan volume intensive margin	Multiplier	Incremental Output
Housing	FHA	319	0.90	286.8	14.3	0.4	120.5
Housing	VA and RHS	80	0.50	40.0	5.0	0.4	18.0
Student Loans	ED	105	0.95	99.8	9.6	2.0	218.6
Business	SBA	17	0.85	14.1	0.8	2.0	29.9
Other Traditional	Various	64	0.75	47.8	3.1	2.0	101.7
Subtotal		**584**		**488**	**33**		**488.6**
Housing	Fannie & Freddie	1,011	0.25	252.8	74.6	0.3	98
Total		**1,595**		**741**	**107**		**587**

Under the assumption that the effects in 2010 were at the midpoint of the two scenarios that show $587 billion in incremental output with distress and $101 billion with normal conditions, the conclusion is that federal credit programs generated an estimated $344 billion in incremental output. That additional output was at a cost of $70.8 billion, which translates to a substantial $4.86

of stimulus per $1 of taxpayer cost. By comparison, CBO estimated that the ARRA increased output by $392 billion with an average multiplier of less than 1.5.

5.3 Sensitivity Analysis

Clearly the estimate of the stimulus effects of credit policies is highly sensitive to the many assumptions that went into the calculations, and the true value could be considerably more or less than the $344 billion that has been presented as the most plausible point estimate. However, the conclusion that federal credit policies have provided a significant amount of fiscal stimulus in recent years would be robust to a fairly wide range of parameter choices. The normal and distress scenarios in themselves may provide lower and upper bounds for the range of plausible stimulus effects of falling between $101 billion and $587 billion. While there is no way to assign probabilities, the midpoint was chosen to represent the best estimate because 2010 was an early year in the recovery, but credit markets remained tight. The assumptions about mortgages and student loans are the most critical because of the size of those programs. To the extent that student loans are the most credible source of stimulus and that the private student loan market was highly distressed, the estimate of $219 billion of stimulus from that program in distress conditions could be taken as a tighter lower bound. A range of $219 billion to $587 billion still leaves a factor of three uncertainty from top to bottom, but that is narrower than the five-fold ranges of multiplier uncertainty shown in Table 1. Given the uncertainties about multiplier effects, it would be difficult to make a strong case for further narrowing the range.

As noted by Gale (1991), tax exempt borrowing also provides federal credit subsidies via the tax code. He reports a subsidy rate of 19% to that assistance. CBO's multiplier range for transfers to state and local governments are similar to those for transfers to individuals. Applying

that subsidy rate and a mid-range multiplier of 1 to 2010 long-term municipal issuance volume, which totaled a record high $430 billion, translates to additional stimulus of $81.7 billion. The base case estimates are also conservative in that the subsidy estimates mostly exclude administrative costs.

6. Discussion and Conclusions

A unique aspect of U.S. credit markets is the large presence of ongoing government-backed direct loan and loan guarantee programs, most notably Fannie Mae, Freddie Mac, the student loan programs, and the FHA, but also over 100 smaller programs. Collectively those activities provided credit subsidies of varying sizes on $1.6 trillion of loans disbursed in 2010, and they relaxed credit rationing constraints on many borrowers. Taking into account the likely effects those programs had on causing borrowing in that year to be over and above what would have been extended privately in their absence, and also applying a multiplier to those incremental balances similar to those applied to traditional government spending and tax policies yields an estimate of fiscal stimulus from those programs in 2010 of roughly $344 billion, similar to the amount CBO attributes to the ARRA. That estimate is in some ways conservative because it excludes other forms of credit support such as tax breaks on municipal bonds, which would add an estimated $82 billion to the stimulus, and omits administrative costs from subsidy estimates. While there is considerable uncertainty around the point estimate, its size suggests that the effects of fiscal policy cannot be fully understood without taking the effects of federal credit programs into account. They also suggest that structural changes to the larger federal credit programs have potential macroeconomic and fiscal policy implications.

The analysis raises several fundamental questions. The first is how these results should change our perceptions about the depth of the downturn and the effectiveness of other fiscal and monetary stimulus. If the high-end estimates presented here are correct, then one might conclude that either the economy was in

worse shape than most economists thought, or conventional fiscal and monetary stimulus had less effect than some had previously estimated. Addressing this issue in depth is beyond the scope of this analysis. My view is that there remains a great deal of disagreement among prominent economists about how effective either fiscal or monetary policy was, or what would have transpired in the absence of those policies. That professional uncertainty is reflected, for instance, in the wide range of multipliers reported in Table 1 that were derived from surveying the literature. My preferred estimate of additional output of $344 billion in 2010, although large in comparison with the ARRA, is small compared to the $14.66 trillion in GDP and deficit of $1.3 trillion. Hence, although the findings here should shift the perception of the total amount of fiscal stimulus that was provided, it need not significantly shift one's prior beliefs about the severity of the downturn or the effectiveness of other policies. With regard to monetary policy, the analysis raises the intriguing question of whether the recovery of the housing market benefited more from the loosening of borrowing constraints via federal housing credit programs or by Federal Reserve actions that lowered interest rates.

A further question is definitional, and concerns whether credit policy should be classified as fiscal policy, monetary policy or as a third category of its own. The subsidies associated with credit policies clearly are an expenditure of economic resources by the government, and hence are fiscal in nature. The treatment of credit subsidies in the federal budget as costs (albeit underestimated costs) concurs with this view. At the same time, the channel through which the subsidies translate into fiscal stimulus—by accommodating increased borrowing and thereby increased spending—is different than for other fiscal policies. That difference was taken into account in the analysis by applying estimates of fiscal multipliers to incremental borrowing rather than directly to the subsidies. Nevertheless, because subsidy provision is the root cause of the increase in aggregate demand, it seems reasonable to consider these policies as part of fiscal policy broadly defined. While the policies have some similarities with actions the Federal Reserve took around the same time through its creation of emergency lending facilities, the case for treating the programs as part of monetary policy is weak. It's been observed that to the extent that the Federal Reserve

was taking uncompensated credit risk through its emergency facilities, its actions were fiscal and not monetary. In fact the Federal Reserve claimed that it was providing liquidity and not taking credit risk. CBO (2010c) for the most part concurred; it found that because most of the risky Federal Reserve facilities were backstopped by the Treasury through TARP (counted as part of fiscal policy) or otherwise protected against credit losses, that the fiscal costs of those facilities were in fact small. By contrast, federal credit programs involve significant uncompensated risk transfers and little liquidity provision.

There are also interesting areas for further research. An intriguing question is to what extent similar channels for fiscal policy through credit policy can be seen in other countries? In the case of Europe, although governments affect credit by intervening heavily in the banking system, there is much less reliance on U.S.-style government credit programs. This raises the possibility that one reason for the relatively strong U.S. recovery is that this channel for fiscal stimulus is less available than in Europe.

Appendix: More on Subsidy Estimation for Federal Credit Programs

This appendix explains the differences between fair value and budgetary estimates of credit subsidy costs, and elaborates on why a fair-value approach is the conceptually right choice for measuring credit subsidy costs and ways in which that approach can be implemented. For further elaboration see Lucas and Phaup (2010) and Lucas (2012). It also explains some of the reasons for the differences between the subsidy rates used in Gale (2001) and the ones used here.

For credit programs that involve uncertain cash flows extending over many years, equating program cost with net cash flows in a given year is widely understood to be misleading. For that reason, the Federal Credit Reform Act of 1990 (FCRA) mandated a switch to an accrual form of accounting for traditional credit programs. On an accrual basis, the subsidy associated with federally-backed credit represents the *ex-ante* value of the resources committed to borrowers at the time of loan origination in excess of the value of what borrowers are expected to pay for them over the life of the loan.[23] Defining credit subsidies on an *ex ante* or accrual basis makes credit subsidies more comparable with other federal spending than cash basis accounting. For example, a dollar's worth of assistance could be delivered to students in the form of an outright grant in a given year, or as the capitalized cost of offering a subsidized interest rate on a federal student loan made in the same year. (By contrast, most press accounts of federal credit costs focus on the losses absorbed by the government *ex post* rather than at the time that contingent resources were committed.)

Specifically, the subsidy conferred to a borrower who obtains federal credit assistance is the difference between the present value of the government's projected cash outflows and inflows

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[23] As is the case for most measures of fiscal policy, in this analysis the focus is on cost not benefits. The two could differ—borrowers could derive more or less utility from the credit extended than its cost to taxpayers.

over the life of the loan. The choice of discount rates significantly affects those present value calculations. For credit programs whose costs are required to be calculated under the rules specified in FCRA, the law prescribes that projected net expected cash flows be discounted at maturity-matched Treasury rates. The mandated use of Treasury rates for discounting causes the subsidy costs reported in the budget to be systematically lower than what a private financial institution need to be paid to extent credit on the same terms. That is because a private institution would also factor in the cost market risk (and any other priced risks such as prepayment risk) in its choice of discount rates. Another practice that contributes to the understatement of reported subsidy costs is that most transactions costs are excluded, although they are reported elsewhere in the budget on a cash basis.

By contrast, a fair-value approach produces estimates of the cost of credit subsidies that either correspond to or approximate market prices. Conceptually, the same projected state-contingent cash flows are used as in FCRA calculations, but the discount rates differ from Treasury rates because they reflect the cost of market risk and other priced risks.

An argument sometimes made against using a fair-value approach for measuring government cost is that market risk does not involve costs for the government because it can borrow at Treasury rates. However, when the government finances a risky loan or loan guarantee by selling a safe Treasury security, it is effectively shifting risk to taxpayers or other federal stakeholders that serve as involuntary equity holders in federal investments: if the borrower defaults, the Treasury security ultimately must be repaid for through higher taxes or lower government spending in the future. This is simply the application of the logic of the Modigliani-

Miller theorem to government investments; absent frictions, the cost of capital for a project or investment depends on the risk of the project's cash flows, not on how it is financed.[24]

The resulting understatement of official subsidy costs from discounting at Treasury rates is most evident in those programs that report a gain to the government while at the same time delivering credit at rates that are well below those charged for credit of similar risk in competitive markets, such as is the case for student loans and FHA mortgage guarantees. In fact, the net effect of traditional federal credit programs was to reduce the reported budget deficit in 2010 by $14.1 billion. Taken literally, that would suggest that federal credit programs were a fiscal drag on the economy rather than a stimulus.

In general, there are three basic approaches that can be used to estimate the fair value of federal financial transactions: comparable market prices, risk-adjusted discount rates, and derivative pricing. The choice between them in a given instance is a matter of data availability and the nature of the contract (e.g., some guarantees are most easily valued as options); each should provide the same answer if correctly implemented. Directly comparable products usually do not exist in the private market, either because they would be unprofitable or because aggressive pricing by the government crowds them out, which necessitates model-based approaches rather than direct price comparisons in most instances.

The fair value subsidy rates in Table 1 differ considerably from those reported by Gale (2001) for a number of reasons that are explained here. During the 1980s OMB produced annual estimates of the economic cost of credit programs that were conceptually similar to fair value estimates in its "Special Analysis F" volume of the federal budget. Gale (1991) reports OMB

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[24] For a more complete discussion of federal budgeting practices for credit and other financial instruments, and of the case for fair value accounting for the government, see Lucas and Phaup (2010).

subsidy rates from that time of 2 percent for mortgages, 25 percent for farm credit, 32 percent for student loans, 14 percent for small business, and 19 percent for tax exempt bonds. The high subsidy rates for farm credit reflect the very risky loans that were being made at that time that eventually necessitated a bailout of the Farm Credit System; those programs have since been restructured to be safer. OMB's higher estimated subsidy rate on student loans is consistent with the more heavily subsidized interest rates at that time. The subsidy rates on small business loans were also higher in the past; SBA's expected losses have fallen because of significant program changes since that time. For housing credit, the subsidy estimate reported here for the GSEs is more than twice OMB's estimate of housing credit subsidies, and FHA and VA subsidy rates here are also considerably higher. The elevated 2010 subsidy rates reflect the severe disruptions in housing finance markets at that time. Under more normal market conditions subsidy rates are likely to be closer to OMB's earlier estimate.

<h1 align="center">References</h1>

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