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Author(s): Walter Perrin Heller and Ross M. Starr
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CAPITAL MARKET IMPERFECTION, THE CONSUMPTION FUNCTION, AND THE EFFECTIVENESS OF FISCAL POLICY*

WALTER PERRIN HELLER AND ROSS M. STARR

We shall derive a conventional macroeconomic consumption function from microeconomic intertemporal consumer behavior. In addition, we show below that expansionary fiscal policy need not be ineffective even when the future tax implications of an increase in current government debt finance are perfectly foreseen. The common basis for both results is an imperfection in the capital market; consumers cannot borrow against future income.

I. INCOME AND CONSUMPTION

The amount of consumption out of current income is an intertemporal allocation (savings) decision. Macroeconomic specifications of consumption behavior, the consumption function, typically imply a significant dependence of current consumption on current income. This contrasts sharply with the behavior predicted by a microeconomic model of a household maximizing a sum of (discounted) utilities over its lifetime with perfect capital markets and without uncertainty. The latter model implies that increments to current income will be spread relatively evenly over the household's lifetime without a particularly strong effect on current consumption. An extra dollar of current income should result in a change in consumption virtually identical to that derived from an additional dollar (present value) of future income. A common view of the dependence is that fluctuations in current income are taken to indicate a similar change in expected (uncertain) future income. The strong effect of current

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increments derives from a corresponding change in the expected future income stream.[1]

An alternative view is analyzed here. Suppose the household to be confronted by a fluctuating but certain income stream, unable to borrow fully to smooth the resulting consumption path, and always required to have a nonnegative net liquid asset holding. An increment to current income then affects both lifetime income and current liquidity. Current income will have a disproportionately strong effect on current consumption because of the borrowing (or liquidity) constraint.[2] If this constraint is binding in the current period, then an extra dollar of current income will be spent immediately. A similar increase in expected future income, on the contrary, can have no effect on current consumption because of the binding constraint.

Impossibility of a negative net liquid asset position is a polar case (as is a perfect capital market). The essential point is that it is not generally possible for a household to borrow the full present value of its future income stream. Consumption then will behave in a liquidity-constrained fashion whenever the difficulty of borrowing is a binding constraint on the lifetime consumption plan. Transactions costs in borrowing are an element of illiquidity and provide an alternative reason for the difficulty, if not inability, to borrow.

In the present model there is only one financial instrument; there is no borrowing; there is no uncertainty. A more completely articulated study would eliminate these simplifications. The essential point is to contrast the consumption behavior implied by a borrowing constraint, (4) below, with that implied by the lifetime budget constraint, (14) below. With (4) we get a consumption function depending on current income with a diminishing marginal propensity to consume. Constraint (14) implies on the contrary that (if the interest rate is zero) changes in present and future income are treated identically, and the marginal propensity to consume out of current income is a constant.

Liquidity constraints also have an important role to play in the recent debate on the effectiveness of government policy. Recognition that individuals may incorporate future tax effects of government

1. Studies of the consumption function as the outcome of utility optimization over time include Ando-Modigliani [1963], Friedman [1957], Merton [1971], Modigliani-Brumberg [1954], Sibley [1975], and Tobin [1967]. None of these consider the role of restricted borrowing. In a stochastic trade model [Foley-Hellwig, 1975], restricted borrowing enters significantly to determine the demand for money. Tobin-Dolde [1971] and Barro-Grossman [1976] consider constrained liquidity in different models.

2. It has been observed by others as well that this behavior can be derived from capital market imperfections [Leijonhufvud, 1969], but we have been unable to find a technically complete discussion in the literature.

debt in their own decision making goes back at least to Ricardo [1821, Ch. XVII, p. 161]. The macroeconomic implication (ineffectiveness of substituting government debt for taxation as expansionary fiscal policy) is recognized in Patinkin [1965, p. 289] and more recently discussed in Barro [1974]. *Nevertheless, even if the future tax implications of increasing debt-finance of government expenditure are perfectly foreseen, current consumption demand may rise, since the household income profile is shifted toward the present, thereby relieving borrowing constraints on current consumption.* We discuss this in Section III.

II. Optimal Consumption Plans Subject to Borrowing Constraint

Consider a household with a known income stream varying over time, seeking to maximize the sum of utilities from consumption over its lifetime. The utility function is supposed to display diminishing marginal utility. If the constraint on its actions is simply the lifetime budget constraint, then the household will follow a policy of equal consumption in all periods (supposing the utility discount rate to equal the interest rate).

Now introduce the additional constraint that the household must have a nonnegative net liquid asset holding in each period. This means that income can be used for consumption at any date subsequent to its receipt, but that it cannot pay for prior consumption. Consumption can be shifted forward in time by saving; it cannot be shifted backward.

Formally, we seek a consumption policy, $C_i, i = 0, \ldots, N-1$, that will maximize the sum of a sequence of utilities (discounted) over time. Suppose, for simplicity, that there is a constant interest rate throughout the household lifetime. The constraint is that liquid assets (called "liquidity" hereafter) at each date x_i must be nonnegative (although the analysis could be carried out with x_i constrained below by some negative amount). Liquidity at date $i+1$ is liquidity at i minus consumption at i, C_i, plus expected income at i, y_i, plus interest. The expected income stream may vary over time; for convenience we take expected income at date i to be held with subjective certainty (point expectations). Utility at date i is given by $u(C_i)$ where $u' > 0$, $u'' < 0$. The utility discount factor is ρ; the interest *factor* is r; the interest *rate* is $r - 1$.

The household's problem then is to choose C_i $(i = 0, \ldots, N)$ and $x_i (i = 1, \ldots, N+1)$ to

(1) $$\max \sum_{i=0}^{N} \rho^{-i} u(C_i),$$

subject to

(2) $$x_{i+1} = rx_i + y_i - C_i \qquad i = 0, \ldots, N$$

(3) $$x_0 = \bar{x}_0 \geq 0$$

(4) $$x_i \geq 0 \qquad i = 1, \ldots, N+1$$

(5) $$C_i \geq 0 \qquad i = 0, \ldots, N.$$

For simplicity, assume sufficient steepness conditions on u ($u'(0) = +\infty$) so that (5) is redundant. The Lagrangean for the problem, with multipliers λ, μ is

$$L = \sum_{i=0}^{N} \{\rho^{-i} u(C_i) + \lambda_i [rx_i + y_i - C_i - x_{i+1}] + \mu_{i+1} x_{i+1}\}$$

(6) $$= u(C_0) + \lambda_0 (r\bar{x}_0 + y_0 - C_0) + \sum_{i=1}^{N} \{\rho^{-i} u(C_i) + \lambda_i (y_i - C_i)$$
$$+ (r\lambda_i - \lambda_{i-1}) x_i + \mu_i x_i\} + (\mu_{N+1} - \lambda_N) x_{N+1}.$$

The Kuhn-Tucker necessary conditions for an optimum are

(7) $$\rho^{-i} u'(C_i) - \lambda_i = 0, \qquad i = 0, \ldots, N$$

(8) $$\lambda_{i-1} - \lambda_i r = \mu_i, \qquad i = 1, \ldots, N$$
$$\lambda_N = \mu_{N+1},$$

and complementary slackness conditions are

(9) $$\lambda_i \geq 0, \qquad i = 0, \ldots, N$$

(10) $$\mu_i \geq 0, \qquad i = 1, \ldots, N+1$$

(11) $$x_i \mu_i = 0, \qquad i = 1, \ldots, N+1.$$

By (11) μ_i is nonzero only when x_i is 0. But by (8) $\lambda_{i-1} > r\lambda_i$ only when μ_i is nonzero. By (10) μ_i is always nonnegative; thus by (8)

(12) $$\lambda_{i-1} \geq \lambda_i r,$$

with strict inequality exactly when (4) is binding. By (7) $u'(C_{i-1}) = \rho^{i-1} \lambda_{i-1}$, so by (12) and (7)

(13) $$u'(C_{i-1}) \geq \rho^i \lambda_i \left(\frac{r}{\rho}\right) = u'(C_i) \left(\frac{r}{\rho}\right)$$

with strict inequality exactly when (4) is binding. Thus, if $r > \rho$, $u'(C_{i-1}) \geq u'(C_i)$, with strict inequality if $r > \rho$ or (4) is binding. Since

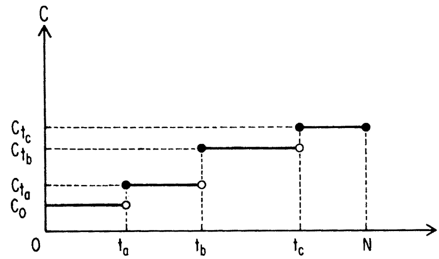

FIGURE I

$u'' < 0$, this means that all changes in C are increases, if the interest rate is no smaller than the subjective time rate of discount.

In contrast to the perfect capital market model, consumption will not in general be constant over time when the interest rate is equal to the discount rate. We know that μ_i is nonzero if and only if (12) holds with strict inequality. In that case, by (13), $u'(C_{i-1}) > u'(C_i)$ (since $\rho = r$). Thus, consumption will be increasing exactly when the liquidity constraint is binding, and it will be constant otherwise.

For ease of analysis, we shall assume for the rest of the paper that the interest rate is equal to the subjective rate of time preference. The typical optimal consumption plan in the case $\rho = r$ is a step function, as in Figure I. The policy consists of intervals of constant consumption with increasing consumption between intervals. However, if the bulk of income occurs in early periods, consumption may be constant throughout. The steps occur at the dates where $\mu_i > 0 (x_i = 0)$. At each date the consumer chooses the maximum level of consumption consistent with sustaining that (or a higher) level of consumption indefinitely without violating the nonnegative liquidity constraint. At the switch dates t_a, t_b, t_c the consumer has run down his liquidity to zero but the prospect of higher future income allows him to plan on increased consumption. There are no decreases in consumption, since any plan including decreases is dominated (since $u'' < 0$) by one where consumption is smoothed. Such smoothing can always be achieved, since consumption can always be shifted forward by holding positive liquidity. Consumption cannot generally be shifted back because this would involve violation of the nonnegative liquidity constraint. Hence the increasing pattern of consumption over time. An increasing pattern over time for y_i ensures that optimal policy is a nondegenerate step function. Special cases where optimal consumption is constant are y_i = constant and y_i decreasing in i.

This optimal policy is in contrast to the policy that would be optimal under a weakened borrowing constraint. If (4) were replaced by the lifetime budget constraint,

$$x_{N+1} \geq 0, \tag{14}$$

then consumption could be shifted both forward and back, and the optimal policy would be constant consumption in the case $\rho = r$.

III. Dependence of Consumption on Income in the Short Run: A Consumption Function

Consider the change in consumption resulting from an increase in current income, holding income in all other periods constant. Recall that t_a is the date of the initial binding liquidity constraint in the above example. A small increase Δy_0 will be spread evenly over the periods $0 \leq i < t_a$ so that the change in consumption in period 0 is $\Delta c_0 = \Delta y_0/t_a$. The marginal propensity to consume then is $1/t_a$.

For a larger Δy_0, the situation is a bit different. The total amount by which consumption in the first interval (from period 0 to t_a) falls short of consumption in the second interval is $t_a(C_{t_a} - C_0)$. We know that consumption never decreases. Therefore, if $\Delta y_0 > t_a(C_{t_a} - C_0)$, and if consumption is not to decrease at t_a, some of the increase in y_0 is spread over the interval between t_a and t_b, where t_b is the date planned for the next binding liquidity constraint. Increments in y_0 are spread over the interval between 0 and t_b, so that the marginal propensity to consume is $1/t_b$. The date of the initial binding liquidity constraint is an increasing function of current income. Thus, as current income rises, the marginal propensity to consume falls.

We can plot current ($i = 0$) consumption as a function of y_0, holding income in other periods constant (see Figure II). An individual consumption function with diminishing marginal propensity to consume (as generally arises in cross-section studies) results from optimization subject to a borrowing constraint.

A puzzle motivating this study is the common assumption that variations in current income exert a singularly strong effect on current consumption. This implies a corresponding weak effect on current consumption of similar variations in expected future income. It should now be clear how such an effect can arise in the borrowing-restricted model. For a household that is genuinely liquidity constrained (e.g., Figure I) there is an initial date at which the constraint is seen to be binding (t_a). Increases in future income for periods later than the first binding period make the household wealthier (i.e., they increase the discounted sum of income plus endowment) but not more liquid. Such

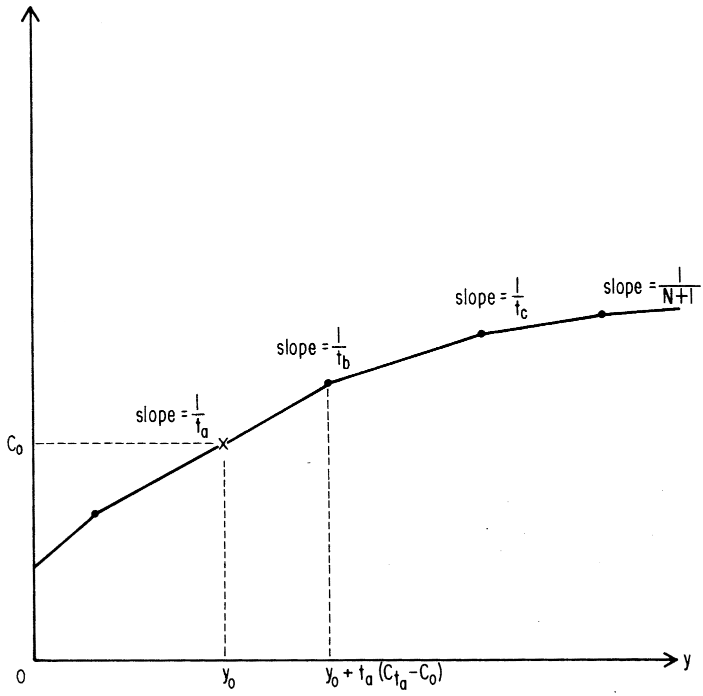

FIGURE II

a future increase does not ease the binding constraint and hence has no effect on current consumption. An increase in current income, conversely, will be spread as consumption not over the lifetime but over the shorter interval from the present to the initial binding constraint. This short interval implies a potent effect.

We may wish to consider the effect on period 0 consumption of an increase δ in y_0 and an offsetting reduction in y_N. The change consists of holding the present value of lifetime income constant while shifting the timing of its receipt toward the present. Suppose, for greatest simplicity, that $\rho = r = 1$. If we refer back to Figure I, it is then clear that for a small change in current income δ, the revision in optimal policy consists in increasing consumption C_i during $0 \leq i < t_a$ by δ/t_a and reducing consumption C_i for $t_c \leq i \leq N$ by $\delta/(N - t_c + 1)$. Thus, in the example there is an increase in current consumption at the rate of the marginal propensity to consume.[3] This would not

3. Even if $\rho \neq r$, the analysis could be adapted to show that current consumption is increased under the same variation in the income stream, as long as the borrowing constraint is binding.

be true, of course, in the opposite case of a perfect capital market. There, the policy of constant consumption is unaffected by a change in the timing of the receipt of income as long as the present value of the income stream stays fixed.

The variation in the timing of receipt has application to the discussion of the short-run effectiveness of fiscal policy. Consider the choice of tax versus debt finance of government expenditures with subsequent expected repayment of the debt from tax revenue. Debt finance reduces current taxes and hence eases the current liquidity constraint, while reducing disposable income by an equivalent amount in future periods. Though wealth has not been increased, liquidity has. This will stimulate consumption in the current period if the borrowing constraint is binding at some date. Thus, *if borrowing is restricted, fiscal policy is effective, even when the future tax implications are perfectly foreseen.* Alternatively, a similar effect could be achieved by enhancing household liquidity. Such an increase in liquidity may correspond to the effects of expansionary short-run monetary policy. If (4) were eased to allow borrowing at $i = 0$ up to the amount of the proposed tax reduction with repayment at $i = N$, the effect would be the same.

IV. SUMMARY

The microeconomic model of utility optimization subject to restricted borrowing results in some relatively familiar macroeconomic propositions on consumer behavior in the short run. Consumption is sensitive to current income because the household wishes to borrow and is constrained from doing so. The household's optimal saving and consumption policy can result in a binding liquidity constraint at a date relatively near the present. When this occurs, current consumption depends primarily on current income and is virtually unaffected by variations in anticipated income for dates subsequent to the binding constraint. Current consumption behavior is characterized by a diminishing marginal propensity to consume corresponding to the loosening of successive binding liquidity constraints as current income increases. Fiscal policy is effective in increasing current consumption demand, even with perfect foresight about offsetting tax increases in the future.

UNIVERSITY OF CALIFORNIA, SAN DIEGO
UNIVERSITY OF CALIFORNIA, DAVIS

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