THE INTERTEMPORAL
ALLOCATION OF CONSUMPTION:
THEORY AND EVIDENCE

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ABSTRACT

Liquidity constraints and, more generally, imperfections in credit markets, can be extremely important for the intertemporal allocation of consumption and have received a substantial amount of attention in the theoretical and empirical literature on consumption. In the first part of the paper I review the reasons why liquidity constraints are important.

Unfortunately, for several reasons, it is not easy to test for the presence of liquidity constraints. Aggregation issues preclude the use of aggregate time series data for such a purpose. Tests based on micro data, however, are complicated by some serious identification problems. If a simple equilibrium model does not fit some data set, one can change the assumptions about the opportunity set available to the economic agents or the specification of their preferences. For instance, empirical evidence that detects excess sensitivity of consumption to income could be explained by liquidity constraints or by non separability between consumption and leisure. However, the available evidence shows that it is possible to find flexible specifications of preferences that fit consumption movements at business cycle frequencies. I also present some simulation evidence that shows that for many plausible parameter configurations, liquidity constraints are likely to be relevant only for a small proportion of economic agents.

In the last part of the paper I present some new evidence on the relevance of liquidity constraints based on debt holding data. The data indicate that the demand for debt of individuals more likely to be liquidity constrained is less elastic to changes in the interest rate.

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Introduction

The determinants of aggregate and individual consumption have always attracted a considerable amount of attention. While from a theoretical point of view the life cycle model constitutes the most appealing and flexible framework to study consumption, there is no widespread agreement among economists on the empirical relevance of the model. Yet, establishing whether the life cycle model represents a reasonable approximation of consumer behavior and which, if any, modifications to the simplest version of the model need to be considered to fit the available evidence is of crucial importance for a number of important policy issues.

The two crucial elements in the analysis of consumption (as in most models of economic behavior) are the characterization of agents' preferences and of their opportunity set. The life cycle model sets consumers in a dynamic framework and provides the applied researcher with an empty box which should be filled with appropriate assumptions about preferences, expectations formations and so on. While rational expectations and expected utility maximization have become the standard paradigm, no consensus has emerged about the preference specifications that are necessary to fit observed behavior. Several issues, including intertemporal separability of preferences, aggregation across commodities, (non) separability between consumption and leisure, the effect of changing family composition on preferences, unobserved heterogeneity, and so on, have to be tackled.

The opportunity set available to consumers and in particular the kind of assets they can use to allocate resources over time has been a matter of considerable controversy. A wide range of hypotheses can be found in the literature. On one extreme, some economists have assumed the existence of perfect insurance markets which allow all consumers in the economy to diversify idiosyncratic risk completely by writing perfect contingent contracts. This hypothesis is attractive from a theoretical point of view for a number of reasons and has recently received a considerable amount of attention from empirical researchers. On the other extreme, consumers are assumed to be liquidity constrained in that they cannot hold negative amounts on any assets and therefore cannot borrow against future resources.

In this paper I argue that, from an empirical point of view, it is extremely difficult to separate the specification of preferences from the specification of the opportunity set available to an individual. Furthermore, I argue that it is extremely difficult, if not impossible, to test hypotheses about the assets available to an individual using either micro- or macro- economic data. One needs

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extremely strong and untestable identification assumptions and extremely rich data sets to be able to say anything on these issues. These considerations apply both to tests of the perfect insurance hypothesis and to test of the liquidity constraints hypothesis.[1]

The message of this paper is not completely negative, however. I argue that with enough identifying assumptions one can use available data sources to establish the plausibility of different market structures. The exercise I propose is not completely vacuous in that to fit the available data, one might be forced to make a number of more or less unrealistic assumptions which may lead the researcher to disregard the model under study for policy analysis. On the other hand, one might be able to fit the available data with reasonable assumptions about preferences and opportunity sets and, at the same time, obtain plausible values for the structural parameters. Under these circumstances, the theoretical model constitutes a useful framework to characterize and describe the data and is potentially useful for policy analysis. In addition, given an assumed market structure and estimated preference parameters, one can establish to what extent certain constraints are likely to be binding.

As stressed above, these problems are relevant for both the perfect insurance and the liquidity constraints paradigm. In what follows, however, I focus on the literature on liquidity constraints. I consider different versions and different implications of the hypothesis and discuss part of the available evidence. In the final section of the paper, I present and discuss some new evidence. I argue that even with detailed data on asset holdings, finance charges, consumption, labor supply and income, it is difficult to distinguish between different hypotheses.

The rest of this paper is organized as follows. In the next Section, I define liquidity constraints and discuss their importance and their implications within the framework of a general intertemporal optimization model. In the following Section, I discuss what can be learned about the presence of liquidity constraints from aggregate time series data. I the pose the same question for micro data. Finally, I present a new test for the presence of liquidity constraints which uses uses data on vehicle loans. The paper ends with some general considerations.

Liquidity constraints : theory

In this section, I define what is meant by liquidity constraints and discuss their importance. I

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[1] This argument is related to the discussion in Heckman and MaCurdy (1988) on the observational equivalence of equilibrium and 'disequilibrium' labor market outcomes. However, my characterization of the problem is not as negative as theirs.

present a fairly general intertemporal model which can be used to sketch some potentially testable implications of liquidity constraints.

What is it meant by liquidity constraints?

In this paper, I consider two possible definitions of liquidity constraints.[2] According to the first, an individual or a household is unable, for whatever reason, to borrow against future earnings beyond a certain limit (which can be positive or zero).[3] In general, the limit itself can be endogenous.[4] As a consequence, the first- order condition which describes the intertemporal allocation of consumption typically relates the expected marginal utility of consumption in two different time periods to the relative price of consumption, does not hold as an equality *if the restriction is binding.*

The second definition is weaker and considers as liquidity constrained individuals who face a difference between borrowing and lending interest rates or, more generally, individuals for whom interest rates are not independent of their net asset position. [5]

In this case, the expected value of the discounted marginal utility of wealth is equal to the current marginal utility of wealth for all those consumers with non- zero net assets. However, the interest rate used to discount future marginal utility is the borrowing rate for borrowers and the lending rate for lenders. Only for those individual with a zero net position does the first order condition hold as an inequality. More generally, if the rate depends in a continuous fashion on the net asset position, the intertemporal first order condition will have to take into account these effects explicitely. [6]

The situation is even more complicated if one considers the possibility of borrowing against a lumpy investment (house, automobile) whose services are obtained slowly over time or one considers assets which provide liquidity services. In these cases, as discussed by Juster and Shay (1964), there

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[2]   I will not discuss the motivation for the existence of liquidity constraints. The standard argument for the presence of rational liquidity constraints on the supply side appeals to asymetric information and adverse selection problems. See Stiglitz and Weiss (1981).

[3]   Indeed if one considers institutional saving such as social security contributions, it might even be negative.

[4]   See Alessie et al (1989) and Weber (1993).

[5]   See, for instance, Pissarides (1978) and Altonji and Siow (1987). Obviously, one can obtain the former definition from the latter if one lets the borrowing interest rate at the borrowing limit go to infinity.

[6]   If we introduce a limit to the amount one can borrow *at any rate*, all individuals borrowing the limit will be characterized by a slack condition.

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might be several kinks in the intertemporal budget constraint. [7]

Fixed costs on some asset transactions might also be considered as liquidity constraints. Access to some forms of wealth can be extremely costly (housing wealth) or even impossible before a certain age (pension wealth) [8].

The presence of liquidity constraints has been appealed to as a possible explanation of the observed correlation between expected consumption and income. Indeed, in many empirical papers the hypothesis of liquidity constraints has been tested by looking at such a correlation. It is therefore worth stressing that, under rational behavior, there is no general presumption that households facing liquidity constraints consume their current labor income and that an increase in disposable income would be entirely reflected in an increase in consumption. For this to be true, these constraints must be binding; individuals must be at a corner. Under the first definition this means that individuals must want to consume more than what they earn and must have run down their net asset positions. Under the second definition, individuals must hold a zero asset position. [9] Only under these conditions will liquidity constrained individuals consume their current disposable income.

This does not mean, however, that if liquidity constraints are not binding consumption behavior is unaffected. Indeed, as Hayashi (1987) clearly argues, the expectation of a future binding liquidity constraint with a zero borrowing limit is equivalent to a shortening of the planning horizon of the consumer. These effects, however, cancel out when we consider first differences of discounted marginal utilities, except in those periods in which the constraint is actually binding. This seriously limits, as stressed by Deaton (1992), the ability to detect the presence of liquidity constraints using the Euler equations which characterize the intertemporal allocation of consumption.

To derive the behavioral implications of the presence of liquidity constraints and to discuss possible tests of this hypothesis, it is useful to consider a general and flexible model of intertemporal optimization. It is to this that I turn now.

A flexible dynamic model of consumption

In this subsection, I introduce a flexible dynamic optimization model which can be used to

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[7]   See also Jackman and Sutton (1982).

[8]   For the discussion at hand, however, the kind of liquidity constraints discussed above are more important. Even though some assets might be affected by transaction costs, the Euler equation for those that are not holds as an equality in the absence of liquidity constraints.

[9]   In both case the increase in income should not be as large as to change them into net savers.

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sketch some of the implications of the two definitions of liquidity constraints given above. Consider the following optimization problem for a generic household. [10]

$$(1) \qquad Max \sum_{j=1}^{T-t} E_t \phi(Z_{t+j}) U(c_{t+j}, l^1_{t+j}, l^2_{t+j}, K_{t+j}, Z_{t+j}) \quad s.t.$$

$$(2) \qquad \sum_i^N A^i_{t+j+1} = l^1_{t+j} w^1_{t+j} + l^2_{t+j} w^2_{t+j} - c_{t+j} - p^k_{t+j} c^k_{t+j} + \sum_i^N A^i_{t+j}(1 + R^i_{t+j})$$

$$(3) \qquad K_{t+j+1} = (1 - \delta) K_{t+j} + c^k_{t+j}$$

$$(4) \qquad l^s \geq 0 \quad s = 1, 2$$

where c is non durable consumption, l^1 and l^2 are the husband's and wife's labor supplies, w^1 and w^2 are the respective real wage, K and c^k are the stock and expenditure on durables, p^k is the price of durables, A^i and R^i are the stock and the (ex-post) real interest rate on the i-th of N available assets and Z is a vector of variables which affect preferences. The function $\phi()$ can be interpreted as a discount factor. The price of non durable consumption is normalized to unity. For notational simplicity, all quantities are real so that we do not have to worry about inflation. Preferences are assumed to be intertemporally separable; the within period utility function depends on consumption of non- durables, the services of durables and leisure, possibly in a non separable fashion. The household can invest or (in the absence of liquidity constraints of the first type) borrow in N different assets. The interest rate on asset i is time varying. Equation (2) is the intertemporal budget constraint. Equation (3) describes the process of accumulation of the stock of durables which are assumed to depreciate at a constant rate δ. Equation (4) states that labor supply cannot be negative [11].

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[10] MaCurdy (1981) considers a very general model which also allows for human capital accumulation and taxes, both of which I ignore here. The model can also be generalized in other ways. For instance, one can make interest rates a function of the net asset position or introduce multiple non durable and durable commodities.

[11] Consumption and leisure hours also have to be positive. It is usually assumed that preferences are such that these constraints are never binding. Such an assumption is not plausible for durable consumption; therefore, it would be desirable to consider the possibility of a corner solution in the stock of durables.

If one ignores the possibility of liquidity constraints, one can derive, for each of the N assets, N Euler equations which relate the marginal utility of non durable consumption across time periods.

$$\phi(Z_t)U_c(c_t, l_t^1, l_t^2, K_t, Z_t) =$$

(5) $\qquad E_t[U_c(c_{t+1}, l_{t+1}^1, l_{t+1}^2, K_{t+1}, Z_{t+1})\phi(Z_{t+1})(1 + R_{t+1}^i)]; \qquad i = 1, ...N$

Similar conditions can be derived in terms of the marginal utility of an additional unit of durable stock, the only complication being that these marginal utilities will depend on future quantities because of the durability of K. [12]

In addition to the intertemporal conditions, one can derive intratemporal first order conditions which relate durable and non durable consumption as well as consumption and labor supply. The latter relate the marginal rates of substitution between consumption and leisure (of husband and wife) to the real wage and will hold either as equalities if the non-negativity constraints (4) are not binding or as strict inequalities if those constraints are indeed binding.

(6) $\qquad\qquad\qquad\qquad U_c(.)w^s \geq U_{l^s}(.), \qquad s = 1,2$

When one has several assets one can model the first kind of liquidity constraint as a limit on the total net worth:[13]

(7) $\qquad\qquad\qquad\qquad \sum_i^N A_{t+j}^i \geq M$

where M is, for the time being, exogenous. The constraint (7) involves a modification of the first order condition (5) in that one has to consider the possibility that the inequality is binding.

$$\phi(Z_t)U_c(c_t, l_t^1, l_t^2, K_t, Z_t) =$$

(5') $\qquad E_t[U_c(c_{t+1}, l_{t+1}^1, l_{t+1}^2, K_{t+1}, Z_{t+1})\phi(Z_{t+1})(1 + R_{t+1}^i)] + \mu_t; \qquad i = 1, ...N$

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[12] If one considers multiple commodities and inflation explicitly, it is possible to derive an Euler equation for each commodity. The 'real' interest rate relevant for each of these equations will involve the inflation rate of the relevant price index.

[13] We can also consider constraints on single assets. The Euler equation, however, will hold for those assets that are not subject to the liquidity constraint.

where μ_t is a Kuhn-Tucker multiplier which is zero if (7) is not binding and is positive when $\sum_i^N A^i_{t+j} = M$. If, in addition, one considers asset specific restrictions, one should add to equation (5') asset specific Kuhn-Tucker multipliers. [14]

Several clarifications are in order. First of all, as noticed by Juster and Shay (1964), Zeldes (1989) and Runkle (1991), the Euler equation will hold as an equality only for those consumers for which inequality (7) is not binding. It is obviously possible that the Kuhn- Tucker multiplier μ_t in equation (5') is, *when different from zero*, correlated with lagged or current expected income. However, this is not the only reason why expected income could enter equation (5'). As noted by Heckman (1974) in response to a paper by Thurow (1969), the life cycle consumption model does *not* necessarily predict the lack of correlation between consumption and income growth, if leisure affects the marginal utility of consumption. It should, therefore, be stressed that the interpretation of an eventual correlation between consumption and income as a symptom of the presence of liquidity constraints depends crucially on the assumption that consumption and leisure are separable in the within period utility function.

It is interesting to note that the presence of liquidity constraints can distort the intratemporal allocation of consumption and leisure. When the amount that can be borrowed depends on earnings, this is obvious (see Alessie et al. (1989) and Weber (1993)). However, even when this is not the case it is possible that a household in which either the husband or the wife would be at a corner in the absence of liquidity constraints, would change its behavior as a consequence of the inability to transfer resources from the future to the present because of the liquidity constraints. In other words, that husband or wife might be induced to enter the labor force as a consequence of the liquidity constraint. [15] This proposition can be easily proved in a two-period model without uncertainty. It is also possible to construct reasonable examples in which this effect can be important for female labor force participation.

Similar considerations apply to the intratemporal conditions which relate the consumption of durables and non-durables. As stressed by Jackman and Sutton (1982), Brugiavini and Weber (1992) and Chah, Ramey and Starr (1991), the effects that liquidity constraints have on the relationship between durable and non durable consumption are affected on the one hand by the

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[14] Note that, if the restriction is on net financial wealth and there are at least two assets which are held in non zero quantities and for which there are no specific constraints, one could eliminate μ_t by taking the difference of equation (5') for the two assets. This fact could be exploited to test the importance of the Kuhn-Tucker multiplier μ_t.

[15] This observation is made, in a fairly informal way, by O'Brien and Hawley (1986).

durability of K and on the other by the fact durables can be collateralized. If the first effect is stronger (maybe because only a small portion of the durable stock can be collateralized), the presence of liquidity constraints will distort the intratemporal allocation in favor of non durables, while the opposite is true when a large part of the stock of durables can be collateralized. The reason for this result is intuitive. When durables cannot be collateralized they aggravate an eventual liquidity constraint because they involve an expenditure which does not give rise to consumption immediately (because of durability) in a period in which the marginal utility of consumption is unusually high. When durables can be collateralized, however, this alleviates the liquidity constraint.

If one relaxes the hypothesis of intertemporal separability, as in Meghir and Weber (1993), other implications of liquidity constraints can be derived. If preferences are defined over several non durable and non collateralizable commodities, one can exploit the fact that the presence of liquidity constraints affects intertemporal but not intratemporal first order conditions. Therefore, the presence of dynamic effects in Euler equations (which could be rationalized by time non separability), must be reflected in the intratemporal first order conditions. In addition, if preferences are not time separable, Meghir and Weber (1993) show that it is possible to identify all the structural parameters from the intratemporal condition. It is therefore possible to test the equality of the parameter estimates obtained from the intratemporal and from the intertemporal first order conditions.

Why are liquidity constraints important and what are their implications?

The life cycle - permanent income model of Modigliani and Brunberg (1954) and Friedman (1957) was partly conceived as an alternative to the Keynesian consumption function which relates consumption to current disposable income. The life cycle - permanent income theory has the advantage of being conceptually more appealing and seems to be able to explain a number of empirical puzzles both in macro and micro data, such as the difference between short-run and long-run propensity to consume and the difference in saving rates by income classes of white and black households. The immediate and obvious implication of the theory is that consumption does not depend on current disposable income and therefore changes in fiscal policy might have very different aggregate effects than those predicted by the Keynesian model.

Among the first to discuss the effects of capital market imperfections on the aggregate consumption function were Flemming (1973) and Tobin and Dolde (1971). Flemming (1973) clearly

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argues that the inability to borrow against future income might cause consumption, in the short run, to depend on current disposable income. However, he stresses that "[t]he aggregate consumption function implied by imperfect capital markets depends on the way in which the distribution of income deviations generate 'distribution effects'. A simple permanent-income-type distributed lag consumption function may well fit the data better than any *ad hoc* alternative not designed to reflect a specific hypothesis about the distribution of income." (p. 163). He also points out that the aggregate marginal propensity to consume depends on the proportion of income fluctuations that are concentrated on people with low levels of assets and for whom it is "virtually impossible .... to borrow against future earnings." (p. 166)[16]

Tobin and Dolde (1971) present a simple life cycle model which is simulated to illustrate the importance of liquidity constraints for the aggregate effects of fiscal policy. They allow for individual heterogeneity (in that they consider individuals with different levels of resources) and conclude that liquidity constraints 'make a difference' (p.135) in that the marginal propensity to consume out of available resources is much higher than it would be without constraints. They also study changes in the tightness of liquidity constraints induced by monetary policy. [17]

Imrohoroglu (1989) assesses the welfare cost of liquidity contraints within the framework of an equilibrium model with infinitely lived agents. She considers both the case in which agents are prevented from borrowing and that in which they face different lending and borrowing rates. She finds that the inability to insure idiosyncratic risk decreases welfare substantially relative to the case of perfect insurance. Obviously, the magnitude of the welfare loss depends on the curvature of the utility function and on the variability of the idiosyncratic shocks. She also finds that introducing the possibility of borrowing, although at interest rates higher than those available to savers, reduces considerably the welfare loss. [18]

Another issue that has received some attention and for which the possible presence of liquidity constraints is important is that of Ricardian equivalence. In a much quoted article Barro (1974) claims that government debt should not be considered net wealth as rational dynasties will antici-

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[16] Flemming (1973) also discusses some informal empirical evidence on the two issues that he thinks important: to what extent changes in labor income are related to changes in hours and to changes in employment and what is the average level of assets that newly unemployed individuals could use to maintain a certain level of consumption.

[17] Tobin and Dolde (1971) do not consider uncertainty. They model liquidity constraints both as a difference in lending and borrowing rates and as a limit in the amount it can be borrowed.

[18] Hansen and Imrohoroglu (1992) consider the effects on the welfare cost of introducing unemployment insurance in a model with borrowing restrictions. Imrohoroglu, Imrohoroglu and Joines (1993) consider social security schemes in an 65 period overlapping generations model.

pate the future taxes necessary to re-pay it; in this respect fiscal policy is neutral. As Tobin (1980) forcefully stressed, the presence of liquidity constraints might give fiscal policy an important role in that it provides liquidity constrained households the means by which to move resources from the future to the present.

Hubbard and Judd (1986) show how liquidity constraints are important for "the welfare costs of taxation..." and "for the debate over the impact of temporary tax cuts financed by debt." In particular, with the help of numerical simulations, they show that, in the presence of liquidity constraints, a reduction in capital taxation and an increase in labor taxation is not necessarily welfare improving and that the Ricardian proposition does not necessarily hold. [19]

In my opinion, the main reasons to worry about the presence of liquidity constraints and some of their implications can be summarized as follows.

(i) In the presence of binding liquidity constraints some individuals will be unable to smooth consumption over time and therefore the marginal propensity to consume out of available current resources would be higher than predicted by the life cycle model. This has obvious implications for the aggregate effects of changes in taxation or, more generally, shocks to disposable income. It should be clear, however, that even if liquidity constraints are important, there is no stable relationship between changes in current aggregate disposable income and consumption. The marginal propensity to consume out of disposable income will depend on the importance and the tightness of liquidity constraints, on which sectors of the population are affected by the change in disposable income, and on the timing and sign of the income shock. An aggregate consumption function which ignores these aspects would be inherently unstable.

(ii) Liquidity constraints affect *changes* in consumption only if and when they are binding. The *levels* of consumption, however, will be affected even by non-currently binding constraints. The severity of liquidity constraints depends on two things: the dynamic behavior of earnings and the specification of intertemporal preferences. The ways in which preferences and liquidity constraints can interplay to affect consumption levels and saving are many. Impatient consumers are more likely to be constrained. On the other hand, as stressed by Carroll (1992), consumers with a strong precautionary motive might be given an additional incentive to save by the impossibility to borrow in the event of a negative income shock sometime in the future. More generally, both

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[19] Scheinkman and Weiss (1986) construct a general equilibrium model with borrowing constraints which is able to generate a fairly rich dynamics which reproduces some important features of actual business cycles. They also stress the implications that liquidity constraints have for the volatility of asset prices.

Deaton (1991,1992) and Carroll (1992) stress how the behavior of impatient consumers with strong precautionary motives is similar to that of liquidity constrained consumers. Impatience prevents them from accumulating much wealth, on the other hand, prudence prevents them from having very low (or negative) amounts of wealth.

(iii) The presence liquidity constraints can increase the steady state aggregate saving rate. Jappelli and Pagano (1994) present an overlapping generation model in which this happens.

(iv) The welfare consequences of liquidity constraints depend on their nature, the extent to which they are binding, the variability of idiosyncratic shocks and the technology available for self-insurance.

(v) Once one admits the importance of liquidity constraints, the Ricardian equivalence proposition loses relevance. Indeed, government debt could be a way of transferring resources from the future to the present, a possibility prevented by the presence of liquidity constraints. The effects of introducing funded or unfunded social security schemes also depend on the relevance of liquidity constraints.

(vi) There are two conceptually distinct ways in which liquidity constraints can affect aggregate consumption and saving, both related to the reasons why individuals might want to transfer resources from the future to the present. On the one hand, young individuals facing steep earning-age profiles might want to borrow against future earnings. On the other, individuals with low levels of assets might find it difficult to smooth temporary negative shocks to their earnings during downturns of the business cycle. For the purpose of policy analysis, the characterization of preferences and of the dynamic and stochastic properties of income for various demographic and economic groups is as important as establishing the study of the financial institutions and arrangements that characterize different economies. [20]

Differences in consumption behavior over time and across countries have often been explained by the different development of financial markets (Jappelli and Pagano (1989, 1994)). Muellbauer and Murphy (1990), Miles (1992), Attanasio and Weber (1994a) all stress the importance that the process of financial liberalization has had in explaining the increase in the average propensity to consume in the late 1980s in the UK.[21] Guiso, Jappelli and Terlizzese (1991) argue that a possible

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[20] The inability to smooth shocks might not necessarily be an indication of liquidity constraints. Suppose that a shock affects everybody in the economy exactly in the same fashion and suppose that there is no technology to transfer resources intertemporally. Consumption, in such a situation, would necessarily absorb the shock. However, in a general equilibrium context, this would be reflected in a movement in the interest rate.

[21] The institutional aspects of the process of financial liberalization are discussed in Davies and

explanation of the high saving rate of Italian households is the scarce development of financial markets in Italy where even borrowing against real estate is extremely difficult and costly. A similar explanation has been advanced to explain the high saving rates observed in Taiwan and South Korea.

The importance of differences in preferences in a stochastic environment is harder to establish. To give an idea of the problems involved in the next subsection I present some evidence based on some simulations.

On the relevance of liquidity constraints: some simulation evidence

The dynamic problem discussed in section II.B does not have an analytical solution unless one is willing to make very strong assumptions about preferences and the nature of uncertainty. A closed form solution for consumption, however, would be extremely useful to assess the importance and likely relevance of liquidity constraints. One would like to establish what kind of mean earning profiles, earning variability, preferences, and so on, make liquidity constraints likely to be binding over the life cycle and over the business cycle. The solution that a number of authors have used is to simulate the model with plausible parameter values. The papers by Deaton (1991), Carroll (1992) and Hubbard, Skinner and Zeldes (1993) are examples of this. In this subsection I present the results of some simulations. A complete analysis of how the effects of liquidity constraints differ with changes in preference and technology parameters is beyond the scope of this paper. The objective of this section is to characterize the configurations of preferences (and in particular discount factors and risk aversion parameter), earning profiles and their variability, institutional arrangements and demographic changes that are likely to make liquidity constraints binding. The simulations derive the optimal consumption rule for a given set of preference and technology parameters *in the absence* of liquidity constraints. I want to characterize the configurations of preferences and income profiles under which the solution would need to be changed in the presence of liquidity constraints. The three main limitations of this analysis are: (i) no attempt is made to model consumption behavior when liquidity constraints are indeed binding; (ii) labor supply choices and, therefore, income are considered as exogenous; (iii) the analysis is partial equilibrium in nature as interest rates are taken as exogenous.

I solve the model using an algorithm developed in Attanasio et al. (1994). The method is similar to that of Deaton (1991) and Carroll (1992), but is slightly more general in that it allows

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Weber (1991).

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for a more flexible income process and preference structure.

I assume that utility is intertemporally separable and that the within period utility function depends on household consumption. However, I allow the within period utility to depend on the number of 'adult equivalents' present in the household.

$$(8) \qquad U(C_t, N_t) = \frac{1}{1-\gamma} (\frac{C_t}{N_t})^{1-\gamma}$$

where C is household consumption and N is the number of adult equivalents. No effort is made to estimate adult equivalent schemes in a rigorous fashion. N_t is computed counting each adult beside the head as 0.8, a child between 16 and 17 as 0.6 and each additional child as 0.5. [22]

In what follows, I simulate the behavior of many identical households with an average age-profile for the number of adult equivalents. I obtain such a profile by first computing the average number of 'adult equivalents' N_t in each year-cohort cells and then smoothing these averages. The smoothing procedure involves regressing the year- cohort averages on a third degree polynomial in age and cohort specific intercepts. [23]

The 'household' is assumed to live for 50 years, being 'born' at age 25 and dying with certainty at age 75. I assume that the 'household' receives labor income until age 65 and retirement income after that. Labor income is given by a deterministic trend T_t^e and by a stochastic component W_t. The deterministic component depends only on the educational attainment of the household head and on his/her age. The stochastic component, consistently with the micro evidence presented by MaCurdy (1983) and Abowd and Card (1986) is given by the following process:

$$(10) \qquad \Delta log(W_t) = \epsilon_t + \theta \epsilon_{t-1}$$

where ϵ_t is normally distributed with variance σ^2. [24]

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[22] The specification of the utility function in equation (8) is quite restrictive. Attanasio et al. (1994) implicitely estimate the relevant adult equivalent scheme in that demographic variables are introduced as determinats of the marginal utilily in the Euler equation and their coefficients are estimated. The implied age profiles for the effect of demographics on the marginal utility of consumption estimated by Attanasio et al. (1994) are not qualitatively different from those used in this paper.

[23] Given the non linearity of the consumption function a more interesting excercise would be that of simulating the consumption of households with different adult equivalent age profile and aggregate their behavior.

[24] When $\theta \neq 0$ the problem has two rather than one state variables. This complicates the computation of the solution considerably. In what follows, I only report simulations with $\theta = 0$. Attanasio et al. (1994) consider the more general case.

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The deterministic component of household income is modeled (up until retirement) as a third degree polynomial in age and is calibrated for four different education groups using data from the Consumer Expenditure Survey. After retirement it is equal to a constant calibrated from the same data. Retirement income is given by the product of the deterministic component and by a the realization of the random component of income at age 64. After age 64, therefore, there is no income uncertainty.

The 'pure' discount factor and the real interest rate are fixed at 0.03. The model can be easily generalized to allow for stochastic interest rates. It should be stressed that the only source of uncertainty in this model i about income. The model is easily generalized to incorporate uncertain lifetime. It is also possible to allow for stochastic utility and wealth shocks, which could be interpreted as shocks to health status.

I obtain the solution by backward recursion. Last period consumption function is obtained from the assumption that the household does not leave bequests. For the remaining periods, the consumption function is derived from the Euler equation. Because of the non-stationarity of labor income, I solve the model, for each age, in terms of the ratio of consumption to current income. Details on the solution method can be found in Attanasio et al. (1994).

I solve the model for four different education groups: high school dropouts, high school graduates, those with some college education and college graduates. Preference parameters are kept constant across the education groups. Income and family compositions, however, differ. In figures 1 and 2, I plot the age profiles for labor income and adult equivalents used in the simulations for the four education groups. Notice the differences in scale and that both income and family composition profiles are steeper for college educated individuals.

In Figures 3 to 5, I report the results obtained for the four education groups for different values of the coefficients of risk aversion and of income uncertainty. Several features emerge clearly (and not completely unexpectedly) from the simulations.

First, the shape of the consumption age profile reflects that of number of adult equivalents plotted in Figure 2. In particular, the model is able to generate the hump-shaped consumption age profile observed in the data. Because there are differences across education groups in the life cycle pattern of family composition, there will be corresponding differences in the pattern of life cycle consumption. [25]

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[25] Indeed, Attanasio et al. (1994) show that some of the differences in the observed consumption age profiles across education groups are explained by differences in demographic variables. This

Second, for relatively low values of uncertainty and risk aversion there is a relatively high demand for borrowing in the early part of the life cycle. This is obviously caused by the desire to smooth a very uneven income profile. The pattern of family composition reduces, to a certain extent, the necessity to borrow against future resources. However, because family composition peaks before income, there will be still a strong incentive to transfer resources from the future. This implies that an eventual liquidity constraint could have potentially strong effects.

Third, increasing the level of uncertainty decreases the desire to borrow. This decrease is caused by the precautionary motive for saving. For instance, when one compares Figures 3 and 4 one notices that the increase in the standard deviation of income induces a strong reduction in borrowing in the first part of the life cycle.

In the literature on liquidity constraints it is argued that 'poorer' households (either in terms of wealth or income) are more likely to be liquidity constrained. While this is plausible, it should also be considered that lower educated (and therefore 'poorer') households are likely to face greater uncertainty in earnings and therefore might have a stronger precautionary motive to save. Notice that with a 10 % standard deviation, high school dropouts do not desire to borrow.

Fourth, increasing the coefficient of relative risk aversion, γ, decreases the incentive to borrow. Several aspects are at play here. An increase in the coefficient of relative risk aversion will make the elasticity of substitution in consumption lower. This, per se, constitutes a greater incentive to smooth consumption and, therefore, to borrow in the first part of the life cycle. On the other hand, an increase in risk aversion also increases precautionary savings. Finally, an increase in γ accentuates the hump induced by demographics on observed consumption expenditure as it 'blows up' the needs of a larger family. In Figure 5, where the coefficient of relative risk aversion is 4, there is a further reduction, relative to Figure 4, in the amount borrowed in the first part of the life cycle.

The evidence presented here is hardly surprising; the aim of the exercise is to quantify the effects of changes in uncertainty and risk aversion given realistic income and family composition profiles. I conclude that for low levels of risk aversion and uncertainty, there might be strong incentives for young individuals to borrow against future earnings. However, these incentives can be strongly reduced changing these two parameters. An analogous effect can probably be obtained by considering a Stone-Geary within period utility instead of an isoelastic one.

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goes some way towards explaining the evidence presented by Carroll and Summers (1991) and discussed in Section IV

A few additional caveats need to be mentioned. All consumption in these simulations is non durable. The issue of durables, for which credit is usually more readily available, is not addressed. A fully specified model would consider both durable and non durable expenditure. Furthermore, the model considered in this subsection ignores transaction costs in both changes in asset and consumption. There is only one source of uncertainty in the model, namely, income uncertainty. No insurance institutions, such as social security, are considered. Hubbard, Skinner and Zeldes (1993) consider shocks related to health status and some forms of social security.

Liquidity constraints: what can we learn from aggregate time series?

Many of the most influential empirical papers on consumption have used aggregate time series data to test the implications of the life cycle- permanent income model.[26] The underlying assumption of many of these papers is that a representative consumer maximizes expected utility over a (possibly infinite) life cycle. Aggregate consumption data are then used to estimate the preferences of such a consumer and test the overidentifying restrictions of the model. The advantage of using aggregate time series data is that one can use relatively long sample periods and therefore circumvent the *small T* problem discussed in section IV. However, as I have argued elsewhere,[27] it is easy to construct examples both in which individuals behave according to the life cycle model, while aggregate data exhibit excess sensitivity and in which the opposite is true. Attanasio and Weber (1993) show that the use of improperly aggregated data explains the rejections of the overidentifying restrictions implied by the Euler equation for consumption that one typically finds in aggregate data. [28]

The implication of this is that one cannot use aggregate time series data to estimate preference parameters or to test the validity of the model. A similar argument applies to tests of liquidity constrains. In a much quoted paper, Campbell and Mankiw (1989) regress aggregate consumption

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[26] A non-exhaustive list of the most widely quoted papers that use aggregate time series data include Hall (1978), Flavin (1981), Hansen and Singleton (1982,1983) Hayashi (1982), Mankiw, Rotemberg and Summers (1985), Bean (1986), Campbell (1987), Hall (1988), Campbell and Mankiw (1989).

[27] Attanasio and Browning (1993).

[28] In Attanasio and Weber (1993) a long time series of UK cross section data is used to generate 'aggregate' time series data using different aggregation criteria. The results indicate that when arithmetic means are used one obtains the same results as in aggregate data, while when theory-consistent aggregation is used, one does not reject the overidentifying restrictions. For a useful survey of contributions to the aggregation literature see Stoker (1993).

growth on aggregate income growth and interest rates and interpret the coefficient on income growth as the fraction of individuals subject to liquidity constraints. This interpretation is justified only under the following very stringent conditions.

(i) Consumption and leisure are separable in the utility function;

(ii) The fraction of consumers who are liquidity constrained is constant over time;[29]

(iii) Liquidity constrained individuals always consume their labor income, in both an up-swing and in a down-swing of the business cycle.

None of these restrictions are realistic or plausible. As a consequence the interpretation of the empirical findings presented by Campbell and Mankiw (1989) is questionable. For the same reason, a flexible, dynamic, Keynesian consumption function of the kind estimated, for instance, by Davidson et al. (1978) is unlikely to be useful for policy analysis: an obvious example of Lucas' (1976) critique. As stressed in the early papers by Tobin and Dolde (1971) and Flemming (1973), to assess the effect of liquidity constraints on the way aggregate consumption reacts to changes in income, one must evaluate the distributional effects of various types of shocks as well as the composition of the population.

This is not to say that the analysis of aggregate time series data on consumption is useless. For many practical purposes, such as forecasting, a flexible dynamic model is extremely useful. Indeed, the life cycle theory and a priori knowledge about the existence of binding liquidity constraints can be useful in the formulation of the econometric specification to be used in estimation and forecasting.[30]

The main innovation of the life cycle model is to treat the allocation of resources over time in a way similar to the determination of the demand for different commodities given a total amount of consumption expenditure. Given the amount of theoretical and empirical studies devoted to aggregation problems in demand analysis, it is interesting to note how the same problems have received little attention in consumption studies.

Liquidity constraints: what can we learn from micro data?

Above, I sketched some of the implications of the presence of liquidity constraints for micro

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[29]   Or at least varies in a fashion such that the product of the variable part of liquidity constrained individuals and of the rate of growth of income is uncorrelated with the instruments used in estimation.

[30]   A good example of this practice is the paper by Blinder and Deaton (1985).

economic data. In this section, I summarize those implications, discuss some of the existing literature and present some new empirical evidence. This section is not meant to be an exhaustive survey. Rather, I want to evaluate critically the most widely cited contributions. I do not dwell on technical criticisms of the various studies as I want to focus on the main ideas of the tests for liquidity constraints. One aspect, however, should be mentioned. Most of these studies use expenditure on food as a measure of consumption. While this is justified by the lack (until recently) of reliable micro data on consumption, one should remember that such a measure is probably not the most appropriate one. To justify its use in the study of intertemporal allocation of consumption, one must appeal to a number of assumptions which are strongly violated in all available studies of demand behavior. Indeed, Attanasio and Weber (1994b) show that the use of food consumption can lead to very misleading conclusions in the analysis of Euler equations for consumption.

Excess sensitivity of consumption to labor income

By far the most common test of the validity of the life cycle model is that of 'excess sensitivity' of consumption to expected labor income. Because one of the main implications of the life cycle model is that consumption should be smoothed, there should not be any relationship between consumption changes and expected current or lagged income, *if consumption and leisure are separable in the utility function.*

As mentioned above, these issues are not new and go back to the exchange between Thurow (1969) and Heckman (1974). Nonetheless, several papers have focussed on the excess sensitivity issue, using both aggregate and microeconomic data. Hall and Mishkin (1982), Zeldes (1989), Altonji and Siow (1987), Runkle (1991) and Keane and Runkle (1992) all use the Panel Survey on Income Dynamics (PSID), while Lusardi (1992) uses the Consumer Expenditure Survey (CES), to test the hypothesis that consumption changes are related to lagged or expected income. This boils down to estimating an equation like the following:

$$(10) \qquad \Delta ln(c_{i,t+1}) = \alpha_0 + f_i + \beta' \Delta z_{i,t} + \alpha_1 r_{i,t+1} + \alpha_2 y_{i,t} + \epsilon_{i,t+1}$$

where f_i is either a random or a fixed effect reflecting unobserved heterogeneity, $r_{i,t+1}$ is the real interest rate, $z_{i,t}$ are demographic variables that might affect the marginal utility of non durable consumption[31] and $y_{i,t}$ is either the expected change or the level of lagged income. The

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[31] With quarterly or monthly observations it is also useful to allow seasonal dummies to affect the marginal utility of consumption.

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null hypothesis considered is that $\alpha_2 = 0$.[32] Several econometric problems are relevant for the estimation of an equation like (10). The most serious, however is the fact that the error term ϵ_t^i include expectational errors which are correlated across individuals.[33] As a number of authors have noted (Chamberlain (1984), Hayashi (1987), and Deaton (1992)), the rational expectations hypothesis does not imply that the cross sectional mean of ϵ_t^i goes to zero as N goes to infinity. Only under special assumptions about the nature of the residuals is it possible to get consistent estimates of the parameters of equation (10) when T, the available number of time periods, is fixed. The number of periods a household stays on a panel is typically not very large: even if the survey runs for several years, in the presence of household specific fixed effects, it might be difficult to obtain consistent estimates.

The availability of time series of repeated cross sections (or short panels) presents a possible solution to these problems. As suggested by Deaton (1985) and Browning, Deaton and Irish (1985), one can construct synthetic panels that can be used in estimation. The advantage is that even in the presence of family (or group) specific fixed effects one can obtain consistent estimates because the relevant dimension is the length of the synthetic panel and not the number of periods a single household is interviewed. Furthermore, even though one works with aggregated equations, one controls the aggregation process directly in that it is possible to compute cohort averages of any non linear function of observable variables. Finally, when necessary, it is possible to use complementary data sources. [34]

Most of the papers mentioned above ignore the possibility that leisure and consumption are not separable in the utility function. However, if this happens to be the case, the marginal utility of consumption depends on leisure which will therefore enter the Euler equation. The observed correlation between consumption and income could, therefore, be rationalized on this basis.

The effects that household labor supply might have on measured consumption seem obvious: going to work and dressing for work involve costs that might be substantial; female labor force participation is likely to imply the substitution of household production with market goods and so on. Browning and Meghir (1991), using the British Family Expenditure Survey, present strong

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[32] Hall and Mishkin (1982) actually estimate an equation for the level rather than the log of consumption. This follows from their use of quadratic utility.

[33] A discussion of several other econometric problems can be found in Keane and Runkle (1992) and in the discussions of that paper in the same issue of the Journal of Economic and Business Statistics.

[34] Moffitt (1993) discusses at length the advantages of synthetic panels methods. For the use of complementary data sources, see Arrellano and Meghir (1992).

evidence against the hypothesis of separability between consumption and leisure.

A simple test of the separability assumption can be performed as follows. Consider equation (6) for $s = 1, 2$ and assume that the marginal utility of the husband's and wife's leisure is log-linear in the two leisures and consumption. If one takes logs and subtracts one equation from the other one obtains, for all the households not at a corner:

$$(11) \qquad log(w_{it}^1/w_{it}^2) = \alpha_1 log(l_{it}^1) + \alpha_2 log(l_{it}^2) + \alpha_3 log(c_{it}) + \beta' Z_{it} + u_{it}$$

where Z_{it} are observable variables thought to affect the marginal utilities of wife and husband leisure and u_{it} reflects unobserved heterogeneity. Notice that this equation holds true for households at an interior solution *regardless of the presence of liquidity constraints*. The hypothesis of weak separability between consumption and leisure implies $\alpha_3 = 0$. Weak separability is necessary but not sufficient to guarantee that neither the husband's nor wife's leisure enter the Euler equation for consumption.[35] However, finding that α_3 is significantly different from zero provides decisive evidence for the inclusion of labor supply variables in the Euler equation for consumption.

I estimate equation (11) by instrumental variables using an appropriate correction for selectivity described in Attanasio and MaCurdy (1993) using data from the Consumer Expenditure Survey 1980-1990. The specification allows for several family composition variables and a polynomial in the husband's and wife's age to affect the marginal rate of substitution between the two leisures.[36] α_3 is estimated at 0.15 with a standard error of 0.068, which implies a p-value of 0.024. This result calls for the inclusion of one or more labor supply variables in equation (10).

A number of papers have used synthetic cohort techniques to estimate and test Euler equations for consumption and to address the issue of excess sensitivity of consumption to income growth when allowance is made for labor supply (and demographic) effects. Attanasio and Weber (1993), Attanasio and Browning (1993)and Blundell, Browning and Meghir (1994) using the UK family expenditure survey show that once labor supply and demographic effects are allowed for, on quarterly data there is no evidence of excess sensitivity of consumption to income. Attanasio and Weber (1994b) reach a similar conclusion using data from the US Consumer Expenditure Survey. It should also be stressed that these studies use comprehensive measures of consumption rather

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[35] If consumption affects the marginal utility of husband and wife's leisure in the same way, i.e. if leisure is weakly but not strongly separable from consumption, $\alpha_3 = 0$ and yet there is no presumption that leisure does not enter the intertemporal Euler equation for consumption.

[36] Details about the estimation methodology, the specification used and the data are available upon request.

than food consumption. [37]

The available evidence on the relationship between consumption and income growth at relatively short frequencies seems to indicate that there is no strong evidence of excess sensitivity of consumption growth to income changes, once one allows for the effects of demographics and labor supply on the marginal utility of consumption. This statement, however, while encouraging for the life cycle model, is not a strong one. It should be stressed once more that the presence of liquidity constraints implies a violation of the Euler equation only when these are binding. Therefore, tests based on Euler equations might not be very powerful against this kind of alternatives. Furthermore, two additional criticisms against this type of evidence might be relevant.

First, it can be argued that introducing in the Euler equation a variety of demographics and labor supply variables might introduce noise that would reduce the power of excess sensitivity tests.[38] It is also difficult to gauge whether the estimated parameters on demographic and labor supply variables imply 'plausible' preference specifications. In other words, as stressed in the introduction, it is not easy to identify the presence of excess sensitivity of consumption to income from non separabilities between consumption and leisure.

Second, while the evidence discussed above shows the lack of relationship between changes in the marginal utility of consumption and expected changes in income at high (business cycle) frequencies, liquidity constraints and 'excess sensitivity' might be relevant at low (life cycle) frequencies. Carroll and Summers (1991), for instance, estimate age profiles for consumption and income for different occupational and education groups and different countries and notice that relatively steeper consumption profiles correspond to relatively steeper income profiles. They interpret this evidence as indicating that 'consumption parallels income', therefore contradicting the life cycle model.

However, in constructing their cross section profiles, Carroll and Summers (1991) ignore both demographic and cohort effects. [39] Their conclusions are therefore ungranted; while it is true that college educated individuals have steeper income and consumption profiles, it is also true

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[37] Blundell, Browning and Meghir (1994) and Attanasio and Weber (1994b) address the issue of aggregation over commodities explicitly.

[38] In particular, if labor supply (and demographic) variables are less affected by measurement error than income and are correlated with it they might capture most of the correlation between expected consumption growth and expected income growth.

[39] In the presence of strong cohort effects, the cross section profiles that Carroll and Summers estimate for income and consumption do not correspond to the life cycle profile of any individual and can be extremely misleading,

that they typically have children later in the life cycle. Attanasio and Browning (1993) show how very simple adult equivalent schemes are able to explain the fact that consumption profiles parallel income profiles. Attanasio et al. (1994) show that preferences estimated on microeconomic data (using the restrictions implied by Euler equations on quarterly movements) and differences in demographic profiles, are able to generate the differences in consumption profiles observed in the actual data across different education groups. Their results are particularly interesting because there is nothing in the estimation procedure that 'fits' the differences in consumption profiles across education groups: preferences parameters are assumed to be the same across groups.

The fact that relatively simple and natural modifications of preferences are able to explain in a very reasonable way one of the alleged implications of liquidity constraints is an example of the difficulty of testing for the presence of such constraints. One can always introduce some simple changes of the basic model which could 'fit' the observed facts. This proposition, however, is not completely empty. For instance, it is not clear that introducing leisure in the expression for the marginal utility of consumption can explain the observed correlation between expected income and consumption. The presence of leisure and demographic variables in the marginal utility does not necessarily rule out the presence of income in the Euler equation for consumption or explain the differences in the shape of the consumption age profiles of different education groups.

Distortions to intratemporal first order conditions

The utility function in section II.B includes two kinds of labor, non durable consumption and services from durables (which are assumed to be proportional to the stock). Such a utility function can be easily generalized to allow for more commodities, in which case additional intratemporal first order conditions should be considered. The important thing to notice, however, is that as long as we consider commodities which are not collateralizable, non durable and at an interior solution, their marginal rate of substitution has to be equal to their relative price in every period, *regardless of the presence of liquidity constraints*. Indeed, I used this fact above to test for weak separability of consumption and leisure.

However, if one considers commodities that can be used as collateral and that provide services (through durability) or affect utility (through habit formation) slowly over time, the presence of liquidity constraints introduces distortions in the intratemporal first order conditions of the kind discussed above. The question is: can one use these implied distortions to test for the presence of liquidity constraints. Unfortunately, the answer is in general, no.

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Consider, for example, the case of durables. Under the assumption of no transaction costs, Chah et al. (1991) derive an expression for the intratemporal first order condition between durables and non durables which, using the notation of section II, takes the following form:

$$(10) \qquad U_{c,t} = \frac{1}{R_t^k}[(1 + R_{t+1}^i)\frac{U_{k,t}}{p^{k,t}} + (\phi(1 + R_t^i) - (1 - \delta)(1 + \pi_{t+1}))\mu_t]$$

where $p^k t + 1$ and R_{t+1}^i are assumed to be known at time t, $R_t^k = 1 + R_t^i - (1 - \delta)(1 + \pi_{t+1})$, $1 + \pi_{t+1} = p_{t+1}^k/p_t^k$, and ϕ is the fraction of dur?bles that can be financed.

Equation (10) is the intratemporal first ore ? condition between durables and non durables and is derived under the assumption of a perfect market in second hand durable goods. The second term in the square brakets on the right hand side measures the distortion introduced by the liquidity constraint. This equation can be used to solve for μ_t and substituted into the Euler equation for non durable consumption (equation (5')). Therefore, binding liquidity constraints imply the presence of some function of durable consumption in the Euler equation for non-durable consumption and the presence of dynamic terms in the intratemporal first order condition between durable and non durables. With a tight parametrization of the utility function, this proposition could be tested. For instance, if the within period utility function is separable between durables and non-durables, one can test the hypothesis that the expected change in the marginal utility of non durable consumption depends on durables. Such tests, however, rely heavily on the functional form assumed for the utility function: in the terms of the example just given, the marginal utility of non durables could be a function of durables and therefore one would not be able to distinguish between the effect of liquidity constraints and non separability between durables and non durables.[40] In other words, an intratemporal first order condition with binding liquidity constraint is observationally equivalent to an Euler equation with non separability between durables and non durables.

Chah and al. (1991) use a specification based on separable preferences and aggregate data to test the proposition that the "long run relationship between durable stocks and non durables flows ha[s] predictive power for future changes in non-durable consumption." Brugiavini and Weber (1992) use micro data and identify liquidity constrained individuals by looking at credit denials. The identification of liquidity constrained and unconstrained individuals from survey questions allows Brugiavini and Weber to study differences in the intratemporal first order conditions in the

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[40] The presence of transaction costs in durable expenditure is another difficult and serious issue that should be addressed in empirical studies.

two groups. [41]

Similar arguments apply to the relationship between labor force participation and changes in the marginal utility of consumption. As mentioned above, binding liquidity constraints can induce female (or male) labor force participation. In other words, a wife who in the absence of liquidity constraints would choose to be at a corner and not supply labor might be induced to participate in the labor force by the inability to transfer some of her husband's future earnings from the future to the present.[42] Therefore, under liquidity constraints, one should observe a relationship between consumption growth and past female labor force participation. However, the same relationship could be justified by the non separability between female leisure and consumption.

From this discussion, one should conclude that it is very difficult to use the theoretical distortions introduced by the presence of binding liquidity constraints to intratemporal first order conditions to test for the presence of such constraints and their relevance. These negative conclusions, however, could be mitigated by the consideration that if one has additional information on the likelihood that a household is liquidity constrained (either self reported status, or other proxies based on liquid wealth, likely future earnings and so on) these restrictions could be profitably used.

Survey questions

While one can devise ingenious implications of the presence of liquidity constraints for observed consumer behavior, a more direct way to assess the relevance of this phenomenon is to rely on survey questions. This is the direction taken by Jappelli (1990) who uses the 1983 Survey of Consumer Finances. The survey contains some questions on the availability of credit. In particular, consumers are asked whether they were denied credit or if they refrained from demanding it because they felt they would be denied. Jappelli is therefore able to characterize liquidity constrained households in various dimensions.

There are advantages and disadvantages in this approach. First, very few data sets contain the sort of information which is found in the SCF. Furthermore, the SCF, while being extremely detailed in terms of assets and liabilities, does not contain any information on consumption. Therefore, it is not possible to characterize differences in consumption behavior by self-defined liquidity

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[41]   Lusardi (1992) reports evidence from the Consumer Expenditure Survey in favor of the hypothesis of non-separable preferences between durables and non durables.

[42]   O'Brien and Hawley (1986) include a variable that should measure liquidity constraints in a female labor force participation equation and find a significant effect. Their proxy for the severity of liquidity constraints is based on housing wealth and is somewhat ad-hoc.

constrained individuals. Finally, it is not clear how reliable the answers to these sorts of questions are. On the positive side, one can check (as Jappelli does) whether individuals who are defined as liquidity constrained (or likely to be so) according to some easily observed variable (as is done in the papers by Juster and Shay (1964), Zeldes (1989) and Runkle (1991)) declare themselves as constrained and vice-versa.

Time series variation of cross sectional moments.

In a recent paper, Deaton and Paxson (1993) consider the implications of the life cycle model and of liquidity constraints for the time series evolution of the cross sectional variance of consumption and income. The idea is simple and clever: given a simple model of intertemporal optimization and a process generating individual income, th y derive the implications for the evolution of the cross sectional variability of consumption and income over the life cycle. In their empirical exercise they analyze data from the US, the UK and Taiwan and they conclude that consumption inequality does increase with age, as predicted by the life cycle model. They also notice that there is '...a good deal of similarity in the life-cycle evolution of inequality in total income and consumption. While such a result is consistent with the theory, it also would occurr if consumption were closely tied to income, as in a model with liquidity constrained consumers"

Two aspects of this approach can be criticized. First, as the authors acknowledge, it is only possible to derive strong implications for the cross sectional variability for very simple models. Once one introduces a few complications, such as demographic variables, these implications are lost. Second, the analysis takes labor supply, and therefore total income, as exogenous. Obviously, matters are greatly complicated if one considers labor supply behavior.

Borrowing behavior

The presence of liquidity constraints, either as a limit to the amount which is possible to borrow or as a difference between lending and borrowing rates, obviously affects borrowing behavior. It seems, therefore, natural to look at data on loans of various kinds (when available) to shed some light on this issue. Unfortunately, even when this data are indeed available, it is very difficult to derive from them any inference on the presence of liquidity constraints. The reason is obvious. The fact that somebody is not borrowing could be because he/she is liquidity constrained or because he/she does not want to borrow.

Some indirect inference, however, can be drawn if one characterizes borrowers and identifies

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the likely reasons for holding debt. Liquidity constrained individuals are prevented from smoothing consumption; a necessary condition for a binding liquidity constraint is the desire to move resources from the future to the present. Therefore, the only households susceptible to liquidity constraints are those facing a steeply increasing income profile (the young) or those affected by a transitory and negative shock to earnings.[43] However, these are only necessary and by no means sufficient conditions to observe binding liquidity constraints. It is conceivable, and perhaps plausible, that young households facing a steeply increasing but highly variable and uncertain earnings profile might not wish to borrow. Analogously, negative shocks hitting individuals over a business cycle might be perceived as permanent or, at least, very persistent. Furthermore, these negative shocks could conceivably increase the conditional variance of future earnings.

Having said this, however, it would be interesting to establish whether the individuals actually using credit are those that are more likely to use it to smooth consumption, either over the life cycle or over the business cycle. In this section, I provide some descriptive evidence on borrowing behavior.

In the three panels of Table 1, I report the percentage of households in the CES paying positive interest charges on three different types of loans. The loans considered are mortgages, vehicle loans and 'other loans' which include credit cards, bank loans and so on. In the top panel, households are divided according to the educational attainment of the household head, in the middle one according to the age of the household head, while in the bottom one according to race of the household head. From the table, significant and interesting differences emerge. There seems to be a strong positive correlation between educational attainment and use of loans. In terms of age composition, notice that the proportion of households with 'other loans' increases sharply during the first age periods and declines subsequently. A similar pattern is evident for mortgages and (to a lesser extent) for vehicle loans. Finally, from the third panel it is evident that blacks borrow less often than whites and other races. To summarize: in my sample lower educated, younger, black households are less likely to borrow in any form than educated, middle aged, white families. This result, obviously, does *not* necessarily imply that lower educated individuals are liquidity constrained.

In Table 2.1, I consider the joint effects of these covariates by estimating a Probit model for each of the three loans categories considered. Besides the variables whose coefficients are reported in the table the equations include time dummies.[44] These results confirm the evidence presented

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[43] These shocks have to be large (in absolute value) relative to the savings of liquidity constrained individuals.

[44] The incentives to hold loans changed substantially over the sample period as a consequence

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in Table 1. Even when considered simultaneously (and with other controls), the variables discussed above have the same effect on the likelihood that a household uses credit. In Table 2.2, I introduce variables meant to measure business cycle fluctuations. In particular, I consider the change in annual household income [45] and two dummies that indicate that the reference person or his spouse were unemployed in the year preceding the interview. [46] These unemployment dummies are negative and strongly significant, while the income decline dummy is positive and significant.

The evidence presented in this section seems to indicate that loans are used more by wealthier individuals [47]. This evidence is consistent with the hypothesis of liquidity constraints, but is not inconsistent with the view that poorer individuals might not want to borrow, rather than their being denied access.

Liquidity constraints: some evidence on vehicle loans

Introduction

While the descriptive evidence presented at the end of the previous section is not very informative about the presence of liquidity constraints, data on borrowing behavior and on the interest paid by borrowers can be used to shed some light on the hypothesis that liquidity constraints are more likely to be binding for some groups of the population than for others.

If one defines an individual to be liquidity constrained if he/she would like to borrow, at the current interest rate, more than what he/she is currently borrowing (which might be zero), that individual's demand for loans should be relatively less sensitive to changes in the interest rate than for unconstrained individuals. This is because liquidity constrained individuals are at a kink or, if they face a difference between borrowing and lending rates, on a particularly steep region of an intertemporal budget constraint. At the same time, they should be more sensitive to the

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of the 1986 Tax Reform Act. The deductibility of all interest payments with the exception of mortgage payments was removed. This created strong incentives, especially for taxpayers in the highest tax brackets, to switch from other sources of debt to mortgages. Maki (1994a) shows that these effects were substantial for high income households.

[45]   No attempt is made to distinguish between expected and unexpected income changes.

[46]   Unfortunately, the survey classifies as 'unemployed' only someone who has been out of work for 52 consecutive weeks. As a consequence the percentage of unemployed individuals is very low.

[47]   I also introduced consumption quantiles dummies in the probit equations of Tables 2.1 and 2.2. The relationship between the level of consumption and the probability of having a loan is strongly positive. Finally, households which have recently acquired durable commodities are more likely to use credit.

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availability of loans. Increases in maturity for a liquidity constrained individual who is borrowing the maximum is equivalent to an increase in the amount that is possible to borrow and, therefore, would have larger effects than on unconstrained individuals.

Ideally, one would like to test such a proposition by measuring how interest rate and maturity variations are reflected, keeping other things constant, in the amount borrowed by different groups of individuals. These ideas are far from new; they are discussed and implemented by Juster and Shay (1964). They construct a survey designed to measure the elasticity of the demand for loans to interest rate and maturity. Different groups of individuals were confronted with financing packages (they could either accept or refuse) which differed in interest rate and maturity.

Unfortunately, such a simple scheme is not available for the present investigation. The first and most important reason is that we do not observe the interest rate and maturity faced by individuals who do not finance their vehicles. This problem is analogous to participation in a labor supply equation; typically one does not observe the real wage for non participants. Furthermore, even restricting the sample to car buyers can introduce biases. It is conceivable that some individuals faced with a particularly high cost of financing will decide to postpone or forgo the idea of buying a new vehicle.

In addition, it is likely that the interest rate and the maturity of a financing contract are endogenous. The terms of a financing contract can depend on the size of the amount borrowed and different groups might face (maybe because of discrimination from lending institutions) different interest rates. Furthermore, households with a particular taste for borrowing might be willing to accept particularly high borrowing rates (or short maturity). Finally, the availability and the terms of vehicle loans probably depend on various features of which only few are observable by the econometrician. The ownership of other assets is an example of an observable variable which is bound to be relevant, while credit history is a relevant variable which is not observable. In what follows, these endogeneity problems are tackled by the use of instrumental variables techniques.

Portfolio choices for both constrained and unconstrained individuals cannot be described by simple models. In reality, one observes individuals holding sizable amounts in both liquid and non liquid assets and, at the same time, liabilities with interest rates well above those earned by those assets. Besides irrationality, these observations can probably be explained by the liquidity services provided by the former and by the transaction costs connected with changes in the latter. Of course these incentives will vary across individuals and over time as a function of the various interest rates.

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In what follows, rather than specifying a structural model, I estimate a simple statistical model that takes into account the problems discussed above and allows me to measure some of the parameters of interest.

A statistical model of vehicle debt

Because the problem is conceptually similar to a labor supply problem with the possibility of non participation, I use a similar methodology. As a first approximation I neglect the effect that the lack of credit availability may have on the decision of purchasing a car and focus on the subsample of cars buyers. The statistical model I consider is made of two equations. The first refers to the decision to finance and the second to the amount of the car purchase that is financed.

$$I_t = \delta' x_t + \epsilon_t \tag{11}$$

$$B_t^i = \beta' z_t^i + \gamma_1 r_t^i + \gamma_2 m_t^i + E[v_t \mid \epsilon_t > -\delta' x_t] + u_t \tag{14}$$

where I_t in equation (13) is a latent variable which is positive for consumers who decide to finance and non positive for those who do not finance, B_t^i is the share of the car purchase that is financed, r_t^i and m_t^i are the interest rate and the maturity of the loan and z_t^i is a vector of observable variables. The vector of observable variables x_t includes the exogenous determinants of the decision whether to finance or not. It includes variables such as time and region dummies, demographics and so on. The dimension of x is greater than or equal to two plus the dimension of z.

Equation (14) models the proportion of a car purchase that is financed (the financing ratio) conditional on financing. The selection term $E[v_t \mid \epsilon_t > -\delta' x_t]$ term can be modeled in a fairly flexible way as in Attanasio and MaCurdy (1993). I assume that the $E[v_t \mid \epsilon_t] = \sum_{j=1}^{4} \alpha_j \epsilon_t^j$. The conditional moments in (14) are then estimated consistently using the formulae for the truncated normal.

As discussed above, it is necessary to instrument the interest rate and maturity. (Over-) identification is achieved using the assumption that time dummies interacted with regional dummies affect the financing ratio only through the interest rate and the maturity of the loan. It should be understood, however, that one identifies interest rate and maturity effects only off temporal and regional variation, which is potentially limited (see Table 3 below).

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I estimate equations (13) and (14) for different groups in the population. While this limits the variability in interest rates (and therefore the potential efficiency of the estimates) it is fundamental for our test. It is likely that less educated, younger individuals will be liquidity constraints so that one should get stronger effects on the interest rate for the more educated, older households and stronger effects of maturity for younger less educated families.

Several extensions and considerations are possible and/or desirable. First, one should consider the effects that the lack of borrowing opportunities would have on the decision to buy a car. Second, it is desirable to control for the effects of variables such as liquid and non liquid (housing) assets availability both on the decision to borrow and on the amount borrowed. It should be considered that these variables are endogenous and (especially in the case of liquid assets) determined jointly with the amount borrowed. A similar argument can be made for other forms of borrowing such as consumer loans and mortgages. Finally, it is worth investigating the possibility of taking into account differences in marginal tax rates for different individuals. [48]

Empirical evidence

In what follows, I use data on vehicle transactions and on whether a particular purchase has been financed or not. I also know the terms of the loan (interest rate and maturity), the amount borrowed, the source of financing and the cost of the vehicle. In addition, I have a substantial amount of information on family background and on consumption.

I focus on the sample of households who have bought an automobile in the twelve months preceding the last interview. To avoid biasing the sample of borrowers in favor of households with relatively longer maturity loans, I do not consider purchases made more than twelve months before the interview and currently financed.

The variable I model is the fraction of the car value which is financed. Some households purchased more than one automobile within the last twelve months. In this case I consider the total value of the cars bought and the total amount financed. If more than one car was financed, the interest rate is a weighted average of the interest rates with weights given by the size of each loan (as is the maturity of the loan).

The total sample of car buyers is made of 5,242 households of which as many as 12% have bought more than one car in the year preceding the interview. About 58% of all the households in

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[48]   Maki (1994b) presents some evidence along these lines. The interest deductibility has been progressively eliminated, starting with the 1986 tax act.

the sample have financed their car purchases. The mean value of the ratio of the loan to the value of the car is, for households who finance, 0.75 (standard deviation 0.20), while the median of the same ratio is 0.78.

There is a considerable amount of heterogeneity in the interest rate and in the maturity of loan contracts, even within a single year. The effective interest rate, computed by the BLS on the basis of the terms of the contract, averages 0.1348. Over time, the evolution of the average interest rate in the sample matches that of the average interest rate on car loans published by the Fed reasonably well; the correlation coefficient between the two quarterly series is 0.75. Loan maturity averages at just over 40 months, while the median is 42 months.

In Table 3, I report the results of simple regression equations which relate interest rates and maturity to several household specific variables and to time dummies. [49] In the first and third column, the variables included are those that in the next sub-section are treated as exogenous and included in the instrument set: regional dummies (northeast, midwest, south and west) race dummies (black and non-black), educational attainment of the household head (high school dropouts, high school graduates, some college and college graduates) and age groups (20-40, 40-55 and 55-70). In the second and fourth column, I add dummies for the financing source: dealers, financial institutions, banks, credit unions and others (which include insurance companies, individuals and others). Because this variable is bound to be endogenous, is not used in the instrument set. The reference groups are non black, high school dropouts, residing in the west and aged between 20 and 40. The excluded financial institution is the last one ('others').

The interest rates on car loans paid by college graduates seem significantly lower than those paid by high school dropouts. The difference (in nominal terms) is more than a percentage point. The dummies for the other two education groups are only marginally significant and are one third in size. The dummy for black households is not statistically significant. The south and the northeast dummies are statistically significant and negative.

Interest rates depend strongly on the financing source. In particular, loans from credit unions and 'other sources' are significantly cheaper. The most expensive are those from financial institutions followed by those offered by banks and by dealers. [50] The introduction of the dummies for the financing source do not change significantly the coefficients on the other variables.

There are no visible regional and age effects on maturity. On the other hand, maturity

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[49]   I do not report the coefficients on the time dummies.

[50]   It is possible that dealers offer better terms on interest rates, but worse ones in terms of prices.

increases with the educational attainment of the household head; the average maturity of the loan of a household headed by college educated individuals is eight months longer than that of household headed by high school dropouts. The maturity of loans originated from 'other' sources is significantly lower than that from banks, dealers, credit unions or financial institutions. However, there are no large differences in maturity among these latter sources.

In Table 4, I describe the main features of the sample of the households who financed compared to those who do not finance. In particular, the table compares educational attainments, assets, and race composition. The sample of households who finance is slightly better educated, contains less blacks and is slightly younger. The mean assets of those who finance are lower but, interestingly enough, the median is higher.

I can now turn to the results obtained estimating equations (13) and (14). For the sake of brevity I only report the estimates of the key parameters of equation (14), the others are available upon request.

I estimated equation (14) twice, first with the coefficients on the interest rate and on maturity contsrained to be the same for all observations and then allowing them to be different for different age groups. In equation (14) I introduce several variables that should control for life cycle effects on the borrowing decision. These include age, education, and race dummies. As discussed above, interest rates and maturity are instrumented by means of time dummies interacted with regional dummies. The interest rate is given by the nominal interest rate payed by the household minus the inflation rate in the CPI at the moment the loan was contracted. All the exogenous variables are used in the selection equation.

In the first line of Table 5, I report the estimates of the coefficients on the real interest rate and maturity for the restricted equation. The coefficient on maturity is estimated quite precisely and has the positive sign one would expect under the hypothesis of binding liquidity constraints. The estimate of the coefficient on the interest rate, on the other hand, is quite imprecise. The coefficient is negative, but not statistically different from zero. This could be due to a low elasticity of the demand for loans to the interest rate or to the lack of good instruments.

In the second, third and fourth line of the table, I report the coefficients on the interest rate and the maturity that one obtains if these variables are interacted with dummies for three age groups. The groups I consider are: individuals aged between 20 and 40, 41 and 54 and 55 and 70.[51] The coefficient on the interest rate for the second and third group is negative and, in the

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[51] I tried finer age groups, but the limited size of the sample makes the estimates extremely

case of the second group, marginally significant. [52] Furthermore, the coefficient on maturity for the middle group is not statistically different from zero. Notice that the middle group is, because of their position in the life cycle, the least likely to be liquidity constrained.

I redo the same exercise splitting the sample using different criteria, such as the amount of liquid assets, the educational attainment, and the race of the household heads as well as various interactions of these variables with the age dummies. Unfortunately, all these criteria produced extremely unprecise results, especially in terms of estimates of the interest rate elasticities. These results are not reported but are available upn request.

Overall I conclude that there is some indication that the demand for loans of the middle aged group is more sensitive to changes in the interest rate than that of the other groups and, in particular, of the youngest. Furthermore, there is some evidence that this same group is much less sensitive to changes in the maturity of the loan.

These results constitute a first step in understanding the possible role of liquidity constraints and in the use of debt data to assess their importance. There is, however, much room for improvment. Several issues are important. First, it is important to find more efficient instruments and/or larger samples so as to measure with greater precision the interest rate elasticity of the demand for loans. Second, the exercise performed above controls for, but does not model, a substantial part of the effect that interest rates have on the demand for loans; i.e. the effect on the decision to finance or not. The selection equation (13) is a reduced form equation in which the interest rate has been substituted out. Without a structural model and an interest rate equation, the effect that the interest rate has on the decision to finance cannot be measured. Finally, I have analyzed only loans linked to the purchase of vehicles, which are highly collateralized. It would be interesting to study other forms of consumer debts.

Conclusions

In this paper I have analyzed the issue of liquidity constraints and their relevance for consumption behavior. The first message of the paper is a negative one; one cannot use macroeconomic data to establish the relevance of liquidity constraints. Furthermore, the implications of binding liquidity constraints for the behavior of aggregate data are far from straightforward.

noisy.

[52] A formal test rejects (marginally) the hypothesis that the coefficient on the interest rate in the first and second group are the same.

Establishing the empirical relevance of liquidity constraints is equivalent to determining the opportunity set available to an individual in an intertemporal optimization problem. It is extremely hard to distinguish hypotheses on opportunity sets from hypotheses on preferences without strong identifying and, therefore, untestable assumptions. Many of the implications that one can derive from the presence of binding liquidity constraints are also consistent with somewhat plausible preference specifications. The most obvious example is the correlation between expected consumption and income growth. This could be an indication of binding liquidity constraints or of non-separability between consumption and leisure in the utility function. On the other hand, it is possible that the only preference specifications consistent with the observed data implies highly implausible parameter values so that they could be ruled out on an a priori basis.

These difficulties apply to the study of both intertemporal and intratemporal first-order conditions. Intratemporal first-order conditions are unaffected by the presence of liqudity constraints as long as they involve commodities whose contribution to utility is intertemporally separable and for which an interior solution is relevant. On the other hand, the presence of liquidity constraints distorts the intratemporal first-order conditions for commodities (such as leisure or durables) for which corners and some form of intertemporal non separability are relevant. However, the implications that one can derive from this kind of analysis can also be rationalized by some form of non-separability in preferences.

The nature of the difficulties discussed so far make additional information, such as the self reported status contained in some surveys, extremely helpful. The caveat, of course, is the availability and reliability of such questions concerning liqudity constraints.

The conclusion that one can draw from the discussion on the use of micro data is that, without a priori information on the structure of preferences (and/or opportunity sets), it is extremely difficult to use data on household consumption behavior to detect the presence of liquidity constraints.

In the last part of the paper, I argue that data on debt can be useful to establish the empirical relevance of liquidity constraints. This is not an easy task. In the last section, I propose a simple exercise that can shed some light on the issue. More can be learned by specifying a structural model, possibly to be estimated using similar data.

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Table 1
Proportion of households paying positive interest

by education attainment

	Vehicle loans	Mortgages	Other Loans
High School Dropouts	0.243	0.320	0.408
High School Graduates	0.344	0.486	0.561
Some College	0.380	0.561	0.652
College Graduate	0.391	0.645	0.637

by age group

	Vehicle loans	Mortgages	Other Loans
< 25	0.354	0.226	0.543
25-30	0.396	0.435	0.631
31-35	0.381	0.587	0.671
36-40	0.372	0.661	0.666
41-45	0.397	0.698	0.665
46-50	0.418	0.634	0.616
51-55	0.361	0.580	0.586
56-60	0.316	0.458	0.471
61-65	0.227	0.310	0.385
66-70	0.146	0.220	0.297

by race

	Vehicle loans	Mortgages	Other Loans
white	0.350	0.530	0.580
black	0.283	0.357	0.506
other	0.367	0.506	0.532

Table 2.1
Probit model for positive interest payments

	Car Interest	Mortagage	Other
High School Dropouts	-.267	-.661	-.377
	(.029)	(.028)	(.027)
High School Graduates	-.065	-.324	-.109
	(.024)	(.024)	(.024)
Some College	-.010	-.170	.064
	(.025)	(.026)	(.064)
25-30	.088	.557	.215
	(.050)	(.053)	(.049)
31-35	.044	.942	.322
	(.049)	(.052)	(.048)
36-40	.020	1.156	.318
	(.049)	(.053)	(.049)
41-45	.093	1.273	.328
	(.050)	(.054)	(.050)
46-50	.167	1.140	.225
	(.051)	(.055)	(.051)
51-55	.025	1.011	.153
	(.052)	(.055)	(.051)
56-60	-.076	.745	-.104
	(.052)	(.055)	(.051)
61-65	-.341	.358	-.315
	(.053)	(.055)	(.051)
66-70	-.634	.112	-.535
	(.056)	(.057)	(.052)
black	-.156	-.373	-.133
	(.030)	(.030)	(.029)
other	.011	-.137	-.167
	(.048)	(.049)	(.048)

Note: Standard errors in parentheses.

Table 2.2
Probit model for positive interest payments

	Car Interest	Mortagage	Other
High School Dropouts	-.312	-.735	-.339
	(.018)	(.017)	(.024)
High School Graduates	-.052	-.284	-.084
	(.024)	(.013)	(.014)
Some College	-.011	-.164	.023
	(.014)	(.014)	(.022)
31-35	-.043	.428	..061
	(.016)	(.016)	(.026)
36-40	-.039	.632	.065
	(.017)	(.017)	(.026)
41-45	.042	.754	.056
	(.018)	(.018)	(.027)
46-50	.077	.606	-.018
	(.019)	(.019)	(.028)
51-55	-.030	.502	-.055
	(.019)	(.019)	(.028)
black	-.168	-.488	-.166
	(.018)	(.017)	(.025)
other	-.014	-.245	-.171
	(.028)	(.028)	(.040)
Reference Person	-.294	-.228	-.133
Unemployed in	(.025)	(.021)	(.022)
Last 12 Months			
Spouse	-.049	.028	-.129
Unemployed in	(.039)	(.036)	(.045)
Last 12 Months			
Drop in Family	-.047	0.006	1.266
Income over Last	(.014)	(.015)	(.017)
12 Months			

Note: Standard errors in parentheses.

Table 3

Interest rate and maturity of car loans

Dep. Var.	Int. Rate	Int. rate	maturity	maturity
black	0.0018	0.0015	-1.4726	-1.7940
	(0.0030)	(0.0030)	(1.0147)	(0.9990)
high sc.	-0.0048	-0.0047	4.2850	4.0217
	(0.0025)	(0.0025)	(0.8707)	(0.8567)
some coll.	-0.0048	-0.0046	6.4398	6.2113
	(0.0026)	(0.0026)	(0.9100)	(0.8959)
college	-0.0131	-0.0128	8.1335	7.8137
	(0.0027)	(0.0027)	(0.9177)	(0.9071)
northeast	-0.0047	-0.0063	0.2888	-0.6537
	(0.0026)	(0.0026)	(0.8809)	(0.8725)
midwest	0.0001	-0.0010	-0.5800	-1.2102
	(0.0023)	(0.0023)	(0.7991)	(0.7891)
south	-0.0049	-0.0058	-1.1038	-1.4559
	(0.0022)	(0.0022)	(0.7688)	(0.7578)
40-55	0.0009	0.0010	-0.6631	-0.7352
	(0.0018)	(0.0018)	(0.6264)	(0.6160)
55-75	-0.0026	-0.0024	-0.1088	-0.1589
	(0.0024)	(0.0024)	(0.8240)	(0.8098)
dealers	-	0.0097	-	11.084
	-	(0.0035)	-	(1.1911)
financial	-	0.0135	-	11.506
institut.	-	(0.0040)	-	(1.3690)
banks	-	0.0118	-	11.475
	-	(0.0033)	-	(1.1324)
credit	-	0.0029	-	9.503
unions	-	(0.0036)	-	(1.2311)
adj.R^2	0.055	0.0625	0.0487	0.0829
s.e.	0.0432	0.0430	14.86	14.59
Mean	0.1356	0.1356	39.75	39.75
Observations	2878	2878	2878	2878

Note : Standard errors in parenthesis.

Table 4

Main features of household financing and not financing

	financing	not financing
age	41	43
	(13)	(15)
median age	40	42
median fin. assets	1310	877
mean fin. assets	9324	13535
	(23587)	(35535)
black	0.08	0.060
HighSchool Dropouts	0.17	0.23
HighSchool	0.33	0.33
Some coll.	0.26	0.23
College	0.24	0.21

Note: standard errors in parenthesis

Table 5

Interest rate and maturity elasticity of financing ratios

	Real Interest Rate	Maturity
Whole Sample	-0.146	0.0035
	(0.286)	(0.0010)
$21 \leq age \leq 40$	0.674	0.0037
	(0.518)	(0.0016)
$41 \leq age \leq 54$	-1.135	0.0026
	(0.655)	(0.0021)
$55 \leq age \leq 70$	-0.481	0.0060
	(1.142)	(0.0035)

Note: standard errors in parentheses.

Figure 1
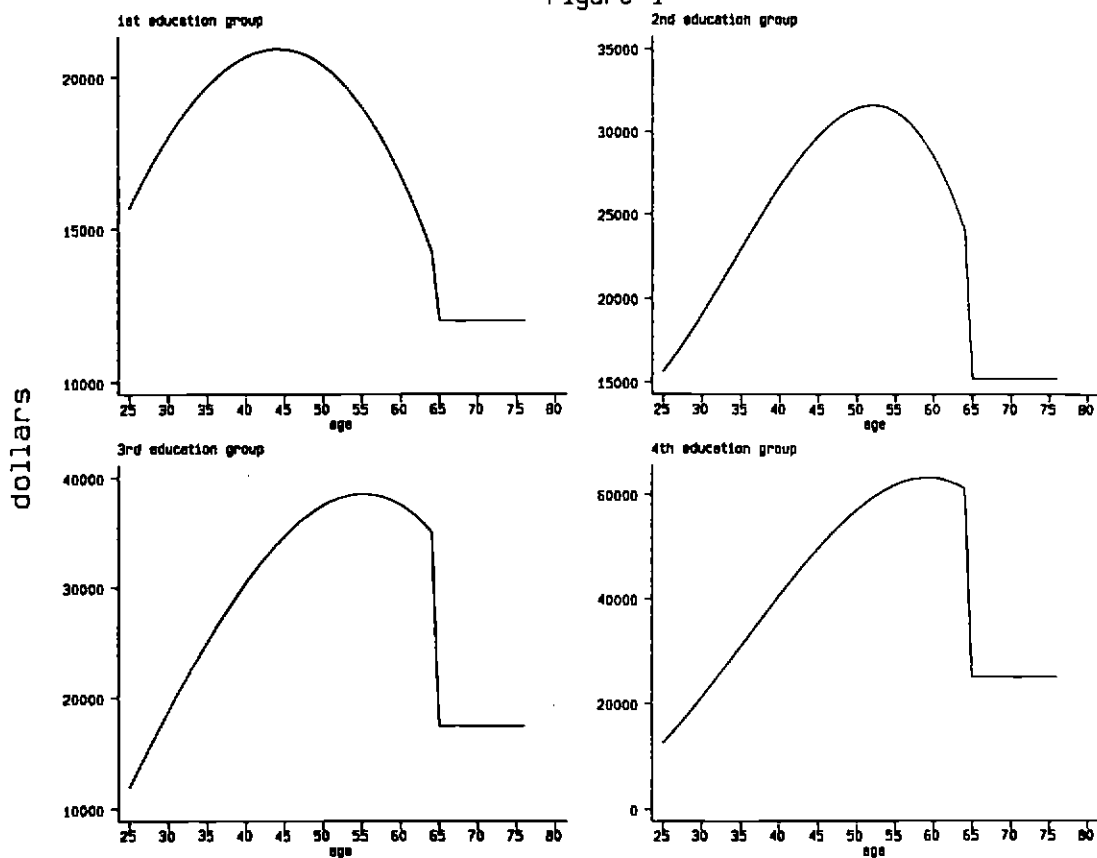
deterministic income profiles

Figure 2

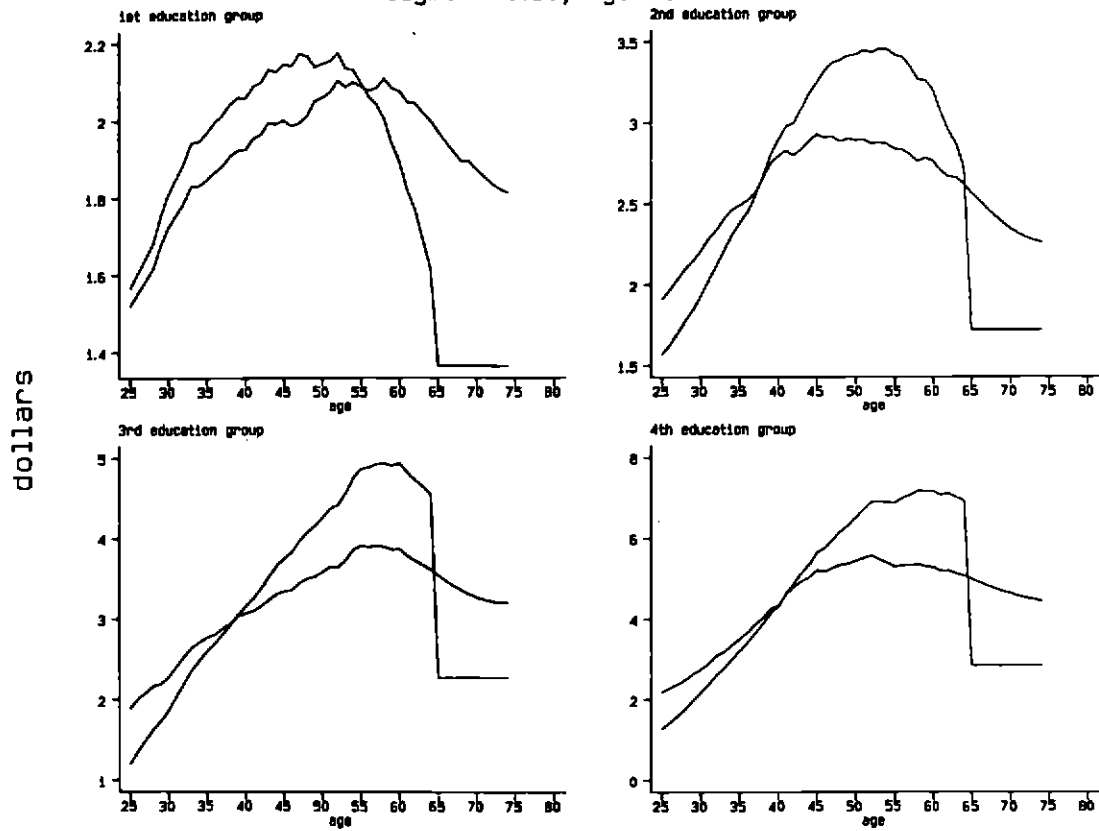adult eq. = 1+ 0.75 (ad.-1) + 0.6 children 16-17 + 0.5×children 0-15
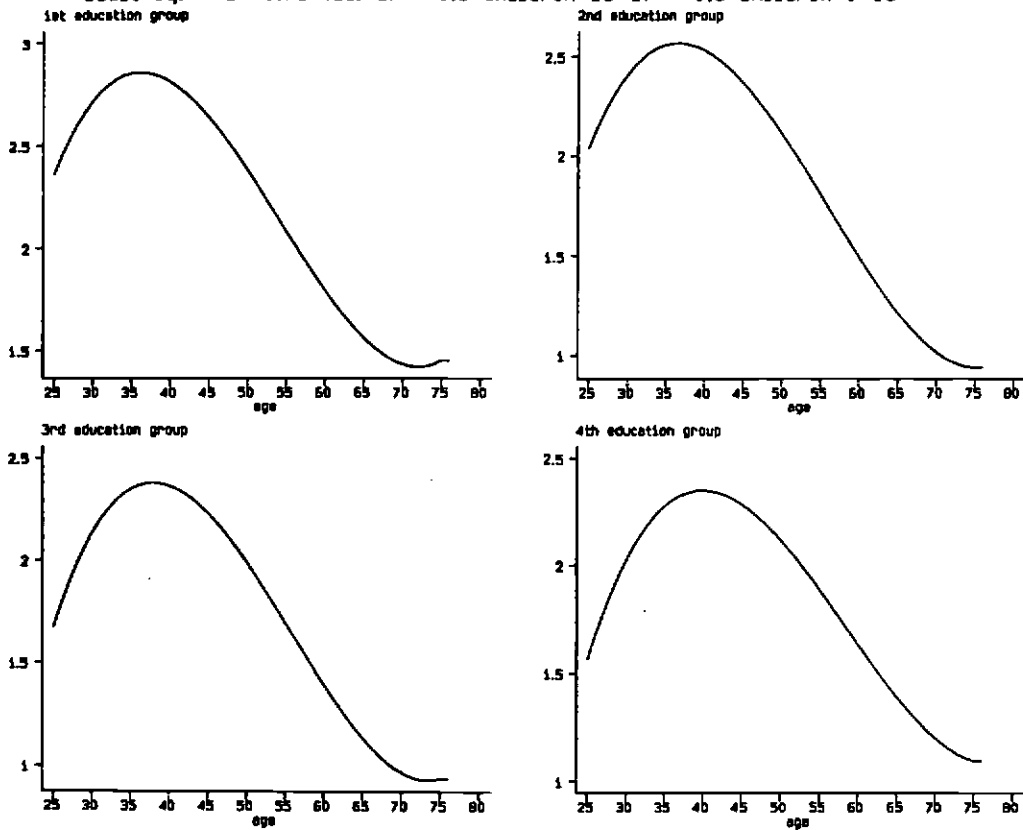
Adult equivalents

Figure 3
sigma = 0.03,   gamma = 2
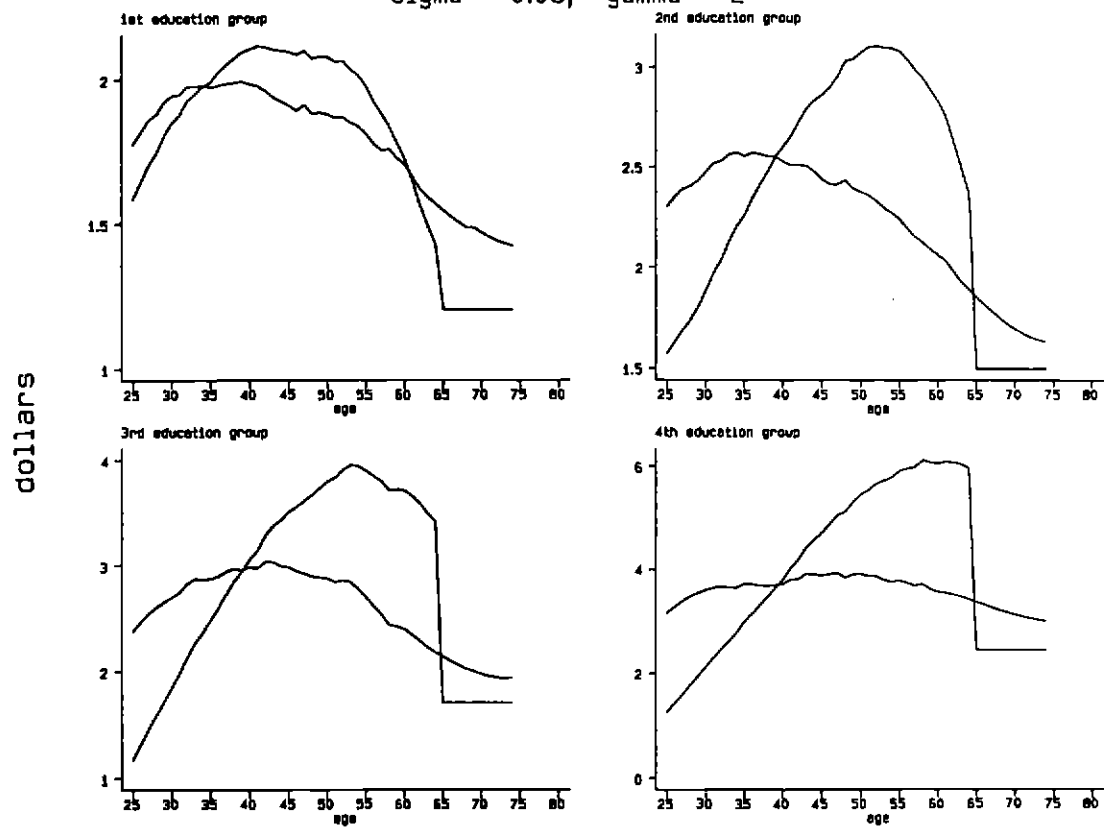
income and consumption average profiles

Figure 4
sigma = 0.10, gamma = 2

income and consumption average profiles