Increasing Returns to Scale in Financial Intermediation and the Non-Neutrality of Government Policy

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A general equilibrium model of imperfectly competitive financial intermediaries is constructed and used to study the effects of some standard policy experiments. One-time increases in the growth rate and in the level of the stock of money have non-neutral (and sometimes surprising) effects on interest rates, the quantity of intermediated borrowing and lending, the number of intermediary firms, inflation and the price level. Optimal government macroeconomic policy is shown to reflect a tradeoff between public sector frictions and the capital market distortion created by increasing returns to scale and imperfect competition in private intermediation.

INTRODUCTION

In theories which explain the role and reasons for the existence of financial intermediaries, intermediation is almost invariably an activity which is subject to increasing returns to scale. Without some element of economies of scale, private agents would be able to do as well with bilateral trading as they would by trading through intermediaries, as is the case in the framework of Fama (1980). In environments specified by Boyd and Prescott (1985), Diamond (1984), and Williamson (1986), financial intermediation arises endogenously as an efficient mechanism for financing investment projects under asymmetric information. In all these papers, financial intermediaries need to be large (in some sense) to perform this role. Also see Townsend (1978), who considers a model where intermediation economises on fixed costs of exchange, and Leland and Pyle (1977) for a discussion of the role of asymmetric information in financial intermediation.

The purpose of this paper is to examine some macroeconomic implications of increasing returns to scale in intermediating between private lenders and borrowers. Of particular interest here are the non-neutrality of government policy which arise as the result of these economies of scale. An implication is that there may be a role for government policy in this context. The government may be able to use its special powers of taxation and its position as monopoly supplier of fiat currency to partially substitute for private intermediation and improve welfare. Other work which studies macroeconomic issues related to financial intermediation is either not explicit in modelling intermediation (Tobin (1969), Tobin and Brainard (1963), (1968)), specifies an intermediation technology which is costless (Wallace (1980), Sargent and Wallace (1982)) or specifies an intermediation technology which has constant costs or decreasing returns (Bryant and Wallace (1979, 1980)).

The model we construct is one of overlapping generations of consumers where an information asymmetry implies that borrowing and lending cannot take place, unless
some private agents incur an information acquisition cost and become financial intermediaries. Since this cost is fixed, this permits a model of imperfect competition for the intermediation industry which is embedded in the general equilibrium overlapping generations framework.

In the model, fixed intermediation costs are found to drive a wedge between borrowing and lending rates of interest, a type of "capital market imperfection". An increase in the money growth rate tends to encourage more intermediation, with the number of intermediaries increasing in equilibrium and the wedge between borrowing and lending rates decreasing. The changes in the margin between borrowing and lending rates and in the number of intermediaries due to a change in the money growth rate, are particular to the assumption of fixed intermediation costs.

The presence of capital market imperfections may imply that the Ricardian Equivalence Theorem does not hold, as Mundell (1971), Barro (1974), and Drazen (1978) have indicated. Ricardian equivalence may also fail if the government does not have access to lump sum taxes and transfers. If intermediation were costless in our model, and if the government had access to lump sum transfers and taxes, a fiscal policy experiment involving a change in the quantity of taxation-backed government debt (i.e. debt to be retired through future taxation) would be neutral. Through fiscal policy, the government would be able to smooth private consumption paths by acting as a kind of financial intermediary, but it would have no advantage in this respect over the private sector. However, in our model, there is a fixed cost of private information acquisition which makes private intermediation costly. In addition, there is sufficient public information for the government to impose distorting taxes and transfers on the private sector, but lump sum taxation is not feasible. There are then costs to government "financial intermediation" in the form of deadweight welfare losses associated with distortions. Optimal government policy reflects a tradeoff between these costs and the fixed costs of private intermediation. In addition to the direct cost imposed by fixed costs of private intermediation there is also an indirect cost, in the form of inefficiencies due to imperfect competition in the intermediation industry.

The paper is organized as follows. In the first section the model is constructed and an equilibrium is defined. Section 2 discusses the effects of a one-time change in the money growth rate brought about through transfers to consumers. In Section 3 the effects are discussed of a one-time change in the stock of fiat money backed by taxes, and welfare issues are examined. The final section is a summary and conclusion.

1. THE MODEL

The basic structure of our overlapping generations model is similar to a setup in Wallace (1980). Here, we add some intragenerational heterogeneity, private information, and costs of information acquisition.

There are \( N \) consumers born in each period \( t = 1, 2, \ldots, \infty \). Each consumer lives for two periods. There are \( \alpha N (0 < \alpha < 1) \) members of the \( t \)-th generation (lenders) who receive \( y \) units of the non-storable consumption good in the first period of their lives and zero units in the second. The remainder of each generation is a continuum of "borrowers", of measure \( (1 - \alpha) N \). Each borrower receives an endowment of zero units of the consumption good in the first period of life, and \( v \) units in the second, where \( v \) differs among borrowers. If we were to draw a borrower at random from the \( t \)-th generation, then

\[
\Pr [v = v'] = \int_{0}^{v'} f(v) dv,
\]
where \( f(v) \) is a probability density function which is positive on \([0, \bar{v}]\), with \( \bar{v} > 0 \). We also have:

\[
\int_0^\bar{v} vf(v) dv = y. \tag{1.1}
\]

Consumers may smooth consumption over their lifetimes by acquiring fiat money in the first period of life in order to exchange it for the consumption good in the second period of life, or by carrying out intragenerational intertemporal exchange. However, there exist information asymmetries which create frictions in intragenerational trading.

We assume that a given agent is publicly observable only in the act of consumption, at which time the agent’s consumption quantity and age are costlessly observable to all. Otherwise, agents can "hide" in the sense that they are indistinguishable. In particular, endowments are private information, and the fact that we observe an agent consuming at time \( t \) does not aid in locating the agent at a later date. Therefore, if a young lender were to make a loan to a young borrower at some time \( t \), there would be no way for the lender to collect interest and principal on the loan at \( t + 1 \), since the borrower could not be located. However, at the cost of \( F \) units of the consumption good at time \( t \), a technology can be acquired which allows an agent to observe the characteristics of all members of generation \( t \) with whom she carries out transactions, and to distinguish each of these agents from other agents. At time \( t \), lenders can then perfectly predict (at a cost) the period \( t + 1 \) endowments of generation \( t \) borrowers to whom they make loans, and can locate these agents at time \( t + 1 \).

Agents who at time \( t \) incur the fixed cost, \( F \), become financial intermediaries, issuing one-period deposit liabilities in exchange for the consumption good and making one-period loans to borrowers. We assume without loss of generality that intermediation is carried out by separate intermediary firms, and that these firms are costlessly identifiable and distinguishable. We also assume that agents who are identifiable do not repudiate their debts.

The information asymmetry and the nature of information costs differ here from those in other models which generate financial intermediation endogenously. For example, in the models of Diamond (1984) and Williamson (1986), borrowers have access to investment projects with random returns which are observable to other agents at a fixed cost per borrower. In Boyd and Prescott (1985), financial intermediation arises endogenously in an environment with adverse selection where costly evaluation (at a fixed cost per investment project) provides information on investment projects. In spite of these differences, financial intermediation is in some sense characterized by increasing returns to scale in all of these other models, as is the case here. However, none of these other models lends itself easily to an analysis of imperfectly competitive intermediaries, or to an examination of macroeconomic issues, as does our model.

Here, the information asymmetry and costly acquisition of information not only creates a role for private financial intermediaries, but also places restrictions on the activities of the government. Since the government has access to the same technology as the private sector, it could incur the information acquisition cost, \( F \), and act as a financial intermediary. However, this opens up a host of issues in regulation and public ownership which are outside the scope of this paper. Our interest here is in exploring the options open to the government due only to its power to tax and its position as monopoly supplier of fiat currency. We assume in what follows that the government does not incur the information acquisition cost in any period \( t = 1, 2, \ldots, \infty \).
What, then, can the government do? Since agents’ endowments are not observable and the wealth of some individuals will be smaller than any positive lump sum tax, lump sum taxation is not feasible. Lump sum transfers are also an impossibility as agents are indistinguishable, and could therefore make repeated claims that they had not received their transfers when in fact they had. However, since the act of consuming is observable, as is the age of an agent when she consumes, the government can impose a tax/transfer system where taxes and transfers are functions of consumption and age. For simplicity, we consider only proportional tax/transfer schemes. The government budget constraint is:

\[ p(t)[M(t) - M(t-1)] = T(t) \]  \hspace{1cm} (1.2)

where \( p(t) \) is the price of fiat money at time \( t \) in terms of the consumption good, \( M(t) \) is the nominal stock of fiat money, and \( T(t) \) is the total transfer to the private sector.

A consumer who is a member of generation \( t \) chooses nominal holdings of fiat money, \( m(t) \), intermediary deposits, \( d(t) \), and intermediary loans, \( l(t) \), to solve:

\[
\max U(c_t(t), c_{t+1}) = \ln c_t(t) + \ln c_{t+1} \hspace{1cm} (1.3)
\]

subject to:

\[
\begin{align*}
& c_t(t) = [1 + \omega_t(t)][w_t(t) + l(t) - p(t)m(t) - d(t)] \\
& c_{t+1}(t) = [1 + \omega_{t+1}(t)][w_{t+1}(t) - r^t(t)l(t) + p(t+1)m(t) + r^d(t)d(t)] \\
& m(t) \geq 0, \quad l(t) \geq 0, \quad d(t) \geq 0.
\end{align*}
\]

Here, \( c_t(s) \) and \( w_t(s) \) are the consumption and endowment, respectively, of a member of generation \( t \) at time \( s \). The variables \( r^t(t) \) and \( r^d(t) \) are the gross real interest rates on one-period intermediary loans and deposits, respectively. The transfer per unit of consumption for agents of the \( t \)-th generation in the \( i \)-th period of life is denoted by \( \omega_t(t) \).

At time \( t = 1 \) there is a generation of old consumers who are collectively endowed with \( M(0) \) units of fiat money which they supply inelastically.

The optimization problems of lenders and borrowers are now solved in order to derive aggregate demand functions for fiat money, deposits, and loans. In the equilibria examined in the paper, fiat money and deposits will both be held. For arbitrage opportunities to be absent, and to guarantee that intermediaries are solvent, the following must hold in equilibrium:

\[ p(t+1)/p(t) = r^d(t) < r^t(t). \]  \hspace{1cm} (1.4)

Note that fiat money and deposits will be perceived as perfect substitutes in equilibrium. This does not mean, however, that outside money and inside liabilities play the same role in the economy. Clearly they do not (see Wallace (1980)). In addition, none of our results would be qualitatively affected by assuming imperfect substitution between fiat money and deposits due to, say, transaction costs (see Williamson (1984)).

Let \( s(t) \) denote the quantity of real savings by each lender. From (1.3) and given (1.4), the first-order condition for an optimum implies:

\[ s(t) = y/2. \]  \hspace{1cm} (1.5)

Lenders are indifferent, with respect to the composition of their portfolios, given the arbitrage condition (1.4). However, individual holdings of fiat money and deposits must add up to total savings:

\[ p(t)m(t) + d(t) = s(t). \]  \hspace{1cm} (1.6)
From (1.3), and the first-order condition for an optimum, the demand for intermediary loans by a generation $t$ borrower with second-period endowment $v$ is:

$$l(t) = v/2r^l(t).$$

(1.7)

Note, given our particular Cobb–Douglas specification for consumer preferences, that individual savings behavior is independent of $\omega_1(t)$ and $\omega_2(t)$. However, since after-tax consumption allocations depend on $\omega_1(t)$ and $\omega_2(t)$, the terms of trade between $t$ and $t+1$ will be distorted if either of $\omega_1(t)$ or $\omega_2(t)$ are non-zero and $\omega_1(t) \neq \omega_2(t)$.

The aggregate demand functions for fiat money, intermediary deposits and intermediary loans are obtained by adding (or integrating) the demands $m(t)$, $d(t)$ and $l(t)$ over consumers. Using equations (1.1), (1.5), (1.6) and (1.7) we obtain:

$$p(t)M^d(t) + D^d(t) = \alpha Ny/2$$

(1.8)

$$L^d(t) = (1-\alpha) Ny/2r^l(t).$$

(1.9)

In equations (1.8) and (1.9), $M^d(t)$, $D^d(t)$ and $L^d(t)$ are aggregate demands for fiat money, intermediary deposits, and intermediary loans respectively.

Given the arbitrage condition (1.4) (conditions are derived later in the paper which guarantee that both fiat money and deposits are held in equilibrium), the gross interest rate on deposits is $p(t+1)/p(t)$, which each intermediary treats as fixed, by assumption. However, an intermediary does take account of the effect of its actions on the market loan rate, $r^l(t)$. It is assumed that each intermediary acts as a Cournot oligopolist in the loan market. Given $K(t)$ private intermediaries at time $t$, the $i$-th intermediary maximizes period $t+1$ profits, given the inverse demand for loans, denoted by the function $g(\cdot)$, and treating $p(t)$, $p(t+1)$ and $x_j(t)$ ($j \neq i$) as fixed parameters:

$$\max_{x_i(t)} \left\{ x_i(t)g(\sum_{j=1}^{K(t)} x_j(t)) - [p(t+1)/p(t)][x_i(t)+F]\right\}. \tag{1.10}$$

Note, in (1.10), that $F$ units of the consumption good are absorbed in the process of taking deposits and making loans, so that an intermediary must borrow the quantity $x_i(t)+F$ in the form of deposits in order to extend the quantity $x_i(t)$ in loans. The first term inside the curly brackets in (1.10) is the revenue from loans, and the second term is the cost of deposits to the intermediary.

The function $g(\cdot)$, the inverse demand for loans, is derived by solving (1.9) for $r^l(t)$. Substituting total loan supply, $\sum x_j(t)$, for loan demand, $L^d(t)$, and substituting for $g(\cdot)$ in (1.10), we get:

$$\max_{x_i(t)} \left\{ \frac{x_i(t)(1-\alpha) Ny}{2\sum_{j=1}^{K(t)} x_j(t)} - [p(t+1)/p(t)][x_i(t)+F] \right\}. \tag{1.11}$$

Since the profit function [the objective function in (1.11)] is concave in the strategic variable, $x_i(t)$, the first-order condition characterizes an optimum. We have:

$$\frac{(1-\alpha) Ny[\sum x_j(t) - x_i(t)]}{2[\sum x_j(t)]^2} - \frac{p(t+1)}{p(t)} = 0, \quad i = 1, 2, \ldots, K(t). \tag{1.12}$$

Given the symmetric property of each intermediary’s optimization problem, in a Cournot–Nash equilibrium for the intermediation industry, treating $\{p(t)\}_{t=1}^{\infty}$ as a parametric sequence,

$$x_i(t) = x_j(t), \quad i, j = 1, 2, \ldots, K(t).$$
Define $Q(t)$ to be aggregate loan supply with:

$$Q(t) = \sum_{j=1}^{K(t)} x_j(t)$$

and

$$Q(t)/K(t) = x_i(t), \quad i = 1, 2, \ldots, K(t).$$

Then, substituting in (1.12) and rearranging, we have:

$$(1 - \alpha) Ny[K(t) - 1]/2Q(t)^2 - [p(t+1)/p(t)]K(t) = 0. \tag{1.13}$$

Free entry implies (ignoring the integer constraint on the number of intermediaries) that profits will be driven to zero in each period $t$. Substituting for industry loan supply in the profit function, (1.11), a zero-profit condition is obtained:

$$(1 - \alpha) Ny/2 - [p(t+1)/p(t)][Q(t) + K(t)F] = 0. \tag{1.14}$$

Substituting $Q(t)$ for $L^d(t)$ in (1.9), solving for $r'(t)$ and substituting in (1.7), we then use (1.3) and (1.6) and sum transfers (or integrate) across agents using (1.1), to obtain the total transfer:

$$T(t) = \begin{cases} 
\omega_1(t)[\alpha Ny/2 + Q(t)] + [\omega_2(t) Ny/2][\alpha p(t+1)/p(t)] + 1 - \alpha, \\
\omega_1(1)[\alpha Ny/2 + Q(1)], & t = 2, 3, \ldots, \infty \\
\end{cases} \tag{1.15}$$

_Definition 1.1._ A general equilibrium is a sequence

$$\{p(t), Q(t), K(t), T(t)\}_{t=1}^{\infty},$$

which satisfies (1.2), (1.8), (1.9), (1.13), (1.14) and (1.15), in addition to the following.

Supply equals demand for intermediary deposits:

$$D^d(t) = Q(t) + K(t)F. \tag{1.16}$$

Supply equals demand for fiat money:

$$M^d(t) = M(t). \tag{1.17}$$

Quantities and prices are non-negative and if $K(t) > 0$, then one intermediary firm must at least break even:

$$p(t), Q(t) \geq 0; \quad K(t) = 0 \quad \text{or} \quad K(t) \geq 1. \tag{1.18}$$

The following are given: $M(0), \{\omega_1(t), \omega_2(t)\}_{t=1}^{\infty}$.

2. STATIONARY MONETARY EQUILIBRIUM WITH MONEY SUPPLY GROWTH

The purpose of this section is to examine the effects in our model of a standard policy experiment, a deficit-financed change in the fiat money growth rate, on the equilibrium number of intermediaries, the quantity of intermediated lending, and the margin between the interest rates faced by borrowers and lenders. Of particular interest is the way in which these non-neutralities depend on the fixed cost intermediation technology, and the imperfectly competitive intermediation sector which this technology permits.

We let the supply of fiat money change over time through transfers to old consumers.\(^3\) Note that fiat money may be retired through taxation (negative transfers). Setting $\omega_1(t) = 0$ in (1.15) and substituting in (1.2), we get:

$$p(t)[M(t) - M(t-1)] = \omega_2(t)[Ny/2][\alpha p(t+1)/p(t)] + 1 - \alpha]. \tag{2.1}$$

Let $q(t)$ denote the real supply of fiat money at time $t$:

$$q(t) = p(t)M(t). \tag{2.2}$$
Let \( z \) denote the gross rate of growth of \( M(t) \), which is set exogenously by the government, and is constant for all \( t \). We then have:

\[
M(t) = zM(t-1), \quad t = 2, 3, \ldots, \infty; \quad M(1) = M(0) \tag{2.3}
\]

Substituting in (2.1) using (2.2) and (2.3) we get:

\[
q(t)[1 - 1/z] = \omega_2(t)[Ny/2][\alpha p(t+1)/p(t) + 1 - \alpha]. \tag{2.4}
\]

Here, the transfer rate is an endogenous variable. The government sets \( \omega_2(t) \) at whatever level is consistent in equilibrium with a constant fiat money growth rate.

In the equilibria we will examine, \( p(t) > 0 \) (which implies \( q(t) > 0 \)) for all \( t \) (monetary equilibria) and there is private financial intermediation. Given the definition of an equilibrium, (1.1), with endogenous determination of \( \omega_2(t) \), four first-order nonlinear difference equations in the variables \( q(t) \), \( K(t) \), \( Q(t) \) and \( \omega_2(t) \) can be derived. The solution of this system is an equilibrium. We focus on one solution to this system, the stationary monetary equilibrium, where the following are satisfied:

\[
\begin{align*}
Q(t) &= Q \quad \\
K(t) &= K \\
q(t) &= q \\
\omega_2(t) &= \omega \\
q &> 0 \\
K &\geq 1 \\
\omega &\geq -1
\end{align*} \tag{2.5}
\]

for \( t = 1, 2, \ldots, \infty \), where \( Q, K, q \) and \( \omega \) are constants. Using (2.2), (2.3) and (2.5) to substitute in (1.8), (1.9), (1.13), (1.14), (1.16), (1.17) and (2.4), and solving for \( q, Q, K, \) and \( \omega \), we obtain:

\[
q = [Ny/2][\alpha(z+1) - z] \tag{2.7}
\]

\[
Q = [(1-\alpha)Ny/2][1 - (1-\alpha)Nyz/2F]^{-1/2} \tag{2.8}
\]

\[
K = [(1-\alpha)Nyz/2F]^{1/2} \tag{2.9}
\]

\[
\omega = [z - (1-\alpha)z^2 - \alpha]/[\alpha + (1-\alpha)z]. \tag{2.10}
\]

From (2.8) and (2.9), we have \( \partial Q/\partial z > 0 \) and \( \partial K/\partial z > 0 \). That is, the equilibrium number of intermediaries and the aggregate quantity of loans increase as the money growth rate increases. To satisfy the conditions \( q > 0 \) and \( K \geq 1 \) in (2.6), \( z \) is bounded as follows:

\[
2F/(1-\alpha)Ny \leq z < \alpha/(1-\alpha). \tag{2.11}
\]

The lower bound on \( z \) represents a condition that \( z \) be high enough so that intermediation is profitable for at least one firm. The money growth must also be low enough that intermediaries' demand for deposits does not exceed the supply of savings, which is necessary for fiat money to be held. Note that the lower bound in (2.11) goes to zero in the limit as the fixed cost, \( F \), goes to zero. Condition (2.11) also implies that \( \omega \geq -1 \), so that (2.6) is satisfied.

From (1.9), and given that \( L^d(t) = Q \) for all \( t \), the gross loan rate facing borrowers is:

\[
r^d = (1/z)[1 - (2F/(1-\alpha)Nyz)^{1/2}]^{-1}. \tag{2.12}
\]
We have $\partial r^l/\partial z < 0$. Since the gross rate of return faced by lenders is $p(t+1)/p(t) = q(t+1)/q(t)z = 1/z$ in the stationary equilibrium, the ratio of the borrowing rate to the lending rate is:

$$w = \left[1 - \frac{2F}{(1 - \alpha)Nyz}\right]^{1/2}.$$

(2.13)

Thus, the fixed intermediation cost drives a wedge between borrowing and lending rates. The market allocation is therefore not Pareto optimal, even when the money stock is fixed ($z = 1$). Essentially, the market does not efficiently allocate the fixed costs of intermediation among consumers. Note that this inefficiency has nothing to do with the distorting effects of taxes and transfers and would occur if taxes and transfers were lump sum. In particular, the solution for $Q, K, r^l$, and $w$ would be identical with lump sum transfers going only to old lenders.

If there were constant costs and perfect competition in intermediation, the wedge between borrowing and lending rates would depend only on the constant intermediation cost. Here, $w$ depends on other features of the environment (the lifetime income of borrowers, the money growth rate) in addition to the fixed cost of intermediation. Note that $w$ goes to unity in the limit as $F$ goes to zero. Also, $w$ falls as $z$ increases. The effects of a change in the money growth rate on the equilibrium number of intermediaries, and on the margin between borrowing and lending rates, are important non-neutralities resulting from the fixed cost intermediation technology. With an increase in $z$, lenders, facing a lower rate of return on holdings of fiat money, shift their portfolios toward intermediary deposits. The resulting drop in the deposit interest rate induces an increase in the quantity of loans, a decrease in the loan rate, and entry of more firms into the industry.

The closed form solutions for $q, Q, k, r^l, \omega$, and $w$, and the comparative steady state results in this section were obtained by ignoring the integer constraint on the number of firms, $K$. For these results, ignoring the integer constraint is innocuous. To see this, suppose that we were to take account of the integer constraint. Then, in general, zero profits would not be a feature of the equilibrium. Suppose that the number of intermediary firms in period $t$ is the largest $K(t) \in \{0, 1, 2, \ldots\}$ such that intermediary profits are non-negative, and that profits are consumed by firms. Equations (2.7), (2.8), (2.9), (2.10), (2.12) and (2.13) are then the steady state solutions for values of $z$ which imply $K \in \{1, 2, \ldots\}$. As was the case when we ignored the integer constraint, at the margin $Q$ will increase and $r^l$ will fall with an increase in $z$. There will be no change in $w$ at the margin, and of course no change in $K$. The equilibrium number of firms and all other endogenous variables will take discrete jumps at values of $z$ for which $[(1 - \alpha)Nyz/2F]^{1/2}$ is an integer. Note, however, that it is still the case that $K$ is non-decreasing in $z$ and that $w$ is non-increasing in $z$. Ignoring the integer constraint therefore only serves to simplify the analysis and exposition and in no way changes the flavour of the results.

3. TAXATION-BACKED GOVERNMENT DEBT: NON-NEUTRALITIES AND OPTIMAL POLICY

Mundell (1971), Barro (1974), and Drazen (1978) have recognized that the Ricardian Equivalence Theorem may not hold when there are capital market imperfections; under such conditions there may be real effects if the government issues debt to be retired in the future through lump sum taxation. The analysis of the previous section shows that our model exhibits a capital market "imperfection". In a laissez faire equilibrium with the supply of fiat money fixed ($z = 1$), consumers cannot borrow and lend at the same
rate of interest, i.e. in equilibrium borrowers discount future consumption at a higher rate than do lenders.

Consider the following fiscal policy experiment. The government issues new debt (fiat money) in each period \( t = 1, 2, \ldots, \infty \) to finance purchases of the consumption good which are then redistributed through transfers to young consumers. In each of the following adjacent periods, \( t = 2, 3, \ldots, \infty \), old consumers are taxed, and the proceeds are used to retire a real quantity of outstanding debt equal to that issued in the previous period. In a stationary monetary equilibrium the experiment results in a one-time increase in the supply of fiat money at time \( t = 1 \).\(^9\) With full information, perfect competition in the intermediation industry, and no distribution effects, it is easy to show that such an experiment is neutral. There is no effect on any real variable or the price level, except that lenders save their transfers to pay taxes in old age, and borrowers reduce their private sector borrowing by an amount equal to their transfers. The government effectively acts as an intermediary, and crowds out an equal amount of private sector intermediation.

However, given the type of limited public information and costly information acquisition in our model, the above fiscal policy experiment will not be neutral, due to public sector and private sector frictions. It may be the case though, that without incurring the fixed cost, \( F \), the government can play a welfare-enhancing role as a financial intermediary by using its powers to tax and to issue fiat currency. As we will see, optimal policy in this context will reflect a tradeoff between the deadweight welfare losses from distortionary proportional consumption taxes on the one hand and private costs of intermediation on the other.

Our fiscal policy experiment implies that \( \omega_1(t) > 0 \) and \( \omega_2(t) < 0 \) for \( t = 1, 2, \ldots, \infty \), \( T(1) > 0 \) and \( T(t) = 0 \) for \( t = 2, 3, \ldots, \infty \). Substituting in the government budget constraint, (1.2), we get:

\[
p(1)[M(1) - M(0)] = T(1) \tag{3.1}
\]
\[
p(t)[M(t) - M(t-1)] = 0, \quad t = 2, 3, \ldots, \infty. \tag{3.2}
\]

Constant transfer rates, i.e. \( \omega_1(t) = \omega_1 \) and \( \omega_2(t) = \omega_2 \) for all \( t \), are consistent with a stationary monetary equilibrium. Given (3.2), \( p(t) = p \) (constant) in a stationary monetary equilibrium, and we can set \( z = 1 \) in (2.8), (2.9), and (2.12) to get the stationary monetary equilibrium solutions for \( Q \), \( K \), and \( r' \):

\[
Q = [(1 - \alpha) Ny/2][1 - 2F/(1 - \alpha) Ny]^{1/2} \tag{3.2}
\]
\[
K = [(1 - \alpha) Ny/2F]^{1/2} \tag{3.3}
\]
\[
r' = [1 - 2F/(1 - \alpha) Ny]^{1/2}. \tag{3.4}
\]

From (1.15), given that \( T(t) = 0, \quad t = 2, 3, \ldots, \infty \) and that \( p(t) = p \) for all \( t \), and substituting using (3.2) in (1.15), we get:

\[
\omega_2 = -\omega_1 \{ \alpha + (1 - \alpha)[1 - 2F/(1 - \alpha) Ny]^{1/2} \}. \tag{3.5}
\]

Also, the quantity of taxation-backed government debt, from (1.15), substituting using (3.2) is:

\[
B = T(1) = [\omega_1 Ny/2]\{ \alpha + (1 - \alpha)[1 - 2F/(1 - \alpha) Ny]^{1/2} \}. \tag{3.6}
\]

We can then solve for the price of fiat money using (3.1) and (3.6):\(^{10}\)

\[
p = (2\alpha - 1) Ny/2 - [\omega_1 Ny/2\{1 - (1 - \alpha)[2F/(1 - \alpha) Ny]^{1/2} \}. \tag{3.7}
\]
Given (3.5) and (3.6), the amount of government intervention which our fiscal policy experiment represents can be measured by \( \omega_1 \). Though changes in \( \omega_1 \) clearly have no effect on \( Q, K \) or \( r' \) given (3.2), (3.3) and (3.4),\(^\text{11}\) the price of fiat money decreases (the price level rises) with an increase in \( \omega_1 \), as indicated by (3.7). Also, changes in \( \omega_1 \) have non-neutral effects on consumption allocations, as we would expect given the distortionary nature of taxes and transfers.

At this stage, we wish to examine the welfare effects of taxation-backed debt and to find the optimal level of such debt. For these purposes, we ignore the welfare of old agents at time \( t = 1 \). The utility of a consumer born in one of periods \( t = 1, 2, \ldots, \infty \) with consumption before transfers of \( c_i \) in the \( i \)-th period of life, \( i = 1, 2 \), is:

\[
\ln (1 + \omega_1) c_1 + \ln (1 + \omega_2) c_2. \tag{3.8}
\]

Since \( c_1 \) and \( c_2 \) are independent of \( \omega_1 \) and \( \omega_2 \) for all agents in the stationary monetary equilibrium, choosing the optimal policy (from the class of policies under discussion) amounts to solving:

\[
\max \{ \ln(1 + \omega_1) + \ln (1 + \omega_2) \} \tag{3.9}
\]

subject to (3.5).

Substituting for the constraint (3.5) in the objective function (3.9) and setting the first derivative equal to zero gives a solution which satisfies the second order condition for an optimum. Let \( \omega_1^* \) and \( \omega_2^* \) be the values of \( \omega_1 \) and \( \omega_2 \) which solve (3.9). Then:

\[
\omega_1^* = \left[ (1 - \alpha)/2 \right] \left[ 2F/(1 - \alpha) Ny \right]^{1/2} \left/ \left[ 1 - (1 - \alpha) \left[ 2F/(1 - \alpha) Ny \right]^{1/2} \right] \right.
\]

\[
\omega_2^* = -\left[ (1 - \alpha)/2 \right] \left[ 2F/(1 - \alpha) Ny \right]^{1/2}. \tag{3.10}
\]

Substituting using (3.10) in (3.6) gives the optimal level of taxation-backed debt,

\[
B^* = \left[ (1 - \alpha) Ny/4 \right] \left[ 2F/(1 - \alpha) Ny \right]^{1/2}. \tag{3.12}
\]

Note, from (3.10), (3.11) and (3.12), that the absolute values of the optimal transfer rates and the optimal debt quantity are increasing in the fixed information acquisition cost, \( F \). That is \( \partial \omega_1^*/\partial F, \ -\partial \omega_2^*/\partial F, \partial B^*/\partial F > 0 \). Also, laissez faire is optimal as \( F \to 0 \) that is,

\[
\lim_{F \to 0} \omega_1^* = \lim_{F \to 0} \omega_2^* = \lim_{F \to 0} B^* = 0.
\]

It is assumed that \( K \geq 1 \) in equilibrium so that, from (3.3), the following is satisfied:

\[
0 \leq [2F/(1 - \alpha) Ny]^{1/2} \leq 1. \tag{3.13}
\]

Given (3.13), (3.10), (3.11), and (3.12), \( \omega_1^* \), and \( \omega_2^* \), and \( B^* \) are bounded as follows:

\[
0 \leq \omega_1^* \leq (1 - \alpha)/2 \tag{3.14}
\]

\[
-(1 - \alpha)/2 \leq \omega_2^* \leq 0 \tag{3.15}
\]

\[
0 \leq B^* \leq (1 - \alpha) Ny/4. \tag{3.16}
\]

What has been calculated is a type of second-best optimum. Note, however, that setting \( \omega_1 = \omega_1^* \), \( \omega_2 = \omega_2^* \) and \( B = B^* \) does not give a Pareto improvement over a laissez faire equilibrium. Although \( \omega_1^* \), \( \omega_2^* \), and \( B^* \) maximize the welfare of lenders and of borrowers in each generation \( t = 1, 2, \ldots, \infty \), agents who supply fiat money in period one are worse off than with laissez faire since, from (3.7), \( \partial p/\partial \omega_1 < 0 \).
Since the price of fiat money is decreasing in $\omega_1$, it is possible that $\omega_1 = \omega^*_1$ may not be feasible (will imply $p \leq 0$), even if $\alpha > \frac{1}{2}$, which is a sufficient condition for the existence of the stationary monetary equilibrium with $z = 1$ in Section 2. Substituting using (3.10) in (3.7), the price of fiat money when $\omega_1 = \omega^*_1$ is:

$$p^* = \frac{Ny}{2}(2\alpha - 1) - \frac{(1 - \alpha)/2}{2F/(1 - \alpha)Ny}^{1/2}.$$ (3.17)

The smallest possible value of $p^*$ is obtained for $2F/(1 - \alpha)Ny = 1$ ($K = 1$). That is:

$$p^*_{\min} = \frac{Ny}{4}[5\alpha - 3].$$ (3.18)

For $p^*_{\min} > 0$, we must have $\alpha > \frac{1}{2}$. Therefore, for $\alpha > \frac{1}{2}$, the second best optimum is feasible for all parameter values satisfying (3.13). If parameter values are such that $p^* < 0$, then the welfare of borrowers and lenders in generations $t = 1, 2, \ldots, \infty$, is maximized by setting the transfer rate $\omega_1$ (and by implication $\omega_2$ and $B$) such that $p$ is marginally greater than zero.

In this example, the second best policy maximizes welfare by finding the optimal tradeoff between the distortion which results from fixed intermediation costs (the margin between borrowing and lending rates of interest) and the intertemporal distortion caused by proportional consumption taxes and transfers. If fixed intermediation costs are positive, and if any government activity is feasible, then it is optimal to have some government intervention. Note that government activity has no effect on the number of intermediary firms or the quantity of lending in equilibrium, so that the indirect effect of policy on industry equilibrium does not play a role in generating welfare gains. In general, policy would affect industry equilibrium, so that this feature is peculiar to our example.

In this example, the results would not be qualitatively different if, say, there were a constant cost intermediation technology. The central point, that costly intermediation might create a role for fiscal policy, remains intact whether or not there are increasing returns to scale in intermediation. How then do economies of scale in intermediation matter? First, whatever game intermediary firms happen to play, and given a wider class of utility functions, policy will in general affect the margin between borrowing and lending rates, with effects on welfare which would not occur with constant intermediation costs. Second, with any game having free entry which does not imply monopoly as an outcome, and again with a wider class of utility functions, policy will in general affect the number of intermediary firms. This has effects on welfare which would be absent with a constant cost technology, where the number of firms is indeterminate in equilibrium and in any event irrelevant.

The government can play a different role in smoothing the consumption paths of private agents than do private intermediaries here, in that the government has the power to tax and is the monopoly supplier of fiat currency. The government is limited in this role, however, due to an information asymmetry which implies that the government cannot impose non-distorting taxes. Optimal "government debt management", in the context of fixed information acquisition costs and an imperfectly competitive intermediation industry, reflects a tradeoff between these public sector and private sector frictions.

**SUMMARY AND CONCLUSION**

In the economy analyzed here, financial intermediation economizes on fixed costs of information acquisition in the context of asymmetric information. Financial intermediation is therefore characterized by increasing returns to scale. These economies of scale were shown to give rise to specific non-neutrality of government policy and to imply the possibility of a welfare-enhancing role for policy.
Fixed intermediation costs permit imperfect competition among financial intermediaries, and these costs drive a wedge between borrowing and lending rates of interest. An increase in the flat money growth rate brought about by transfers to consumers was shown to encourage more intermediation, to increase the number of intermediary firms in equilibrium and to reduce the margin between borrowing and lending rates. With the private sector and the government having access to the same information and facing the same costs, the government can subject consumers to distorting taxes and transfers, but lump sum taxation is not feasible. Fiscal policy, in the form of the substitution of government debt for a current tax reduction (an increase in transfers) with a corresponding change in future tax liabilities, was shown to act as a substitute for private intermediation in our model. In effect, the government can perform a consumption-smoothing function similar to that of private intermediaries.

Optimal government policy was shown to reflect a tradeoff between public and private sector distortions. Fixed intermediation costs produce a distortion in that borrowers' and lenders' intertemporal marginal rates of substitution differ, and distorting taxes and transfers sufficiently limit the government's ability to smooth consumption that the above tradeoff exists. At a second best optimum, the optimal level of government activity increases with the size of the fixed intermediation cost. As the fixed cost approaches zero in the limit, laissez faire is optimal.

In this paper we have shown that increasing returns to scale in financial intermediation imply that frictions exist which violate the assumptions required for policy irrelevance. These frictions apply to both the public and private sectors, though costs faced by the government differ as it is the monopoly supplier of unbacked liabilities (fiat money) and has the power to tax.

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NOTES
1. We are not especially attached to the particular information asymmetry specified here. What this is intended to capture is that some activities and agent characteristics in real-world economies are difficult or costly to observe, while others are not.
2. We justify the assumption that intermediaries act as price takers in the market for deposits while behaving as oligopolists in the loan market by noting that, in equilibrium, intermediary deposits and government-issued fiat money are perfect substitutes. In the loan market, there are no substitutes for intermediary loans. In any event, this assumption is made mainly for the purpose of analytical tractibility, and our conclusions would not be different without it.
3. Transfers could also be made to young consumers, but this would make no difference for our conclusions.
4. The system of four first order difference equations can be used in a straightforward manner in constructing a proof along the lines of Wallace (1980) which demonstrates the global "stability" of the stationary monetary equilibrium and provides support for the exclusion of other perfect foresight equilibria.
5. Note that, for \( z \) satisfying (2.11), \( \omega \) is first increasing and then decreasing in \( z \).
6. In a model identical to the one here, except that borrowers all have a second period endowment of \( Y \), and there is full information, Wallace (1980, p. 62) shows that, when the stationary fixed supply (\( z = 1 \)) monetary equilibrium exists, it is Pareto optimal. In our model, note that stationary monetary equilibrium allocations for different values of \( z \) cannot be ranked according to the Pareto criterion. Increases in \( z \) made lenders worse off, borrowers better off, and old agents in period one worse off in a stationary monetary equilibrium.
7. The qualitative results here are due to the increasing returns feature of intermediation and not the particular assumptions which are made concerning the game which intermediary firms play. For example, if intermediation were carried out by a single monopolist which deterred entry by pricing loans at average cost, then \( w = [1 - 2F/(1 - \alpha) NYz]^{-1} \), and \( w \) would decrease with an increase in \( z \).
8. We assume that firms play a two-stage game, i.e. they decide whether or not to enter and if so, they play Cournot–Nash against other entering firms. In the first stage, a firm will not enter if it foresees negative profits as the outcome of the second stage when all firms adjust output.

9. Note that taxes are levied to retire the debt within the lifetime of agents who were alive when the debt was issued. We therefore do not obtain effects from debt issue due to having finite-lived agents, as discussed in Barro (1974).

10. Here, as in Section 2, we ignore integer constraints on the number of intermediary firms. Again, this is innocuous. Following a similar argument to that in Section 2, take $K$ to be the largest integer such that profits are nonnegative. Then the equilibrium solution involves substituting this integer for $[(1-\alpha)\gamma_0/2F]^{1/2}$ in (3.2), (3.3), (3.4) and (3.7). Ignoring the integer constraint also does not affect the welfare analysis which follows, as the number of intermediary firms is unaffected by changes in $\omega_1$ and $\omega_2$.

11. This feature is peculiar to this example, as indicated previously in the paper.

12. The reader may wonder whether our results might differ if an individual agent’s age and market trades are observable (as might appear more natural) rather than his or her age and consumption quantity. Clearly, this depends on what trades are observable, and on what trades the government taxes. However, suppose that each agent’s endowment is labour rather than the consumption good, and that perfectly competitive firms own a constant returns technology which will convert labour into the consumption good one-for-one. Also, suppose that in a monetary equilibrium fiat money must be used in all transactions. Then, if the government can observe only trades of fiat money for the consumption good, or if it chooses to tax only these trades, this setup is equivalent to the one we have specified.

REFERENCES


