ECONOMIC EFFECTS OF FEDERAL CREDIT PROGRAMS

By

William G. Gale
University of California, Los Angeles

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William G. Gale
Department of Economics
University of California, Los Angeles
Los Angeles, CA 90024
(213) 825-6619

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ABSTRACT

Since 1980, more than one-third of all non-federal borrowing has been directly subsidized by the federal government. This paper presents numerical estimates of the effects of federal credit programs. The results indicate that credit subsidies have important effects on the allocation of credit, and may raise aggregate investment. The proper focus of analysis, however, is the welfare impact of such policies. The efficiency costs of lending programs are shown to be large. Even programs for groups that would not have received funds without public assistance require the existence of external benefits to raise welfare, because program costs are high. In addition, most of the direct welfare gains of current policies accrue to borrowers who would have received funds without public assistance. High program costs and the inframarginal nature of credit programs combine to create government costs in excess of 50 cents per dollar of incremental targeted lending. Interactions among programs can indirectly eliminate much or all of the original direct gain provided by a credit subsidy; these effects are particularly noticeable if the supply of funds is inelastic or borrowers are rationed. Policy reforms are also considered.

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I. Introduction

From 1980 to 1987, the Federal government borrowed $1253 billion to cover budgetary shortfalls.[1] Large and persistent fiscal deficits have generated widespread attention in academic and policy debates. Over the same period, federal lending programs extended $1208 billion of net credit, while new federal and federally assisted lending exceeded $2.5 trillion. Since 1980, the federal government has subsidized, guaranteed, or directly extended more than one-third of all borrowing by non-federal sectors. Nevertheless, the extent of federal credit is still a frequently unrecognized feature of modern capital markets.

The government supplies or reallocates credit through the provision of direct loans, loan guarantees, interest subsidies, tax-exempt status, and a variety of Government-Sponsored Enterprises. Credit programs aid borrowers in virtually every sector of the economy. Principal ongoing lending programs assist homeowners, farmers, students, small business, and state and local governments. Credit subsidies are often proposed as solutions to national problems, such as energy development or maintaining international competitiveness. In addition, the government has provided emergency assistance loan guarantees to Chrysler, Lockheed, and New York City in recent years.

Despite the potential importance of federal credit activity, and the many issues such policies raise, there exist few systematic analyses of the effects and appropriate role of the government as a lender. However, given the magnitude and pervasiveness of federal lending, analysis of these

policies would seem critical to understanding real world credit markets. For example, there is a large literature concerning the existence of liquidity constraints or other capital market imperfections. Federal credit can be, and in many cases is meant to be, a response to such factors. Yet only Mankiw [1986] has analyzed the effects of credit subsidies under these circumstances.[2]

The purpose of this paper is to develop a framework in which to analyze the effects of federal lending on credit allocation, economic efficiency, and related issues. The underlying model is based on Stiglitz and Weiss [1981], and posits asymmetric information between borrowers and lenders. Government interventions are modelled as part of an overall market for credit, which may be characterized by market clearing, rationing, or redlining. Thus, it is possible to see how the effects of credit interventions depend upon the initial regime. In addition, unlike previous research, the model accounts for the funding and resource costs of federal credit, interactions between programs, and diverse credit instruments.

The main contribution of this paper is to simulate the model described above to generate numerical estimates of the effects of current credit programs. The model can also be used to examine the quantitative effects of interactions among programs and possible policy reforms. To my knowledge, this is the first paper to derive such estimates. With the simulation results, it is possible to quantify many important effects for which theoretical models can only supply qualitative (and often ambiguous) answers. In addition, the robustness of various results to particular assumptions can be established.

Literature Review

Previous research has focused almost exclusively on the theoretical determinants of the effectiveness of credit interventions. The best way to compare the model presented here with prior analyses is to focus on four issues that commonly arise in credit market analysis. Asset Substitutability: Penner and Silber [1973] demonstrate that the incidence of benefits and crowding out induced by credit subsidies depend on the substitutability of various assets in lenders' portfolios. In this paper, I assume that financial intermediaries are risk-neutral, thus making all assets perfect substitutes. As discussed in Section VI, this assumption is likely to be a good approximation and simplifies the analysis considerably.

Real-Financial Linkages: One of the most studied and controversial issues in economics concerns the relationship between financial and real activity. In the context of credit subsidies, Rao and Kaminow [1975], Plantes and Small [1981] and Bosworth, et al. [1987] emphasize the possibility of borrowers substituting subsidized debt for equity to finance a given project, or substituting subsidized capital for labor in producing a given product. In such instances, the change in credit allocation will not induce a similar change in real activity. Alternatively, if federal credit provides the marginal source of funding for a large project, the change in real activity may be substantially greater than the change in credit allocation. This paper makes no attempt to resolve these types of issues. Instead, a one-to-one link is assumed. Pending the resolution of real financial issues, this assumption is a useful benchmark. Penner and Silber [1973] and Mankiw [1986] make similar assumptions.

Elasticity of Supply of Funds: Another controversy concerns the openness of world capital markets, with important contributions by Harberger

[1978, 1980] and Feldstein and Horioka [1980]. Previous analyses of credit programs make varied assumptions in this regard. Mankiw [1986] assumes perfectly elastic supply; Bosworth, et al. [1987] assume perfectly inelastic supply; and Penner and Silber [1973] assume an intermediate value. This paper reports simulation results for high elasticity and low elasticity cases. Thus, it is possible to determine which results are sensitive to this assumption.

Information: Mankiw [1986] shows that the presence of asymmetric information between borrowers and lenders (1) can allow small changes in credit policy to induce large changes in credit allocations, and (2) allows for the possibility of welfare-improving credit subsidies. The theoretical model presented here employs similar informational assumptions and also generates the two conclusions listed above. In addition, the model analyzes the costs, crowding out, and interactions associated with government lending.

Principal Conclusions

Despite the diversity of federal credit activity, many useful conclusions emerge. The allocational effects of lending policies depend on the size of the effective subsidy, rather than on credit volume. As a consequence, lending programs exert important effects on the allocation of funds to farmers, students, small business, and tax-exempts. The well-known federal mortgage guarantee programs are estimated to have little net effect because of the small subsidies they provide.

The crowding out of non-targeted borrowers depends critically on the supply elasticity of funds, but is bounded at a maximum of about 5% of original borrowing by non-targeted sectors. Aggregate investment (the sum of non-targeted and targeted investment) rises by between 0 and 4%,

depending on the supply elasticity.

Allocational effects, however, do not in themselves provide any sort of justification for credit interventions. Instead, analysis should properly focus on the welfare effects of government lending.[3] The simulations indicate that current credit programs are very inefficient. Most programs require the existence of large external benefits to be welfare-improving. Even programs for groups that would have been excluded from private markets without federal assistance (say, students) require the existence of external benefits to raise welfare, because the program costs are so large. In addition, the vast proportion of the direct welfare gains for credit programs accrue to borrowers who would have received credit without government subsidies. These subsidies represent pure windfall gains for the recipients with no corresponding societal benefits. Because of the intramarginal nature of most credit programs, credit programs cost the government 50-80 cents per dollar of incremental target group investment. Notably, the welfare results described above are <u>not</u> sensitive to assumptions concerning the elasticity of supply.

An additional problem facing credit policy is that interactions among credit programs can indirectly eliminate much or all of the original direct gain. This occurs because a credit program to one target group crowds out non-targeted groups <u>and other target groups</u>. In the low supply elasticity case examined here, up to 15% of the direct gains to farmers, students, and small businesses are offset by the effects of other credit programs. Interactions can be even more severe if a target group is rationed. Although they may not have important macroeconomic effects, interactions can substantially affect sectoral credit markets.

Analysis of programmatic reform suggests two general principles. First, the effectiveness of any proposed reform depends on the structure of the original subsidy. Second, programs in which the government provides appropriate marginal incentives (e.g., to reduce defaults) appear to be more efficient than programs that attempt to replace private credit arrangements. The results, taken together, indicate that although there is still a role for government in the more marginal sectors of the credit market, that role is much more limited than current policies would suggest.

Section II provides an overview of current federal credit activity. Section III develops the formal model. Section IV specifies parameter values. Section V presents the main results. A concluding section discusses caveats and extensions to this line of research. Appendices A and B describe some important calculations and provide detailed references for the parameter specifications, respectively.

II. An Overview of Federal Credit Subsidies[4]

Federal lending activity is distinguished by its diversity and magnitude. Direct loans typically offer large subsidies, and are concentrated in the agricultural and rural sectors. Loan guarantees assist a wide range of borrowers, particularly homeowners, small businesses, students, and export traders.[5] Hardin and Denzau [1981] report the existence of more than 350 direct and guaranteed lending programs. Government-Sponsored Enterprises aid borrowers in housing, agricultural, and student loan markets, primarily through the operation of secondary markets.[6] Tax-exempt status allows state and local governments to borrow at reduced cost, and to operate their own credit programs, by passing on the interest savings to preferred borrowers. Effective subsidy rates, default rates, and credit

volume vary greatly across sectors and programs, and are discussed in detail in Section IV and Appendix B below.

In recent years, lending subsidies have been employed (with varying degrees of success) to attain a variety of policy goals, including correction of a capital market imperfection, the promotion of competition, redistribution of wealth, or emergency assistance.

As shown in Table 1, lending programs account for an important share of credit advanced in domestic capital markets. The volume of net federal lending has grown at approximately the same rate as overall credit in the 1980s and has exceeded $100 billion in every year since 1980. In a typical year, federal lending accounts for 25-29% of all net credit advanced, and 34-41% of all nonfederal borrowing. Since 1980, net federal and federally assisted lending is approximately the same size as federal borrowing.

Extensive lending activity, per se, does not imply that credit policy imparts important effects on the economy. However, the sheer magnitude and pervasiveness of credit interventions suggests the need for further analysis. In particular, the volume of federal credit activity indicates that any formal analysis should consider the effects of subsidies on non-targeted groups, and the funding of credit policy. The diversity indicates the need to model several types of lending instruments and interactions among credit programs. Finally, since many of the targeted groups appear to be the marginal borrowers in modern credit markets, analysis of both rationing and market clearing outcomes should be relevant. The next section provides a model with these characteristics.

TABLE 1

Federal Lending and Domestic Credit Markets

(Dollar Amounts in Billions)

Fiscal Year	1980	1981	1982	1983	1984	1985	1986	1987	Total
Net Credit Advanced in Nonfinancial Credit Markets	341.7	375.9	388.9	550.2	753.9	854.8	831.7	685.2	4782.3
Net Federal and Federally Assisted Lending	110.2	109.9	131.8	140.2	129.9	246.7	159.9	179.5	1208.1
Direct Loans	24.2	26.1	23.4	15.3	6.3	28.0	11.2	-19.0	115.5
Guaranteed Loans	31.6	28.0	20.9	34.1	20.1	21.6	34.6	60.4	251.3
GSE	24.1	32.4	43.3	37.1	53.1	60.7	83.3	107.8	441.8
Tax-Exempt Credit	30.3	23.4	44.2	53.7	50.4	136.4	30.8	30.3	399.5
Federal Borrowing From the Public	70.5	79.3	135.0	212.3	170.8	197.3	236.3	151.7	1253.2
Federal Lending as a Percentage of Net Credit	32	29	34	25	17	29	19	26	25
Federal Lending as a Percentage of Federal Borrowing	156	138	98	66	76	125	68	118	96
Federal Lending as a Percentage of Nonfederal Borrowing	41	37	52	41	22	38	27	34	34

Sources: Table F-22, "Special Analysis F," Special Analyses: Budget of the United States, 1988; Flow of Funds Accounts, Fourth Quarter, 1987, pp. 2-3.

III. A Model of the Credit Market[7]

A. Description

The underlying model is a variant of Stiglitz and Weiss [1981], and analyzes a competitive loan market where lenders have imperfect information about borrowers. The market consists of government and many borrowers, depositors, and financial intermediaries. All agents are risk-neutral; there is no aggregate risk. Depositors supply funds to the market according to a function $S(\rho)$, where ρ is the certain rate of return on bank deposits.

Borrowers are divided into N+1 groups: N target groups for credit policy and one general (non-targeted) group.[8] Borrowers are characterized by two pieces of information: their group identity and their location within that group. Group identity is assumed to be public information and will provide a (noisy) signal of borrowers' riskiness. Location within a group refers to the riskiness of the individual's projects and is known only to the individual borrower. With these informational assumptions, lenders (including the government) can determine which borrowers are eligible for credit subsidies, yet still face residual uncertainty within each group.

Each borrower group is characterized by two behavioral assumptions. First, the demand for loans (L_i^D) is a decreasing function of the effective interest rate (r_i^*) paid by the borrower. Second, the repayment rate (ϕ_i) falls as r_i^* rises. That is, increases in effective interest rates generate adverse selection in each loan market.

Financial intermediation ("banking") is subject to free entry and constant returns to scale. Therefore, banks earn zero profits. Since banks can discern only a noisy signal of borrowers' riskiness, banks set different loan rates for each group.[9]

The expected return to the bank of lending to target group i at rate r_i is given by

$$\rho_i = \rho_i(r_i, \phi_i, C_i),$$

where C_i (a vector) represents credit policy for target group i. Holding credit policy constant, the existence of adverse selection implies that an increase in lending rates may eventually lead to a reduction in the banks' expected return.[10] This relationship is shown as the ρ_j curve in Figure 1.

As shown in Figure 1, the maximum bank return on general loans (ρ_G^*) is assumed to be at least as great as that available on target group loans: $\rho_G^* \geq \rho_j^*$, $j = 1,\ldots,n$.[11] This assumption is necessary and sufficient to imply that situations exist in which the general market clears, while target groups are rationed or redlined.

The government may assist target groups through direct lending, interest subsidies, and loan guarantees. The subsidies raise loan demand by reducing the effective interest rate. They also raise the expected bank return to target group lending indirectly through $\phi_i(r_i^*)$ and in some cases directly (e.g., loan guarantees). The government borrows to fund its credit programs, and pays its creditors with program revenue first and general revenues thereafter. These assumptions force explicit recognition of the costs of the programs. The government has the same information and borrowing costs as banks.

The model is competitive in that there are many agents and entry is free. There is, however, one important departure from the standard competitive framework: in addition to caring about aggregate demand, banks also care about the identity of the borrowers demanding loans. Thus, an important concept will be effective demand -- demand for loans that banks

Figure 1

Expected Bank Return on Loans to Various Borrower Groups

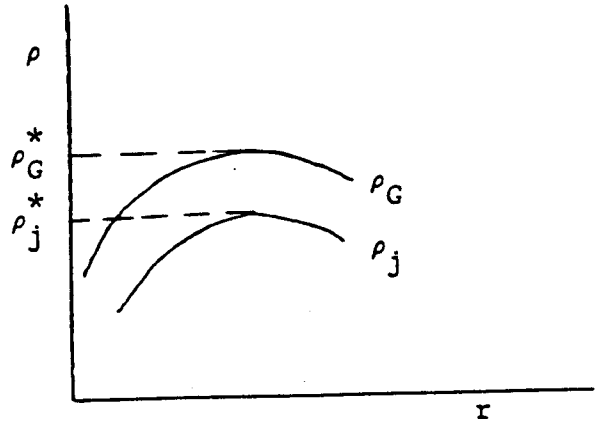
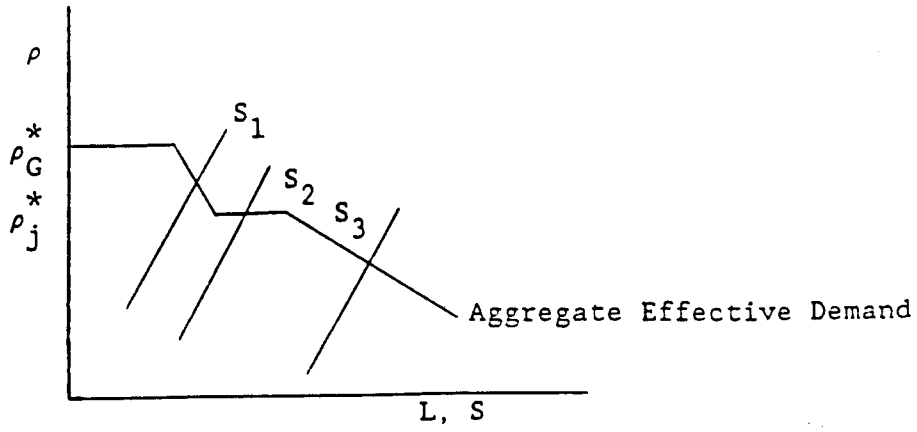


Figure 2

Types of Equilibria



are willing to supply. Effective demand for borrower group i is given by

$$L_i = \begin{cases} L_i^D & \text{if} \quad \hat{\rho} < \rho_i^*(r_i^*) \\ 0 & \text{if} \quad \hat{\rho} > \rho_i^*(r_i^*) \end{cases}$$

where $\hat{\rho}$ is the equilibrium value of ρ. For example, in Figure 1, if the equilibrium cost of funds is greater than ρ_j^*, banks will not consider making loans to group j, since such loans would generate negative expected profits. If $\hat{\rho} = \rho_i^*$, L_i is determined as a residual, after other credit demands have met, such that $0 \leq L_i \leq L_i^D(r_i^*)$. These considerations imply that aggregate <u>effective</u> demand, shown in Figure 2 (for N=1), is a step function.[12] In equilibrium, the market for target group loans may be characterized by market clearing (S_3), rationing (S_2) or redlining (S_1), depending on the relative magnitudes of supply and demand.[13]

One important characteristic of this model is that, in equilibrium, banks order borrower groups by their maximum rate of return and serve the groups sequentially. That is, if the cost of funds is ρ, all groups j with $\rho_j^* > \rho$ have clearing credit markets, those with $\rho_j^* = \rho$ are rationed,[14] and those with $\rho_j^* < \rho$ are redlined.

Because banks order the borrower groups sequentially and because $\rho_G^* > \rho_j^*$, target groups are the residual borrowers. As a consequence, if a target group is rationed, the marginal effects of any change in supply or demand falls completely on the rationed group while general borrowers are left unaffected. An interesting application of this result occurs when one target group is rationed and another is redlined: the burden of subsidies to the redlined group falls entirely on the rationed group. In this case, credit subsidies simply rearrange loans among target groups; aggregate targeted borrowing does not rise.

More formally, equilibrium is characterized by two economic conditions. First, banks' expected returns to lending are equalized across all groups that receive loans, and equal to the cost of funds (zero profits):

$$\hat{\rho} = \rho_i \quad \text{if} \quad \rho_i^* \geq \hat{\rho}. \tag{1}$$

Second, the sum of private and public demands equals the supply of funds (no idle funds):

$$S(\rho) = \sum_{i=0}^{n} [L_i + G_i] \tag{2}$$

where G_i is government borrowing to fund programs for group i. In addition, a third set of equations links effective interest rates and loan rates:

$$r_i^* = g(r_i, C_i), \quad i = 0,1,\ldots,n. \tag{3}$$

That is, credit subsidies drive a wedge between rates charged by the bank and rates paid by borrowers.

B. Functional Forms

In the simulations, supply and demand curves are specified in constant elasticity forms:

$$S = a(\rho)^{\alpha} \tag{4}$$

$$L_i^D = b_i(r_i^*)^{\beta_i}, \quad i = 0,1,\ldots,n, \tag{5}$$

where α and β_i represent elasticities of supply and demand, respectively, and a and b_i are constants. As shown in Appendix A, government borrowing for group i is given by

$$G_i = L_i s_i, \tag{6}$$

where s_i is the percentage reduction in the present discounted value of

borrowers' loan payments due to federal credit subsidies.

Appendix A also shows that the relationship between ρ, r, and r_i^* may be reduced to a single set of equations, summarized here as:

$$(7) \qquad r_i^* = f(\rho, \phi_i, C_i), \quad i = 0,1,\ldots,n.$$

The effective interest rate rises with increases in deposit rates and falls with increases in the probability of repayment and credit subsidies. Equations (2) and (4)-(7) represent the market clearing equilibrium, with S, L_i^D, G, ρ, and r_i^* endogenous.[15,16]

If group j is rationed, equation (2) is modified to become

$$(8) \qquad L_j + G_j = S - \sum_{h \neq j} (L_h^D + G_h);$$

where h indexes groups with $\rho_h^* \geq \hat{\rho}$. That is, lending to group j is determined as a residual. In addition, as shown in Figure 2, the equilibrium cost of funds must equal the maximum bank rate of return on group j loans:

$$(9) \qquad \hat{\rho} = \rho_j^*.$$

Equations (4)-(9) represent the rationing equilibrium.

IV. Parameter Specification

The specification of federal credit programs is potentially complicated due to the large number and diversity of credit programs, as discussed in Section II. However, a sizeable percentage of both the credit allocated directly by the government and the subsidies inherent in credit programs is concentrated in a relatively small number of programs. These programs target different borrower groups with different instruments and widely varying subsidy rates and loan volume across sectors. In 1986, the five

sets of programs listed in Table 2 accounted for 93% of all new credit advanced, subsidized, or guaranteed by the government, including 75% of direct loan obligations and 90% of guaranteed loans.[17,18] The subsidies in these programs accounted for approximately 75% of all subsidies extended through loan guarantees and 50% of subsidies extended through direct lending (excluding foreign military sales credit). Therefore, in order to capture the main effects of credit interventions without needlessly complicating the analysis, the simulations focus on these five major types of programs. Table 2 specifies current parameters of these lending credit programs. A brief discussion of the parameters is presented here; references and further discussion are in Appendix B.

The overall percentage reduction in the present discounted value of a borrower's loan payments induced by a federal subsidy is given by s, and estimated by the Office of Management and Budget.[19] All target groups except mortgage borrowers receive substantial subsidies from the government.[20] These benefits may appear in one of two forms: a subsidized fee for a loan guarantee (s^G), or "other" forms (s^0), including reduced interest payments, deferral of payments, grace periods, and longer maturities. A loan guarantee fee is considered subsidized if it does not cover the expected default costs.

The composition of the overall subsidy varies considerably across programs. For example, the principal benefit for students is the ability to defer payments until after graduation (s^0). In contrast, most of the benefits derived by small business arise from a guarantee fee that covers only a very small portion of default costs.

The parameters used to calculate s^G and s^0, given s, are listed next: γ represents the proportion of principal and interest covered by the

TABLE 2

Characterization of Current Federal Credit Policies

Sector	Principal Credit Instrument[1]	s	s^G	s^0	γ	δ	σ	G
Housing	Loan Guarantees	.02	*	.02	1.0	1.0	0.01	.02
Farm	Ddirect Lending	.25	0.00	.25	0.0	0.0	0.00	.25
Students	Loan Guarantees	.32	0.04	.28	1.0	1.0	0.39	.32
Small Business	Loan Guarantees	.14	0.09	.05	0.9	0.0	0.91	.14
Tax-Exempt	Interest Subsidy	.19	0.00	.19	0.0	0.0	0.00	.19

* = less than .01.

Variable Definitions

- s — overall reduction in the present discounted value of loan payments induced by federal credit subsidies = $s^0 + s^G$.
- s^G — overall reduction in the present discounted value of loan payments induced by just the subsidized guarantee.
- s^0 — reduction in percent discounted value of loan payments due to other factors.
- γ — proportion of principal and interest covered by the guarantee.
- δ — proportion of guarantee fee paid by the borrowers.
- σ — subsidized portion of the guarantee fees.
- G — government borrowing per dollar of subsidized credit.

Sources: See text and Appendix B.

guarantee, and δ the proportion of the fee paid by the borrower; both are obtained from government documents. The percentage subsidy in the guarantee fee, σ, is the percentage of default costs not covered by the guarantee fee, and is calculated in Appendix B.

The final column of Table 2 lists government borrowing per dollar of target group credit, given the parameters specified above.[21] The direct cost to the government varies widely across the programs. Mortgage programs have virtually no direct costs, while farm and student loans cost the government (after repayment) 25 and 32 cents per dollar lent, respectively.

Table 3 presents estimates of other key parameters. Credit allocations are normalized to equal 100 and are based on recent historical averages. The allocations for each target group are meant to include only federal lending. Consequently, unsubsidized loans for mortgages, farms, etc., are included in general borrowing.

Repayment rates are specified as constants rather than functions of interest rates, as in Section III, for simplicity and due to the lack of any useful data on the shape of the function. It is still possible to generate rationing outcomes by specifying a maximum effective interest rate for each group, and assuming that banks will not lend to the target group at higher rates. The effect of this assumption to generate a ρ-r curve that rises linearly to an interior maximum at r_j^* and then falls. Thus, the specification of constant ϕ's considerably simplifies the calculations without losing any important aspect of the underlying model. For general borrowers, ϕ is set to 1.0. Other reported repayment rates are based on government data and existing studies.

Effective interest rates (r*) are calculated (as described in Appendix A) on the assumption of $\rho = .10$. Effective interest rates in the

TABLE 3

Specification of Other Parameters

	L^1	β	ϕ	r^{*2}	$\bar{r}^2$
Housing	4.6	-1.80	0.97	.101	.103
Farm	2.0	-1.00	0.88	.078	.118
Student	0.6	-0.65	0.91	.032	.122
Small Business	0.2	-0.80	0.90	.092	.127
Tax-Exempt	8.3	-0.40	1.00	.054	.099
General Borrowers	81.9	-0.80	1.00	.100	.099

Variable	Definition
L	Credit allocation as percentage of total credit.
β	Interest elasticity of loan demand.
ϕ	Repayment rate.
r^*	Effective interest rate.
$\bar{r}$	Interest rate in the absence of credit subsidies.

Notes: [1]Private credit allocations sum to only 97.6, rather than 100, because government for credit subsidies requires 2.4% of available credit.

[2]Calculated on the assumption that ρ, the banks' cost of funds, is 0.10.

Source: See text and Appendix B.

absence of credit subsidies are presented in the last column. Credit subsidies lower effective target group interest rates below those paid by general borrowers for all target groups except mortgage borrowers.

Perhaps the single most important and controversial parameter is the elasticity of supply of funds, or more generally the openness of capital markets. A large literature on this topic has developed from papers by Harberger [1978, 1980], Feldstein and Hurioka [1980], with mixed conclusions. The supply of credit from domestic sources is also controversial. DeFina [1984] surveys existing results and lists interest elasticities ranging from 0 to 5. There is clearly no consensus estimate.

Previous analyses of federal credit have employed extreme assumptions in this regard. Mankin [1986] assumes an infinitely elastic supply of credit. Bosworth, et al. assumes essentially no supply response.[22] This paper employs two alternative assumptions concerning the elasticity of supply: $\alpha = 5.0$ and $\alpha = 0.5$. These specifications are meant to bracket existing estimates. When $\alpha = 5.0$, only 1% of general borrowing is crowded out by credit policies, which is close to the zero crowding out that would occur if $\alpha = \infty$. When $\alpha = 0.5$, aggregate private investment is left virtually unchanged by credit subsidies. Therefore, in addition to providing upper and lower bounds for the allocative effects of credit policies, the simulations will indicate which results are robust to alternative views about capital markets.

V. Results

Before discussing the effects of credit policies, it is necessary to resolve two further issues: (1) the interpretation of existing credit allocations (summarized in Table 3) as representing market clearing or

rationed outcomes, and (2) assumptions concerning the allocation of credit without any lending subsidies. I specify two interpretations of existing credit patterns and policies: one in which all groups clear; and one in which farmers are rationed but other groups clear.[23] The credit market without lending subsidies is more subtle. The allocation depends on assumptions about whether the market is rationed with existing credit policies, as well as assumptions concerning the shape of the ρ-r curve for each group. If all markets clear with existing policies, I examine two alternatives in the world without credit subsidies: (a) all markets clear, and (b) tax-exempt and mortgage markets clear, but farmers, students, and small businesses are redlined. These cases are meant to represent optimistic and pessimistic extremes concerning the viability of target group markets in the absence of credit policy. If the existing credit allocation represents rationing of farmers, I assume case (b) holds without credit policy.

A. Allocation of Credit

The effects of credit subsidies on the allocation of credit are presented in Table 4. Starting from a world with no credit subsidies, as represented by scenario (a) or (b) described above, the introduction of all credit programs generates the base case allocations from Table 3 (reproduced here for convenience). Many of the aggregate effects depend on the elasticity of supply.

In high-elasticity case (α=5), credit programs serve to raise private borrowing to 97.61 from 95.24 (a) or 93.77 (b). Aggregate private borrowing therefore rises by 2.5-4.1%. Crowding out effects are very small: general borrowing falls by approximately 1% in either scenario. Aggregate target group investment rises to 15.70 from either 12.69 (a) or 11.01 (b), increases of 23% and 42%, respectively. With the exception of mortgage

TABLE 4

Allocation of Funds Under Alternative Scenarios[1]

Sector	Base Case	$\alpha = 5.0$ (a)	$\alpha = 5.0$ (b)	$\alpha = 0.5$ (a)	$\alpha = 0.5$ (b)
Mortgage	4.60	4.48	4.50	4.75	4.87
Farm	2.00	1.31	0	1.36	0
Student	0.60	0.25	0	0.26	0
Small Business	0.20	0.15	0	0.16	0
Tax Exempt	8.30	6.50	6.51	6.58	6.62
Total, Target Groups	15.70	12.69	11.01	13.10	11.49
General Borrowers	81.91	82.55	82.76	84.78	85.72
Total, All Groups[2]	97.61	95.24	93.77	97.88	97.21
ρ	.1000	.0990	.0987	.0958	.0945

Notes: [1]Scenarios are described in the text.

[2]For the base case, government borrowing to fund credit programs = 2.39, so total credit sums to 100. For the alternative cases (a) and (b) government borrowing is zero.

borrowers, all other target groups experience substantial increases in investment. From case (a), the introduction of credit subsidies raises farm credit by approximately 50%, student loans by 140%, small business credit by 33%, and tax-exempt housing by 28%. Mortgage credit, in contrast, rises by only 2.5% because the effective subsidy rate for mortgages is so low (s=.02).

If the supply of funds is inelastic (α=0.5), different aggregate patterns emerge, as expected. Credit programs have essentially no net effect on aggregate private borrowing. However, general borrowing falls by between 3.5% (a) and 4.6% (b). The fall in general borrowing is matched by an equivalent absolute rise in targeted lending. Notably, the benefits to individual target groups other than mortgage borrowers do not depend on the supply elasticity. Comparison of the second and fourth (or third and fifth) columns of Table 3 indicates that credit programs continue to exert powerful sectoral effects, despite the absence of any aggregate impact.

The notable exception, again, is mortgage borrowers. Table 3 indicates that, with low supply elasticities, the creation of all credit programs serves to <u>reduce</u> the allocation of funds to targeted mortgages. This effect occurs because credit programs raise ρ by 0.5% points (or 5%) while reducing mortgage payments by 2%. In contrast, when $\alpha = 5$, credit programs raise ρ by only 0.1% points, so the net effect for mortgage borrowers is still positive.

Finally, the high government cost of federal credit should be noted. Table 2 listed estimates of government borrowing per dollar of subsidized credit ranging from .02 to .32. However, credit subsidies accompany all borrowing by the target groups, not just incremental borrowing. Therefore, the government cost per dollar of <u>incremental</u> target borrowing is fairly

substantial. Specifically, in the base case government borrowing for credit subsidies equals 2.39. Credit programs raise total target group investment by between 2.60 and 4.69. Thus, aggregate average government cost per dollar of incremental target group investment is 41-91 cents.

This cost varies considerably across target groups and scenarios. When there are no inframarginal borrowers (the situation for farmers, students, and small business in scenario (b)), the cost per dollar of incremental target group investment is given by s in Table 2. In the opposite case, where targeted borrowers would receive funds without public assistance, the cost of marginal target group investment is much higher. For scenario (a), $\alpha = 5$, government costs for incremental targeted investment are: 77, 69, 55, 56, and 87 cents for the five target groups, respectively.

The allocational results may be summarized as follows: the effects of lending subsidies on overall investment depend positively on the supply elasticity of funds, with zero net effect as a reasonable lower bound and 4% as an upper bound. Similarly, the crowding out effect on non-targeted borrowers depends on the supply elasticity and is bounded by approximately 5%. In contrast, credit subsidies raise the investment of targeted groups (other than mortgages) by significant amounts, regardless of the supply elasticity or the original scenario. Finally, the government cost per marginal target group investment varies considerably by target group; a lower bound estimate is the stated subsidy in Table 2.

B. Welfare Effects

Standard welfare analysis (see Harberger [1971]) aggregates consumers' and producers' surplus and adjusts for the direct and resource costs of the government's funding requirements. The welfare analysis described here is based on the traditional approach, with two qualifications. First,

consumers' surplus is multiplied by the probability of repayment, so that borrowers obtain the surplus only if their project succeeds. Second, loan demand curves are assumed to become infinitely elastic at $r^* = 50\%$. Although the latter qualification affects the level of econsumers' surplus, it does not affect the difference in welfare effects across policy regimes, unless a group is redlined. The government's direct cost is $1+\rho$ times its borrowing requirements. Resource costs are assumed to be 30 cents per dollar raised, based on estimates in Ballard, et al. [1985] and Judd [1987].

In the absence of pre-existing distortions, externalities, or distributional concerns, the traditional approach would provide all of the necessary information for welfare analysis. In the present context, such an analysis suggests that credit programs generate sizeable efficiency costs. Depending on the particular scenario employed, credit programs reduce traditional welfare measures by 10-14%.

However, as discussed in Section II, credit programs are enacted for a variety of reasons. For example, perceived external benefits to loans for housing, students, and small business are often a principal motivating theme for these subsidies. In addition, market imperfections are an important justification for agricultural, student, small business, and other federal credit. Thus, to focus solely on the aggregate welfare effects would be naive. Although it is beyond the scope of this paper to develop a model explicitly incorporating all of these issues, several useful insights concerning the welfare effects of credit policy can be derived.

First, under all scenarios, all target groups except mortgage borrowers experience large gains in consumer surplus. Therefore, lending programs do provide benefits to the targeted groups. Whether the benefits induce borrowers to undertake socially preferred activity or merely constitute a

simple transfer of wealth is more controversial. That is, because credit programs subsidize both inframarginal and incremental borrowers, and because there are no societal benefits to subsidizing the former group, the division of direct welfare benefits should be an important policy concern.

Under scenario (a), the vast majority of direct welfare benefits accrue to target group members who would have received credit without public assistance. Approximately 76% of student welfare gains are inframarginal. For farmers, small businesses, and tax-exempts, 90% of the benefits constitute lump-sum transfers. More than 99% of mortgage borrowers' welfare gains also fall into this category. These estimates are extremely insensitive to changes in α. Under scenario (b), of course, none of the gains made by farmers, students, or small business are inframarginal.

Therefore, whether credit programs, in aggregate, principally aid inframarginal borrowers or new borrowers depends on assumptions concerning the status of sectoral credit markets without lending subsidies. Because credit programs have been an integral part of domestic credit markets for many years, it is difficult to determine with precision which scenario, (a) or (b), is closer to reality.[24] What should be clear, however, is that for any existing base case where a target group market clears, any <u>marginal increase</u> in subsidies will benefit primarily inframarginal borrowers, rather than new borrowers.

A second issue concerning welfare effects is the existence and potential importance of external benefits. External benefits are often cited in justifying credit for housing (more stable communities), students (a more educated society), and small business (encouraging entrepreneurship). Specification and calculation of the external benefits would be extremely complicated. However, it is possible to calculate how large the

external benefits would need to be in order to offset the welfare losses described above. For each program it is convenient to express the minimum necessary level of external benefits to raise welfare as a percentage of the change in the target group's investment. These percentages are referred to as threshold levels, and are presented in Table 5.[25]

The data indicate that sizeable external benefits must occur for current policies to raise welfare. For tax-exempts, the external benefits must be larger than the change in targeted investment. Other groups require external benefits of 60-90% of the change in sectoral borrowing, if their markets clear without credit assistance. The threshold levels for marginal changes in policies are slightly lower than for overall changes.

Threshold levels for redlined groups are considerably lower, because the change in target group investment is much larger. For farmers and students, threshold levels fall to 20% and 30% respectively. These figures may appear encouragingly low. However, they are notewworthy primarily because they are still positive: even if the government creates the market for farm or student loans, there is a welfare loss unless sufficient exgernal benefits exist. In contrast, SBA guarantees may (if $\alpha = 5$) generate welfare gains even in the absence of external benefits.[26]

Credit programs may generate external benefits of the appropriate magnitude to raise welfare. However, in the absence of any compelling empirical evidence that such benefits occur, the results serve primarily to emphasize the efficiency losses associated with credit interventions.

Notably, the results are not sensitive to the choice of α. Therefore, the potential welfare cost is large even if the crowding out effect is small. The absence of crowding out implies only that the costs are borne by agents other than non-targeted investors, not that the welfare costs are small.

TABLE 5

Threshold Levels For Alternative Credit Policies (%)[1]

Sector	Target Group Market With No Credit Subsidy	Proposed Policy	Threshold Level $\alpha = 5.0$	Threshold Level $\alpha = 0.5$
Mortgage	Clearing	Current Policy	60.6	62.6
	Clearing	Increase in Subsidy	61.4	63.2
Farm	Clearing	Current Policy	93.4	92.1
	Redlined	Current Policy	22.5	20.7
	Clearing	Increase in Subsidy	91.2	90.1
Student	Clearing	Current Policy	69.1	66.7
	Redlined	Current Policy	31.7	29.6
	Clearing	Increase in Subsidy	62.6	60.5
Small Business	Clearing	Current Policy	78.0	70.6
	Redlined	Current Policy	-2.1	0.8
	Clearing	Increase in Subsidy	70.8	68.2
Tax-Exempts	Clearing	Current Policy	105.2	106.3
	Clearing	Increase in Subsidy	88.1	90.2

Note: [1]Threshold levels are defined in the text.

C. Interactions and the Effects of Credit Rationing

Because federal credit programs reallocate funds and raise the overall rate of return, a program that subsidizes one target group will necessarily affect credit allocations to other groups. The magnitude of the consequent crowding out is clearly an important policy concern. If policies completely or largely offset each other, then the government is spending substantial resources for little gain.[27]

Assume that in the absence of credit programs, target group j receives $D_j(0)$ in funds. When only a subsidy for group j is introduced, the group receives $D_j(j)$. When all current programs exist, group j receives $D_j(all)$. The offset is then measured by:

$$OFFSET_j = \frac{D_j(j) - D_j(all)}{D_j(j) - D_j(0)} .$$

That is, the offset is the percentage of the gain induced by the original credit subsidy that is eliminated by the introduction of all other credit programs. Offset percentages are shown in Table 6.

Starting from scenario (a) and setting $\alpha = 5$ yields very small interactions for all credit programs except mortgages. Almost two-fifths of the original rise in mortgage credit due to subsidies is eliminated by other programs. This large crowding-out effect occurs because the original subsidy to mortgages is small (s=.02). Thus, even a small increase in ρ eliminates a substantial percentage of the original benefits. For the other groups, the offset is small (1-4%) because direct subsidies are large (14-32%; see Table 2).

At the lower value for α, the interactions are much larger. For groups other than mortgage borrowers, the interactive effect quadruples: approximately 15% of small business investment gains are eliminated by other

TABLE 6

Offsets: The Effects of Interactions Among Programs

Sector	Scenarios With No Subsidy	Interpretation of Base Case	Offsets (%)[1] $\alpha = 5.0$	Offsets (%)[1] $\alpha = 0.5$
Mortgages	(a)	Clearing	38.3	175.0
Farm	(a)	Clearing[2]	2.5	10.9
	(b)	Rationed[3]	33.8	35.3
	(b)	Rationed	17.4	19.8
Student	(a)	Clearing	2.6	11.0
Small Business	(a)	Clearing	3.5	14.9
Tax-Exempt	(a)	Clearing	1.2	4.9

Notes: [1]Offsets are defined in the text.

[2]Rationed at 67% of notional demand.

[3]Rationed at 83% of notional demand.

federal credit programs, and approximately 10% of increases in farm and student credit. Although interactions of this magnitude are unlikely to have important macroeconomic effects, their effects on individual sectors is nonetheless sizeable. For mortgage borrowers, the results are more striking. If $\alpha = 0.5$, mortgage borrowers would be better off if all subsidies were eliminated. The crowding out induced by other subsidies more than offsets the small subsidy provided by government. Thus, as shown in Table 3, mortgage credit falls with the creation of all programs.

Interactions will prove important whenever the direct subsidy or the supply elasticity is small. Calculations that begin with scenario (b) and assume a market clearing base case generate offsets of approximately 33% to 67% of the corresponding values beginning from scenario (a) (not shown).

Interactions are also potentially important when a group (farmers, in Table 5) is rationed given current credit policies. If only a farm policy is introduced from scenario (b), farm credit rises to a point on farmers' notional demand curve. However, as other credit programs are introduced, interest rates rise and make the farmers' rationing constraint bind. Farmers' notional demand at that rate is typically much higher than the residual amount allotted to them. If farmers are rationed at 67% (83%) of their notional demand, the offset is approximately 34% (18%). In any case, if a group is rationed in equilibrium, the associated effects will typically be large. The magnitude of this effect does not depend on the overall change in interest rates.

D. Policy Reform[28]

This section uses the model to examine the implications of some recent proposals to reform federal credit. Because specific features of individual credit markets may be important in this regard, the results are necessarily

exploratory. Nevertheless, some interesting conclusions can be developed.

The primary mortgage guarantee programs of the Federal Housing Administration and the Veteran's Administration have recently been proposed for elimination. Although the programs guarantee a significant amount of credit, their elimination would have only small effects on total mortgage credit because the subsidy rate is very low. Effective interest rates on mortgages would rise by 0.3% and mortgage borrowing would fall by 4%.

Due to the high and rising costs of federal farm credit, most proposals in this area have focused on reducing the subsidy rate in agricultural lending. Halving the effective subsidy rate would reduce farm borrowing by 22%, and government borrowing costs for farm credit by 60%. Elimination of the subsidy would reduce farm credit by 35%.

Although they occupy only a small portion of modern credit markets, guaranteed loans to students and small businesses have generated a substantial amount of controversy, presumably because of their perceived high costs. However, because of the differing structure of the programs, different methods for reducing costs are warranted. For example, as shown in Table 2, the principal subsidy to students (and practically all of government costs) arise from the stipulation that borrowers may defer principal and interest until nine months after graduation with no penalty. Elimination of that subsidy reduces the government's costs by 96% and loan demand by 60%. However, most of the policy debate has focused on collecting defaulted student loans. The simulations indicate that eliminating government costs from default (i.e., setting the guarantee fee equal to the default rate) would reduce government costs by 23%, and loan demand by 14%. Clearly, the vast proportion of government costs would still remain.

In contrast, most of the benefits to the Small Business Administration (SBA) loan guarantees reside in the subsidized guarantee fee. Setting the guarantee fee (currently 1%) equal to the loss rate (currently 11%) would reduce small business borrowing by 16%, but government costs would fall by 70%. Thus, for SBA loan guarantees, collecting a fairer fee, attempting to reduce the default rate, or collecting collateral more effectively would have a major impact on program costs, whereas for students, program costs will continue to be large as long as deferral until graduation is allowed.

An alternative suggested strategy is to reduce the guarantee rate on these loans. A reduction to 75% would cause modest declines in target group borrowing, (7.5% for students, 4% for small business) target group welfare, and government cost.

In its Preferred Lenders' Program (PLP), the SBA offers lending institutions significant reductions in paperwork and allows for greater lender discretion in making loans in exchange for reducing the guarantee rate to 75% from 90%. If the program works as intended, the increased flexibility will attract more lenders to the program while the reduced guarantee will induce more careful screening. The effect of the program should be to reduce loss rates. If loss rates stay constant, the results are given above for $\gamma = .75$. However, if loss rates fall by 2.5% points (from 10% to 7.5%), the allocation of funds to small business would fall by 1.5%, but small business welfare would rise, because the probability of repayment rose. Government borrowing for small business would fall by 30% and aggregate welfare would rise slightly.[29] Although this result is speculative, the analysis indicates the potential for credit programs to raise welfare by improving the incentives and organization of sectoral credit markets.

VI. Conclusions

The role of government in imperfect capital markets is an issue of obvious theoretical and practical concern. This paper has presented a simulation model of federal credit interventions that is capable of addressing a number of important issues. The allocational results indicate that lending programs can and, for the most part do, exert important effects on targeted sectors. Aggregate investment effects and the crowding out of non-targeted sectors depend critically on the supply elasticity of savings.

The overall welfare costs appear to be high; most programs generate welfare costs equal to at least 60-90% of the net change in target group investment. Thus, the resources used to fund credit subsidies represent an important cost to the economy, even when the crowding out effect is small. Even when credit policy creates a previously missing market, the direct welfare benefits are usually negative because of the high funding costs. In addition, the vast proportion of direct welfare benefits accrue to borrowers who would have received funds without credit assistance. Subsidies to these borrowers amount to pure windfall gains with no societal benefit. The inframarginal nature of credit subsidies implies that government costs per incremental dollar of targeted investment are typically 50-90 cents. Finally, interactions among credit programs were shown to eliminate a significant portion of the direct welfare gains whenever one of the following conditions holds: a low direct subsidy rate, a low elasticity of supply, or the existence of rationing in equilibrium.

The model can also be employed to study the effects of programmatic reforms. Although the results are necessarily more speculative, some useful principles can be derived. First, examination of the structure of student and small business loan guarantees indicates differing sources of high cost

in each program. For small business, the source is a high default rate (or loss rate) relative to the guarantee fee charged, suggesting that cost-cutting reform should focus on better collateral or higher fees. For student loans, 90% of the cost is associated with the allowance of deferral of payments until after graduation. Even a costless and perfect collection program for defaulted loans would reduce costs by only a small amount. Thus, in general, the correct approach to cost-cutting depends critically on the structure of subsidies inherent in the program rather than just the absolute level.

Second, SBA's Preferred Lenders' Program, in which lenders accept reduced guarantees in exchange for reduced paperwork and increased discretion, is one example of how the government may be able to generate welfare-improving credit programs at lower cost than current subsidies. Specifically, in the PLP, the government provides better incentives (from a societal viewpoint) to lenders while preserving the basic purpose and nature of the credit program.

Some caveats and possible extensions should be mentioned at this stage. First, any simulation is necessarily based on a variety of maintained assumptions and approximations. Therefore, the results should be interpreted as suggesting the direction and relative magnitudes of various effects rather than as precise estimates.

Second, the model assumes that all agents are risk-neutral. As a consequence, all assets are perfect substitutes, and therefore rates of return are equalized across assets. There is some evidence that many important financial assets are not good substitutes for each other in asset demand (Frankel [1985] and Friedman [1978]). In the context of credit policies, it may be thought that student loans, small business credit, and

farm credit may not be good substitutes for mortgages, tax-exempts, or corporate debt. In that case, if lenders are risk-averse, the crowding out effect of the subsidies aimed at the first set of groups would be smaller than they otherwise would be, but so would the direct benefits (Penner and Silber [1973] and Friedman [1978]). With a range of substitutabilities among assets, credit policies could actually crowd in investment by other groups, depending on a variety of elasticities (Friedman [1978]). However, given that 75% of all net credit advanced is funnelled through financial intermediaries (Moran [1985]), which presumably face competitive pressures to maximize profits, the assumption of risk neutrality and hence rate of return equalization may be a good approximation.[30]

Perhaps the most important and most difficult extension concerns the connection between credit allocations and real economic activity. The model maintains a simple, direct link: an increase in credit leads to increased real activity. A goal of future research is to endogenize this relationship. For example, subsidized credit may simply induce borrowers to substitute debt for equity and/or capital for labor. The borrower, in many cases, could also use the funds for some entirely unrelated purpose. Under this view, changes in credit may not induce any shift in real activity.

Alternatively, government-provided credit may actually raise investment by more than the actual credit extended. This could occur if government credit provided the marginal source of funds for a large project or set of projects. In addition, a loan subsidy may serve to keep an enterprise viable now and raise investment in the future. Under this scenario, investment rises by more than the change in government credit.

The relationship between financial and real activity is a deeply studied but unresolved set of issues. This paper makes no attempt to

resolve those issues. Instead, the 1:1 link between credit and investment may be taken as a benchmark, which further research will modify. Thus, one application of further research on federal credit would be to help clarify real-financial linkages, perhaps through empirical analyses of individual programs. Research on federal credit must also address how the design of credit programs influence their effects. For example, it is easy to show that guarantees and subsidies generate differing incentive effects. Focusing on incentives can explain some of the divergent default behavior across programs, which were simply taken as given above (Gale [1987]).

Credit programs may also help explain recent depressed U.S. saving. Specifically, student and mortgage guarantees reduce the level of initial wealth required to make sizable purchases of education and housing and thereby reduce one motive to save. Hayashi, et al. (1987) find limited support for this effect proposition in comparing U.S. and Japanese saving data. Finally, it may be possible to exploit changes in credit programs to test for the nature and existence of liquidity constraints.

APPENDIX A

Calculation of Effective Interest Rates and Government Borrowing

Throughout this Appendix the analysis focuses on a single borrower group, so group subscripts are ignored.

Effective Interest Rates

Consider a \$1 loan and assume that all defaults occur in the first period of repayment. In the absence of credit subsidies, competitive banks set interest rates such that the expected present discounted value of loan payments is equal to the discounted value of the banks' costs. This calculation may be divided into two stages. First, given the probability of repayment, ϕ, and the maturity period for loans, m, banks require constant annual loan payments, X_1, such that

$$\text{(A.1)} \qquad \phi \sum_{k=1}^{m} \frac{X_1}{(1+\rho)^k} = \sum_{k=1}^{m} \frac{\rho}{(1+\rho)^k} + \frac{1}{(1+\rho)^m}, \quad \text{or}$$

$$\text{(A.2)} \qquad X_1 = \frac{1}{\phi \sum_{k=1}^{m} \frac{1}{(1+\rho)^k}} .$$

since the right side of (A.1) equals 1. The interest rate, r_1, implied by X_1 is that rate which sets the discounted stream of X_1 payments equal to 1:

$$\text{(A.3)} \qquad X_1 = \frac{1}{\sum_{k=1}^{m} \frac{1}{(1+r_1)^k}} .$$

Substitution of (A.2) into (A.3) and rearranging yields

$$(A.4) \qquad \sum_{k=1}^{m} \frac{1}{(1+\rho)^k} = \frac{1}{\phi} \sum_{k=1}^{m} \frac{1}{(1+r_1)^k} .$$

Equation (A.4) describes the determination of effective interest rates, given ρ, ϕ, and m in the absence of credit subsidies.

Suppose that the government introduces a loan guarantee. The bank now requires annual payments, X_2, such that its discounted costs equal its discounted expected receipts, or

$$(A.5) \qquad \phi X_2 \sum_{k=1}^{m} \frac{1}{(1+\rho)^k} + (1-\phi)\gamma = 1 + (1-\delta)(1-\sigma)(1-\phi)\gamma,$$

where new terms are described below. The first term represents bank receipts if the borrower repays times the probability of repayment, just as in (A.1). The second term represents the probability of default times γ, the percentage of outstanding principal and interest covered by the loan guarantee. Thus, the left side represents expected bank revenues. The last term represents bank payments for the guarantee fee: the fair-insurance cost of the guarantee is $(1-\phi)\gamma$, but the government absorbs σ of the fee, leaving private agents to pay $(1-\sigma)(1-\phi)\gamma$. Of that amount borrowers pay a fraction δ and banks pay the rest. In addition, banks must pay depositors a present discounted value of \$1, as in (A.1). Rearrangement of (A.5) yields

$$(A.6) \qquad X_2 = \frac{1 - [1-(1-\delta)(1-\sigma)](1-\phi)\gamma}{\phi \sum_{k=1}^{m} \frac{1}{(1+\rho)^k}} .$$

Equation (A.6) shows the annual loan payments that borrowers make in the presence of just a loan guarantee program. Note that, from (A.3),

$$X_2 = X_1(1 - [1-(1-\delta)(1-\sigma)](1-\phi)\gamma). \tag{A.7}$$

The percentage reduction in the present value of loan payments induced by the subsidized loan guarantee, s_G, is found by solving

$$1 - s_G = \frac{\delta(1-\sigma)(1-\phi)\gamma + \sum_{k=1}^{m} \frac{X_2}{(1+r_1)^k}}{\sum_{k=1}^{m} \frac{X_1}{(1+r_1)^k}}. \tag{A.8}$$

The first term in the numerator is the part of the guarantee fee paid by the borrower; the remaining terms represent discounted future loan payments with a loan guarantee. Discounting at the rate the borrower would have had to pay without the guarantee and using (A.3) yields

$$1 - s_G = \delta(1-\sigma)(1-\phi)\gamma + \frac{X_2}{X_1}. \tag{A.9}$$

Substitution of (A.7) into (A.9) and rearranging yields

$$s_G = \sigma(1-\phi)\gamma. \tag{A.10}$$

Equation (A.10) shows that the benefit accruing to borrowers from a subsidized guarantee fee is proportional to the subsidy rate, the guarantee rate, and the probability of default. In accordance with standard incidence theory, the effective subsidy does not depend on who pays the fee (δ). The presence of s_G, of course, translates into lower effective interest rates.

In addition to subsidizing loan guarantees, the government also provides subsidies through direct reductions in interest payments, deferral of payments, allowance of grace periods and longer maturities, and other means. These subsidies are modelled here as further reductions in annual loan payments. Define X_3 as annual borrower payments with guarantee subsidies and other subsidies, and s as the percentage reduction in the

present value of loan payments due to all aspects of credit policy. Then

$$(A.11) \qquad 1 - s = \frac{\delta(1-\sigma)(1-\phi)\gamma + \sum_{k=1}^{m} \frac{X_3}{(1+r_1)^k}}{\sum_{k=1}^{m} \frac{X_3}{(1+r_1)^k}}.$$

Calculations similar to those used in deriving (A.9) yield

$$(A.12) \qquad X_3 = X_1[1 - s - \delta(1-\sigma)(1-\phi)\gamma].$$

The percentage reduction in the present value of loan payments due to reasons other than the guarantee is defined to be

$$(A.13) \qquad s_o = s - s_G,$$

the overall reduction minus the reduction due to the guarantee. Substitution of (A.13) into (A.12) and rearranging and substituting (A.9) into (A.12) yields

$$(A.14) \qquad X_2 = X_3 + s_o X_1, \quad \text{or}$$

$$(A.15) \qquad X_2 = X_3 + \frac{s_0}{\phi \sum_{k=1}^{m} \frac{1}{(1+\rho)^k}}.$$

Borrowers pay $\delta(1-\sigma)(1-\phi)\gamma$ for the guarantee and X_3 in m subsequent periods if they repay. Their effective interest rate, r*, is the solution to:

$$(A.16) \qquad X_3 = \frac{1-\delta(1-\sigma)(1-\phi)\gamma}{\sum_{k=1}^{m} \frac{1}{(1+r^*)^k}}.$$

Substitution of (A.16) into (A.14), further substitution into (A.6) and rearrangement yields

$$(A.17) \qquad \frac{1 - [1-(1-\delta)(1-\sigma)](1-\phi)\gamma - s_o}{\phi(1-\delta(1-\sigma)(1-\phi)\gamma)} \sum_{k=1}^{m} \frac{1}{(1+r^*)^k} = \sum_{k=1}^{m} \frac{1}{(1+\rho)^k} .$$

Equation (A.17) gives the effective interest rate borrowers must pay given the banks' costs of funds, the borrower group's probability of repayment, the maturity of the loan, and the description of federal credit subsidies. The effective interest rate rises with ρ, and falls as ϕ, σ, γ, or s_o rise.

Government Borrowing

The government funds credit programs with program revenues (i.e., guarantee fees and direct loan repayments) and by borrowing. For a guarantee, the government receives $(1-\sigma)(1-\phi)\gamma$ in guarantee fees, but expects to pay $(1-\phi)\gamma$ in defaults. Thus the government cost of a guarantee is s_G as defined by (A.10). In addition, in providing the other subsidies described above, the government pays $X_2 - X_3$ with probability ϕ for each period of the loan. Given (A.13) and (A.14), the cost to government in each period is, with probability ϕ,

$$(A.18) \qquad X_2 - X_3 = s_o X_1 = (s-s_G)X_1 .$$

Total government borrowing requirements, discounted at the government's cost of borrowing, are given by

$$(A.19) \qquad G_{LG} = s_G + (s-s_G)\phi X_1 \sum_{k=1}^{m} \frac{1}{(1+\rho)^k} = s,$$

by using (A.2). Therefore, government borrowing per dollar of targeted borrowing is just the percentage reduction in borrower payments induced by credit policy. That is, the government pays what the borrower would otherwise have to pay.

Under a direct loan program, the government faces costs equal to 1: the present discounted value of payments made to bondholders. Program receipts are X_3 period with probability ϕ, and 0 with probability 1-s. From (A.14), $X_3 = X_2 - s_0X_1$. But since $X_2 = X_1$ for a direct loan, $X_3 = (1-s_0)X$. Therefore, expected government borrowing is given by:

$$G_{DL} = 1 - \phi(1-s_0) \sum_{k=1}^{m} \frac{X_1}{(1+\rho)^k} = s_0 = s, \tag{A.20}$$

where the second equality follows from (A.2), and the third from (A.13) and the fact that s_G is zero for a direct loan.

In a tax-exempt program, the government foregoes $X_2 - X_3$ in receipts each period with probability ϕ. Government financing costs are given by:

$$G_{TE} = \phi \sum_{k=1}^{m} \frac{X_2-X_3}{(1+\rho)^k} = s_0 = s, \tag{A.21}$$

where the second equality follows from (A.14) and (A.2), and the third because $s_G = 0$.

APPENDIX B

Parameter Specification

Two types of parameters are specified directly: features of federal credit subsidies (s, s^G, s^0, δ, σ, γ), and aspects of borrower and lender behavior (α, β, ϕ, m, and L). Given these parameters, the model may be solved backwards to generate values of a and b, the constants in the supply and demand equations.

Credit policy is described for each of the five groups listed in Table 2. Unless otherwise specified, data are collected from annual versions of "Special Analysis F," of the U.S. budget. Primary mortgage guarantees

issued by the Federal Housing Administration (FHA) and the Veteran's Administration (VA) cover 100% of the outstanding principal and interest (γ=1) and are paid for by the borrower (δ=1)). In recent years, the government has reported annual default rates of approximately 1.5% of outstandings for FHA guarantees, and 1.0% for VA guarantees. However, government accounting practices typically understate default rates for several reasons (see Special Analysis F). Default rates of 3.0% were assumed for both programs. Since the FHA guarantee fee is 3.8%, and the FHA guarantee program breaks even financially, a 3% default rate is consistent with a small administrative cost per loan. The fee for VA guarantees is 1.0%. New FHA guarantees account for 70% of the sum of FHA and VA guarantees in 1983-87. Thus, a weighted average of the fee collected is 2.96% (= .7 × .038 + .3 × .01). Therefore, the subsidy in the guarantee fee is small; σ = .013 (= 1 - .0296/.03). Finally, the overall reduction in borrower payments due to the FHA and VA programs (s) is estimated to be approximately 1% for FHA and 4.2% for VA guarantees. Weighting by new credit issued yields an average reduction of 2%.

Student loans are 100% guaranteed. Loss rates due to default are approximately 9% (Bosworth, Carron, and Rhyne [1987], pp. 134-35). Therefore ϕ = .91. Students currently pay the full fee of 5.5%, implying δ = 1, and σ = .39 (= 1 - .055/.09). Other characteristics of the loan program, particularly the deferral of principal and interest at no cost until graduation, substantially reduce borrower costs. Students would have had to pay 41%, 47% and 52% more (in present value terms) for loans in 1984, 1985, and 1986 if there were no guarantee program (Table F-12). Therefore, the guarantee reduced borrower payments (in present value) by 29%, 32%, and 34%, respectively, in these years. The value of 32% is chosen to represent s.

Small Business Administration (SBA) loan guarantees provide timely payment of 90% of outstanding principal and interest. The loss rate on SBA guarantees has been estimated at 9.7% (Bosworth, Carron, and Rhyne [1987], p. 93) and 12.5% (Boskin and Barham [1984], p. 28). Since fees are currently 1% of loan volume, and are paid by the bank (δ=0), a loss rate of 11% (ϕ=.89) implies that σ = .91. In 1984-86, SBA guarantees reduced the present value of borrower payments by 10.8%, 14.1%, and 18.6% (based on data in Table F-12). Therefore, s is set equal to 0.14.

For tax-exempt borrowing, the only parameter to set is s, the overall reduction in borrower payments. If the non-tax exempt borrowing rate is 10% (the value of ρ below), and tax-exempt rates are 7% (a spread consistent with results reported in Poterba [1986]), tax-exempt status reduces the discounted (at 10%) value of borrower payments on a 10 year loan by 19%. The rate of default for tax-exempts is set equal to zero.

Direct farm lending is meant to represent an amalgam of government lending programs to the agricultural sector. These include programs in the Farmers' Home Administration, Rural Electrical Administration, and Export Credits, but exclude Commodity Credit Corporation price-support "loans". The latter represent short term price supports, while the other programs represent longer term debt. In 1984-86, the loan programs reduced borrower payments by 21.4%, 20.0%, and 30.0% (Table F-11). I use s = .25 as a rough average. Calomiris, Hubbard, and Stock [1986, Table A-2] report delinquency rates of approximately 4.0% of loan volume for all agricultural credit in 1982-85. However, federal credit programs in agriculture undoubtedly have higher default rates; the FmHA is estimated to have held 4.5% of its portfolio in deliquent loans in 1980, rising to 23.0% in 1985 (General Accounting Office [1986], p. 53). A loss rate of .12 (ϕ=.88) is

used in the simulation.

The demand elasticity for general borrowers is assumed to be -0.8, based on estimates by Hall [1977], Friedman [1978] and Feldstein and Jun [1987] that center around that value. In the absence of better data, this value is also used for small businesses. The elasticity of mortgage borrowing is specified to be -1.8, based on estimates in Dhrymes and Taubman [1969]. Farm investment has also been found to be sensitive to interest rates (see LeBlanc and Hrubovcak [1986]). The estimate of -1.0 was chosen to reflect this fact. The elasticity of student loan demand is estimated from figures in Bosworth, Carron, and Rhyne [1987]. The tax-exempt demand elasticity is based on estimates in Hendershott and Koch (1977).

Loan maturities were chosen as follows: 30 years for mortgages, 10 years for students, small business, and tax-exempts, and 20 years for farmers, based on data in Special Analysis F, Table F-11, 1985 and 1986.

Credit allocations are based on flow of funds figures from recent years. Since flow of funds data are based on net borrowing, while credit subsidies accompany new credit, some adjustments are necessary. Tax-exempt borrowing represented 8.3% of net borrowing in 1980-87 (see Table 1). FHA and VA mortgages accounted for 4.6% of net borrowing since 1980. Agricultural lending represented less than 0.1% of net borrowing in 1980-87, because net agricultural lending was negative in several of those years. Nonetheless, many new agricultural loans were made. In 1970-75 and 1976-80, farm credit averaged 4.1% and 4.2% of net credit, respectively. In addition, federal lending has typically provided between one-third and one-half of all agricultural lending (Council of Economic Advisers [1986], p. 197). Federal farm credit is set at 2% of aggregate credit.

Net guaranteed student loans (reported in Special Analysis F) for 1980-87 totalled $29.4 billion, or 0.6% of total net borrowing. Net SBA loan guarantees have been negative in recent years. However, SBA disbursements have been approximately one-third of guaranteed student lending in 1980-87, so the SBA allocation is set at 0.2%.

Finally, ρ is specified to equal 0.1. All other interest rates are calculated given (A-17).

Footnotes

[1]All statistics in this paragraph are based on the data provided in Table 1, except for new federal and federally assisted lending, which is based on the annual "Credit Budget" listed in "Special Analysis F" of the U.S. Budget.

[2]Smith [1983] discusses optimal government lending with imperfect information, but his analysis focuses on monetary policy rather than targeted credit subsidies.

[3]A similar point is made forcefully by Bosworth, et al. [1987, p. 18].

[4]Detailed information concerning federal credit programs may be found in "Special Analysis F," Special Analyses: Budget of the U.S. Government, any year, or Bosworth, Carron and Rhyne (1987).

[5]Chaney and Thakor (1985) demonstrate that special government guarantees, such as those for Chrysler Corporation, create adverse incentives for other firms. However, special guarantees should be distinguished from standard ongoing loan guarantee programs that guarantee many loans, smaller amounts per loan, and do so at the time the loan is made.

[6]The five Government-Sponsored Enterprises are Federal Home Loan Banks, the Federal National Mortgage Association, the Federal Home Loan Mortgate Corporation, the Student Loan Marketing Association, and the Farm Credit System (FCS). Only the FCS operates in primary markets.

[7]This model is developed in greater detail in Gale (1987), Ch. 3.

[8]Additional non-targeted groups would be easy to incorporate in the analysis.

[9]Allowing banks to set a given interest rate and collateral requirement for each group would change none of the results as long as the collateral is incomplete (i.e., as long as banks prefer that borrowers repay rather than default).

[10]More generally, adverse selection implies that ρ need not be monotonic in r. See Stiglitz and Weiss (1981).

[11]Figure 1 also shows $\rho_G(r) > \rho_j(r) \quad \forall j,r$. This assumption is not necessary for any of the results or interpretations, but simplifies the analysis.

[12]See Riley [1987] for an independent derivation of this demand curve.

[13]A supply curve intersecting the horizontal demand strip to the left of S_1 would represent rationing of general borrowers and redlining of target borrowers. This case is not considered.

[14]There is an infinitesimal chance that these groups clear or are redlined, depending on the position of S_2 in Figure 2.

[15]The loan rate, r_i, vanishes from the equilibrium calculation because it is determined by ρ, ϕ_i, and C_i.

[16]An equilibrium with redlining of certain groups is identical to the market clearing equilibrium, except that the index runs over only those groups with positive loan values.

[17]These figures omit most Government-Sponsored Enterprises, which are also omitted from the simulations, in order to avoid the need to model the operation of secondary markets. However, since GSEs are concentrated in mortgage, farm, and student credit markets, the importance of credit subsidies to five sectors listed would increase.

[18]The programs listed in Table 2 are in some cases meant to refer to combinations of individual programs, as discussed in Appendix B.

[19]These estimates may be found annually in "Special Analysis F," Special Analyses: Budget of the United States. Although the estimates are necessarily rough, they serve to provide a general impression of the overall subsidy rate.

[20]The overall subsidy for tax-exempt borrowers is not provided in Special Analysis F; its calculation is described in Appendix B.

[21]These figures are calculations of the model, given the definition of government borrowing in equation (6). The numbers bear no relation to any reported budget figure. Federal budgetary treatment of credit programs is highly misleading and inconsistent. (See Boskin and Barham [1984], Bosworth, et al. [1987] or the Congressional Budget Office [1984] for discussion.) The figures reported in Table 2 refer to the present discounted value of government costs associated with a $1 credit subsidy. Appendix A describes the calculation.

[22]Bosworth, et al., state: "A loan subsidy program does not increase the total supply of funds to capital markets. All it does is provide an advantage to one group of borrowers relative to others" (p. 10).

[23]I assume farmers are rationed at 80% of their desired quantity of loans. It is straightforward to analyze the effects of rationing on other groups as well. The important analytical point, however, is how effects differ across rationing and clearing regimes, which may be illustrated with any single group.

[24]Although it may appear obvious that students (who have no collateral or credit history) and small businesses (who must be turned down by at least two banks to qualify for a guaranteed loan) would be redlined in the absence of public assistance, this may not actually occur. For example, parents could borrow on behalf of their children. SBA guarantees are typically for larger loans with longer maturities than private credit to small business.

Thus, without guarantees, small businesses could perhaps qualify for short-term credit. In addition, under current SBA regulations, lenders have incentives to reject private applications in hope of acquiring a guarantee.

[25]The estimates assume that the investment crowded out by a credit policy contains no external benefits. Therefore, the reported threshold levels are lower bounds on the level of external benefits required to raise welfare.

[26]These results are not very sensitive to the assumption that demand becomes infinitely elastic at $r = 50\%$.

[27]The possible importance of such interactions has been recognized independently by Bosworth et al. [1987]. They do not quantify these effects, however. Penner and Silber [1973] focus on interactions among programs that focus on the same target group.

[28]The results presented in this section are based on $\alpha = 5$, but are not sensitive to changes in α.

[29]Although screening costs would increase, they would at least partially be offset by reduced lender paperwork for the SBA.

[30]However, given the presence of federal deposit insurance, banks may be risk-seeking.

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