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A reconciliation of two alternative approaches towards buffer stock saving

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A Reconciliation of Two Alternative Approaches towards Buffer Stock Saving*

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Abstract

This paper shows that the two main models in the buffer stock saving literature can be nested in a model that varies the level of available social insurance. Equivalently, the assumption about the time series process for labor income (and social insurance during unemployment) is crucial in determining the level (but not the shape) of optimal consumption as a function of liquid wealth.

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Key Words: Buffer Stock Saving, Precautionary Savings Motive, Liquidity Constraints, Unemployment Benefit.

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1 Introduction

A chief modification to the classic Permanent Income-Life Cycle Hypothesis (PIH) is the so-called buffer-stock model of precautionary saving, pioneered by the work of Deaton (1991) and Carroll (1992, 1997). The model modifies the PIH framework to allow for precautionary saving motives and restrictions on borrowing and has become a workhorse of modern day consumer theory. Buffer stock saving behavior can arise from (at least) two distinct assumptions. Deaton (1991) explicitly imposes a no borrowing constraint but assumes that the agent is always employed (and therefore always receives a positive (but possibly small)) income transfer. Carroll (1992), on the other hand, generates endogenously a no borrowing constraint by assuming that with a very small probability, an individual will receive a zero, transitory, labor income shock (and therefore zero labor income for ever is a possibility), implying that the agent will optimally never want to borrow given that the marginal utility of zero consumption is infinite. In this formulation, the agent may face an unemployment spell but receives zero labor income in that period.

It can be argued that the two assumptions lie at the two ends of a spectrum of empirically plausible possibilities. Specifically, individuals facing unemployment typically receive a certain level of unemployment insurance in that state. For instance, Nickell et. al. (2001) report the replacement ratio of wage income once unemployed and the duration over which unemployment is paid in OECD economies between 1960 and 1995. In the period 1988-95, the lowest annual replacement ratio in the OECD is 22 percent (in the UK). The U.S. and Australia are close seconds with a 26 percent unemployment benefit replacement ratio. On the contrary, many European countries have replacement ratios close to sixty percent, illustrating their more generous benefit systems (a notable exception is Italy). Taking the duration of benefits into account, Nickell et. al (2001) conclude that a reasonable range of values for the level of unemployment benefits in the OECD over $1960-1995$ would be between ten and seventy percent of mean labor income. Moreover, for the 1988-1995 period, this range can be reduced to somewhere between thirty and seventy percent of mean labor income.

This paper investigates the implications for optimal consumption when varying the level of available social insurance and shows that if the unemployment benefit is high enough, the model collapses to the model originally studied by Deaton (1991). If, on the other hand, the unemployment benefit is virtually non-existent, then the Carroll (1992) policy function results. Depending on the level of available social insurance, a range of consumption functions between these two extreme cases exists, illustrating the importance of the time series process for labor income on the level of optimal consumption. These results indicate firstly that the institutional setting providing social insurance can be an important determinant of optimal consumption decision making and might therefore be one explanatory variable in the determinants of consumption dynamics across different countries.

The rest of this paper is organized as follows. Section 2 compares the two different methods for generating buffer stock saving behavior and Section 3 describes the results. Section 4 concludes.

2 Microeconomic Consumption Models: Alternative Ways of Generating Buffer Stock Saving Behavior

This section presents the model of individual consumption behavior; the framework can nest the models analyzed in Deaton (1991) and Carroll (1992, 1997). Time is discrete and agents have an infinite horizon. We assume there is one non-durable good and one financial asset (a riskless bond). The asset yields a constant, after tax, gross, risk-free, real return, R_f. At time t, the agent enters the period with assets held over from last period (A_{it}), and receives Y_{it} units of the non-durable good from inelastically supplying one unit of labor. The agent chooses the level of non-durable good expenditures (C_{it}) to solve the following dynamic program:

$$MAX_{\{C_{it}\}} E_0 \sum_{t=0}^{\infty} \beta^t U(C_{it}), \tag{1}$$

subject to

$$A_{it+1} = (R_f)(A_{it} + Y_{it} - C_{it}) \tag{2}$$

where E_0 is the expectation conditional on information available at time 0, and $\beta = \frac{1}{1+\delta}$ is the constant discount factor. We assume that preferences are of the constant relative risk aversion family; specifically, $U(C_t) = \frac{C_t^{1-\rho}}{1-\rho}$ when $\rho > 0$; if $\rho = 1$, $U(C_t) = \ln C_t$.

2.1 Labor Income Process

The specification of the labor income process is very important in this setup and will effectively differentiate between the two models that generate buffer stock saving behavior. The growth in individual labor income (during employment) follows

$$\Delta \ln Y_{it} = \ln G_t + \ln N_{it} + \ln U_{it} - \ln U_{it-1}, \tag{3}$$

where the unconditional mean growth for individual earnings is μ_g, and the unconditional variance equals $(\sigma_g^2 + \sigma_n^2 + 2\sigma_u^2)$. This process has a single Wold representation that is equivalent to the MA(1) process for individual income growth estimated using household level data (MaCurdy [1982], Abowd and Card [1989], and Pischke [1995]). The assumption that a disastrous earnings shock can arise with a positive probability involves an assumption about the transitory innovation, U_{it}. The level of transitory earnings in the disastrous state can be thought of as unemployment insurance and the probability of receiving it as the probability of becoming unemployed for one year.

2.2 Different Models for Buffer Stock Saving

Two distinct methods have been used to generate no-borrowing behavior. An exogenous imposition of a no-borrowing constraint was used by Deaton (1991) who assumed that $A_{it+1} \geqslant 0$. The second method assumes that the consumer will receive zero transitory labor income ($U_{it} = 0$) in any given period with a small probability (Carroll, 1992, 1997). The positive probability of receiving a zero transitory labor income shock can be interpreted as the probability of unemployment. To the extent that unemployment spells imply zero labor income (associated with the lack of any social insurance mechanism), a no-borrowing constraint can be generated endogenously by taking advantage of the assumption that $\lim_{c\to 0} U'(C) \to \infty$; a backward induction argument can then be used to show that it is optimal for these consumers never to borrow.

In this paper, the implications of the different assumptions in generating buffer stock behavior are investigated by explicitly imposing the liquidity constraint and assuming that in the event of a disastrous labor income shock there exists a positive, lower bound on the transitory labor income shock (U_{it}). In the event that this innovation is very close to zero, the explicit imposition of a liquidity constraint does not matter because the individual, anticipating this possibility, will optimally never want to borrow and the policy function will be the one derived by Carroll (1992, 1997). To make clear the discussion that follows, I call this the "precautionary savings buffer stock model" since it is the precautionary motive that generates the voluntary liquidity constraint. As the magnitude of social insurance rises, the constraint will be important in preventing the individual from borrowing. This is the model with a positive income floor and can be called a "liquidity constraints buffer stock model" since the liquidity constraint is now needed to prevent borrowing. When the income floor is not explicitly imposed but is implied by the labor income process, the model is the one studied by Deaton (1991).

2.3 Euler Equation

Following Deaton (1991), we define "cash-on-hand", X_{it}, as the sum of current income and assets, $Y_{it}+A_{it}$ which evolves according to $X_{it+1} = R_f(X_{it} - C_{it}) + Y_{it+1}$. Given the borrowing restriction, the first order condition for optimal consumption choice is given by:

$$U'(C_{it}) = MAX[U'(X_{it}), \beta E_t\{R_f U'(C_{it+1})\}] \tag{4}$$

If the agent is constrained at time t, the maximum that can be spent on consumption is the cash on hand (X_{it}), implying that marginal utility can never be less than $U'(X_{it})$.

Given that individual earnings process is nonstationary, we normalize by the permanent component of earnings, P_{it}. Letting lower case letters denote the normalized variables, normalized cash-on-hand evolves according to $x_{it+1} = \frac{X_{it+1}}{P_{it+1}} = \frac{R_f}{G_{t+1}N_{it+1}}(x_{it} - c_{it}) + U_{it+1}$. Taking advantage of the homogeneity of degree $(-\rho)$ of the marginal utility function $U'(.)$

the first-order conditions can be written as

$$U'(c_{it}) = MAX[U'(x_{it}), \beta E_t\{R_f(G_{t+1}N_{it+1})^{-\rho}U'(c_{it+1})\}] \tag{5}$$

We make the following additional assumption:

$$\beta E_t\{R_f(G_{t+1}N_{it+1})^{-\rho}\} < 1 \tag{6}$$

that gives the "impatience" condition common to buffer-stock models which ensures that borrowing is part of the unconstrained plan.

3 Consumption Implications from Varying the Unemployment Benefit

3.1 Parameter Choice

We begin by solving an annual frequency version of the model under a set of "baseline" parameter assumptions and then move on to ask how our results vary when these parameter values are changed. We set the rate of time preference, δ, equal to 0.05, and the constant real interest rate, r, equal to 0.02. Carroll (1992) estimates the variances of the idiosyncratic shocks using data from the *Panel Study of Income Dynamics*, an annual data set, and our baseline simulations use values close to values in that paper: 0.10 for σ_u and 0.08 for σ_n. The unemployment benefit will be varied from 0.1 to 70 percent of mean labor income that appear to be the most relevant for existing arrangements in OECD economies. We set the mean (μ_g) and standard deviation (σ_g) of aggregate labor income equal to 0.02 and 0.025, respectively.

3.2 Policy Function Comparison

The individual consumption policy rules that result from varying the lowest earnings realization relative to the Deaton (1991) policy function are plotted in figures $1-4$. At one extreme, the Carroll (1997) policy function is being plotted; in that case the probability of being unemployed in any given period is 0.5 percent. At the other extreme, the Deaton (1991) policy function where the probability of being unemployed is zero is also shown. In between these extremes, a "liquidity constraint buffer stock saving model" exists where the liquidity constraint is explicitly imposed and the agent faces a 0.5 percent probability of being unemployed but in that state receives a certain fraction of mean earnings (0.1 in the figures denotes a transfer equal to ten percent of mean earnings).

Figure 1 plots the consumption policy function for $\rho = 2$ for the two extremes (Carroll vs Deaton). For any given level of cash on hand, total saving is higher in the precautionary savings than in the liquidity constraints buffer stock model. Moreover, consumption equals cash on hand using the liquidity constraint approach until levels of liquid wealth close to ninety five percent of mean labor income, whereas consumption is lower than cash on hand in the precautionary savings model for very low levels of cash on hand. Increasing the level of unemployment benefit to 0.1 (ten percent of mean labor income) in figure 2 results in a consumption policy rule that more closely matches the Deaton (1991) model, namely that consumption equals cash on hand for low levels of liquid wealth, but nevertheless still generates a higher level of saving.

Figure 3 illustrates that if the unemployment benefit is raised to around 40 percent of mean labor income, then the two policy functions collapse to the same rule. We can now see that the two assumptions used to generate buffer stock saving generate consumption functions that lie in between the two extremes. At one end, for instance, the truly disastrous labor income shock being equal to zero generates the Carroll (1992) model. At the other extreme, if the lowest labor income shock is sufficiently high, then the Deaton (1991) model arises. In between these extreme cases, however, there is a range of consumption policy functions that arise by varying the value of labor income received in the disastrous state.

Figure 4 plots the results from the comparative statics exercise of raising the CRRA coefficient from $\rho = 2$ to $\rho = 3$. The results are as expected, with higher level of savings for stronger prudence. One important difference between the Carroll and Deaton specifications arises, however. In the Deaton model, consumption equals cash on hand until around 95 percent of mean labor income. Stronger prudence does not significantly alter this implication of the model; higher saving only arises when the liquidity constraint stops being binding.

In the Carroll specification, on the other hand, the liquidity constraint stops being binding earlier, and therefore stronger prudence affects the consumption/savings decision at a much lower level of cash on hand. The divergence of consumption from cash on hand at much lower levels of liquid wealth for lower levels of unemployment insurance is an important difference between the two models since the saving ratio plays an important role in smoothing consumption fluctuations.

4 Conclusion

The "liquidity constraints buffer stock model" can replicate the policy functions generated in Deaton (1991) and Carroll (1997) by varying the amount of available social insurance. In general, the explicit imposition of a liquidity constraint allows the researcher to investigate the implications of institutional social insurance arrangements on the optimal consumption/savings decision.

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Fig.1 : Normalized Consumption (rho=2)

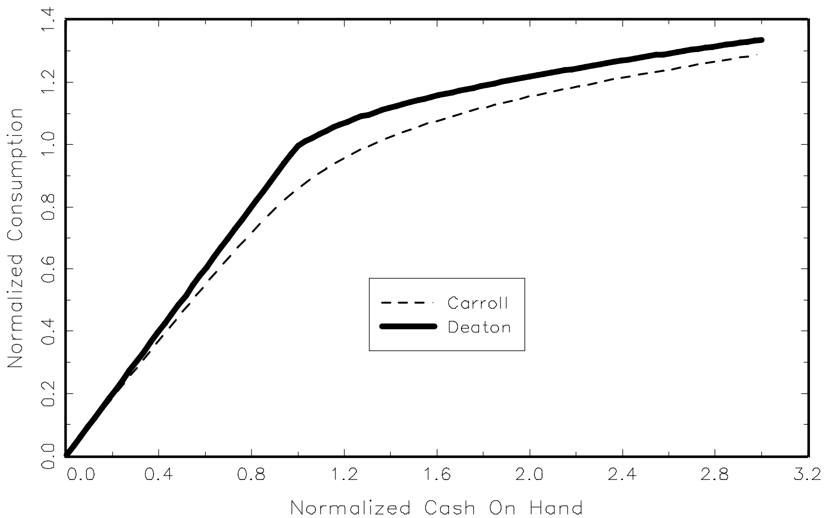

Fig.2 : Normalized Consumption (rho=2)

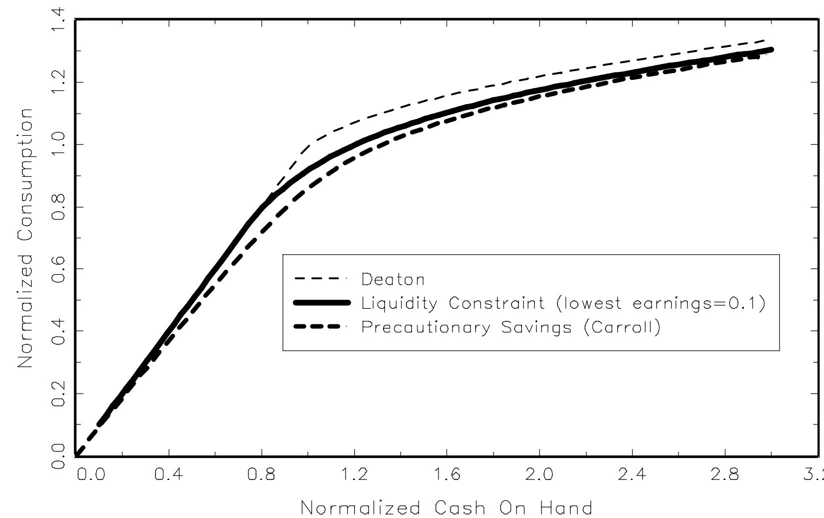

Fig.3 : Normalized Consumption (rho=2)

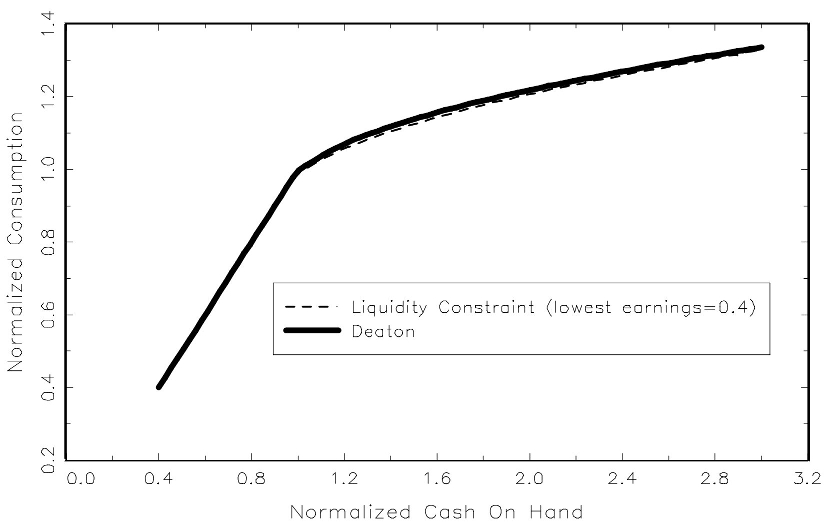

Fig.4 : Normalized Consumption varying rho