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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 rational expectations models. I show that these can be attributed to different assumptions regarding (i) the concept of the deficit that is held fixed in the face of an open market operation, (ii) diversity among agents, and (iii) the features generating money demand. With regard to (iii), 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.

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Even abstracting from business cycles or Phillips curve considerations, there seem to exist 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), there are diverse views about the effects of open market operations and of bond-financed deficits. One view, labeled View 1, is that Ricardian equivalence holds and that open market purchases and sales are equivalent, respectively, to transfers and taxes financed by money creation and destruction (see Barro (1983), Lucas (1983)). Another view, labeled View 2, can be expressed loosely in terms of two propositions. First, if there is laissez-faire in private intermediation and if there is a single intermediation technology which displays constant average costs, then a version of Ricardian equivalence holds and a Modigliani-Miller irrelevance result holds; open market operations are neutral and do not change the price level. Second, if, however, there are legal restrictions on private intermediation that prevent 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 (see Wallace (1981, 1983) Sargent-Wallace (1982), Bryant-Wallace (1984)). In this paper, I will attempt to sort out and comment on the features responsible for these different results.

I will discuss three features that are at work in generating the different results: (i) differences in the open market operation policy experiment and, in particular, differences in the concept of the deficit path that is held fixed in the face of an open market operation; (ii) different assumptions regarding diversity and, in particular, single-agent models versus many-agent models; and (iii) different assumptions regarding money demand and, 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, we will see 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 begin in Section I 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 that is consistent with View 1 and another that is consistent with View 2. In Section II, that model is amended in two ways: (a) by making money an argument of utility functions; and (b) 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. In Section III, I 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, in the concluding section, I attempt to answer the question that is the title of the paper. Despite the Section II models, I argue that Ricardian equivalence and rate of return dominance of money are not mutually consistent <u>generally</u>.

I. Neutrality in a Single-Return Overlapping Generations Model

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

We begin with a pure exchange model of two-period lived overlapping generations, defined over discrete dates $t \geq 1$, in which there is a single consumption good at each date. Agent h in generation t, for $t \geq 1$, is alive at t and t + 1 and gets utility from consumption of time t good and time t + 1 good, $c_t^h(t)$ and $c_t^h(t+1)$, respectively, and has positive pre-tax endowments of those two goods, $w_t^h(t)$ and $w_t^h(t+1)$, respectively. At t = 1, there are people in the second and last period of their lives. If h is such a person, then h attempts to maximize $c_0^h(1)$, his or her consumption of time 1 good. In addition to endowments of goods, we 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 set-up, which we call model I, we set out several neutrality propositions. The first four are motivated by View 1 and, in particular, Barro's (1983) description of open market operations.

Barro analyzes an open market operation as a combination of two policies: the first is a change in fiat currency brought about by a current tax or transfer; the second is 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 policies an open market operation.

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

To facilitate the statement of the propositions and to introduce some of the notation we need, we write the budget set for a typical member of generation t, $t \geq 1$, as follows:

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

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

Here p_t is the price of a unit time t currency in units of the consumption good, $\bar{m}^h$ is initial currency holdings of h, ℓ_t^h nominal loans granted by h at the nominal time t gross interest rate R_t, m_t^h is fiat currency carried by h from t to t + 1 and $z_t^h(t+i)$ is nominal lump-sum taxes to be paid by h at t + i. Since all our propositions are about perfect foresight equilibria, we will not distinguish between actual and anticipated future prices and taxes.

Given that 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

$$(3) \qquad c_t^h(t) + c_t^h(t+1)/r_t + p_t m_t^h(1-1/R_t) \leq w_t^h(t) + w_t^h(t+1)/R_t + p_t \overline{m}^h - p_t[z_t^h(t)+z_t^h(t+1)/R_t].$$

Here $r_t \equiv R_t p_{t+1}/p_t$ 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, we 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; while if $R_t < 1$, then h would have a budget set that is 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.

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

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

A few remarks will suffice as a proof. First, note that the asserted changes leave the right-hand 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 satisfied (1) and (2) for $\lambda = 1$, then $(\ell_t^{h'}, m_t^{h'}) = \lambda(\ell_t^h, m_t^h)$ satisfy (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. Note, of course, that we are augmenting <u>all</u> initial money holdings, including any held by the "old" at $t = 1$.

We next turn to Ricardian equivalence. Suppose for some h in generation $t \geq 1$, taxes, the z's are altered in such a way that the present value of taxes, the term in square brackets on the right-hand side of (3), is left unchanged at the initial R_t. Then, it is utility maximizing for h to respond 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 is an equilibrium absent this tax and borrowing operation is also an equilibrium under it. We state this as follows:

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

We are now ready to consider combinations of the Propositions 1 and 2 policies which can be interpreted as an open market operation.

We do this in the following proposition.

Proposition 3. 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 as follows:

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

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

with $\sum_h \theta^h = 1$, then there is neutrality and price level proportionality and 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-hand side of (3) is unaffected. Thus, affordable utility maximizing consumption does not change. For market clearing, we want $\sum m^{h'} = \lambda M$ and $\sum \ell^{h'} = \lambda\sum\ell^h - (\lambda-1)M$. We 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-hand 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 our 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 there is no combination of the policies not involving time 1 taxes and transfers among people that preserves neutrality and proportionality. If, however, the young at t = 1 own among them the entire stock of fiat currency, then there does exist such a policy. We describe it in the following proposition.

<u>Proposition 4.</u> If $\sum \bar{m}^h = M$, with the summation being over the members of generation 1, then with $\theta^h = \bar{m}^h/M$ 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 Propositions 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, we want to contrast it with what I will call a pure intermediation experiment. 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.

Proposition 5. Pure intermediation is irrelevant.

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

II. Neutrality and Nonneutrality in an Amended Overlapping Generations Model

Here we consider two alternative amended versions of model I. Model IIA is model I except that the utility of h in generation t for t > 1 depends on an additional argument, real currency holdings that h carries from t to t + 1--$p_t m_t^h$, in the notation adopted above. Model IIB is model I except that individuals face an additional constraint, a Clower constraint: for h in generation t, t > 1, $c_t^h(t+1) - w_t^h(t+1) > p_{t+1} m_t^h$, where, recall, m_t^h is nominal currency holdings carried from t to t + 1. This form of the Clower constraint says that time t + 1 consumption in excess of 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. We state this as a proposition.

Proposition 6. Propositions 1-4 hold in models IIA and IIB.

The proofs or outlines of proofs that we gave 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 considered in those propositions. Note that the product of these two variables is $p_{t+1} m_t^h$, which appears in our Clower constraint.[1/]

Proposition 5, however, does not hold in models IIA and IIB. First, if $R_t > 1$, then an arbitrary amount of government intermediation gives rise to profits, which must somehow be distributed. Second, 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 IIA, 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 for this model that for each young person there exists 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 time t good, w_1 (c_1) is the endowment (consumption) when young, and w_2 (c_2) is endowment (consumption) when 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.

We want to find a p_t sequence and a government intermediation strategy that supports c_1^*, c_2^*, q^* as an equilibrium. We 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, we 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 $\ell_t^h = -(q^*-pM)/p$ and $m_t^h = M + (q^*-pM)/p$ and $c_t^h(t) = c_1^*$, $c_t^h(t+1) = c_2^*$ 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 IIA and IIB, 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.

III. The Legal Restrictions Theory of Significantly Positive Nominal Interest

As we have noted, models IIA and IIB can give rise to equilibria with positive nominal interest rates. Indeed, by choosing parameters including policy appropriately, nominal interest rates of any magnitude are consistent with those models.

That, indeed, is the main virtue of those models, a virtue because we seem to observe a wide range of magnitudes for nominal interest rates at different times and places.

However, accounting for positive nominal interest rates should not be all we ask of a model. We also observe that the assets used for transactions differ in different places and at different times: sometimes, in one country, a currency issued by another country is used; sometimes a private liability (private bank notes) is used; and sometimes a commodity is used. Such observations and other considerations suggest that we attempt to describe the stuff that yields utility or satisfies the Clower constraint in terms of general properties. For example, if we view the stuff as "currency," then we, perhaps, want to say that the stuff ought to be in standard and small denominations, be storable easily, be payable to bearer, and be, in some sense, safe.

If we do define the stuff by such general properties, then we must consider the possibility that the private sector can supply it. That, in turn, gives rise to an important additional restriction. We cannot have 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. 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 in order to produce equilibria in which nominal interest rates are freed from the above no-profit condition. Moreover, the same possibility and some fairly innocuous assumptions about intermediation technologies--namely, constant costs and symmetry between government costs and private costs of intermediation--imply that legal restrictions are also necessary in order that Modigliani-Miller irrelevance not hold.

We will now examine some models of legal restrictions in order to determine whether Proposition 2 holds for them. We will look at some models that attempt 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-Wallace (1982), Bryant-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-Wallace (1982) use the usual discrete time OG model and specify special endowment and preference patterns that generate the following interior solutions. There is a group of low endowment positive savers who end up holding only the low return, small denomination stuff. There is a group of high endowment positive savers and a group of high endowment negative savers (borrowers) who interact in a credit market that determines a return on high denomination private securities. These people hold none of the low return, small denomination stuff.

Bryant-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. In general, equilibria in the Bryant-Wallace model are such that some people end up at a point like A in Figure 1 (an interior solution involving the holding only of small denomination stuff) and some end up at B (a corner solution involving the holding only of a single 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 above models, C. Y. Chang (1982) has formulated and analyzed a continuous time version of the above models that gives rise to more realistic individual portfolios--to ones 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. There is a single consumption good which 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, there is a stationary equilibrium 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 solid 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 by having one person 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 there are equilibria in which bonds are held. If one bond is purchased, the implied pattern of currency holdings is as depicted by the dash 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 can either involve everyone holding the same portfolio or can be quasi-equilibria with some fraction of the individuals holding one portfolio and the remaining fraction holding another portfolio. In any case, everyone ends up holding some divisible currency almost all the time.

These legal restrictions models, which were not specified with an eye to whether Proposition 2 would or would not hold in them, are ones for which that proposition does not hold. They are, however, very special models. Legal restrictions consistent with money dominated in return can take many forms. As we now illustrate, not all give rise to budget sets like that shown in Figure 1 and some give rise to linear budget sets that imply satisfaction of Proposition 2.

A reserve requirement according to which 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 requirement is binding, then the rate earned on positive saving (lending) is less than the rate paid on dissaving (borrowing). Alternatively, a legal restriction according to which some part of one's endowment must be held in the form of government currency gives rise to a linear budget set. The latter implies satisfaction of Proposition 2 and the former does not.

Even though we are able to formulate legal restrictions consistent with money dominated in return and Ricardian equivalence, it should be clear that most of the legal restrictions in place in the United States and other countries are 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.

IV. Concluding Remarks

Since almost no one accepts the legal restrictions theory described in the last section, I want to 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 given that the Section II models are ones for which they are consistent with one another. I can do it because almost no one accepts those models--or more accurately, money-in-the-utility-function or Clower constraints--as serious models of money dominated in return. Instead, they are viewed as, in some sense, convenient short cuts that are 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 most often cited as rationalizing money dominated in return. The crucial feature of these models is a transaction cost that is decreasing in the magnitude of the transaction. As is well known, that feature generates a nonconvex budget set in the space of present consumption and future wealth or consumption (see Miller (1976)). That model, therefore, would not seem to be consistent with Ricardian equivalence.

Recently, there have been attempts to specify complete environments that in some sense rationalize the Clower constraint (see, for example, Lucas (1980), Townsend (1980, 1982)). These generally are settings in which individuals are spatially separated and in which contact with other individuals is limited. Therefore, there would not seem to be a centralized, well-functioning private credit market in these models. 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 it should come as a surprise that models which attempt to specify physical environments implying a role for an outside asset which is 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 model of Section I and variants of it. 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 the model of Section I.

Most such attempts have, however, been guided by the following principle: successful theories or models will be of environments in which there are barriers or difficulties to exchange so that there is something for media of exchange to do. If that principle is right, and I think that it is, then it would be very surprising if perfect credit markets were to emerge from such specifications. That is the basic reason why we should have a strong predilection for the view that Ricardian equivalence and money dominated in return are mutually inconsistent generally.

Footnote

[1]/Note that Proposition 2 would not hold for a version of Model IIB, a Clower constraint model, in which time t + 1 taxes have to be paid in currency or in which time t + 1 transfers could be used to purchase consumption.

Figure 1

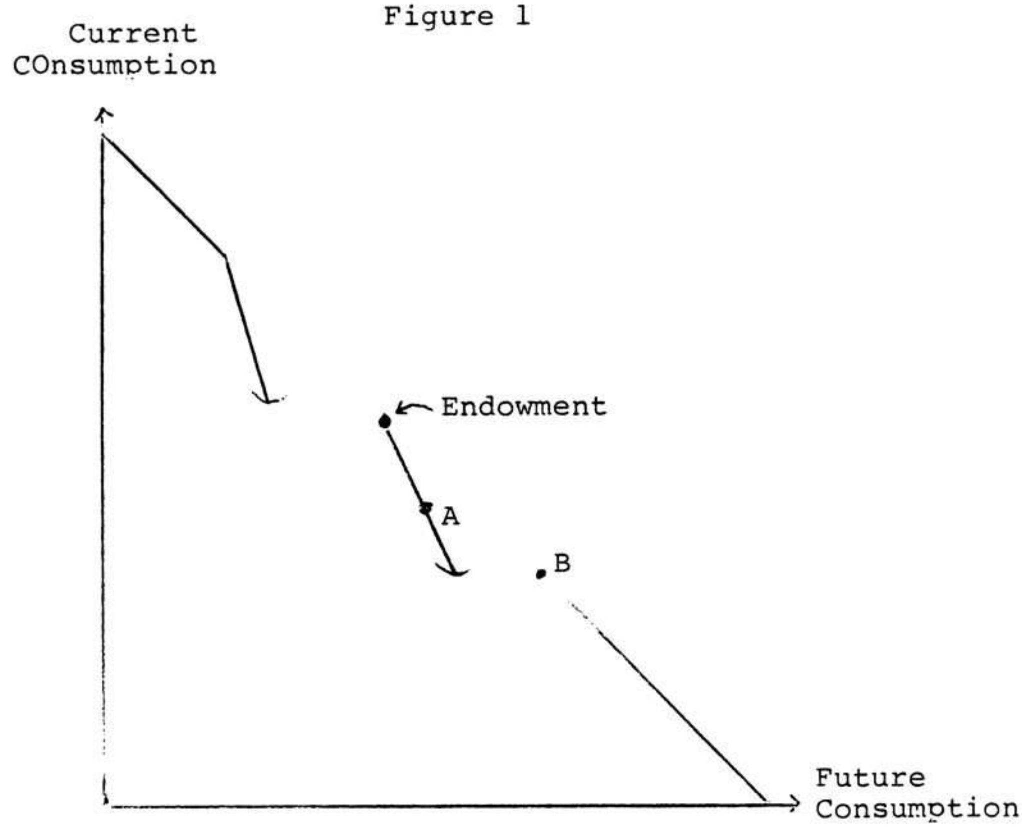
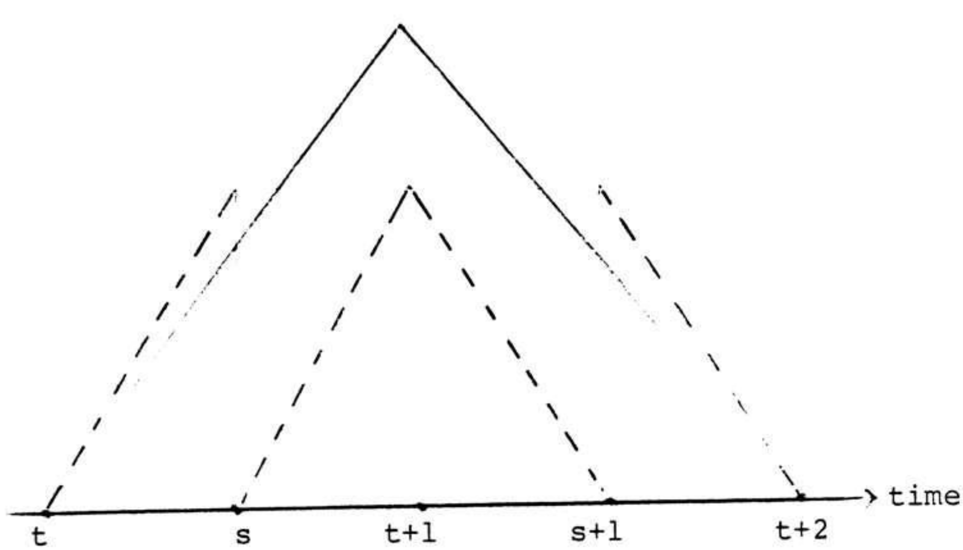


Figure 2



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