

CONSUMPTION BEHAVIOR AND LIQUIDITY CONSTRAINTS

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I. INTRODUCTION

According to the Life Cycle - Permanent Income Hypothesis (LC-PIH), households maximize a lifetime utility function subject only to the lifetime budget constraint in a perfect capital market. However, many recent empirical studies such as Flavin (1981), Hall and Mishkin (1982), Hayashi (1985), Zeldes (1989) and Jappelli (1990) reject the LC-PIH. These studies suggest liquidity constraints (or borrowing constraints) as the most likely source of the rejection.

The notion that consumption is more sensitive to income than is consistent with the LC-PIH has been related to the idea that households are not able to borrow against future earnings. Instead of being able to smooth consumption by borrowing, households cannot consume more than current income and savings. Such households face liquidity constraints if they do not hold liquid assets or collateral suitable for borrowing.

Under the assumption such as certainty of income stream and liquidity constraints of nonnegative net liquid asset holding, Heller and Starr (1979) derive macroeconomic policy implications from microeconomic intertemporal consumer behavior. The household is faced with a fluctuating but certain income stream, is unable to borrow fully to smooth the consumption path, and is always required to hold a nonnegative net liquid asset. If this constraint is currently binding, an increase of current income will have a strong effect on current consumption while a similar increment in expected future income has no effect on current consumption because of the binding constraint. Thus, consumption will behave in a liquidity-constrained fashion whenever the difficulty of borrowing is a binding constraint on the lifetime consumption plan.

This model considers nondurables only and shows that consumption will be increasing at the time when the liquidity constraint is binding, and it will be constant otherwise, if the interest rate is equal to the time preference rate. Therefore, the optimal consumption plan for nondurables is a nondegenerate step function.

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Heller and Starr conclude that fiscal policy is effective in increasing current consumption demand for nondurables, even with perfect foresight about offsetting tax increases in the future if current consumption for nondurables depends primarily on current income and is unaffected by variations in anticipated income as a result of the binding constraint.

Considering that most durables provide services over a certain time period and are financed by borrowing, the timing of durable consumption should be affected by liquidity constraints at least as much as one of nondurable consumption. If the LC-PIH is rejected, then it is most likely to be revealed in the pattern of durable consumption.¹ In spite of the importance of durables, however very few previous studies consider the implications of liquidity constraints for durables.²

As a natural step, in this paper, I set up the simple model for both durables and nondurables to investigate how the behavior of consumption for durables and nondurables are different. This paper develops testable implications of the optimal consumption behavior for both durables and nondurables in the presence of liquidity constraints. In the present model, there is no uncertainty. Assuming that the utility function is separable in durables and nondurables, two possible types of liquidity constraints are employed.

One concerns some quantity restrictions on holding of assets. The constraint is that net liquid assets should be nonnegative in each period, so that the borrowing constraint affects nondurable expenditures and durable expenditures in same degree. This means that agents cannot borrow against future earnings, in other words that debt cannot exceed total non-human assets such as future labor income. The other is the constraint that the sum of net liquid assets and the value of durables (illiquid assets) should be nonnegative in each period. In reality, it is not terribly hard to finance cars by a loan. In this case, consumers are allowed to borrow to finance durables, accordingly, net liquid assets can be negative while total assets (including the illiquid asset) are still nonnegative. Therefore, with this alternative constraint, durables are less restricted in financing. In section 2, in the simplified model, optimal consumption paths for durables and nondurables with both forms of liquidity constraints are derived.

If durables cannot be debt-financed, reductions in durables expenditures are followed by predictable increases in income. Consumers temporarily run short of

¹ Mishkin (1976) studies the neglected illiquid aspect of the consumer durable assets and points out that durables (automobiles in particular) are large, primarily debt-financed illiquid assets. Thus, durables purchases should be relatively more sensitive to liquidity constraints or imperfections in the consumer loan market, which are the most plausible sources of failure of the LC-PIH.

² Mankiw (1982, 1985), Bernanke (1984, 1985), Bar-Ilan and Blinder (1990) consider durables. They do not derive the alternative model incorporating liquidity constraints explicitly but examine whether the LC-PIH is rejected on data or not.

their durables stocks and reallocate expenditures to current nondurables consumption. They anticipate a subsequent increase in durables expenditures in the future. In the case that durables expenditures can be debt-financed, a rise in durables expenditures with the expectation of increase in financial ability is followed by predictable increases in income. In both cases, optimal behavior in the presence of liquidity constraints implies that changes in nondurables consumption are followed by changes in durables consumption. Therefore, changes in nondurables consumption are predictable by corresponding changes in durables consumption. I show that if liquidity constraints are binding, then the change in the stock of durables will anticipate the change in nondurables consumption, which is contrary to the implication of optimal consumption behavior in Hall's random walk hypothesis. With nonnegative liquid asset constraints, the change in durables and the change in nondurables are negatively correlated. In particular, a decrease in the stock of durables today signals an increase in nondurables next period. By contrast, in the case of nonnegative total asset constraints, a jump in the stock of durables precedes a jump in nondurables next period. In either case, rather striking result is that the change in durables has a predictive power for the change in consumption of nondurables. These restrictions have potentially important testable implications for the LC-PIH and may shed light on the existence of and possibly the appropriate form of liquidity constraints. These are discussed in section 3.

Section 4 contains concluding remarks.

II. SIMPLE MODEL WITH BORROWING CONSTRAINTS

1. Optimal Consumption Paths with Liquid Asset Constraints: $A_t \geq 0$

I assume that the household maximizes a separable lifetime utility function.³⁾ In each period t , household's problem is to choose C_t , D_t and A_t to

$$\text{MAX} \sum_{t=0}^T (1 + \beta)^{-t} [U(C_t) + V(D_t)] \quad (1)$$

subject to

$$A_t = (1 + r) A_{t-1} + Y_t - C_t - D_t P_{D,t} + (1 - \delta) D_{t-1} P_{D,t} \quad (2)$$

$$A_t \geq 0 \quad (3)$$

³ This section closely follows Heller and Starr (1979) which consider the consumption of nondurables only.

$$C_t \geq 0, D_t \geq 0 \quad (3A)$$

$$A_{-1} = 0, D_{-1} = 0 \quad (4)$$

where

A_t = nonhuman wealth at the end of period t

C_t = consumption of nondurables at period t

D_t = stock of durables at the end of period t

Y_t = labor income at period t

$P_{D,t}$ = relative price of durables in terms of nondurables at period t

r = constant interest rate

β = subjective rate of time preference

δ = rate of physical depreciation of durables

$U_c > 0, U_{cc} < 0, V_D > 0, V_{DD} < 0$

Equation (2) is the budget constraint of the household. Equation (3) states that liquid assets A_t at each period must be nonnegative. This means that income can be spent for consumption after its receipt but that it cannot be used for prior consumption. For simplicity, assume sufficient steepness condition $U_c(0) = V_D(0) = +\infty$. (3A) is nonnegativity condition constraints for nondurables and durables consumption. These constraints are redundant if we assume sufficient steepness for U and V . (4) is initial values for liquid asset and the stock of durables. Suppose, in addition, that the interest rate r is constant and the relative price of durables $P_{D,t}$ equals one. For convenience, income at t is known (subjective certainty), even though the income may vary over time. First derivatives of utility with respect to durables and nondurables are positive ($U_c > 0, U_D > 0$) and second derivatives are negative ($U_{cc} < 0, U_{DD} < 0$).

The Lagrangean for the problem with multiplier λ, ξ is

$$L = \sum_{t=0}^T (1+\beta)^{-t} [U(C_t) + V(D_t)] + \xi_t [(1+r)A_{t-1} + Y_t - C_t - D_t + (1-\delta)D_{t-1} - A_t] + \lambda_t A_t \quad (5)$$

The Kuhn-Tucker necessary conditions for an optimum are

$$U_{c,t} (1 + \beta)^{-t} - \xi_t = 0 \quad (6)$$

$$V_{D,t} (1 + \beta)^{-t} - \xi_t + (1 - \delta) \xi_{t+1} = 0 \quad (7)$$

$$-\xi_t + \xi_{t+1}(1+r) + \lambda_t = 0 \quad (8)$$

and complementary slackness conditions are

$$\xi_t \geq 0 \quad (9)$$

$$\lambda_t \geq 0 \quad (10)$$

$$A_t \lambda_t \geq 0 \quad (11)$$

By (6) and (8)

$$U_{c,t} - \left(\frac{1+r}{1+\beta} \right) U_{c,t+1} = (1+\beta)^{-t} \lambda_t \quad (12)$$

Since $(1+\beta)^{-t} > 0$, by (6) and (12)

$$U_{c,t} \geq \left(\frac{1+r}{1+\beta} \right) U_{c,t+1} \quad (13)$$

with strict inequality exactly when (3) is binding so that λ_t is positive and A_t is zero. For convenience of analysis, I assume for the rest of paper that the interest rate r is equal to the subjective rate of time preference β .⁴ If (3) is binding only at $t = t^*$, which means $\lambda_{t^*} > 0$ and $A_{t^*} = 0$ then

$$U_{c,t^*} > U_{c,t^*+1} \quad (14)$$

Since $U_{cc} < 0$, this implies that

$$C_{t^*+1} > C_{t^*} \quad (15)$$

In contrast to liquidity-unconstrained model, consumption for nondurables generally will not be constant over time. It will increase at t^*+1 , if the liquidity constraint is binding only at $t = t^*$, and it will be constant otherwise if the interest rate is equal to the rate of time preference. Therefore, under the assumption of $r = \beta$, the optimal constrained consumption path for nondurables is a step function. Due to the binding liquidity constraint at t^* , a consumer is prevented from increasing his consumption for nondurables by borrowing before t^*+1 , at which time income will increase.

⁴ Hall (1978), Hall and Mishkin (1982), and Mankiw, Rotemberg and Summers (1985) assume that the interest rate is equal to the rate of subjective time preference.

Figure 1a shows the jump between t^* and t^*+1 in consumption for nondurables. In Figure 1a, the step occurs at t^*+1 when income increases if liquidity constraints are binding at t^* so that $\lambda_{t^*} > 0$ and $A_{t^*} = 0$.⁵⁾ At t^* , the consumer has run down his liquid assets to zero but the prospect of higher future income makes him plan on increased consumption for nondurables. Consumption for nondurables in general cannot be shifted backward because this would violate the nonnegative liquid asset constraint. Hence the optimal consumption path for nondurables jumps at t^*+1 when the constraint is binding at t^* . The optimal consumption path for nondurables is the same in the case of the alternative constraint of nonnegative total asset holding.

By (7) and (8)

$$V_{D,t} - V_{D,t+1} = (1 + \beta)^t [\lambda_t - (1 - \delta)\lambda_{t+1}] \quad (16)$$

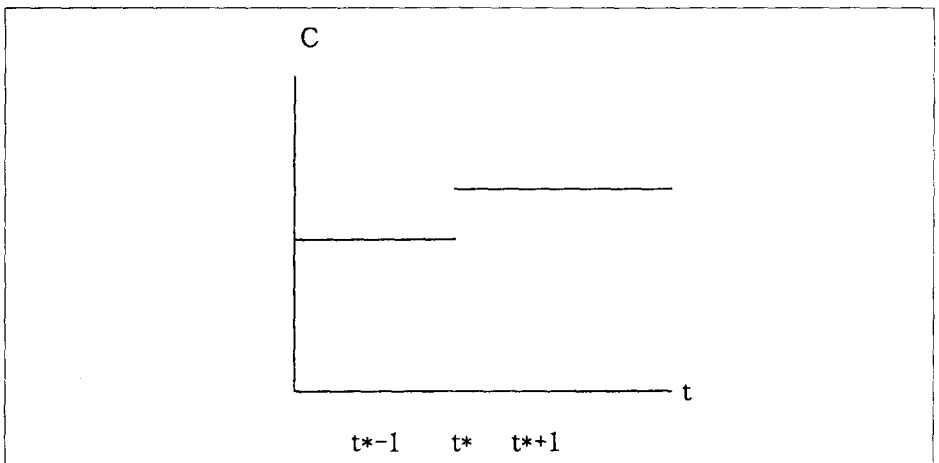
If t is one period lagged then

$$V_{D,t-1} - V_{D,t} = (1 + \beta)^{t-1} [\lambda_{t-1} - (1 - \delta)\lambda_t] \quad (17)$$

By adding (16) and (17),

$$V_{D,t-1} - V_{D,t+1} = (1 + \beta)^{t-1} [\lambda_{t-1} + (\beta + \delta)\lambda_t - (1 + \beta)(1 - \delta)\lambda_{t+1}] \quad (18)$$

[Figure 1a] Nondurables



⁵⁾ The step occurs at the t when the liquidity constraint is binding only at $t = t^*$ if A_{t^*} is the amount of liquid asset at the beginning of t .

If liquidity constraint is binding only at $t = t^*$, then $\lambda_{t^*} > 0$, $\lambda_{t^*-1} = 0$ and $\lambda_{t^*+1} = 0$. (16), (17) and (18) with these conditions are

$$V_{D,t^*-1} - V_{D,t^*} = -(1 + \beta)^{t^*-1} (1 - \delta) \lambda_{t^*} > 0$$

$$V_{D,t^*} - V_{D,t^*+1} = (1 + \beta)^{t^*} \lambda_{t^*} > 0$$

$$V_{D,t^*-1} - V_{D,t^*+1} = (1 + \beta)^{t^*-1} (\beta + \delta) \lambda_{t^*} > 0$$

Thus,

$$V_{D,t^*-1} < V_{D,t^*}$$

$$V_{D,t^*} > V_{D,t^*+1}$$

$$V_{D,t^*-1} > V_{D,t^*+1}$$

and

$$V_{D,t^*+1} < V_{D,t^*-1} < V_{D,t^*}$$

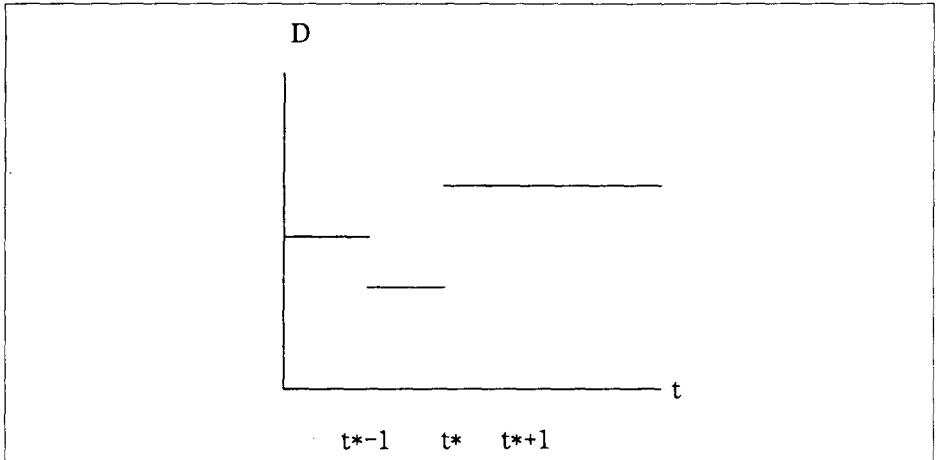
This implies that

$$D_{t^*} < D_{t^*-1} < D_{t^*+1} \quad (19)$$

With the constraint of nonnegative liquid assets holding, if liquidity constraints are binding at $t = t^*$, then the stock of durables at t^* is lower than at $t = t^* - 1$. It actually decreases at t^* and increases at $t^* + 1$. Thus, the period before an increase in income, a consumer will actually reduce his stock of durables. This behavior is optimal because by selling durables the consumer can substantially increase his financial assets while losing only one period's worth of the services from durables.⁶ Once the increase in income is realized, the consumer will increase his stock of durables to a new higher level.

Figure 1b shows those changes in the stock of durables in a different step function. One feature of durables is that it depreciates as time goes by. At the period liquidity is constrained, the value of durable stocks is very small and so is the services from it. However, the consumer cannot afford new one in period t^* because of the constraint of nonnegative liquid assets holding. Thus, if liquidity co-

⁶ For analysis, perfect resale market for durables is assumed so that durables can be sold and bought at the same price. Imperfect resale market for durables is discussed in Mishkin (1976).

[Figure 1b] Durables($A_t \geq 0$)

nstraint is binding at t^* , then a consumer optimizes his behavior rather by selling durables so that sacrificing only one period's worth of the services from durables and increasing his financial assets at t^* . When income is increased at t^*+1 , he will increase the stock of durables to a new higher level. This explains why D_{t^*} is lower than D_{t^*-1} and D_{t^*+1} is higher than D_{t^*} .

2. Optimal Consumption Paths with Total Asset Constraints: $A_t + D_t \geq 0$

Under this alternative specification of liquidity constraints, which requires non-negative total asset holding, durables are relatively easy to finance and less likely to cause constraints. There is no change in optimal path of nondurables, but (3), (7) and (11) will be changed as follows

$$A_t + D_t \geq 0 \quad (3)'$$

$$V_{D,t} (1+\beta)^{-t} - \xi_t + (1-\delta)\xi_{t+1} + \lambda_t = 0 \quad (7)'$$

$$(A_t + D_t)\lambda_t = 0 \quad (11)'$$

Thus, (17) becomes

$$V_{D,t-1} - V_{D,t} = (1+\beta)^t \lambda_t \quad (17)'$$

since $(1+\beta)^t > 0$, if the new borrowing constraint (3)' is binding only at $t = t^*$

so that λ_t is positive and $A_t + D_t$ is zero then

$$V_{D,t^*-1} > V_{D,t^*}$$

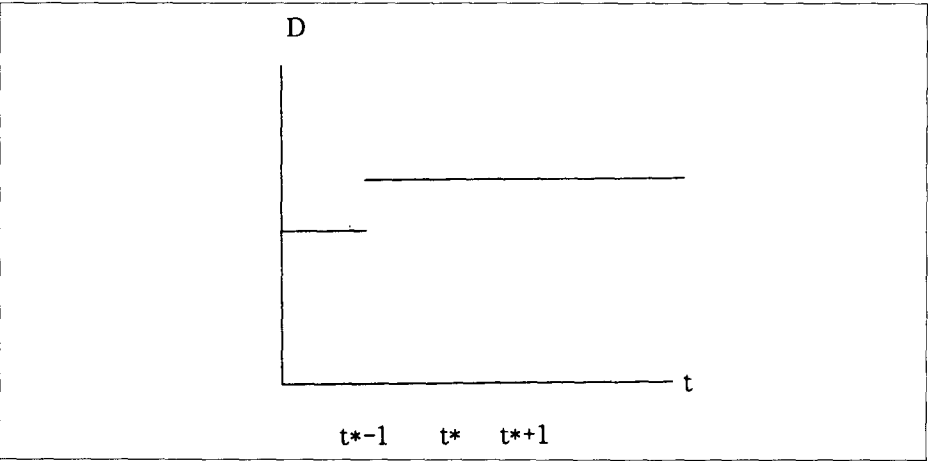
which implies

$$D_{t^*-1} < D_{t^*} \tag{19'}$$

If the new borrowing constraint (3)' is binding only at $t = t^*$, then the stock of durables will increase a period earlier than the increase in nondurables consumption. Thus, it increases at t^* , not t^*+1 . The period before an increase in income, a consumer will increase his stock of durables. This is optimal behavior since by purchasing durables in the current period he enjoys the services from durables but starts paying off the loan in the next period, when income is higher. With total asset constraints, durables can be financed by borrowing as long as total assets are nonnegative, so that the increase of durables a period earlier than the increase of nondurables is possible.

Figure 1c shows a similar step function as one in Figure 1a except that the jump (step) in the stock of durables occurs a period in advance. With the constraint of nonnegative total asset (sum of liquid and illiquid assets) holding, financing durables is relatively less restricted. Nevertheless, expenditures on the user cost of durables must be financed with current income. Therefore, durable consumption will not be constant over time. However, the period before an increase in income, it will be optimal to increase the stock of durables. Durables can be

[Figure 1c] Durables($A_t + D_t \geq 0$)



purchased as long as total asset is nonnegative. This fact allows the household to increase consumption for durables at the period in which liquidity constraint is binding. Thus the optimal path for durables jumps at the same time when constraint is binding.

III. CHANGES IN DURABLES CONSUMPTION SIGNAL CHANGES IN NONDURABLES CONSUMPTION

With either specification of liquidity constraints, the change in optimal consumption for durables occurs earlier than the change in optimal consumption for nondurables. With the constraint that liquid assets be nonnegative, durables and nondurables have a negative relationship so that a decrease in durables indicates a subsequent increase in nondurables. By contrast, durables and nondurables have a positive relationship, with the constraint that total assets be nonnegative so that an increase in durables indicates a subsequent increase in nondurables. This relationship suggests that an observed change in the stock of durables has a predictive power for the changes in nondurables consumption. In particular, it contradicts the random walk hypothesis which implies that nothing can anticipate the change in nondurable consumption when either form of liquidity constraints is binding. Therefore, these are potentially important results for testing the LC-PIH and liquidity constraints.

One implication derived above is that in the absence of liquidity constraints, the LC-PIH implies that nondurable consumption cannot be predicted by anything except previous nondurable consumption, while with both types of liquidity constraints, the lagged change in durable stocks signals the change in nondurable consumption.

The other implication concerns the form which liquidity constraints take. If changes in durable consumption are negatively correlated with nondurable consumption, this suggests that liquidity constraints take the form of a restriction on the holding of negative liquid assets. Alternatively, if the durable and nondurable consumption relationship is positive, liquidity constraints are more appropriately specified as a constraint that total assets be nonnegative.

IV. CONCLUDING REMARKS

This paper examines the consumption behavior for both durables and nondurables in the presence of liquidity constraints. I analyze the consumption behavior under the simple model with two types of liquidity constraints.

With a typical constraint of nonnegative liquid asset holding, the lagged change of durable consumption has negative effect on the change of nondurable consumption. If liquidity constraint is binding today, then the decrease of durable stocks from yesterday to today has a predictive power for the increase of nondur-

ables from today to tomorrow. On the contrary, with the constraint of nonnegative total asset holding, durables have a positive effect, which means the increase of durable stocks from yesterday to today has a predictive power for the increase of nondurables from today to tomorrow.

Therefore in this simplified model, the change of nondurables can be predicted by the change of durable stocks and the random walk hypothesis for nondurable consumption does not seem to hold when liquidity constraints are binding. This doesn't mean that consumers do not optimize their consumption plans through their lifetime at all. Consumers are not able to smooth their consumption paths only over the periods in which liquidity constraints are binding. They smooth out their consumption behaviors within each finite horizon which is shorter than lifetime period. In addition, testable implication such that the form of liquidity constraints can be either liquid asset constraints or total asset constraints is considered. In each constraints, the change in durables has a different effect on the change in nondurables.

Testing these implications for the LC-PIH and liquidity constraints will be a future research. If the significance of the change of durable stocks for the change of nondurable consumption is found in empirical studies then the right form of liquidity constraints can be selected by testing the direction of effect of durables on nondurables. For convenience, certainty and other simplifications are assumed in this model. These can be relaxed in more complete studies in the future.

REFERENCES

- Bar-Ilan, A. and Blinder, A. (1990): "The Life-Cycle Permanent-Income Model and Consumer Durables," in *Inventory Theory and Consumer Behavior* by A. Blinder, Harvester Wheatsheaf, 257-276.
- Bernanke, B. (1984): "Permanent Income, Liquidity, and Expenditure on Automobiles: Evidence from Panel Data," *Quarterly Journal of Economics*, Aug.:587-614.
- Bernanke, B. (1985): "Adjustment Costs, Durables, and Aggregate Consumption," *Journal of Monetary Economics*, 15:41-68.
- Deaton, A. (1992): *Understanding Consumption*, Oxford University Press, Oxford.
- Flavin, M. (1981): "The Adjustment of Consumption to changing Expectations about Future Incomes," *Journal of Political Economy*, 89:974-1009.
- Flavin, M. (1985): "Excess Sensitivity of Consumption to Current Income: Liquidity Constraints or Myopia?", *Canadian Journal of Economics* 18, 117-36.
- Hall, R. (1978): "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence," *Journal of Political Economy*, 86:971-984.
- Hall, R. and Mishkin, F. (1982): "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Individuals," *Econometrica*, Mar.:461-481.
- Hall, R. (1989): "Consumption," in Robert J. Barro ed., *Modern Business Cycle Theory*, Basil Blackwell, 153-177.
- Hayashi, F. (1985): "The Effect of Liquidity Constraints on Consumption: A Cross-section Analysis," *Quarterly Journal of Economics*, Feb.:183-206.
- Hayashi, F. (1987): "Tests of Liquidity Constraints: A Critical Survey and Some New Observations," in Truman F. Bewley ed., *Advances in Econometrics: Fifth World Congress*, 2, 91-120.
- Heller, W. and Starr, R. (1979): "Capital Market Imperfection, The Consumption Function, and The Effectiveness of Fiscal Policy," *Quarterly Journal of Economics*, Aug.:455-463.
- Jappelli, T. (1990): "Who Is Credit Constrained in the U. S. Economy?", *Quarterly Journal of Economics*, Feb., 219-234.
- King, M. (1985): "The Economics of Saving: A Survey of Recent Contributions," in *Frontiers Of Economics*, ed. by K. Arrow and S. Honkapohja, New York, NY, Basil Blackwell.
- Mankiw, G. (1982): "Hall's Consumption Hypothesis and Durable Goods," *Journal of Monetary Economics*, 10:417-425.
- Mankiw, G. (1985): "Consumption Durables and the Real Interest Rate," Re-

view of Economics and Statistics, 10:353-392.

Mankiw, G., Rotemberg, J. and Summers, L. (1985): "Intertemporal Substitution in Macroeconomics." *Quarterly Journal of Economics*, Feb:225-251.

Mishkin, F. (1976): "Illiquidity, Consumer Durable Expenditure, and Monetary Policy," *American Economic Review*, Sep.:642-654.

Zeldes, S. (1989): "Consumption and Liquidity Constraints: An Empirical Investigation," *Journal of Political Economy*, Apr.:305-346.