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CREDIT RATIONING AND CONSUMER INTERTEMPORAL CHOICE***

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Abstract

This paper provides an answer to the question of how expected future borrowing constraints - which are assumed to temporary - affect saving under uncertain imposition of rationing. Under quite plausible circumstances both a fall in the future credit limit and a rise in the probability for facing the binding borrowing constraint in the future will increase current saving. This is, in fact, in accordance with some recent empirical findings.

1. INTRODUCTION

In what has become known as the life cycle theory consumption depends on wealth, in the form of either financial assets or discounted future income. With perfect capital markets households can dissave and borrow within the bounds of solvency at the same interest rates at which they can save and lend. For various reasons, however, the expected profits of banks may not rise with increases in interest rates so that borrowers may be subject to binding borrowing constraints (see Stiglitz and Weiss (1981)). Moreover, it is now well-known that the conventional life cycle theory does not necessarily imply a positive savings ratio. Namely, if the myopic replanning assumption of the original Modigliani-Brumberg model is replaced by the assumption that households currently foresee the growth of future income, then with perfect capital markets the life cycle model may yield a negative savings ratio (see Farrell (1970)). Liquidity constraints, by limiting dissaving via borrowing for many consumers, may after all guarantee a positive savings ratio.

There is now a small literature dealing with life cycle theory under 'capital market imperfections'. Russell (1977), working in a balanced growth framework, derives conditions under which steady state consumption will be positively or negatively related to quantitative limits on borrowing. He does not, however, address to the short-run sensitivity question. Artle and Varaiya (1978) analyze the effects of liquidity constraints on consumption profile over life cycle, while Flemming (1973), Wiseman (1975) and Heller and Starr (1979) deal with the short-run relationship between consumption and income under liquidity constraints and end up with a consumption function displaying a diminishing marginal propensity to to consume out of current income. Pissarides (1978) in turn has shown how the composition of portfolio will be chosen simultaneously with the optimal consumption plan in the presence of transactions costs in asset markets. Finally, Jackman and Sutton (1982) have demonstrated how the response of aggregate consumption to changes in interest rates under liquidity constraints involves an asymmetry: an increase in interest rates will have a larger short-run impact than a fall.

The studies mentioned above have been mainly concerned with the effect of certain types of (permanent) 'capital market imperfections' on the relationship between consumption, income and wealth when imposition of credit rationing is known with certainty. Turning to the relationship between consumption and 'capital market imperfections' it is obvious that a rise in current binding borrowing constraint decreases current consumption via the direct liquidity effect. But how do expected future borrowing constraints - which are assumed to be temporary - affect current consumption and saving? The purpose of this paper is to provide an answer to this question in an intertemporal model under the uncertain incidence of borrowing constraints.

In what follows, the simplest model to illustrate the working of expected future borrowing constraints, namely a three-period model, is used as a frame of reference. A two-period model with a binding borrowing constraint with respect to either the first or the second period does not allow for intertemporal choice, because asset accumulation (or decumulation) and the interest rate link two periods together. The binding borrowing constraint in the second period necessitates more assets during that time so that the first period consumption has to be reduced because of the budget constraint[1).

2. AN INTERTEMPORAL MODEL UNDER UNCERTAIN CREDIT RATIONING

Consider a three-period Fisherian consumption-savings model, where an economic agent´s utility function is defined over his consumption, c_i, in three periods and over his stock of assets at the end of period three, A_3, so that $U = U(c_1,c_2,c_3,A_3)$. The role of assets in the utility function can be interpreted as representing either (i) the bequest motive[2)] or (ii) the derived utility from consumption beyond period three.

In order to make the analysis more tractable all intertemporal prices are assumed to be unitary and the utility function to be additively separable with respect to its arguments and strictly concave with 'steepness'-conditions $U_i'(0) = +\infty$ and $U_i'(\infty) = 0$ for all i. This last assumption eliminates corner solutions so that for example the complex issue of consumer´s bankruptcy, which would necessitate a study of its own, is excluded here[3)]. The underlying idea is that there are heavy economic penalties associated with bankruptcy, which will be left unspesified, however. Moreover, the assumption of additive separability makes the variable A_3 redundant. Noting that c_3 and A_3 enter the budget constraint as (leaving aside the discount terms) $c_3 + A_3$ and into the utility function as $U_3(c_3) + U_4(A_3)$, c_3 could be redefined as $\hat{c}_3 + A_3$ and U_3 redefined as $U_3(c_3) = \text{Max}\{\hat{U}_3(c_3) + U_4(A_3)\}$with $\hat{c}_3 + A_3 = c_3$, where $\hat{c}_3$ is the original c_3. Therefore, A_3 can be dropped with no further loss of generality and some simplification of notation.

An economic agent has an exogenous income stream y_i for $i = 1,2,3$, which is paid at the beginning of each period and the intertemporal wealth is defined by

(1) $$W = y_1 + R_2y_2 + R_3y_3$$

where y_1 includes A_0 (the stock of assets at the end of period 0). In (1) R stands for the discount term. In what follows we consider for simplicity the benchmark case where the interest rate is the same at all dates and equal to the subjective rate of time preference so that $R_1 = 1$, $R_2 = (1+r)^{-1}$ and $R_3 = (1+r)^{-2}$, where r = the interest rate.

Assume that in period 2 a consumer-borrower may face a binding borrowing constraint, according to which his stock of debts must not exceed a certain limit, Z_2. The imposition of future credit rationing is uncertain, however, and suppose that a consumer borrower has a subjective probability, say Θ, for facing the binding borrowing constraint. If consumption in periods 2 and 3 is denoted by c_2 and c_3 in the nonrationed case and by d_2 and d_3 in the rationed case, then the intertemporal budget constraints[4)] can be written respectively as

(2.1) $$W \geqq c_1 + R_2c_2 + R_3c_3$$

(2.2) $$W \geqq c_1 + R_2d_2 + R_3d_3$$

If the credit limit is exogenous, then the following asset constraint[5)] is implied

(3) $$R_2(y_2 - d_2) + y_1 - c_1 \geqq - R_2Z_2$$

Finally, we assume that a consumer-borrower is a risk-averse ($U'>0, U''<0$) and chooses c_1, c_2, d_2, c_3 and d_3 so as to maximize the expected discounted utility:

(4) $$V = U_1(c_1) + R_2EU_2(c_2,d_2) + R_3EU_3(c_3,d_3)$$

where $EU_i(c_i,d_i) = U_i(c_i)(1-\Theta) + U_i(d_i)\Theta$ for $i = 2,3$, subject to constraints (2.1), (2.2) and (3). The necessary (and also sufficient under the stated assumptions) conditions for the expected utility maximization can be written as

(5.1) $$U_1' - q - s - u = 0$$

(5.2) $$R_2U_2'(c_2)(1-\Theta) - qR_2 = 0$$

(5.3) $$R_2U_2'(d_2)\Theta - sR_2 - uR_2 = 0$$

(5.4) $$R_3U_3'(c_3)(1-\Theta) - qR_3 = 0$$

(5.5) $$R_3U_3'(d_3)\Theta - sR_3 = 0$$

(5.6) $$W - c_1 - R_2c_2 - R_3c_3 = 0$$

(5.7) $$W - c_1 - R_2d_2 - R_3d_3 = 0$$

(5.8) $$R_2(y_2 - d_2) + y_1 - c_1 + R_2Z_2 = 0$$

where q,s and u denote the Lagrange multipliers for the (intertemporal) budget constraints (2.1) and (2.2) and for the asset constraint (3) respectively.

If the imposition of rationing is certain ($\Theta = 1$), then the relevant necessary conditions for the utility maximization are (5.1), (5.3), (5.5), (5.7) and (5.8). The binding borrowing constraint means that consumption can be shifted forward in time by saving, but it cannot be shifted backward. If the utility function is the same at all dates, then (5.1), (5.3) and (5.5) imply $c_1^* = d_2^* < d_3^*$, where (*) refers to optimal values of c_i and d_i. Under the stated assumptions the optimal consumption path would be constant with no borrowing constraint, but increasing over time with the binding borrowing constraint[6)]. In the latter case there are no decreases in consumption, since such plans are dominated by the ones, in which consumptions are smoothed (see Heller and Starr (1979)).

In order to find out qualitative behaviour of c_i with respect to credit limit, Z_2, and to the probability for facing the binding borrowing constraint, Θ, we totally differentiate (5.1) - (5.8) with respect to $c_1, c_2, d_2, c_3, d_3, Z_2$ and Θ. After cancelling out the discount terms from (5.2)-(5.5) this yields the following coefficient matrix

$$(7)\quad H = \begin{bmatrix} U_1'' & 0 & 0 & 0 & 0 & -1 & -1 & -1 \\ 0 & U_2''(c_2)(1-\Theta) & 0 & 0 & 0 & -R_2 & 0 & 0 \\ 0 & 0 & U_2''(d_2)\Theta & 0 & 0 & 0 & -R_2 & -R_2 \\ 0 & 0 & 0 & U_3''(c_3)(1-\Theta) & 0 & -R_3 & 0 & 0 \\ 0 & 0 & 0 & 0 & U_3''(d_3)\Theta & 0 & -R_3 & 0 \\ -1 & -R_2 & 0 & -R_3 & 0 & 0 & 0 & 0 \\ -1 & 0 & -R_2 & 0 & -R_3 & 0 & 0 & 0 \\ -1 & 0 & -R_2 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

and the vector of differentials with respect to Z_2 and Θ

$$(8)\quad T = \begin{bmatrix} 0 \\ U_2'(c_2)d\Theta \\ -U_2'(d_2)d\Theta \\ U_3'(c_3)d\Theta \\ -U_3'(d_3)d\Theta \\ 0 \\ 0 \\ -R_2 dZ_2 \end{bmatrix}$$

As far as the effect of credit limit is concerned, tedious though straightforward, computation yields

$$(9.1) \qquad \frac{\partial c_1}{\partial Z_2} = \frac{R_2 U_2''(d_2)\Theta}{[R_3 U_1'' + U_2''(d_2)\Theta]} > 0$$

Thus, if the probability of rationing is positive, then a fall in the future credit limit decreases current consumption and increases current saving for precautionary reasons. If the consumer-borrowers do not know the rationing scheme, but expect the bank loan market to become 'tighter' in the future, then they increase saving.

If the imposition of future rationing is certain, then it can be shown moreover that

$$(9.1) \qquad \frac{\partial d_2}{\partial Z_2} = \frac{R_3 U_1''}{[R_3 U_1'' + U_2''(d_2)]} > 0$$

and

$$(9.2) \qquad \frac{\partial d_3}{\partial Z_2} = -R_2/R_3 < 0$$

where $d_3 = \hat{d}_3 + A_3$. A temporary fall in future credit limit will induce consumer-borrowers to reduce their consumption over their effective planning horizon ((9.1),(9.2)) so that consumption and asset holding in period 3 increases ((9.2)). These together with asset accumulation equations w.r.t. A_3, A_2 and A_1 imply that the level of assets due to temporary future rationing is higher in all three periods than in the absence of rationing. If the interest rate is positive, then $\partial(c_1+d_2)/\partial Z_2<1$ and $\partial(\hat{d}_3+A_3)/\partial Z_2< -1$ so that the size of credit limit and total consumption and asset accumulation are negatively related due to the 'income effect' of rationing. On the other hand, in the case of zero rate of interest there are no 'income effects' of rationing, $\partial(c_1+d_2)/\partial Z_2 = 1$ and $\partial(\hat{d}_3+A_3)/\partial Z_2 = -1$ so that a fall in future credit limit decreases current and second period consumption by the same amount than consumption and asset holding in period three is increased.

Does it make a difference if consumer- borrowers do not expect changes in the size of credit limits, but think that there is a change in the probability for them to be subject to rationing in the future? For certain types of loans this may be a more relevant concern than variations in the credit limit. Straightforward computation yields

$$(10) \qquad \frac{\partial c_1}{\partial \Theta} = \frac{R_2[U_2'(d_2) - U_2'(c_2)(1+R_2)(1+R_3)^{-1}]}{[R_3U_1'' + U_2''(d_2)\Theta]}$$

where we have utilized the fact that $U_2'(c_2) = U_3'(c_3)$ so that $U_2''(c_2) = U_3''(c_3)$ in the neighborhood of optimum. The denominator is negative so that $\partial c_1/\partial \Theta \lesseqgtr 0$ as $U_2'(d_2)/U_2'(c_2) \gtreqless (1+R_2)/(1+R_3)$. The marginal utility of consumption in the rationed situation exceeds that of the nonrationed case so that with zero rate of interest ($R_2 = R_3 = 1$) a rise in the probability of being rationed in the future unambiguously decreases current consumption and increases current saving. More generally, the more severe the possible borrowing constraint and the lower the interest rate - which is usually the case - the more likely a rise in the probability of being rationed in the future decreases current consumption and increases current saving. Saving is increased basically because consumer-borrowers want to avoid being caught with too low level of consumption and high (in relative terms) marginal utility of consumption if rationing does take place. Under these circumstances saving is more than simply a transfer of resources over time; it is a transfer of resources with the property that they will with certainty be available for consumption expenditures in the future[7)].

3. CONCLUDING REMARKS

The purpose of this paper has been to provide an answer to the question of how expected future borrowing constraints - which are assumed to be temporary in nature - affect current consumption and saving under the conditions of uncertainty about the imposition of rationing. We have shown that under quite plausible circumstances both a fall in the future credit limit and a rise in the probability for facing the binding borrowing constraint in the future tends to increases current saving for precautionary reasons.

There is now some confirming evidence in favour of the hypothesis that expected changes in 'tight money' has a positive effect on household saving (see, Koskela and Virén (1982), Mellin and Virén (1982), Muellbauer (1981)). In recent analyses of household saving behaviour models which in one way or another emphasize price and/or real income uncertainty have turned out to be promising. An area for further research would be to extend the model with uncertain imposition of rationing presented here to allow for those uncertainties.

FOOTNOTES

1) Of course the number of periods does not make a difference in this sense. If e.g. the last two periods in a three-period model are characterized by binding borrowing constraints, then the budget constraint again "rules the roost".

2) In this connection the bequest refers to the bequest at death. While in the presence of perfect capital markets the optimal consumption programs are neutral with respect to the actual form in which inheritance is bequeathed, this is not so when there is imperfection in the capital market (for an analysis of this question, see Ishikawa (1974)).

3) It has been pointed out by Hellwig (1977) how allowing the possibility of bankruptcy creates many analytical problems in modelling creditor-debtor interaction for example in the sense that creditor behaviour can be indeterminate.

4) In this connection one may be asked how the intertemporal budget constraint is actually enforced so as to prevent "Ponzi games". Foley and Hellwig (1975) have suggested some reasons for the enforceability of the intertemporal budget constraint. More spesifically, if the lender behaves as if his loan were the last the borrower will get ("stand-alone" principle), then a lender who expects other lenders to apply this "stand-alone" principle will exact loan terms at least as stringent as the "stand-alone" principle dictates. It is obvious that under these circumstances the intertemporal budget constraint will be enforced.

5) Here we have followed a standard way of specifying the credit limit not in terms of flows of loans, but in terms of net stock of assets.

6) If the interest rate is greater or smaller than the subjective rate of time preference, then consumption will be increasing or decreasing respectively under no borrowing constraints. In the former case the binding borrowing constraint makes the consumption profile steeper over time, while in the latter case the consumption profile may still be decreasing even though less than without borrowing constraint. Thus also in the case of divergence between the interest rate and the subjective rate of time preference the binding borrowing constraint shifts consumption forward.

7) This is analogous to "uncertainty increases saving"-proposition by Foley and Hellwig (1975), who have pointed out a close connection between 'trading uncertainty' and holding of liquid assets in a model with random incidence of unemployment and illiquid "human wealth".

REFERENCES

/1/ ARTLE, R. and VARAIYA, P.: Life Cycle Consumption and Home-ownership, Journal of Economic Theory, 1978, 38-58.

/2/ FARRELL, M.J.: The Magnitude of "Rate-of-Growth" Effects on Aggregate Savings, the Economic Journal, 1970, 873-894.

/3/ FLEMMING, J.S.: The Consumption Function When Capital Markets Are Imperfect: The Permanent Income Hypothesis Reconsidered, Oxford Economic Papers, 1973, 160-172.

/4/ FOLEY, D.K. and HELLWING, M.F.: A Note on the Budget Constraint in a Model of Borrowing, Journal of Economic Theory, 1975, 305-314.

/5/ FOLEY, D.K. and HELLWIG, M.F.: Asset Management with Trading Uncertainty, Review of Economic Studies, 1975, 327-346.

/6/ HELLER, W.P. and STARR, R.M.: Capital Market Imperfection, the Consumption Function, and the Effectiveness of Fiscal Policy, Quarterly Journal of Economics, 1979, 455-469.

/7/ HELLWIG, M.F.: A Model of Borrowing and Lending wit Bankruptcy, Econometrica, 1977, 1879-1906.

/8/ ISHIKAWA, T.: Imperfection in the Capital Market and the Institutional Arrangement of Inheritance, Review of Economic Studies, 1974, 383-404.

/9/ JACKMAN, R. and SUTTON, L.: Imperfect Capital Markets and the Monetarist Black Box: Liquidity Constraints, Inflation and the Asymmetric Effects of Interest Rates, The Economic Journal, 1982, 108-128.

/10/ KOSKELA, E. and VIRÉN, M.: Inflation, Tight Money and Household Savings Behaviour: Finnish Evidence, forthcoming in the Scandinavian Journal of Economics, 1982:3.

/11/ MELLIN, I. and VIRÉN, M.: An Empirical Analysis of the Demand for Houses, Durables and Nondurables, forthcoming in Empirical Economics, 1982:1.

/12/ MUELLBAUER, J.: Testing Neoclassical Models of the Demand for Consumer Durables, in the Theory and Measurement of Consumer Behaviour (ed. by DEATON, A.), Cambridge University Press, 1981, 213-233.

/13/ PISSARIDES, C.A.: Liquidity Considerations in the Theory of Consumption, Quarterly Journal of Economics, 1978, 279-296.

/14/ RUSSELL, T.: Rate of Growth Effects on Aggregate Savings: Further Analysis, Review of Economic Studies, 1977, 153-168.

/15/ STIGLITZ, J.E. and WEISS, A.: Credit Rationing with Imperfect Information, American Economic Review, 1981, 393-410.

/16/ WISEMAN, C.: Windfalls and Consumption Under a Borrowing Constraint, Review of Economics and Statistics, 180-184.