Do Informational Frictions Justify Federal Credit Programs?

Through federal agencies, the U.S. government administers a wide array of credit programs, which alter the allocation of credit (and the distribution of income) in the United States in important ways. In this paper, we will consider the credit market effects of three types of federal credit programs. First, we examine direct government lending, which takes place in the United States through several federal agencies, including the Farmers Home Administration (FmHA) and the Small Business Administration (SBA). Second, we consider loan guarantees, which are an important form of federal government intervention in credit markets. Much of the activity of the SBA is accounted for by loan guarantees, and the mortgage insurance programs of the Federal Housing Administration (FHA) are essentially loan guarantees. Third, we study the promotion of secondary markets in private loans, an area in which the federal government has been active, especially in regard to the mortgage market. The Government National Mortgage Administration (GNMA) buys FHA-insured mortgages and packages these as “pass-through securities.” GNMA pass-through securities are backed by the U.S. government. The Federal National Mortgage Administration (FNMA) is a privately owned corporation which performs a role similar to GNMA. The mortgages backing FNMA pass-through securities are conventional rather than insured, and these securities have no explicit government backing. However, it is generally recognized that the liabilities of FNMA are implicitly backed by the U.S. government; i.e. FNMA is “too big to fail.”

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When efficiency arguments are used to justify federal credit programs, there is usually some appeal to "market failures" which, it is argued, arise because of informational frictions in credit markets. The following quote from Jaffee and Stiglitz (1990, p. 839) is instructive.

When credit is allocated poorly, poor investment projects are undertaken, and the nation's resources are squandered. Credit markets . . . may not function well . . . in allocating credit. The special nature of credit markets is most evident in the case of credit rationing, where borrowers are denied credit even though they are willing to pay the market interest rate (or more), while apparently similar borrowers do obtain credit.

Jaffee and Stiglitz stop short of advocating specific types of government intervention in credit markets, but it would seem that an implication of the above passage is that the "special nature of credit markets" creates problems that need to be addressed.

The literature on the effects of government credit programs in environments with imperfect information is perhaps smaller than one would expect. A set of related papers, in which adverse selection models are used to analyze federal credit programs, includes Smith and Stutzer (1989), Gale (1990a, 1990b, 1991), and Lacker (1993b). The more specialized topic of government-provided deposit insurance programs has also received some attention (for example, Kareken and Wallace 1978 and Diamond and Dybvig 1983).

The purpose of this paper is modest. We will confine attention here to two particular private information models of the credit market, and the effects of some government credit programs in those models. Without being all-encompassing, the models incorporate many features of credit markets on which the literature in this area has focused, including moral hazard, adverse selection, the incentive role of debt contracts, and credit rationing.

We first study a costly state verification model, which is similar to models in Williamson (1986, 1987). Those models in turn built on earlier work by Townsend (1979) and Diamond (1984). Other closely related work is Gale and Hellwig (1985). The setup here is a two-period model of a credit market, where the optimal financial contracts written by lenders and borrowers are debt contracts. Given costly verification of the return on borrowers' investment projects, debt contracts act to give borrowers the incentive to correctly report investment outcomes, while minimizing the deadweight losses from costly verification.1 The costly state verification model has the property that an equilibrium can exhibit credit rationing. That is, in equilibrium it may be the case that some would-be borrowers do not receive loans while other identical agents do. Credit rationing arises because an increase in the loan interest rate not only increases the expected payment from the borrower to the lender, but also increases the probability that the borrower defaults, thus increasing expected verification costs. This second effect may outweigh the first at the equilibrium interest rate, so that there is no contract an agent who is rationed out of the market can offer which will yield a higher expected return to the lender.

1. Another model of optimal debt contracting is Lacker (1993a).
Given the possibility of a credit rationing "problem" in the credit market, is there any role for government credit programs to improve the allocation of credit? For the particular programs we consider, the answer is no. Direct government lending on the same terms offered by the private sector will only displace an equal quantity of private lending, and does not relieve any of the rationing that exists in the absence of government intervention. The effects of government loan guarantees are perverse; these act to distort private contracts in such a way that, if rationing exists without the government loan guarantee, the program lowers the interest rate faced by lenders, increases the interest rate faced by borrowers, and increases the probability that a borrower is rationed. Therefore, all credit market participants are worse off with intervention.

The second modeling framework we consider is a new one, from Wang and Williamson (1993). In this model, there is costly screening of borrowers in a credit market with adverse selection. There are two types of borrowers, g and b, who differ according to the distribution of investment returns that they face, and type is private information. A lender can learn a borrower's type by incurring a fixed screening cost. This type of model is similar to the costly state verification setup, in that there can be costly revelation of private information. However, an important difference is that information costs are incurred before investment takes place, rather than ex post, as in the costly state verification model.

Some features of the equilibrium in this model are similar to those of the standard Rothschild-Stiglitz (1977) adverse selection model. If an equilibrium exists, then it is a separating equilibrium where types g and b are offered different incentive-compatible contracts, and there are conditions under which an equilibrium will not exist.

In equilibrium a type g borrower (whose investment return distribution is superior to that of a type b borrower, in the sense of first-order stochastic dominance) is screened with positive probability, while a type b borrower is not screened. An important feature of the model is that debt contracts are equilibrium contracts, as they act to induce self-selection while minimizing expected screening costs.

In the costly screening model, we consider two types of government credit programs, direct loans to would-be borrowers who are denied private credit, and direct subsidized loans. The offering of loans to borrowers who have been denied private credit alters incentives to borrowers who consider misrepresenting their type, as the denial of credit is a penalty that is used by private lenders to induce self-selection. If the interest rate on government loans is set sufficiently high, then the agents who bear the necessarily higher screening costs are worse off, and no agents are better off. However, if the interest rate on government loans is set sufficiently low, then the welfare of type g borrowers falls, the welfare of type b agents rises (if an equi-

2. This is similar to a result in Gale (1990a).
3. A related model with costly screening is in De Meza and Webb (1988).
4. The flavor of this result is similar to those in Smith and Stutzer (1989) and Gale (1990b). In their setups, loan subsidies to the wrong type can worsen adverse selection problems.
librium existed in the absence of the government credit program), and an equilibri-
um may exist with government intervention where it did not exist without it. Thus,
this type of program can act to alter incentives in possibly useful ways.

Direct subsidized lending in the costly screening model can act to reduce interest
rates faced by all agents, including those who are not directly targeted by the pro-
gram. Here, if type \( b \) agents can receive a subsidized loan from the government,
then type \( g \) agents can be screened less intensively. The costs of subsidization,
which may include screening costs (if subsidized loans are sufficiently attractive),
must be borne by someone, which implies that subsidized lending programs are not
a Pareto improvement.

It is straightforward to extend the costly state verification and costly screening
models studied here, following Williamson (1986) and Wang and Williamson
(1993), to the case where a financial intermediary structure is an equilibrium phe-
nomenon. Thus, these models can be used to address problems related to the re-
packaging of private loans into tradeable securities, a form of financial
intermediation. Here, there is no role for the government to play in promoting finan-
cial intermediation, as there are no unrealized intermediation opportunities in equi-
librium. However, in the U.S. regulatory environment, where there are various
restrictions (including branching regulations) which tend to limit diversification by
banks, institutions like GNMA and FNMA may have a welfare-improving role to
play. Here, we suggest that a first-best solution would involve eliminating restric-
tions that limit the size of U.S. banks and their ability to branch.

The remainder of the paper proceeds as follows. In section 1, we set up a model
of a credit market with costly state verification, and study the effects of two govern-
ment credit programs in this environment. We follow a similar approach for the
costly screening model in section 2, while in section 3 we study financial inter-
mediation and the role of pass-through securities. Section 4 is a summary and
conclusion.

1. CREDIT WITH COSTLY STATE VERIFICATION

The model studied in this section is similar to the costly state verification models
in Williamson (1986) and Williamson (1987). This type of model is useful for our
purposes, as it has informational frictions capable of generating equilibrium credit
rationing, an apparent "inefficiency."

1.1 The Model

Consider the following partial equilibrium model of a credit market. There are
two periods, 1 and 2, and the population consists of a continuum of agents with unit
mass, uniformly distributed on the interval \([0, 1]\). Letting \( i \) index agents, if \( i \in [0, \alpha] \), then \( i \) is a lender, and if \( i \in (\alpha, 1] \), then \( i \) is an entrepreneur. Thus, the fraction
of the population who are lenders is \( \alpha \), where we assume that \( \frac{1}{2} < \alpha < 1 \). Each
lender has one unit of time in period 1, which can be used either to produce one unit of the investment good, or consumed as leisure. A given lender \( i \) has preferences given by \( u^i(c, \ell, e) = c - \ell \left[ r_\ell + \left( \frac{i}{\alpha} \right) (r_u - r_\ell) \right] - e \), where \( c \) is consumption in period 2, \( \ell \) is leisure in period 1, \( e \) is effort expended in monitoring borrowers, and \( 0 < r_\ell < r_u \). Note that different lenders have different marginal utilities of leisure, so as to generate a supply function for credit which is increasing in the return on credit instruments. Each lender can potentially supply an unlimited quantity of effort in period 2.

Each entrepreneur has access to a technology that takes one unit of the investment good as input in period 1, and yields a stochastic quantity of consumption, \( x \), in period 2, where \( x \) is distributed according to the probability distribution function \( F(x) \), with the corresponding probability density function \( f(x) \). Assume that \( f(x) > 0 \) for \( x \in [0, 1] \), \( f(x) = 0 \) otherwise, and that \( f(x) \) is continuously differentiable on \( [0, 1] \). There is costly state verification (Townsend 1979, Gale and Hellwig 1985, Williamson 1986, 1987), in that the return \( x \) is observable only to the entrepreneur. Any other agent must incur a fixed cost of \( \gamma \) units of effort to observe \( x \) in period 2. Entrepreneurs maximize the expected value of consumption in period 2.

1.2 Equilibrium

Optimal contracts between lenders and entrepreneurs are determined as by Williamson (1987), to maximize the expected utility of an entrepreneur, subject to the constraint that the lender receive an expected return from the contract that is at least the credit market expected return, \( r \). Assuming that verification strategies are deterministic, the optimal contract is a debt contract. That is, suppose a loan is made from a lender to an entrepreneur, and let \( R(x) \) denote the payment from the entrepreneur to the lender in period 2. Then the optimal contract is \( R(x) = x \), \( x \in [0, R] \), and \( R(x) = R \), \( x \in [R, 1] \) for some constant \( R \in [0, 1] \). Verification takes place for \( x \in [0, R] \), and does not take place otherwise. Thus, the states where \( x < R \) correspond to bankruptcy states, \( R \) is the promised payment on the debt, and \( \gamma \) is a bankruptcy cost. Here, \( R \) satisfies

\[
\pi^\ell(R, \gamma) = \int_0^R (x - \gamma) \, dF(x) + R[1 - F(R)] = r .
\]

A debt contract acts here to minimize the deadweight losses associated with verification costs. It is necessary for verification to occur in some states of the world, otherwise the entrepreneur would always report to the lender that the return on the investment project was \( x = 0 \), implying a payment of zero. A debt contract induces

5. In Townsend (1979, 1988), and Mookherjee and Png (1989), it is shown that a random verification strategy can in general improve on any deterministic verification strategy. However, Boyd and Smith (1993) show that the quantitative improvement is small for plausible parameter values.
the entrepreneur to report the investment outcome truthfully, and payments are as high as possible in verification states so as to minimize expected verification costs.

In (1), $\pi^\ell(R, \gamma)$ is the expected return to the lender, which can be rewritten, using integration by parts, as

$$
\pi^\ell(R, \gamma) = R - \int_0^R F(x) \, dx - \gamma F(R) .
$$

(2)

We will assume restrictions on $F(x)$ which guarantee that $\pi^\ell(R, \gamma)$ has the following property.

$$
\pi^\ell_{11}(R, \gamma) = -f(R) - \gamma f'(R) < 0 .
$$

(3)

Given condition (3), $\pi^\ell(R, \gamma)$ is a concave function of $R$ for fixed $\gamma$, as in Figure 1, and there exists some $R^*$ such that $\pi^\ell(R, \gamma)$ achieves a unique maximum for fixed $\gamma$ with $R = R^*$. Let $r^*$ denote the maximum possible expected return to the lender, where $r^* = \pi^\ell(R^*, \gamma)$.

Assuming that $r^* > r_\epsilon$, so that the credit market does not shut down entirely, there can be two possible outcomes, as in Williamson (1987). First, there may exist an equilibrium where every entrepreneur receives a loan. Here, we have $r \leq r^*$ and the quantity of loans is $1 - \alpha$, where $r = r_\epsilon + \left( \frac{1 - \alpha}{\alpha} \right) (r_u - r_\epsilon)$ and $R$ is determined by $\pi^\ell(R, \gamma) = r$. This equilibrium exists if and only if $r_\epsilon + \left( \frac{1 - \alpha}{\alpha} \right) (r_u - r_\epsilon) \leq r^*$. Alternatively, the equilibrium may exhibit credit rationing. Here, in equilibrium each entrepreneur offers a loan contract on the market with a promised payment of $R^*$, and each lender accepts a contract at random. We have $r = r^*$, and the loan quantity is $q$, which is the solution to

$$
r^* = r_\epsilon + \left( \frac{q}{\alpha} \right) (r_u - r_\epsilon) .
$$

(4)

This equilibrium exists if and only if the solution to (4), $q < 1 - \alpha$, that is, $r_\epsilon + \left( \frac{1 - \alpha}{\alpha} \right) (r_u - r_\epsilon) > r^*$. Thus, the equilibrium is unique, and either displays rationing or does not. All borrowers here are identical, but in equilibrium some may not receive loans while others do. In a rationing equilibrium, the entrepreneurs who do not receive loans are worse off than the entrepreneurs who do, but would-be borrowers cannot bid loans away from those who receive them, as any alternative to the equilibrium loan contract will only yield a lower expected return to the lender.\(^6\)

6. It is not clear whether or not rationing equilibria can exist with random verification. Rationing equilibria are possible in this case if expected verification costs increase as the expected return to the lender increases. This might occur since there would be a greater incentive to cheat with a higher expected return to the lender, requiring that verification probabilities increase in at least some states.
The rationing equilibrium represents a situation that some government credit programs seem designed to "correct." A group of similar (identical in this case) would-be borrowers is treated asymmetrically by the credit market, which might lead to the inference that the market is not working efficiently, and that matters can be improved with government help. Furthermore, note that in any credit rationing equilibrium the market return, \( r \), is less than the social return from investment.\(^7\) Investment projects that go unfunded would yield a return higher than \( r \) if funded, as entrepreneurs always receive some of the surplus. We will consider two types of government credit programs in turn. The first is a program of direct loans, like those administered by the Farmers Home Administration (FmHA) and (to some extent) the Small Business Administration (SBA). The second is a program of loan guarantees, similar to much of the activity carried out by the SBA, and also to the mortgage insurance programs of the Federal Housing Administration (FHA).

1.3. Direct Government Loans

Suppose that the government makes direct loans at the market loan interest rate, \( R \), financing these loans by borrowing from lenders at the risk free interest rate \( r \). The government is assumed to have access to the same verification technology as the private sector, and faces the same prohibition on the use of randomized verification strategies. Now, whether or not there is credit rationing in equilibrium, it is an immediate result that the equilibrium will be invariant to the quantity of government lending, \( g \). Here, the government has no advantage in lending over the private sector, and acts in the same way as would a private lender.\(^8\) Acting in this way, there-

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\(^7\) This is also true in an equilibrium with no rationing.

\(^8\) Note here that there is no role for financial intermediation as, for example, in Williamson (1986). Here, lending is just as efficient when carried out through individuals as through well-diversified intermediaries.
fore, the government simply displaces a quantity of private lending equal to $g$. Gale (1990a) obtains a similar result in an adverse selection credit rationing model where debt contracts are imposed.

The only way the government can alter the allocation of resources in this framework is through tax and subsidy schemes. For example, if the government has access to lump sum taxes and transfers on lenders and entrepreneurs, then resources could be transferred directly from lenders to borrowers in period 1, and back again in period 2. The government would need to incur verification costs in taxing borrowers, but an appropriate set of taxes and transfers would imply that the quantity of projects financed would correctly reflect the social return from investment. A scheme like this would seem to assume too great an advantage for the government. Also, such a scheme would not result in a Pareto improvement over the case with no government involvement, as some borrowers would necessarily be worse off.

1.4 Government Loan Guarantees

Suppose now that the government guarantees to each lender some fixed fraction of the promised payment on a loan. That is, the government guarantees that the lender will receive no less than $vR$, where $0 < v < 1$ and $R$ is the promised payment. Lenders pay an insurance premium, $P$, which is constant across states of the world, and is treated as fixed by lenders. The premium is set so as to make the loan guarantee program self-financing. Assume here that verification is publicly observable, so that the government knows if a lender verifies the return on an entrepreneur’s project, and what the return is if verification takes place.9 Here, the government will never make a payment to a private lender unless the borrower fails to meet the promised payment, verification takes place, and $x < vR$.

The expected return to the lender is now

$$\pi^L(R, \gamma, v) = \int_0^{vR} (vR - \gamma) \, dF(x) + \int_{vR}^R (x - \gamma) \, dF(x) $$

$$ + R [1 - F(R)] - P,$$

which can be rewritten using integration by parts as

$$\pi^L(R, \gamma, v) = R - \int_{vR}^R F(x) \, dx - \gamma F(R) - P.$$ (5)

(6)

Again, the lender treats the premium, $P$, as fixed, but the government sets $P$ so that the loan guarantee program breaks even, that is,

9. It would not make any qualitative difference for the results if verification were not observable. The government would then have to verify the return to the entrepreneur when a lender makes a claim to a government payment. This then makes the government loan program even less efficient than with the assumptions we make but, as will be shown, loan guarantees are inefficient even without replication of verification costs.
\[ P = \int_{0}^{\nu R} (\nu R - x) \, dF(x) \quad (7) \]

From equation (6), we have

\[ \pi_{13}(R, \gamma, \nu) = 1 - F(R) + \nu F(\nu R) - \gamma f(R) \]

so that

\[ \pi_{13}(R, \gamma, \nu) = F(\nu R) + \nu^2 f(\nu R) > 0. \]

Therefore, for given \( P \), each lender perceives that the first partial derivative of their expected return function with respect to the loan interest rate is higher for each loan interest rate. In Figure 2, we show a typical expected return function with \( P = \nu = 0 \), and, holding constant the probability distribution of the return on the investment project, \( F(x) \), and the verification cost, \( \gamma \), the lender’s perceived expected return function with \( P > 0 \) and \( \nu > 0 \).

Now, suppose that there is no credit rationing in an equilibrium without loan guarantees, that is, \( P = \nu = 0 \), and the loan quantity is \( q = 1 - \alpha \). The equilibrium loan payment, \( \hat{R} \), and the equilibrium risk-free market return, \( \hat{r} \), are determined as in Figure 3. If the government implements a loan guarantee program with \( \nu > 0 \) and \( P \) determined by (7), then equilibrium interest rates are invariant to the loan guarantee program, as in Figure 3. We obtain this result by substituting for \( P \) in (5) using (7), and given that \( \hat{R} < R^* \) since, with the loan guarantee, \( \pi_{13}(R, \gamma, \nu) > 0. \)

In the case where, in the absence of loan guarantees, there is initially a credit

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Fig. 2. Effect of a Loan Guarantee on the Lender’s Expected Return Function
rationing equilibrium, as in Figure 4, we have an initial equilibrium loan payment \( R_1 \), and an equilibrium risk free market return \( r_1 \). Here, when loan guarantees are introduced, the equilibrium will now be one with a higher loan payment, \( R_2 \), and a lower risk free market return, \( r_2 \). The equilibrium with a loan guarantee must be at a point where the perceived expected return function for the lender with a loan guarantee intersects the expected return function with no guarantee (that is, the loan guarantee program is self-financing). Therefore, with a loan guarantee, we must have \( r_2 \leq r_1 \), so that there will be rationing in equilibrium. Since \( \pi_{f3}(R, \gamma, \nu) > 0 \), we get \( R_2 > R_1 \) and \( r_2 < r_1 \). As there must be rationing, the equilibrium occurs at the maximum of the perceived expected return function for the lender.

With a loan guarantee, the lower market return to lenders implies that the supply of loanable funds will be lower, and more borrowers will be rationed than without the loan guarantee program. In this case, the effect of loan guarantees is perverse. Such programs are typically intended to promote more lending, which should make all credit market participants better off. Here, all agents are worse off in terms of expected utility. Lenders face lower interest rates, borrowers face higher interest rates, and the probability of receiving a loan for each entrepreneur is lower.

Here, the reason that loan guarantees have at best no effect, and at worst reduce welfare for everyone, is that they distort an otherwise optimal contractual arrangement between borrowers and lenders. One way to correct the harmful effects of the loan guarantee program is to face lenders with a premium schedule that reflects the higher risk inherent in higher loan interest rates. In fact, if lenders face a premium schedule given by (7) then, substituting in (6), the expected return function faced by a lender is independent of \( \nu \), and the loan guarantee program is neutral, which is optimal.
2. CREDIT WITH COSTLY SCREENING

In this section, we consider a credit market model with adverse selection and costly screening of loan applicants. This model is similar to the one studied in Wang and Williamson (1993).\(^{10}\) It is related to the costly state verification approach in the previous section, in that there exists private information that can be revealed at a cost, and debt contracts will prove to be the optimal contractual arrangement. However, there are two important differences between this type of model and the costly state verification approach. First, in this model there is a cost of screening borrowers ex ante, rather than a cost of verifying the ex post return. Arguably, screening costs are more important to the operation of real-world credit markets than ex post auditing costs. Second, debt contracts in this context are in some ways more robust. For example, debt contracts survive here even with randomization, which is not the case in costly state verification models.

2.1 The Model

There are two periods, 1 and 2, and a continuum of agents. The agents are of three types: lenders, type \(b\) borrowers, and type \(g\) borrowers. The fraction of borrowers who are type \(g\) is \(\delta\), where \(0 < \delta < 1\), and the fraction of all agents who are lenders is strictly greater than the fraction who are borrowers.

In period 1, each lender has one unit of an investment good, which can either be

\(^{10}\) A related model is De Meza and Webb (1988), in which there is a similar screening technology. De Meza and Webb do not have random screening, as is the case here, and they ignore the role of debt contracts in minimizing screening costs.
exchanged with a borrower for some promise to pay consumption goods in period 2,
or invested for one period at the risk free return \( r \), which we treat here as fixed.
Lenders maximize the expected value of \( u'(c, e) = c - e \), where \( c \) is consumption
in period 2, and \( e \) is effort in screening borrowers in period 1.

Borrowers have no endowment in period 1, and maximize the expected value of
period 2 consumption. Each borrower has access to an investment project which
requires 1 unit of the investment good to fund in period 1, and yields a random
quantity of the consumption good, \( x \), in period 2 if the project is funded. Here, \( x \) is
public information, in contrast to the costly state verification model studied in the
previous section. The return on the investment project of a borrower of type \( i \) is
distributed according to the probability distribution function \( F_i(\cdot) \), where \( i = g, b \).
The associated probability density function is \( f_i(\cdot) \). Assume that \( f_i(x) > 0 \) for \( x \in [0, 1] \), \( f_i(x) = 0 \) otherwise, that \( f_i(x) \) is continuous on \( [0, 1] \), and that

\[
\frac{f_g(x)}{f_b(x)} < \frac{f_g(y)}{f_b(y)} ; \quad x, y \in [0, 1]; x < y .
\]

(8)

Condition (8) is essentially identical to the monotone likelihood ratio property often
assumed in principal agent problems with moral hazard, and it implies first-order
stochastic dominance of \( F_b(\cdot) \) by \( F_g(\cdot) \), that is, \( F_b(x) > F_g(x), x \in (0, 1) \). Letting \( \mu_i \)
denote the mean investment return for a type \( i \) borrower, we assume that \( \mu_i > r \), for
\( i = g, b \).

If borrowers are not screened, then type is private information. However, each
lender has access to a technology with which to observe a borrower’s type at a cost
of \( \gamma \) units of effort in period 1, where \( \gamma \geq 0 \). A given borrower can contact at most
one lender in period 1, but a lender may contact as many borrowers as she wishes.

2.2 Equilibrium

The equilibrium concept used here is similar to the one in Rothschild and Stiglitz
(1977). Contracts offered by lenders to borrowers in period 1 consist of payment
schedule/screening probability pairs \( [R_i(x), \pi_i] \), \( i = g, b \), where \( R_i(x) \) denotes the
period 2 payment from a type \( i \) borrower to the lender, and \( \pi_i \) is the probability that
the lender uses the screening technology to verify the type of an agent claiming to be
type \( i \) when that agent applies for a loan.\(^{11}\) Equilibrium contracts must satisfy five
conditions. First, they must be feasible. That is,

\[
0 \leq R_i(x) \leq x, \quad x \in [0, 1], \quad i = g, b .
\]

Second, the contracts are constrained to be monotonic.

\(^{11}\) Note that the payment schedule faced by a borrower is independent of whether or not screening
takes place. This contract structure would arise if we assumed a technology that allows the lender to
commit to a particular screening strategy, but third parties could not observe whether or not screening
takes place.
\[
x \leq y \Rightarrow R_i(x) \leq R_i(y); x, y \in [0, 1]; i = g, b .
\]

(9)

This monotonicity restriction can be justified if it is possible for borrowers to fake higher levels of output. For example, suppose that borrowers can borrow temporarily in period 2 before their output quantity is publicly observed. If the payment schedule did not satisfy (9), then for some realizations the borrower could do better by borrowing temporarily in period 2 (at a zero interest rate) so as to make a lower payment to the lender. Third, the contracts should be incentive compatible, or

\[
\int_0^1 R_i(x) \ dF_i(x) \leq (1 - \pi_j) \int_0^1 R_j(x) \ dF_i(x) + \pi_j \mu_i; i, j = g, b .
\]

(10)

On the left side of (10) is the expected cost to a type \( i \) borrower of applying for and receiving a loan when reporting her true type, while the right side is the expected cost when the borrower applies and misreports her type as \( j \). Here, the borrower is screened with probability \( \pi_j \). If screening does not take place, then the borrower’s expected cost is the expected payment for a type \( j \) agent, and if the borrower is screened and found to be lying, then she is denied a loan and the expected cost is \( \mu_i \).

Fourth, a contract should earn zero expected profits given the agents who accept it. Fifth, there should exist no alternative contract that some agent type strictly prefers to the equilibrium contract offered to their type, and that earns nonnegative expected profits given the agents who accept it.

As is shown in Wang and Williamson (1993), the equilibrium has some features in common with the equilibrium in the Rothschild-Stiglitz (1977) insurance model. In particular, if an equilibrium exists, it is a separating equilibrium where different contracts are offered to each type of borrower, and an equilibrium does not exist for some parameter values. Three important properties of the equilibrium are:

1. Type \( g \) borrowers are screened with positive probability, while type \( b \) borrowers are not screened. That is, \( \pi_g > 0 \) and \( \pi_b = 0 \).
2. The unique equilibrium contract for a type \( g \) borrower is a debt contract, that is \( R_g(x) = x \) for \( x \in [0, \bar{R}_g] \), and \( R_g(x) = \bar{R}_g \) for \( x \in [\bar{R}_g, 1] \) for some constant \( \bar{R}_g \in [0, 1] \).
3. There exists a continuum of equilibrium contracts for a type \( b \) borrower, and one of these contracts is a debt contract, characterized by the promised payment \( \bar{R}_b \in [0, 1] \).

We can determine \( \pi_g, \bar{R}_g, \) and \( \bar{R}_b \) as the solution to the following three equations.

\[
\bar{R}_b - \int_0^{\bar{R}_b} F_b(x) = r ,
\]

(11)

\[
\bar{R}_g - \int_0^{\bar{R}_g} F_g(x) \ dx = \pi_g \gamma + r ,
\]

(12)
$$r = (1 - \pi_g) \left[ \tilde{R}_g - \int_0^{\tilde{R}_g} F_b(x) \, dx \right] + \pi_g \mu_b.$$  

(13)

Here, equations (11) and (12) are zero expected profit conditions for the contracts offered to type b and type g agents, respectively. That is, the expected payment to the lender must equal the expected screening cost plus the opportunity return which could be earned elsewhere by the lender. Equation (13) is the incentive constraint (10) for \(i = b\) and \(j = g\). That is, the incentive constraint is binding for a type b agent. It is straightforward to show that the solution to (11), (12), and (13) satisfies the incentive constraint for a type g agent, that is, (10) for \(i = g\) and \(j = b\), with strict inequality, or \(\tilde{R}_b > \tilde{R}_g\).

In equilibrium, type b borrowers are faced with higher interest rates than are type g borrowers. To induce borrowers to self select, type g borrowers must be screened with positive probability. Since screening is costly, lenders wish to minimize the screening cost so as to offer the best possible contract to type g borrowers. This is accomplished by offering debt contracts to type g borrowers. Condition (8) implies that a type g borrower tends to have more probability mass in the upper end of her return distribution than does the type b borrower. Therefore, if the type g agent is offered a debt contract, this does as much as possible to manipulate payment schedules in a way that the type g agent likes and the type b agent does not. This induces self-selection at the lowest possible expected screening cost.

An equilibrium does not exist in the case where there is a pooling contract which both agents prefer to the contracts which solve (11), (12), and (13). In Wang and Williamson (1993), it is shown that an equilibrium exists if and only if \(\tilde{R} \geq \tilde{R}_g\), where \(\tilde{R}\) is the solution to

$$\delta \left[ \tilde{R} - \int_0^{\tilde{R}} F_g(x) \right] + (1 - \delta) \left[ \tilde{R} - \int_0^{\tilde{R}} F_b(x) \right] = r,$$

and \(\tilde{R}_g\) is determined by (11), (12), and (13). Here, \(\tilde{R}\) characterizes a pooling debt contract offered to both types with no screening of either type, and this pooling contract earns zero expected profits if it attracts both types in the relative proportions that exist in the population. It is shown in Wang and Williamson (1993) that, for fixed \(\gamma\) and \(r\), an equilibrium exists for \(\delta \leq \delta^*\) for some \(\delta^* > 0\), and does not exist otherwise. Also, for fixed \(r\) and \(\delta\), an equilibrium exists for \(\gamma \leq \gamma^*\) for some \(\gamma^* > 0\), and does not exist otherwise. An increase in \(\gamma\) leads to an increase in the loan interest rate faced by a type g borrower, and to a decrease in the screening probability.

### 2.3 Government Credit Programs

In this model, the government credit programs considered in the previous section will have no effect. Direct government loans that have contractual arrangements identical to private loans, for type g and b borrowers, will not alter equilibrium in-
terest rates, and neither will government loan guarantees for either borrower type. These two types of programs do not affect incentives for borrowers, and therefore self-selection is achieved in the same manner with the government program as without it. We will therefore consider two alternative government credit programs which will have important incentive effects here: (1) government lending to those denied private credit, and (2) government lending at subsidized interest rates. Many federal credit programs for housing, agriculture, and small business contain restrictions of lending to those without access to private credit, and much of this lending activity would not be profitable for a private intermediary, and therefore involves subsidization.

**Government Lending to Borrowers Denied Private Credit.** Thus far, we have assumed that a borrower can contact at most one lender in period 1. Here, we will assume that a borrower can contact one private lender, and can then contact the government. Borrowers are only potentially denied credit in a separating equilibrium, where a type b borrower claiming to be a type g borrower is caught cheating with probability \( \pi_g \), in which case the borrower does not receive a loan. In the separating equilibrium discussed above, no one is ever denied credit in equilibrium, as the incentive constraint (13) implies that type b agents weakly prefer to accept the contract offered to their own type. Suppose, however, that the government implements a credit program offering a debt contract with a promised payment of \( R_p \), to any borrower who is denied credit. Assume that, if the government makes a loss or profit on this lending, the required taxes or transfers fall on agents other than lenders and borrowers in the credit market. Effectively, government credit will only go to agents who apply for credit under a separating contract, misreport their type, and upon screening are found to have cheated.

Suppose first that, in the absence of this government credit program, there exists an equilibrium \( \pi_g, \bar{R}_g, \) and \( \bar{R}_b \), the solution to (11), (12), and (13). With the government credit program in place, the incentive constraint for a type b agent is altered from (13) to

\[
r = (1 - \pi_g) \left[ \bar{R}_g - \int_0^{\bar{R}_g} F_b(x) \, dx \right] + \pi_g \left[ R_p - \int_0^{R_p} F_b(x) \, dx \right]. \tag{15}
\]

A separating equilibrium is now the solution to (11), (12), and (15). It is straightforward to show that a solution exists, and that this solution is unique, if and only if \( R_p \geq R_b \), where \( R_b \) is the solution to (11). Substituting for \( \pi_g \) in (12) using (15), we get an equation which solves for \( \bar{R}_g \):

\[
\bar{R}_g - \int_0^{\bar{R}_g} F_g(x) \, dx = r + \gamma \left[ \frac{r - \bar{R}_g + \int_0^{\bar{R}_g} F_b(x) \, dx}{R_p - \int_0^{R_p} F_b(x) \, dx - \bar{R}_g + \int_0^{\bar{R}_g} F_b(x) \, dx} \right]. \tag{16}
\]
Supposing that \( R_p \geq \bar{R}_p \), and letting \( \bar{R}^*_g \) denote the solution to (16), \( \bar{R}^*_g \) decreases as \( R_p \) increases. Here, we get the noninterventionist solution for \( R_p = 1 \), which implies that, with \( \bar{R}_b \leq R_p < 1 \), type \( g \) borrowers face higher interest rates with the government credit program than without it. Also note, from (12) that, since \( \bar{R}^*_g > \bar{R}_g \) we also have \( \pi^*_g > \pi_g \), so that type \( g \) agents are screened with higher probability when the government credit program is in place. As the government credit program causes the loan interest rate faced by a type \( g \) agent to rise, it is now possible that an equilibrium will not exist, where existence was obtained without the government credit program. That is, we could have \( \bar{R}^*_g > \bar{R} \geq \bar{R}_g \), where \( \bar{R} \) solves (14).

Here, offering loans to agents who are denied private credit simply increases the incentive for type \( b \) agents to misrepresent their type, which in turn implies that lenders must put more effort into screening in order to induce self-selection. As expected screening costs are higher in making loans to type \( g \) agents, these agents must bear higher interest rates. Type \( b \) agents are no better off, as they face the same interest rate, given by the solution to (11). Thus, in this case the government credit program simply exacerbates incentive problems in the credit market, making some agents worse off without making anyone better off, or causing a problem of nonexistence of equilibrium.

In the case where \( \bar{R} < R_p \leq \bar{R}_p \), where \( \bar{R} \) solves (14), an equilibrium does not exist. Here, from (15), there exists no verification probability that will force self-selection. That is, the loan contract offered by the government to those denied credit is sufficiently attractive that a type \( b \) borrower posing as a type \( g \) borrower is not penalized enough if caught cheating and denied a private loan. There does not exist a pooling equilibrium as, given that \( \bar{R} < R_p \), a contract can always be offered that type \( g \) borrowers strictly prefer to a pooling contract, and that does not attract any type \( b \) borrowers, even given the favorable loan contract offered by the government.

If \( \bar{R} \geq R_p \), then an equilibrium always exists, but it is a pooling equilibrium, with the loan contract \( \bar{R} \) satisfying (14). Here, \( R_p \) is sufficiently low that, in the pooling equilibrium, there is no contract that could be offered that would make type \( g \) agents better off while earning nonnegative expected profits and not attracting any type \( b \) agents. That is, the government loan contract offered to those denied private credit is so attractive that it is impossible to induce borrowers to self-select. If an equilibrium exists in the absence of the government credit program, then it must be the case that \( \bar{R} > \bar{R}_g \), that is, type \( g \) borrowers are worse off with the government program than without, while \( \bar{R} < \bar{R}_g \), so that type \( b \) agents are better off. An equilibrium may not exist without the government credit program, in which case all agents are clearly better off with government intervention than without it.\(^{12}\)

Here, offers of government loans to borrowers denied private credit alter the payoffs to type \( b \) agents claiming to be type \( g \) agents, in a way that encourages cheating. If the offered interest rate on government loans is set too high, then the incentive effect causes a decrease in expected utility for some agents and no change for others, \(^{12}\)

\(^{12}\) With “nonexistence,” all lenders invest at the certain return \( r \), and no borrower gets a loan. Thus, lenders are indifferent with respect to cases where credit market equilibria do and do not exist, and all borrowers are strictly worse off with nonexistence.
or it leads to nonexistence of equilibrium. If the interest rate on government loans is set sufficiently low, then the equilibrium is not Pareto comparable to the equilibrium without government intervention. Type $g$ agents are worse off with government intervention, while type $b$ agents are better off. In this case, government intervention can yield existence of equilibrium when an equilibrium would not exist otherwise. Thus, this type of government loan program in a credit market with adverse selection need not be a bad thing. Note also that, in equilibrium, there is no direct cost to government lending activity, as the government only makes offers to lend that are never accepted, but that agents take into account in making their decisions.

**Subsidized Government Lending.** Now, consider a government loan program of direct lending, whereby the government writes debt contracts with private agents with a promised payment $R_p$. We will assume that a borrower can contact the government and then contact one private lender in period 1. Any subsidy in this program is financed by taxes that fall on agents other than the lenders and borrowers in the credit market.

Suppose first that an equilibrium exists in the absence of government intervention, characterized by the interest rates $\hat{R}_g$ and $\hat{R}_b$, and the screening probability $\pi_g$ which solve (11), (12), and (13). If the interest rate on government loans is set such that $\hat{R}_g \leq R_p < \hat{R}_b$, then the equilibrium depends on the quantity of government lending which takes place. If the government offers a quantity of loans which is less than the number of type $b$ borrowers, then equilibrium interest rates are unaffected by government intervention. Type $b$ borrowers prefer a government loan, and so apply to the government first, but the government must ration credit. Some type $b$ borrowers are then forced to borrow at the higher private loan rate, and type $g$ borrowers face the same interest rate as without intervention. Thus, the type $b$ agents who receive subsidized loans are better off, but all other agents are indifferent to the government intervention. In the case where the government serves all type $b$ borrowers, let $\hat{R}_g^*$ and $\pi_g^*$ denote, respectively, the promised payment and the screening probability for a type $g$ agent. Here, $\hat{R}_g^*$ and $\pi_g^*$ solve the following two equations.

\[
\hat{R}_g^* - \int_0^{\hat{R}_g^*} F_g(x) \, dx = \pi_g^* \gamma + r ;
\]  

\[
R_p - \int_0^{R_p} F_b(x) \, dx = (1 - \pi_g^*) \left[ \hat{R}_g^* - \int_0^{\hat{R}_g^*} F_g(x) \, dx \right] + \pi_g^* \mu_b .
\]  

Here, since $R_p < \hat{R}_b$, the solution we obtain has the property that $\hat{R}_g^* < \hat{R}_g$ and $\pi_g^* < \pi_g$. That is, since the government loan interest rate is more attractive to type $g$ borrowers than the interest rate they would receive on a private loan in the absence of government intervention, the government loan program acts to mitigate the incen-

13. Smith and Stutzer (1989) and Gale (1990b) obtain results similar in flavor to some of the ones here. In their models, rationing of low-risk types achieves self-selection, and any government program that acts to relieve this credit rationing will exacerbate incentive problems.
tive problem in the credit market. Thus, type $g$ borrowers are screened less intensively, so that lenders face lower costs and therefore offer type $g$ borrowers a lower interest rate. In this case, the subsidy makes all borrowers better off.

In cases where an equilibrium does not exist without government intervention, the introduction of this subsidized government loan program could produce existence. That is, since $\tilde{R}_g^* < \tilde{R}_g$, it could be the case that $\tilde{R}_g^* < \tilde{R} < \tilde{R}_g$, where $\tilde{R}$ solves (14). Here, lenders are indifferent to government intervention, and all borrowers are strictly better off with intervention.

The final case we need to consider is one where $R_p < \tilde{R}_g$. First suppose, at the extreme, that the government lends to all borrowers at the gross interest rate $R_p$. This would clearly make all borrowers better off than they would be without government intervention. Second, suppose the government rations funds, allocating loans at random, but makes no attempt to discriminate among borrowers according to type. Here, the credit market equilibrium will be identical with and without government intervention, but the quantity of private lending will be smaller. Both borrower types strictly prefer government loans to private loans, so the fraction of borrowers receiving government loans who are type $g$ will be $\delta$, the population fraction. Those getting government loans are better off than they would be without the government lending program, and others are indifferent. Third, suppose that the government wishes to target type $b$ borrowers for government lending, and attempts to produce self-selection by screening borrowers. This scheme will not work here, as borrowers have the option of borrowing from a private lender if denied credit by the government.

A more interesting setup to consider here (and one that eliminates the criticism that the government is treated differently in this section from the private sector) is one in which borrowers can contact at most one lender during the period; that is, if a borrower contacts the government, then the borrower does not have the option of obtaining private credit. Given this assumption, there is the potential that the government could successfully screen borrowers by (1) modifying the contract offered to those receiving government loans; (2) rationing government loans; (3) using the costly screening technology.

Exploring this fully is outside the scope of this paper, but we can make the following conjectures about results. Given that the objective is to confine government lending to type $b$ agents, a contract that would be most desirable for type $b$ agents relative to type $g$ agents is an all-or-nothing contract where the payment by the borrower is zero if $x < s$, and $x$ for $x \geq s$, for some constant $s \in [0, 1]$. Rationing schemes also aid in generating the correct incentives, as type $g$ agents have more to lose from being denied a loan. Finally, costly screening works as previously, except that type $b$ borrowers are screened rather than type $g$ borrowers. With any of these schemes, the equilibrium will be identical to the one with no government intervention unless a scheme is imposed where all type $b$ agents apply for a government loan in equilibrium. In this case, there need not be any screening of loan applicants in the market for private credit. As a result, type $g$ agents do not bear any screening costs, and they must then be better off than without government intervention. Type $b$ agents will also be better off.
In this type of model, subsidized government lending programs typically make all credit market participants at least as well off as in the absence of intervention. We get this result because subsidized lending generally introduces slack into incentive constraints, and therefore the expected costs of screening private loan applicants can fall. However, subsidized lending is clearly not a Pareto improvement here, as the subsidies need to be financed through taxes on some agents, and if the government sets its interest rates sufficiently low, then it may also need to incur the costs of screening out groups of borrowers that it does not wish to target.

3. FINANCIAL INTERMEDIATION AND PASS-THROUGH SECURITIES

In studying some types of government loan programs, it is necessary to consider the financial intermediation process in more detail than in sections 1 and 2, where there was direct lending from ultimate borrowers to ultimate lenders. The U.S. government, through its agencies, engages in the promotion of forms of financial intermediation that seem designed to correct for perceived deficiencies in the private financial intermediation process. Principal among these schemes are programs to ensure a secondary market in private loans, through the trading of “pass-through” securities. These pass-through securities are assets backed by a portfolio of loans, most typically mortgage loans, some with guarantees from federal agencies. The pass-through securities of the Government National Mortgage Administration (GNMA), for example, are backed by mortgages insured by the Federal Housing Administration (FHA) or guaranteed by the Veterans Administration (VA), and the pass-through securities themselves are backed by the U.S. government. Pass-through securities issued by the Federal National Mortgage Administration, a private corporation, have no explicit government backing, but are implicitly backed by the federal government.

Each of the models in sections 1 and 2 is capable, with minor modification, of generating a financial intermediary structure endogenously. In the costly state verification model in Section 2, we can simply follow Williamson (1986), and assume that investment projects each require \( k \) units of the investment good in period 1 in order to operate, where \( k > 1 \). An optimal financial structure then has all lending done by large financial intermediaries, which lend to a large number of borrowers, and borrow from a large number of depositors. An intermediary writes debt contracts with borrowers, and makes risk-free payments of \( r \) units of consumption to each depositor in period 2, by exploiting the law of large numbers. The monitoring of borrowers is delegated to the financial intermediary (Diamond 1984) which would have an incentive to misreport its portfolio returns to depositors (and would therefore need to be monitored) if it were not fully diversified. Thus, financial intermediation serves here to economize on verification costs; if there were direct lending, each of the \( k \) lenders who lent to an entrepreneur would have to verify the investment project’s return in the event of default.

In the model of section 2, we can obtain a similar “delegated screening” result [see Wang and Williamson (1993) for more details]. Suppose, as with the costly
state verification model, that each borrower's investment project requires \( k \) units of the investment good to operate, where \( k > 1 \). Again, a perfectly diversified intermediary writes debt contracts with borrowers and offers depositors a certain return. Here, only loans made to type \( g \) borrowers are intermediated in equilibrium, as loans to type \( b \) borrowers do not require costly screening. In this model, intermediation economizes on screening costs, in that direct lending requires that each lender screen the borrower, but with intermediation each borrower is screened only once.

If we consider either the costly state verification model with financial intermediation, or the costly screening model with financial intermediation, there is no role for the government to play in promoting pass-through securities. In these models, securitization is simply a form of financial intermediation, but these models contain no unrealized gains to intermediation activity in equilibrium. Therefore, in these models the issuance of pass-through securities would not be profitable for a private lender, and it would not be welfare-improving for the government to promote this activity.

To gain some perspective on mortgage-backed (and related) securities, and their role in a U.S. context, it is useful to examine experience in other countries. In Canada, for example, loan sales are virtually nonexistent in the mortgage market. Mortgage loans are negotiated by chartered banks and other depository institutions and are then held in the asset portfolios of those institutions. An important difference between Canada and the United States is Canada's branch banking system, which permits banks and other mortgage lenders to diversify broadly. In the United States, a patchwork of branch banking restrictions and other regulatory constraints tends to limit the diversification that an individual institution is able to achieve. Therefore, given existing banking regulations, government intervention to promote a market in mortgage-backed securities may well be welfare improving. This government-promoted intermediation activity simply provides the diversification that the private sector is unable to supply because of regulatory impediments. However, the form that intermediation takes in the United States is second best, in that there is a replication of screening and monitoring costs. For example, borrowers in the mortgage market are screened first by a particular lending institution or mortgage broker, and may later by screened (possibly at random) when the mortgages are sold to FNMA for packaging. If the loans are negotiated and held by the same financial intermediary, the screening costs are only incurred once. Therefore, it would seem that the first best solution would be to eliminate regulations that promote unit banking. This would likely do away with the need for markets in securities backed by private loans.

4. SUMMARY AND CONCLUSION

Here, we have studied the effects of some government credit programs in two private information models of credit markets. The first of these models is a setup with costly state verification, where a borrower's investment project return is observable by a lender at a cost. The second model is an adverse selection environment, where a borrower's type is private information, but where there exists a costly screening technology that reveals type. Together, these models exhibit many of
the important characteristics useful in determining what role for government credit programs, if any, arises because of informational frictions. In particular, the two models have elements of moral hazard, adverse selection, costly information acquisition, incentive problems as determinants of optimal contractual arrangements, and equilibrium credit rationing.

In the costly state verification model, a program of direct government loans (at market interest rates and with the same contractual arrangements as private loans) has no effect, even if there is credit rationing without the government program. Government lending simply displaces an equal quantity of private lending. Government loan guarantees have no effect on the quantity of lending or interest rates, if there is no credit rationing prior to government intervention. If an equilibrium without intervention exhibits credit rationing, then a loan guarantee program has perverse effects. Interest rates faced by lenders (borrowers) fall (rise), and credit rationing becomes more severe.

The costly screening model has the property that, in general, government loan programs will have no effect unless they alter the incentives of borrowers or are subsidized. Government loans to borrowers denied private credit tend to increase screening costs for lenders and to increase interest rates for some groups of borrowers. If government loan interest rates are set appropriately, then the welfare of targeted groups may increase. Subsidized government loans make the targeted recipients of the loans better off, but they can also make other borrowers better off by reducing incentive problems. If government lending becomes more attractive, then misrepresenting type becomes less attractive for some borrowers, screening costs fall for lenders, and interest rates decrease.

An important form of government intervention in credit markets in the United States is the promotion of secondary markets for private loans. Given the current regulatory environment, this type of intervention may be welfare improving, but in a world with no regulatory impediments to diversification by private financial intermediaries, intervention is most likely suboptimal. It can be argued that markets in "pass-through" securities are an inefficient form of financial intermediation, which can thrive only because of the unit banking restrictions which make private financial intermediation inefficient.

Many types of government credit market interventions which are potentially important have not been considered here. In particular, we have ignored government deposit insurance and its interaction with financial regulations, mainly because we feel that there are not ready-made models that deal with deposit insurance in a satisfactory way. Also, we have only touched on issues associated with the structure of financial intermediaries. As both models studied here can deliver intermediary structures endogenously, this is an area where this work can be extended.

LITERATURE CITED


