RICARDIAN EQUIVALENCE AND MONEY DOMINATED IN RETURN:
ARE THEY MUTUALLY CONSISTENT GENERALLY?

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Abstract_____

Different conclusions about the effects of open market operations
are reached even among economists using full employment and ra-
tional expectations models. I show that these differences can be
attributed to different assumptions regarding the concept of the
deficit that is held fixed for an open market operation, the
diversity among agents, and the features generating money de-
mand. With regard to those features, I argue that plausible ways
of explaining the holding of low-return money preclude the kind of
perfect credit markets needed to obtain Ricardian equivalence.

Even when they abstract from business cycles or Phillips curve considerations, economists seem to have widely divergent views about the effects of monetary and fiscal policy. That is, even among those using models that assume competitive market-clearing and perfect foresight (rational expectations), economists disagree about the effects of open market operations and bond-financed deficits. One view--which I will call View 1--is that Ricardian equivalence holds and open market purchases (and sales) are equivalent to transfers (and taxes) financed by money creation (and destruction). Another view--which I will call View 2--can be expressed loosely in terms of two propositions. If private inter-mediation is unrestricted and the intermediation technology dis-plays constant average costs, then a version of Ricardian equiva-lence holds and a Modigliani-Miller irrelevance result holds: open market operations are neutral and do not change the price level. If, however, private intermediation is restricted by laws preventing the private sector from issuing claims that compete perfectly with some of those issued by the government, then, in general, Ricardian equivalence fails and open market operations are nonneutral. (For some examples of View 1, see Barro 1983 and Lucas 1984. For some examples of View 2, see Wallace 1981, 1983; Sargent and Wallace 1982; and Bryant and Wallace 1984.) In this paper, I will attempt to sort out and comment on the features responsible for these two views.

I will discuss three features that generate the views' different results: differences in the open market operation

policy experiment, in particular, differences in the concept of the deficit path that is held fixed for an open market operation; different assumptions regarding diversity, in particular, single-agent models versus many-agent models; and different assumptions regarding money demand, in particular, money dominated in rate of return.

I will discuss these features against the background of a nonbequest overlapping generations (OG) model. Although View 1 is generally expounded in other contexts, my discussion will show that the nonbequest OG framework does not by itself prejudice outcomes against View 1.

As a way of highlighting the role played by the policy experiment and by the presence or absence of diversity, I will begin with a simple OG model that gives rise to a single rate of return on all assets. For that model I will set out several neutrality propositions, including one consistent with View 1 and another consistent with View 2. Then I will amend that model in two ways: by making money an argument of utility functions and by imposing a particular kind of Clower constraint. Both of the resulting models are consistent with View 1 and with Ricardian equivalence and money dominated in return. Next I will briefly exposit the legal restrictions theory that lies behind View 2 and survey existing models of legal restrictions. These turn out to be models which do not satisfy Ricardian equivalence or View 1. Finally, I will attempt to answer the question that is in the title of the paper. My answer is no; despite the results of some

of the models, I will argue that Ricardian equivalence and rate of return dominance of money are not mutually consistent generally.

Neutrality in a Single-Return Overlapping Generations Model

My neutrality propositions are to be understood as being of the following form: if an equilibrium E exists under policy parameters A, then an equilibrium E' exists under policy parameters A', where E and E' are either identical or related in a special way. Since proofs of such propositions follow from little more than an examination of budget sets, I can leave some details of the models vague.

I begin with a pure exchange model of overlapping generations which live two periods each, a model defined over discrete dates $t > 1$ in which a single consumption good exists at each date. Agent h in generation t, for $t > 1$, is alive at t and $t + 1$ (is young at t and old at $t + 1$); gets utility from consumption of the time t and time $t + 1$ good, $c_t^h(t)$ and $c_t^h(t+1)$, respectively; and has positive pretax endowments of those two goods, $w_t^h(t)$ and $w_t^h(t+1)$, respectively. At $t = 1$, some people are in the second and last period of their lives. If h is such a person, then h attempts to maximize $c_0^h(1)$, her or his consumption of the time 1 good. In addition to endowments of goods, I assume that the people alive at $t = 1$ own arbitrary nonnegative amounts of fiat currency which total M. No future generation is endowed with currency.

For this setup, which I call Model 1, I set out several neutrality propositions. The first four are motivated by View 1,

particularly, Barro's (1983) description of open market opera-
tions.

Barro analyzes an open market operation as a combination
of two policies: a change in fiat currency brought about by a
current tax or transfer and an offsetting current tax or transfer
financed by government borrowing or lending which, in turn, is
repaid through announced future taxes or transfers (a Ricardian
experiment). As Barro notes, if the quantities are chosen so that
there is no net change in current taxes, then fiat currency and
government debt move in opposite directions and in equal
amounts. This is what justifies calling the combination of poli-
cies an open market operation.

My first four propositions verify Barro's claims about
the effects of these policies in the context of my OG model.

To facilitate the statement of the propositions and to
introduce some notation, I write the budget set for a typical
member of generation t, t ≥ 1, as follows:

(1) $\qquad c_t^h(t) \leq w_t^h(t) + p_t \overline{m}^h - p_t \ell_t^h - p_t m_t^h - p_t z_t^h(t)$

(2) $\qquad c_t^h(t+1) \leq w_t^h(t+1) + R_t p_{t+1} \ell_t^h + p_{t+1} m_t^h - p_{t+1} z_t^h(t+1).$

Here p_t is the price of a unit of time t currency in units of the
consumption good, $\overline{m}^h$ is the initial currency holdings of h, ℓ_t^h is
the nominal loans granted by h at the nominal time t gross inter-
est rate R_t, m_t^h is the fiat currency carried by h from t to t + 1,
and $z_t^h(t+i)$ is the nominal lump-sum taxes to be paid by h at t +
i. All my propositions are about perfect foresight equilibria, so

I will not distinguish between actual and anticipated future prices and taxes.

Since h can either borrow or lend at R_t, the above pair of constraints is equivalent to the single constraint obtained by eliminating $p_t \ell_t^h$; namely,

(3) $\quad c_t^h(t) + c_t^h(t+1)/r_t + p_t m_t^h(1 - 1/R_t)$

$\quad\quad\quad \leq w_t^h(t) + w_t^h(t+1)/R_t + p_t \overline{m}^h - p_t[z_t^h(t) + z_t^h(t+1)/R_t]$

where $r_t \equiv R_t p_{t+1}/p_t$, which is the gross real rate of return (the price of time t consumption in units of time t + 1 consumption).

Since, in this version of the model, h gets utility only from consumption, I immediately conclude that if fiat currency has value in an equilibrium, then $R_t = 1$. (If $R_t > 1$, then h would not hold fiat currency; if $R_t < 1$, then h would have a budget set unbounded in consumption.) This fact, however, will not be used in the proofs of Propositions 1-4. Only Proposition 5 relies on the fact that $R_t = 1$ in any equilibrium.

I am now ready for the first neutrality proposition. Suppose that, at t = 1, I multiply each person's initial holdings of fiat currency by $\lambda > 0$ and adjust all the nominal taxes, the z's, in the same proportion. Then if a price sequence $\{p_t\}$ and a consumption allocation are an equilibrium for $\lambda = 1$, the same consumption allocation and a new price sequence $\{p_t'\} = \{p_t/\lambda\}$ are also an equilibrium. This can be summarized as follows:

Proposition 1. For proportional changes in initial fiat currency holdings, neutrality and price level proportionality hold.

A few remarks will suffice as a proof. First, note that the asserted changes leave the right side of (3) unchanged. Thus any consumption bundle that is affordable and utility-maximizing under $\lambda = 1$ remains affordable and utility-maximizing. Now consider (1) and (2). For a given consumption bundle, if ℓ_t^h and m_t^h satisfy (1) and (2) for $\lambda = 1$, then $(\ell_t^{h'}, m_t^{h'}) = \lambda(\ell_t^h, m_t^h)$ satisfies (1) and (2) at the new price sequence. If the money purchases m_t^h sum to M, then the money purchases $m_t^{h'}$ sum to λM. As for the loan market, the sum of $\ell_t^{h'}$ gives rise to the same real sum as does the sum of ℓ_t^h--zero if there is no government debt, the same real value if there is some. Note, of course, that I am augmenting all initial money holdings, including any held by the old at $t = 1$.

Next, turn to Ricardian equivalence. Suppose that, for some h in generation $t \geqslant 1$, taxes, the z's, are altered in such a way that the present value of taxes, the term in brackets on the right side of (3), remains unchanged at the initial R_t. Then h would maximize utility by responding with a new quantity of lending, $\ell_t^{h'} = \ell_t^h - [z_t^{h'}(t) - z_t^h(t)]$. [See (1) and (2).] Thus if the government lowers time t taxes on h and raises time $t + 1$ taxes on h in such a way that the present value of taxes at the initial prices is unchanged and if it borrows to finance the time t tax reduction and repays the debt at $t + 1$ out of the higher time $t + 1$ taxes, then any consumption allocation and prices that are an equilibrium without this tax and borrowing operation are also an equilibrium with it. This can be stated as follows:

<u>Proposition 2.</u> "Changes in the time pattern of individual taxes that leave each individual's wealth intact and that are financed by government borrowing are neutral.

Now I am ready to consider combinations of the Proposition 1 and 2 policies which can be interpreted as an open market operation. I do this in the following proposition.

<u>Proposition 3.</u> If each person's money holdings at $t = 1$ are multiplied by λ, if all nominal taxes other than those levied on generation 1 are multiplied by λ, and if for each h in generation 1 taxes are altered so that

$$(4) \qquad z_1^{h'}(1) = \lambda z_1^h(1) + \theta^h(\lambda-1)M$$

$$(5) \qquad z_1^{h'}(2) = \lambda z_1^h(2) - R_t \theta^h(\lambda-1)M$$

with $\sum_h \theta^h = 1$, then neutrality and price level proportionality hold, and there is no change in the total of time 1 taxes except for a proportional change by λ.

In proof, notice that at proportionally changed prices the right side of (3) is unaffected. Thus affordable utility-maximizing consumption does not change. For market-clearing, $\sum m^{h'} = \lambda M$ and $\sum \ell^{h'} = \lambda \sum \ell^h - (\lambda-1)M$. I propose as an equilibrium portfolio for h the following: $m^{h'} = \lambda m^h$ and $\ell^{h'} = \lambda \ell^h - \theta^h(\lambda-1)M$. These obviously satisfy market-clearing and, as the reader can verify, imply no change in the magnitudes of the right sides of (1) and (2) at prices $p_t' = p_t/\lambda$ for all t. Finally, the sum

condition on total time 1 taxes is implied by the sum condition on the θ^h.

However, although this combination of policies leaves total time 1 taxes minus transfers unaffected, unless further restrictions are imposed, it involves changes in the composition of time 1 taxes minus transfers across people and, therefore, hardly qualifies as an open market operation. In the OG context, these additional restrictions are far from innocuous. In fact, if some of the initial stock of fiat currency is owned by people who are old at t = 1, then no combination of the policies not involving time 1 taxes and transfers among people preserves neutrality and proportionality. If, however, the young at t = 1 own among them the entire stock of fiat currency, then such a policy does exist. I describe it in the following proposition.

Proposition 4. If $\sum \overline{m}^h$ = M, with the summation being over the members of generation 1, then with $\theta^h = \overline{m}^h/M$ for each h in generation 1, all the hypotheses of Proposition 3 hold and leave each person's time 1 taxes (in real terms) unaffected.

Proposition 4 highlights how diversity limits the applicability of View 1. Put differently, with diversity among people, only very special initial conditions and a very special combination of the Proposition 1 and 2 policies can be interpreted as an open market operation.

Propositions 3 and 4 also highlight the fiscal policy aspect of the View 1 open market operation experiment. According

to that view, an open market operation involves, say, government lending at t with the repayment turned back to the private sector at t = 2. Thus, at t = 2, there is more government currency outstanding with no offsetting private liability to the government. As a description of central bank intermediation, this seems rather strained.

Whether it is strained or not, I want to contrast it with what I will call a <u>pure intermediation experiment</u>. In this model, such an experiment differs from the Proposition 3 experiment only in that no taxes or transfers (current or future) are altered. It gives rise to a trivial instance of Modigliani–Miller irrelevance.

<u>Proposition 5</u>. Pure intermediation is irrelevant.

In proof, note that with $R_t = 1$ (which is necessary for existence of an equilibrium), only the sum $m_t^h + \ell_t^h$ appears in (1) and (2).

Neutrality and Nonneutrality in an Amended Overlapping Generations Model

Here I consider two alternative amended versions of Model 1. <u>Model 2</u> is Model 1 except that the utility of h in generation t, for $t \geqslant 1$, depends on an additional argument: real currency holdings that h carries from t to t + 1, or $p_t m_t^h$, in the notation adopted above. <u>Model 3</u> is Model 1 except that individuals face an additional constraint, a <u>Clower constraint</u>: for h in generation t, $t \geqslant 1$, $c_t^h(t+1) - w_t^h(t+1) \geqslant p_{t+1} m_t^h$, where, recall,

m_t^h is nominal currency holdings carried from t to t + 1. This form of the Clower constraint says that the amount of the time t + 1 consumption that exceeds the time t + 1 endowment for a member of generation t must be financed by holdings of currency carried over from period t.

In either of these models, there can be equilibria with $R_t > 1$, equilibria in which currency is dominated in rate of return. Moreover, Propositions 1-4 hold in both models.

Proposition 6. Propositions 1-4 hold in Models 2 and 3.

The proofs or outlines of proofs given for Propositions 1-4 apply unaltered to these models. They apply because those proofs did not use the fact that $R_t = 1$ and because in all four cases $p_t m_t^h$ and p_{t+1}/p_t are real variables that can be invariant across the class of policies the propositions considered. Note that the product of these two variables is $p_{t+1} m_t^h$, which appears in the Clower constraint. (Note also that Proposition 2 would not hold for a version of Model 3, a Clower constraint model, in which time t + 1 taxes have to be paid in currency or time t + 1 transfers could be used to purchase consumption.)

Proposition 5, however, does not hold in Models 2 and 3. If $R_t > 1$, then an arbitrary amount of government intermediation gives rise to profits, which must somehow be distributed. Also, even intermediation policies which do not generate profits are not necessarily neutral.

To illustrate this last point, consider a stationary, one-person-per-generation version of Model 2, the money-in-the-utility-function model, in which the initial stock of fiat currency M is owned by the old at t = 1. Suppose there are a level of real money balances q^* and a consumption bundle (c_1^*, c_2^*) that satisfy $c_1^* + c_2^* = w = w_1 + w_2$, $0 < c_1^* < w_1 < q^*$, and the following marginal utility conditions: $u_1(c_1^*, c_2^*, q^*)/u_2(c_1^*, c_2^*, q^*) = 1$ and $u_3(c_1^*, c_2^*, q^*)/u_1(c_1^*, c_2^*, q^*) = 0$. Here w is the economy's endowment of the time t good, w_1 and w_2 are the endowment when young and old, c_1 and c_2 are consumption when young and old, and $u(c_1, c_2, q)$ is the utility function. Note that q^* is to be interpreted as a satiation level of real balances.

I want to find a p_t sequence and a government inter-mediation strategy that support c_1^*, c_2^*, q^* as an equilibrium. I propose as equilibrium prices $R_t = 1$ and $p_t = p$ for all t, where p satisfies $pM = w_1 - c_1^*$. As a government portfolio, I propose that the government grant one-period loans each period in the nominal amount $(q^* - pM)/p$ at a zero nominal interest rate. By construction, then, the implied market-clearing quantities $\ell_t^h = -(q^* - pM)/p$, $m_t^h = M + (q^* - pM)/p$, $c_t^h(t) = c_1^*$, and $c_t^h(t+1) = c_2^*$ satisfy (1) and (2) and are utility-maximizing. This intermediation is nonneutral because any equilibrium must satisfy $p_t m_t^h < w_1$ in the absence of government intermediation.

As this illustration suggests, in Models 2 and 3, government intermediation that does not take the form of the special combination of policies described in Proposition 3 has complicated

effects. Nevertheless, as noted above, these are models which imply both Ricardian equivalence and money dominated in return.

The Legal Restrictions Theory of
Significantly Positive Nominal Interest

As noted above, Models 2 and 3 can give rise to equilibria with positive nominal interest rates. Indeed, if parameters and policy are chosen appropriately, nominal interest rates of any magnitude are consistent with those models. That, indeed, is the main virtue of the models, a virtue because nominal interest rates actually seem to take on a wide range of magnitudes at different times and places.

However, accounting for positive nominal interest rates should not be all one asks of a model. The assets used for transactions also seem to differ in different places and at different times: a country can sometimes use a currency issued by another country, other times use a private liability (private bank notes), and still other times use a commodity. Such observations and other considerations suggest that the stuff that yields utility or satisfies the Clower constraint should be described in terms of general properties. For example, if the stuff is viewed as currency, then perhaps it ought to be in standard and small denominations, be storable easily, be payable to the bearer, and be, in some sense, safe.

If the stuff is defined by such general properties, then the possibility that the private sector can supply it must be considered. That, in turn, gives rise to an important additional

restriction. There cannot be an equilibrium in which nominal interest rates are so high that profits can be made by arbitraging or intermediating between, on the one hand, the loans and securities yielding nominal interest and, on the other hand, the currency yielding nothing. (This I will call the no-profit condition.) If permitted, such arbitrage could be carried out by financial intermediaries that hold as assets interest-bearing, nominally default-free securities (U.S. Treasury bills, for example) and that issue as liabilities notes which promise the bearer x units of currency (Federal Reserve notes, for example) at or after a date that matches the maturity of the assets held, where x is one of several standard currency denominations.

The possibility of such arbitrage implies that legal restrictions that inhibit it are necessary to produce equilibria in which nominal interest rates are freed from the no-profit condition. Moreover, the arbitrage possibility and some fairly innocuous assumptions about intermediation technologies—namely, constant costs and symmetry between government and private costs of intermediation—imply that legal restrictions are also necessary for Modigliani-Miller irrelevance to not hold.

I will now examine some models of legal restrictions to determine whether Proposition 2 holds for them. I will look at some models that try to capture the legal restriction in the United States that gives the Federal Reserve a monopoly on the issue of bearer notes in standard and small denominations. In an attempt to model this restriction, Sargent and Wallace (1982),

Bryant and Wallace (1984), and Chang (1982) all posit minimal size restrictions on privately issued securities. As they show, this kind of legal restriction gives rise to the kind of budget set depicted in Figure 1.

Sargent and Wallace (1982) use the usual discrete-time OG model and specify special endowment and preference patterns that generate interior solutions. A group of low-endowment positive savers end up holding only the low-return, small-denomination stuff. A group of high-endowment positive savers and a group of high-endowment negative savers (borrowers) interact in a credit market that determines a return on large-denomination private securities. These people hold none of the low-return, small-denomination stuff.

Bryant and Wallace (1984) also work with the usual discrete-time OG model. They assume no within-generation diversity and demonstrate the existence of corner solutions for policies in which the government issues some small-denomination stuff and some large-denomination stuff. They show that the legal restriction and the existence of multiple government liabilities can be interpreted as price discrimination. As suggested by Figure 1, the price discrimination takes the form of two-part pricing. Generally, in equilibria in the Bryant-Wallace model, some people end up at a point like A in Figure 1 (an interior solution involving the holding of only small-denomination stuff) and some end up at B (a corner solution involving the holding of only one large-denomination security), with both A and B being on the same indifference curve.

Those two models give rise to what many regard as unrealistic individual portfolios whenever they imply rate of return dominance. They imply that some people do not hold any low-yielding assets. Motivated partly by this feature of the models, Chang (1982) has formulated and analyzed a continuous-time version of them that gives rise to more realistic individual portfolios—some that look like those that emerge from the partial equilibrium inventory models of money demand (Baumol 1952 and Tobin 1956). I will describe Chang's model with the aid of Figure 2.

In Chang's model, a member of generation t appears at t and lives until t + 2. A single consumption good is consumed as a flow—one constant flow over the interval (t,t+1) and a possibly different constant flow over the interval (t+1,t+2). Utility depends on these two constant flows in the usual way. Chang also assumes that each member of generation t has an endowment consisting of a positive constant flow when young, over (t,t+1), and nothing when old, over (t+1,t+2). Generations are assumed identical, and each consists of a continuum of individuals.

If the only asset available is a fixed stock of divisible fiat currency, then, as Chang shows, a stationary equilibrium exists in which the time path of the stock of currency held by a member of generation t has the form of an inverted "V," as depicted by the dashed line in Figure 2. Chang's main contribution is to introduce bonds into this setting.

Chang's scheme for bonds resembles the U.S. savings bond program. He assumes that the government makes available bonds in

any number. These bonds, however, have a minimum denomination (in real terms), have a fixed maturity of one period, and bear interest at some announced rate. A legal restriction prevents these bonds from being shared; that is, a person cannot buy one and sell parts of it to others. Chang closes the model by assuming that interest is financed by lump-sum taxes.

Chang shows that equilibria exist in which bonds are held. If one bond is purchased, the implied pattern of currency holdings is as depicted by the solid line in Figure 2. The bond is purchased at time s and matures at time s + 1.

As noted above, budget sets for Chang's model (including equilibrium budget sets), resemble the one shown in Figure 1. Moreover, as he shows, equilibria either can involve everyone holding the same portfolio or can be quasi equilibria with some fraction of the individuals holding one portfolio and the rest holding another. In any case, everyone ends up holding some divisible currency almost all the time.

These legal restrictions models were not specified with an eye to whether Proposition 2 would hold in them, and it turns out not to. They are, however, very special models. Legal restrictions consistent with money dominated in return can take many forms. As I now illustrate, not all such restrictions give rise to budget sets like that in Figure 1. Some give rise to linear budget sets that imply satisfaction of Proposition 2.

A reserve requirement that at least some fraction of positive saving must be in the form of government currency implies

a convex budget set with a kink at the endowment; if the require-
ment is binding, then the rate earned on positive saving (lending)
is less than the rate paid on dissaving (borrowing). Alterna-
tively, a legal restriction that some part of one's endowment must
be held in the form of government currency implies a linear budget
set. The latter implies satisfaction of Proposition 2, and the
former does not.

Even though I can formulate legal restrictions consist-
ent with money dominated in return and Ricardian equivalence, most
of the current legal restrictions in the United States and other
countries are clearly not of that type. More generally, the legal
restrictions theory of money dominated in return and Ricardian
equivalence seem basically at odds. The former relies on legal
restrictions that inhibit the operation of private credit markets
to produce money dominated in return, while the latter relies on
the smooth functioning of private credit markets to make the
timing of individual receipts and expenditures irrelevant.

Concluding Remarks

Since almost no one accepts the legal restrictions
theory described in the last section, I will end by discussing
other grounds for claiming that money dominated in return and
Ricardian equivalence are, in general, inconsistent with one
another. The reader may wonder how I can possibly do that when
they are consistent with one another in Models 2 and 3 above. I
can do it because almost no one accepts those models—more accur-
ately, money-in-the-utility-function or Clower constraint models—

as serious models of money dominated in return. Instead, they are viewed as, in some sense, convenient shortcuts meant to capture the essential implications of more complicated and more serious models of money. However, an examination of these "underlying" models reveals something other than the smoothly functioning private credit markets needed for Ricardian equivalence.

The partial equilibrium inventory models of money demand (Baumol 1952, Tobin 1956) are those most often cited as rationalizing money dominated in return. The crucial feature of these models is a transaction cost that decreases as the transaction magnitude increases. As is well known, that feature generates a nonconvex budget set in the space of present consumption and future wealth or consumption (Miller 1976). That model, therefore, would not seem to be consistent with Ricardian equivalence.

Recently, some have tried to specify complete environments that in some sense rationalize the Clower constraint (for example, Lucas 1980; Townsend 1980, 1984). These generally are settings in which individuals are spatially separated and contact with other individuals is limited. Therefore, these models would not seem to have a centralized, well-functioning private credit market. Indeed, some of these settings seem to rule out the existence of a market in which open market operations could be carried out.

I don't think anyone should be surprised that models which attempt to specify physical environments implying a role for an outside asset dominated in return seem inconsistent with the

existence of the kind of private credit markets needed for Ricardian equivalence. Those attempts, after all, arise mainly from dissatisfaction with the simple OG model (Model 1) and its variants. They are attempts to produce both a more realistic pattern of exchange among objects and a more realistic pattern of returns among objects than emerge from Model 1. Most such attempts have, however, been guided by the following principle: successful theories or models are of environments which have barriers or difficulties to exchange so that media of exchange have something to do. If that principle is right—and I think it is—then what would be very surprising would be the emergence of perfect credit markets from such specifications. That is basically why I think Ricardian equivalence and money dominated in return are mutually inconsistent generally.

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Figure 1

A Budget Set in a Model With a Minimum Size Restriction
on Private Securities

Current
Consumption

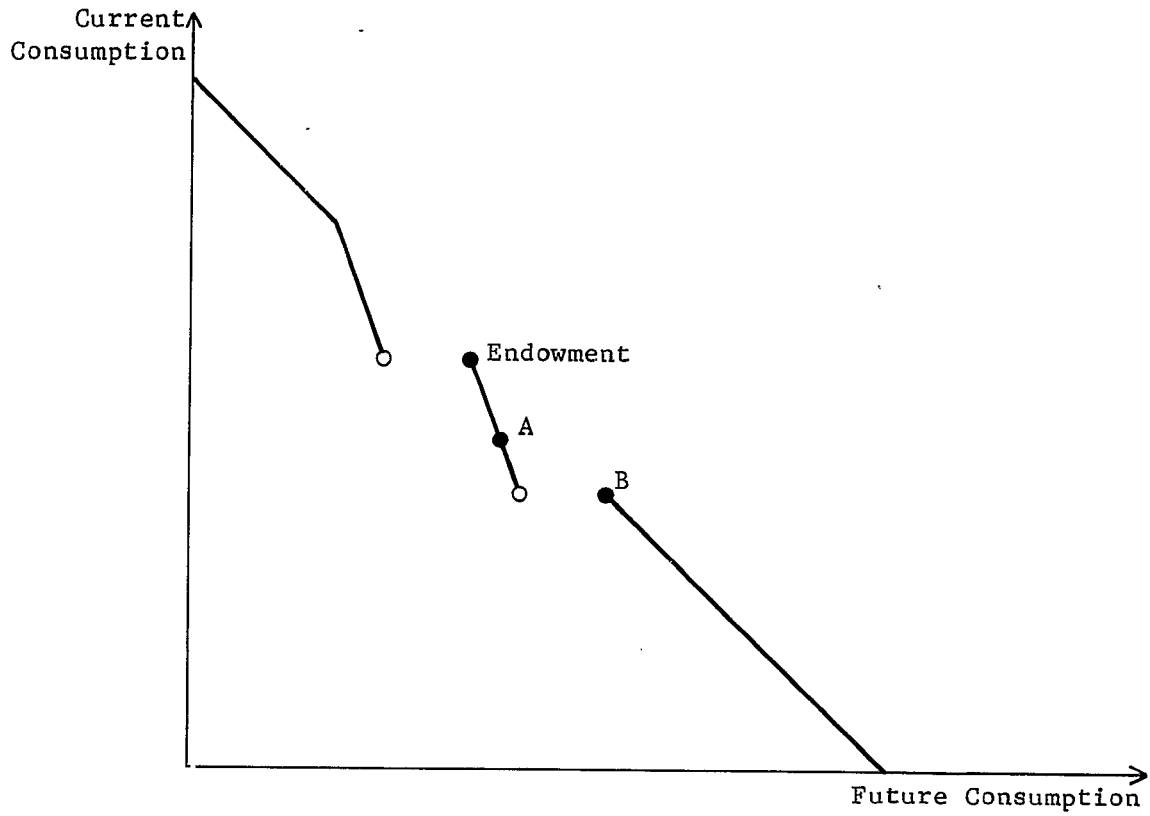Endowment

A

B

Future Consumption

Figure 2

A Person's Holdings of Currency
in Chang's Continuous-Time Model

Currency

Without Bonds

With One Bond

t   s   t+1   s+1   t+2   Time