Fordham University
Department of Economics
Discussion Paper Series

Consumer Debt is 130% of Income: Avoiding Budget Constraint Orthodoxy

Hrishikesh D. Vinod
Fordham University, Department of Economics

Discussion Paper No: 2008-13
August 2008

Department of Economics
Fordham University
441 E Fordham Rd, Dealy Hall
Bronx, NY 10458
(718) 817-4048

Consumer Debt is 130% of Income: Avoiding Budget Constraint Orthodoxy

H. D. Vinod, Economics Department, Fordham University, Bronx, NY, 10458, vinod@fordham.edu *

August 12, 2008

Abstract

Consumer theory maximizes utility subject to a budget constraint, ignoring that the ratio of consumer debt to disposable income has varied between 30% and 130%. Granger-causality tests also confirm Consumption-precedence over income. We discuss features of newer US data allowing families greater control on the timing and level of income. Our 'target-seeking' Wiener-Hopf-Whittle optimization yields a two-equation system where both consumption and income are endogenous, similar to quantities and prices in a demand system. We resolve five old 'puzzles' from the consumer theory literature and provide estimates of shadow prices of the income level and adjustment costs

JEL Classification Codes: E21, E63
Key Words: Stochastic dynamic optimum; Target seeking; VAR, Wiener-Hopf-Whittle; Causality testing; Habit.

1 Introduction

Schoenfeld and Bloch (2008) state that in July 2008 American household debt inclusive of mortgages is "130 percent of disposable income, up from

*I thank Parantap Basu, Talha Yalta and Johanna Francis for helpful comments.

30 percent in 1929." The consumer debt is \$2.56 trillion (credit card and installment purchases) while mortgage debt is \$10.6 trillion. What kind of strict equality budget constraint allows household debt to income ratio to range between 30% to 130% ? This paper follows a tradition of consumer theory in using such empirically puzzling facts as pedagogical devices to study new features of consumption and income data and to possibly develop new theoretical insights. This tradition goes back to Kuznets (1946), when he challenged some aspects of the Keynesian consumption function:

$$C = a + b\,Y, \quad a > 0,\ b = MPC, \tag{1}$$

where C = aggregate consumption, Y = aggregate disposable income, and MPC=marginal propensity to consume. Time series regressions fitted over short time spans typically have the average propensity to consume (C/Y = APC) > MPC. By contrast, long term data studied by Kuzents showed that consumption and income are approximately in the same proportion. Consumer theory needed to reconcile long term APC = MPC, with the short term inequality of the Keynesian model. Friedman's permanent income hypothesis (PIH) gave us the insight that consumption is sensitive to the expected value of lifetime wealth or permanent income. Modigliani's insight was to consider the life cycle (LC) of consumption.

Hall's (1978) celebrated model assumes: Consumers are forward looking with rational expectations, having access to credit to lend or borrow at a fixed interest rate and that they compare consumption streams C_t with C_{t-1} in terms of a quadratic utility function. Then consumption is a martingale implying that the regression: $C_t = \alpha + \beta\ C_{t-1} + \varepsilon_t$ having $\alpha = 0, \beta = 1$, is a random walk. Similar to many in the literature, our estimates of this regression do not yield the coefficient estimates predicted by Hall's theory. Assuming that Y_t follows a random walk, the PIH yields a closed form solution stating that consumption must move in sync with income, as observed by Kuznets.

If the PIH is correct, people save transitory increases in income "for a rainy day" so that they have money put aside to be used when they are hit by negative transitory shocks. Campbell (1987) uses detailed econometric analysis including vector autoregression (VAR) and cointegration to test such implication of PIH and concludes that "overall the PIH can be strongly rejected." Campbell and Mankiw (1990) focus on liquidity constrained people who "consume their current income rather than permanent income." Carroll

and Weil's (1994) extensive study using simulations, international panel data, case studies, three household surveys and Granger causality tests concludes that "none of the models was fully satisfactory."

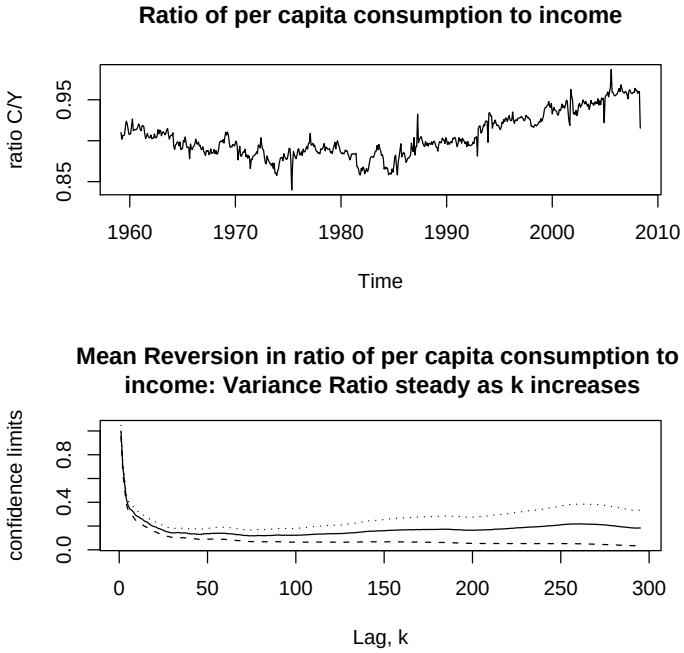
Attempts to test the LC-PIH still continue in the literature. If the growth in Y_t refers to labor income, and has positive serial correlation, the LC-PIH predicts that the growth in C_t should be more volatile than the growth in Y_t and that C_t should not be sensitive to growth in Y_{t-1}. In fact, the C_t data reveal the opposite. Hence two puzzles are called 'excess sensitivity' and 'excess smoothness' of consumption. Ludvinson and Michaelides (2001) show that the buffer-stock savings model cannot explain these two 'puzzles.' More recently, Luengo-Prado and Sorensen (2008) show that the two puzzles remain in State level panel data and derive further implications.

A strand of literature studies consequences of relaxing some unrealistic assumptions of the LC-PIH model, such as twice differentiability of the utility function (e.g., quadratic utility). Bernanke (1984) uses considerable ingenuity (assuming non-separability of durables and non-durables) to reconcile durable expenditures on cars with the LC-PIH. A dissertation by my student, Yalta (2007), uses the updated 'Panel Study of Income Dynamics' (PSID) survey data on US households to study purchases of durables including a car and/or a house. Abraham and Pavoni (2005) discuss optimal allocation of consumption in the presence of moral hazard plus hidden borrowing and lending, showing how consumption *reacts* to predetermined idiosyncratic risk in Y_t.

We begin our empirical work using up to date data by checking the constancy of R_t, the ratio of per capita consumption to income, claimed by Kuznets. The upper panel of Fig. 1 shows a drift up in R_t. An autoregression of R_t on R_{t-1} using US monthly data from March 1959 to May 2008 ($T = 591$ observations) suggests that the ratio has a statistically significant drift parameter (intercept= 0.03460) with a Student's t value of 3.379 (p-value =0.000775 < 0.05). The debt to disposable income ratio changing from 30% to 130% also does not support Kuznets.

Let us reformulate the Kuznets result in modern econometric parlance as possible 'mean reversion' in R_t arising from some deeper dynamically equilibrating behavior of economic agents. Poterba and Summers' (1988) definition of mean reversion requires negative serial correlation ρ_k at some lag k. Our data reveal that $\min(\rho_k) = 0.7546, (k \in [1 : 28])$ is far from negative. Poterba and Summers (1988) also suggest a nonparametric test,

Figure 1: US Consumption to Income Ratio R_t and a Nonparametric Mean Reversion Test with Confidence Limits



discussed in Vinod (2008, Ch. 2), using a ratio of variances:

$$VR = \frac{\text{Var}(R_t - R_{t-k})}{[k\,\text{Var}(R_t - R_{t-1})]}\frac{T}{[T-k-1]} \tag{2}$$

Since the lower panel of Fig. 1 shows that the variance ratio is not declining to zero as the lag k increases, Kuznets' mean reversion does not occur till $k = 295$ months, or even after waiting for almost 25 years. We conclude that R_t is not mean reverting, that is, no hidden human trait or market force is goading us to consume a constant proportion of our income.

The absence of Kuznets-type mean reversion, on top of near universal rejection of LC-PIH suggests that it is time we seek a new approach. Almost twenty five years ago, the current Chairman of the Board of Governors of the Federal Reserve System, Ben Bernanke (1984, p.603), stated that a "goal of future research" in consumer theory should be to relax two assumptions: "First, real interest rates are assumed constant over time; second, family

income is treated as exogenous." Similar to the familiar demand and supply equations where both prices and quantities are endogenous, this paper develops a behavioral model where both C_t and Y_t are endogenous.

1.1 Consumer in the driver's seat

The older data reflect the preponderance of male breadwinners holding union or corporate jobs leading to the precedence of income before consumption. However, since the 1970's we have seen a paradigm shift with a highly flexible budget constraint than what is implicit in the traditional mathematical model. This subsection describes recent trends in the American workplace allowing family income to be endogenous while placing consumers in the driver's seat.

(i) Tilly (1991) reports that since the 1970's both voluntary and involuntary part-time work has increased. These trends are accelerating since the 1990's.

(ii) The Bureau of Labor Statistics reports that the labor force participation rate for white women (age 20 +) has steadily increased from 32.7% in 1954 to 60.1% in 2007, whereas for African American women it has increased from 51.2% in 1972 to 64% in 2007.

(iii) Buckles (2008) considers the trade off faced by working women between work and family and the wage premium from postponing child-bearing. Clearly, the ability to choose is more pronounced in recent decades.

(iv) Davis (2008) remarks that "American workers face lower risks of job loss." He also provides graphics showing a dramatic decline in new claims for unemployment benefits since the 1960's and other evidence at "odds with populist rhetoric about declining job security." There is also evidence of a decline in median job tenure, a greater willingness of workers to quit when jobs are plentiful and a higher share of quits.

(v) Jefferson (2008) reports recent declines in poverty rates and volatility.

(vi) Dynan et al (2008) find that family income volatility has greatly increased since the 1970's in all major age and education groups, with very large income changes becoming common. Two-thirds of college students have student loan debt.

(vii) Mantell (2005) reports that almost 50% families now own stocks.

(viii) Modern families have greater access to consumer credit and greater control over family cash flows while enjoying a wide range of asset ownership options such as owning, leasing, pawning, mortgaging, reverse mortgaging by the elderly and refinancing. Cash flows from maturing investments and fund transfers (from friends and relatives, tax refunds, social security, welfare payments, etc.) are often known to the consumer in advance. See an interactive graphic at Shoenfeld and Bloch (2008).

(ix) Unemployment insurance is more widely available. Thousands of war veterans use government-insured mortgages to buy homes.

(x) Chicago Tribune's 'retail therapy' from 1986 is replaced by 'shop therapy' in popular magazines, Item (2008). It refers to consuming more as a treatment for real or imaginary psychological depression (without any reference to available income, of course).

The ascendance of consumers is not resisted by business interests, perhaps because it has come with flexibility in setting wages and hours, allowing lower volatility in firm's profits, output and employment. All these facets of the new data paradigm suggest that relaxing the assumption of exogenous income from the Bernanke agenda has become all the more necessary.

The plan of the remaining paper is as follows. Section 2 discusses our results using Granger-causality tests. These tests are inconsistent with assumptions of traditional theory that consumers maximize utility subject to their budget constraint, where current income precedes current consumption decisions. Section 3 describes an alternate Wiener-Hopf-Whittle model that is consistent with the result that consumption precedes income. Section 4 contains our Final Remarks.

2 Granger-causality Tests

An assumption in consumer theory is that the consumer maximizes utility by controlling the consumption stream within the budget constraint, dictated by exogenous family income. It also means Y-precedence, or the idea that income comes first, and then consumption. In the framework of Granger-causality (precedence) within a VAR model, we shall test Y-precedence and

its dual C-precedence in our bivariate model. A test for C-precedence evaluates whether past p data for C are useful for predicting Y. The Granger noncausality null hypothesis states: The past p data for C denoted by (C_{t-1} to C_{t-p}) do *not* help in predicting the value of Y_t. We specify a regression function:

$$Y_t = f(Y_{t-1} \text{ to } Y_{t-p}, \quad \text{and} \quad C_{t-1}, \text{ to } C_{t-p}). \tag{3}$$

The simplest estimation of such VAR models uses ordinary least squares (OLS). An F-test determines whether the coefficients of all C_{t-1} to C_{t-p} terms in (3) are jointly zero. In practice, if the p-value < 0.05 we reject the non-causality null hypothesis at the 5% level, and conclude that C_t precedes Y_t in agent decisions. Conversely, we want to test whether Y_t precedes C_t by running the other regression upon interchanging Y and C in (3). This time, if the p-value > 0.05 we conclude that C_t precedes Y_t.

Our definition of per capita consumption C_t is a sum of three major components: durables, non-durables and services, and real per capita disposable income is Y_t. We fit a VAR to these two series with $p = 1$ lag each. According to the VAR results in the lower panel of Table 1, note that C_{t-1} has a significant *positive* effect on Y_t. Macro theory posits that when consumption C_{t-1} increases, savings at time $t-1$ is reduced, thus lowering the interest income. This should have a negative effect on income, Y_t. Clearly, our results do not find evidence of any such negative effects but seem to suggest Duesenberry's ratchet effect. Duesenberry (1948) coined the term 'ratchet effect' to describe how consumption moves up more easily than down at the micro level. According to Safire (1998), Duesenberry was thinking of a car jack when he coined the term into the English language.

The null of Granger non-causality with Y_t as the alleged 'cause' has the test statistic F(1, 1157)= 2.6211, with a p-value = 0.1057, suggesting acceptance of the non-causality by Y_t. When C_t is the alleged 'cause,' we have F(1, 1157) = 15.9525, with a p-value = 0.00006899, suggesting the rejection of non-causality by C_t, where $T = 591$. Both tests reinforce each other and support the proposition that consumption C_t Granger-causes (precedes) income Y_t, thereby rejecting the traditional notion that income precedes consumption.

Further analysis reveals that income used to precede consumption in earlier times. We find that if we use the older data set from March 1959 to March 1971 with the first $T = 150$ monthly observations, income does precede consumption. For $T = 160, \ldots, 200$ an ambiguous bi-directional prece-

dence seems to hold. However, for $T = 200, \ldots, 591$, consumption precedes income. This is consistent with newer data properties from Section 1.1.

Table 1: VAR Model Estimation Results

	Estimate	Std. Error	t value	Pr(>|t|)	quarterly t
dependent=C_t					
intercept	−7.0454	15.0061	−0.47	0.6389	0.757
C_{t-1}	0.9892	0.0075	132.25	0.0000	67.880
Y_{t-1}	0.0119	0.0074	1.62	0.1060	0.010
dependent=Y_t					
intercept	90.8886	29.8598	3.04	0.0024	2.790
C_{t-1}	0.0594	0.0149	3.99	0.0001	2.545
Y_{t-1}	0.9429	0.0146	64.42	0.0000	33.312

Notes: In the upper panel where C_t is the dependent variable, Y_{t-1} is insignificant; but in the lower panel (Y_t= dependent variable) C_{t-1} is significant. For brevity, the last column reports for quarterly data comparable t-values, NOT the coefficients.

The reader may wonder whether our Granger-causality results are sensitive to the choice of the time unit t=one month in the above analysis. Hence we also study a quarterly version of our data. For brevity, the last column of Table 1 reports only the comparable *signed* t-values when we use quarterly data. Granger non-causality of quarterly consumption as the cause of quarterly income is rejected with F(1, 374)= 5.2801, p-value = 0.02212. The converse case has F(1, 374)= 0.1044, p-value = 0.7468. Again consumption precedes income in quarterly data also. In the sequel, it is convenient to refer to our Granger-cause results as the "C-precedence puzzle," which also leads to the rejection of the LC-PIH. In light of related results by Carroll and Weil (1994), Campbell (1987), among others, we need not belabor this by considering myriad other ways of doing our causality tests.

It may be possible to write a sophisticated dynamic stochastic general equilibrium model where C-precedence can occur despite a binding budget constraint. However, remember that in light of the high (130%) and changing (between 30% to 130%) debt to income ratio, we wish to avoid the binding budget constraint.

Let us begin by trying to explain away the C-precedence and high debt puzzles by three arguments.

A1) Almost 72% of debt is for home mortgages, which are viewed as capital investments, not consumption by most families. Also, the high household debt is due to high house prices and does not prove that the budget constraint is violated. In any case, the LC-PIH consumer theory assumes an inequality requiring that consumption not exceed income: $C_t \leq Y_t$, not equality. Although the argument A1 has some merit, the change in the debt burden from only 30% in 1929 to 130% in 2008 is simply too large to permit sticking to the orthodoxy of utility maximization subject to a budget constraint. Also, the typical derivations do not use Pontryagin's maximum principle to formally allow for inequality constraints, but simply replace the inequality by equality in writing the first order conditions.

A2) In the Granger testing framework of (3), the puzzling C-precedence may be because the budget constraint refers to C_t conditional on past income, where the current Y_t is absent from the list of conditioning variables. The argument A2 fails to explain why Y_t conditioned on C_{t-1} should outperform Y_t conditioned on Y_{t-1}.

A3) The result that consumption "predicts" future income might be a statistical artifact arising because income is anyway easier to predict. Unbeknownst to the statistician, consumers have advance knowledge of their own future income stream as they dynamically adjust C_t (perhaps by borrowing or paying off debt) to satisfy a known forward-looking budget constraint. The argument A3 fails to convince, because Granger-cause tests show superior ability of C_{t-1} over Y_{t-1} to forecast Y_t. Even if we were to concede that income might be easier to forecast, why should C_{t-1} do a better job?

Thus, it is unwise to explain away C-precedence and high debt without attempting to gain insights from it. Note that C-precedence is also consistent with the anecdotal evidence of recent decades suggesting that American consumer has been the engine of world economic growth. Subsection 1.1 mentions several features of the American labor market which have arisen over the last few decades. The new paradigm allows many Americans to adjust their future income Y_{t+1} when their current C_t is subject to a shock. For example, they change hours worked, begin or stop full time /part-time work / school. We claim that they do offer an explanation for C-precedence in the domestic US data.

A greater control over family income and cash flows during the immediate future allows family consumption to precede family income. Section 3 offers an alternate formulation of consumer behavior consistent with C-precedence and weak budget constraint.

3 Wiener-Hopf-Whittle Model if Consumption Precedes Income

Sargent's foreword to Whittle (1983) notes that Whittle's frequency domain methods are useful for "deducing closed form solutions for decision rules". Vinod (1990) applies Whittle's closed form solution to a 'target seeking' minimization problem from regulatory economics. Vinod (1996) applied that solution to the consumer's choice problem.

Recognizing C-precedence and placing the consumer on the driver's seat does not mean that an individual consumer at the micro level can ignore the budget constraint. A representative consumer, being subject to the ratchet effect, decides his or her consumption and then must work hard enough to earn the income needed. In practice, some micro level consumers ratchet up, while others (who may have lost a job, or retired) are forced to ratchet down. The aggregate C_t is assumed to follow a Houthakker-Taylor type habit equation defined as:

$$C_t = b_1 + \ b_2 Y_t + \ b_3 C_{t-1} \ + \epsilon_{1t}, \tag{4}$$

where current consumption depends on past consumption and current income. Ravina (2007) reviews recent litearture on habit models in consumption and provides robust evidence supporting the existence of habit with a log-linearized Euler equation for a representative sample of U.S. credit-card holders. Our specification is admittedly less sophisticated. Note that (4) is the first of our system of two equations. Even though Y_t is on the right hand side of (4), it is not exogenous but determined by the following optimizing model.

The consumer minimizes Whittle's Lagrangian in the frequency domain

$$L = E\left[(C_t - C_t^*)^2 + \mu_1 (Y_t - \bar{Y})^2 - 2\mu_2 \bar{Y}\right], \tag{5}$$

where bars denote averages and C_t^* denotes known target values satisfying the aggregate desire to ratchet up, implying that $C_t^* > C_t$ for all t. The

Lagrangian coefficient μ_1 incorporates the adjustment costs measured by $|Y_t - \bar{Y}_t|$ associated with working (hard) to sustain higher consumption through higher income. Similarly $-\mu_2$ explicitly recognizes that our consumer prefers a higher average income $\bar{Y}$ over lower. That is, our representative consumer should not be a satiated ascetic.

As explained in Vinod's (1990) appendix, Wiener-Hopf-Whittle solution methods translate the expectation operator of the stochastic dynamic optimization problem (5) into a Cauchy integral with the absolute value defined over the unit circle. A derivative involving z-transforms yields the first order conditions for minimization of (5). Let $\bar{C}$ denotes the average of lagged consumption and let us add an error term to the theoretical decision rule. Then the ultimate solution consists of the following linear decision rule for income determination:

$$(Y_t - \bar{Y}) = Q_1 \ (C_{t-1} - \bar{C}) + \ Q_2 \ (C_t^* - \bar{C}^*) \ + \epsilon_{2t}, \tag{6}$$

where

$$Q_1 = (\xi - b_3)/b_2 \ \text{ and } \ Q_2 = (K^2 b_2)^{-1}, \tag{7}$$

and where

$$\xi = (A/2) + (1/2)(A^2 - 4)^{1/2}, \tag{8}$$

$$A = b_3 + (1/b_2) + (b_2^2/\mu_1 b_3), \tag{9}$$

$$K^2 = \mu_1 b_3/(\xi b_2^2), \tag{10}$$

$$\bar{C} = \bar{C}^* + \mu_2(\xi - b_3)b_2^{-1}. \tag{11}$$

Since we have Y_t on the left side of (6), current income has become endogenous. We admit that real world agents might fail to optimize by inserting the error term ϵ_{2t}.

Unlike LC-PIH we are not assuming that interest rates r_t are constant for all time, or that we have data on a long time series of r_t for the entire time horizon. We are also not assuming exogeneity of Y_t. Thus, we are satisfying both aims in the Bernanke research agenda mentioned earlier. Endogenous labor supply decisions have been studied in the literature. For example, Gurdgiev (2004) shows relevance of comprehensive habits where both consumption and leisure may overshoot their targets leading to greater volatility of consumption around the steady state than in the traditional models of habit formation.

A weakness in our model is that we assume knowledge of the target C_t^* at time t. We can forecast the target time series by using some exogenous variables including time itself. We can also imagine a micro study allowing us to forecast detailed estimates of targets for various groups of consumers before aggregating it. For further richness, such a study can incorporate the average consumption of all people in the family's social circle, as suggested by Duesenberry (1948). Then, this apparent weakness of our model will become an asset.

The beauty of this system of two equations is that the endogenous variable Y_t appears on the right hand side of (4), but its left hand variable C_t does not appear on the right hand side of (6). In other words, we have Hermon Wold's recursive system of equations, which does not need two stage least squares (2SLS) or similar methods. The OLS is consistent.

Table 2: OLS Estimation of the Habit Equation (4)

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	−22.7072	14.9086	−1.52	0.1283
Y_t	0.0227	0.0073	3.13	0.0018
C_{t-1}	0.9783	0.0074	132.33	0.0000

3.1 Determination of Target Consumption

The minimand (5) of the Wiener-Hopf theory in this section contains a notional variable C_t^* for the ideal, desired, aspirational or target level of consumption. If the Duesenberry ratchet effect mentioned earlier holds, $C_t^* > C_t$ for all t. Strictly speaking, our theory needs additional data on C_t^*, which permits a much richer model of consumer behavior as explained above. It is well known that instead of asking for additional data on 'permanent income,' Friedman used a version of 'errors in variables' model to obtain a plausible approximation to permanent income using only the available data. This subsection attempts to obtain our missing series by a similar (perhaps more lame) method. Our task then is to construct a time series of length T to approximate target consumption satisfying $C_t^* > C_t$.

Consider a pseudo demand regression:

$$C_t = \eta_0 + \eta_1 C_{t-1} + \eta_2 Y_t + \eta_3 \pi_t + \eta_4 q_t + \epsilon_{ct}, \tag{12}$$

where π_t is a measure of consumer inflation using monthly data on consumer price index (CPI for all urban consumers in the U.S. based on average of all items, with the base period over 1982-84). The variable q appearing in (12) is the sequence of numbers 1 to T=591 (March 1959 to May 2008) representing all changes over time in the form of improvements in the durability (quality) of all products.

According to the theory of demand: (i) the quantity demanded C_t on the left hand side decreases when prices rise and /or durability improves, (ii) the direct utility of the consumer increases when C_t increases, and (iii) the indirect utility of the consumer increases when the price level π_t decreases and /or durability quality q improves. Now, we use these tenets of demand theory to come up with a plausible time series for C_t^*.

The OLS results upon fitting (12) are reported in of Table 3. Unfortunately, the coefficient $\hat{\eta}_3$ of the price variable is positive, perhaps because the CPI does not fully reflect the quality improvements, or because of confounding with q. The coefficient $\hat{\eta}_4$ does have the desired negative sign and is statistically significant. Hence we ensure that $C_t^* > C_t$ holds, quite simply as follows. The magnitudes of fitted values on the left hand side obviously increase by completely removing the regressor q with a negative coefficient (=–0.7069) from the right hand side. Thus, we use the fitted regression coefficients of (12), to define our:

$$C_t^* = \hat{\eta}_0 + \hat{\eta}_1 C_{t-1} + \hat{\eta}_2 Y_t + \hat{\eta}_3 \pi_t. \tag{13}$$

Table 3: OLS Estimation of Pseudo Demand Equation (12)

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	−146.7195	66.1779	−2.22	0.0270
C_{t-1}	0.9647	0.0090	106.83	0.0000
Y_t	0.0478	0.0124	3.87	0.0001
π_t	0.9451	0.4088	2.31	0.0211
q	−0.7069	0.2801	−2.52	0.0119

We claim that (13) provides a plausible approximation to a time series for target consumption, with room for improvement upon disaggregation. It may be thought of as the consumption of some aspirant population group based on the life experiences of each consumer captured by the variables on

the right hand side of the equation. Finally, we are ready to estimate the equation representing the linear decision rule (6) for income determination, after introducing the intercept term.

Table 4: Estimation of the Decision Rule (6) for Income

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	4087.7169	53.3757	76.58	0.0000
C_{t-1}	−16.7933	0.3203	−52.44	0.0000
C_t^*	17.4035	0.3130	55.61	0.0000

This completes estimation of our system of two equations. The estimates of b_1 to b_3 appearing in the habit equation are: -22.70724, 0.02270, and 0.97826, respectively. The estimates of Q_1 and Q_2 appearing in the decision rule are: -16.79334, and 17.40349, respectively. The minimand of the Wiener-Hopf-Whittle theory has three terms: $E(C_t - C_t^*)^2, E(Y_t - \bar{Y})^2$, and $\bar{Y}$. The first term is the average of the squared gap between the target consumption and actual consumption, or V_{gap} = 64547.68. The variance of per-capita income appearing in the second term is estimated to be: V_Y =30712673. The mean of per-capita income is: $\bar{Y}$=18605.52.

Simple algebra shows that the first Lagrangian is given by:

$$\mu_1 = b_2 \ (Q_1 b_2 + b_3) \ / \ Q_2 b_3, \tag{14}$$

estimated to be 0.0008. Similarly, the second Lagrangian is:

$$\mu_2 = \ (\bar{C} - \bar{C}^*) \ / Q_1, \tag{15}$$

estimated to be 13.30752. The three weights on the three terms of the minimand (5) are: (1, μ_1 and $2\mu_2$) =(1, 0.0008 and 26.61504) involving Lagrangian coefficients. These help find the three shadow prices associated with the three terms of the minimand L, except that they are sensitive to units of measurement. These can be made free from units of measurement by using partials with respect to logs of V_{gap}, V_Y, and $\bar{Y}$, suggesting the formula:

$$[V_{gap}, \quad \mu_1 V_Y, \quad 2\mu_2 \bar{Y}]. \tag{16}$$

If we change the units of measurement of Y to λY, the relative magnitudes of all terms in (16) remain unchanged, because Q_1 becomes λQ_1 and $\bar{Y}$ becomes

$\lambda\bar{Y}$. Similarly, if we multiply both C and C^* by w, all terms get multiplied by w^2, keeping the relative magnitudes unchanged.

It is convenient to assign a reference weight (shadow price) of unity for the failure to reach the target consumption level. Hence we divide all terms by V_{gap} to yield the shadow price weights:

$$[1, \quad \mu_1 \ (V_Y/V_{gap}), \quad 2\mu_2 \ (\bar{Y}/V_{gap})] \tag{17}$$

estimated as: [1, 0.3788043, 7.671643].

It appears that US consumers place about 38% weight or importance (shadow price) on the variance of income (the adjustment cost) and considerable weight on achieving high average level of income (the last term). Since highly nonlinear functions (14), (15) and (17) are involved in estimating the unit-free shadow prices, their finite sample estimates are subject to wide confidence intervals and should be interpreted with caution.

3.2 Resolving Several Puzzles of Consumer Theory

Consumer theory contains at least five old 'puzzles' useful as pedagogical devices to encourage everyone to think more deeply about subtle aspects of consumer behavior.

1] Lowenstein and Thaler (1989, p. 192) note that "people care about changes in, as well as, absolute levels of income." This is considered a puzzle, because traditional LC-PIH theory does not recognize such behavior. By contrast, our minimand (5) contains a term for such changes.

2] An implication of LC-PIH theory, Flavin (1981), is that consumption should not respond to anticipated changes in income. On the other hand, Deaton (1986) shows that consumption is "too smooth" with reference to unanticipated changes in income. Since the habit equation (4) of our theory explicitly recognizes response of consumption to income, excess smoothness or excess sensitivity have become empirical questions–not puzzles.

3] The PIH theory implies, Zeldes (1989, p.277) and Caballero (1990), that the growth rate of consumption should be negative when $\delta > r$ (market interest is lower than rate of time preference). Since it is a fact that during periods of low r consumption grows, this is a puzzle. Wiener-Hopf-Whittle theory can explain higher consumption during those periods by letting the target consumption C_t^* reflect a higher target values in response to the 'income effect' of lower prices (e.g., lower interest charges on home mortgages

and cars).

4] The Fourth puzzle of traditional theory is that the effect of interest rates on consumption is 'too small,' in the sense that rational consumers should respond more actively to changes in r, Hall and Taylor (1986, sec.7.4). An analogous puzzle is that LC-PIH does not allow for the inability of liquidity constrained consumers to borrow during recessions, Muelbauer (1983). In our theory, target consumption adjusts to incorporate the effect of such changes viewed as 'price' changes. After all, consumption of housing, automobiles, etc., is sensitive to r. It is a simple matter to lower the C_t^* during recessions due to liquidity constraints.

5] Another puzzle of consumer theory is that during business cycle boom times consumers work harder as well as consume more. It is a puzzle because LC-PIH does not allow for the time preference δ to depend on business cycles. Our explicit decision equation (6) encourages consumers to earn more when they can, in response to changing C_t^* and C_{t-1}.

4 Summary and Final Remarks

Recent data do not support Kuznets' claim that MPC=APC. Moreover, the ratio of per capita consumption to income is not found to be mean-reverting to a dynamic equilibrium. Using a VAR model our Granger causality tests reveal a C-precedence puzzle, suggesting that the traditional assumption of exogenous income preceding consumption needs to be relaxed, as suggested in Bernanke (1984). Section 1.1 describes a paradigm shift in recent data with ten pieces of evidence, including the striking statistic that in 2008 the household debt is 130% of disposable income. Could a binding budget constraint typically used in first order conditions of traditional models allow a debt ratio changing between 30% to 130%?

This is not a matter of having a majority of ponzi consumers who keep accumulating debt forever. However, the budget constraint has become too flexible for calculus tools. Modern consumers certainly do not balance budget every period when they accumulate large debt, sometimes burdening the next generation. A life cycle theory that can rob life cycle earnings of children and grand children can be made internally consistent by assuming lifetimes over three generations. However, such unrealistic proposals invite Leontief's (1982) admonition against "the splendid isolation" of academic economists from the real world. Since it is difficult (for me) to insert a flexible bud-

get constraint within the orthodox constrained utility maximization, I am proposing an alternative target seeking model for consumer behavior based on Wiener-Hopf-Whittle methods.

Our references show that two pillars of our model: habit persistence and and consumption targets, are not new. A linear closed form solution of the model is not so new either, since I am staying slavishly close to Whittle's (1983) derivations. Estimating a recursive system of two behavioral equations where both income and consumption are endogenous is new and shown to be subject to fewer puzzles than the traditional LC-PIH theory.

Our model can be extended and improved on two fronts. On the theoretical front, it would be interesting to represent adjustment costs by the first few differences $C_t - C_{t-1}$, $C_t - C_{t-2}$, etc., instead of the variance, even though variance equals half "mean difference" for all pairs, Kendall and Stuart (1977, §2.21-22). This innocuous-looking change is difficult for me due to my limited familiarity with Cauchy integrals in the frequency domain. Researchers with superior skills might be able to replace the variance by first differences, and add other flexibilities.

On the empirical front, our tentative model for constructing a time series of target consumption C_t^* can be enriched with additional data. One can incorporate micro level characteristics by using the massive PSID type survey data for subsets of consumers to model their aspirations as target consumption. Our model readily admits aggregating all target consumption estimates of all subgroups as C_t^*. Target seeking model can incorporate Duesenberry's (1948) idea that people's consumption is influenced by the behavior of peers (Keeping up with the Joneses) by collecting data on consumption of group wise peer characteristics such as age, education, region, sex and ethnicity to determine our C_t^*. We do not claim, however, that this is the only way.

References

Abraham A. and Pavoni N. 2005. The Efficient Allocation of Consumption Under Moral Hazard and Hidden Access to the Credit Market. Journal of the European Economic Association 3(2-3), 370–381.

Bernanke, Ben S. 1984. Permanent Income, Liquidity, and Expenditure on Automobiles: Evidence from Panel Data. Quarterly Journal of Economics 99(3), 587–614.

Buckles, Kasey. 2008. Understanding the Returns to Delayed Childbearing for Working Women. American Economic Review 98(2), 403-07.

Caballero, R. J. 1990. Consumption Puzzles and Precautionary Savings, Journal of Monetary Economics 25, 113–136.

Campbell, J. Y. 1987. Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis. Econometrica, 55 (6), 1249–1273.

Campbell, J. Y and N. G. Mankiw, 1990. Permanent Income, Current Income and Consumption. Journal of Business and Economic Statistics 8 (3), 265–279.

Carroll, Christopher D. and David N. Weil. 1994. Saving and Growth: A Reinterpretation. Carnegie-Rochester Conference Series on Public Policy 40, North Holland. 133–192.

Davis, Steven J.. 2008. "The Decline of Job Loss and Why It Matters", American Economic Review 98(2), 263-67.

Deaton, A. S. 1986. Life Cycle Models in Consumption: Is the Evidence Consistent with the Theory? In Advances in Econometrics, Fifth World Congress 2, T. G. Bewley (ed.) Cambridge University Press, New York, 121–148.

Duesenberry, J.S. 1948. Income - Consumption Relations and Their Implications, in Lloyd Metzler et al., Income, Employment and Public Policy, New York: W.W.Norton & Company, Inc.

Dynan, Karen E. Douglas W. Elmendorf, and Daniel E. Sichel, 2008, The Evolution of Household Income Volatility, The Brookings Institution. Also: http://www.brookings.edu/papers/2008/02_us_economics_elmendorf.aspx.

Flavin, M. A. 1981. The Adjustment of Consumption to Changing Expectations about Future Income. Journal of Political Economy 89, 974–1009.

Grossman, S.J and Shiller,R.J. 1981. The Determinants of the Variability of Stock Market Prices. American Economic Review, Papers and Proceedings

71, 222–227.

Gurdgiev, C. T. 2004. Component-Specific versus Comprehensive Habits in a Model of Income and Consumption Taxation. Trinity College, Department of Economics Working Paper No. TEP 14/2004, Dublin.

Hall, R.E. 1978. Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. Journal of Political Economy 86, 971–986.

Hall, R.E. and J. B. Taylor. 1986. Macroeconomics: Theory, Performance and Policy, Norton, New York.

Item. 2008. Shop Therapy: Societys Slippery Slope. (http://www.item.com/Shop_Therapy.html) No author. Checked on August 10, 2008.

Jefferson, Philip N.. 2008. "Poverty Volatility and Macroeconomic Quiescence", American Economic Review 98(2), 392-97.

Kendall, M. and A. Stuart. l977. The Advanced Theory of Statistics, Vol. 1, 4th ed., Griffin, London.

Kuznets, S. 1946. National Product Since 1869. New York: National Bureau of Economic Research, Princeton University Press

Leontief, W. 1982. Academic Economics. Science (magazine), 217, 104107.

Lowenstein, G. and R. H. Thaler. 1989. Anomalies: Intertemporal Choice. Journal of Economic Perspectives 3(4), 181–193.

Ludvigson, Sydney, and Alexander Michaelides. 2001. Can Buffer Stock Saving Explain the Consumption Excesses? American Economic Review 91(3), 631–647.

Luengo-Prado, M. J. and B. E. Srensen. 2008. What Can Explain Excess Smoothness and Sensitivity of State-level Consumption? Review of Economics and Statistics, 90(1), 65–80

Mantell, Ruth 2005. Stock Ownership on the Rise: Half of U.S. Households Invested, Mostly Through Funds. MarketWatch. Last update: 5:47 p.m.

EST Nov. 10. http://www.marketwatch.com/News/

Muelbauer, J. 1983. Surprises in Consumption Function. Economic Journal 93, 34–40.

Poterba, J. M. and L. H. Summers (1988). Mean Reversion in Stock Prices. *Journal of Financial Economics*, 22, 27–59.

Ravina, Enrichetta. 2007. Habit Persistence and Keeping Up with the Joneses: Evidence from Micro Data New York University Working Paper: November 2007.

Safire, William 1998. On Language; Ratcheting Up the Periscope New York Times, July 12, 1998.

Schoenfeld, Amy and M. Bloch. 2008. The American Way of Debt. New York Times, July 20, 2008, page 15 Interactive graphic http://www.nytimes.com/interactive/2008/07/20/business/20debt-trap.html

Tilly, Chris. 1991. Reasons for the Continuing Growth of Part-time Employment. Monthly Labor Review, March, 10–18.

Vinod, H. D. 1988. Random Walk in Consumption: Maximum Likelihood and Nonparametrics, in T.B. Fomby and G.F. Rhodes, Jr. (eds.), Advances in Econometrics: Robust and Nonparametric Statistical Inference, Vol. 7. Greenwich, Conn.: JAI Press, 291–309.

Vinod, H. D. 1990. Regulatory Economics: Dynamic Optimization and Control Under Multiple Objectives, Journal of Quantitative Economics 6, 245–269.

Vinod, H. D. 1996. Consumer Behavior and a Target Seeking Supply Side Model for Income Determination, Ch. 18 in M. Ahsanullah and D. Bhoj (eds.) Applied Statistical Science, I Nova Science Pub. Carbondale, IL, 219–233.

Vinod, H. D. 2008. Hands On Econometrics With R: Templates for Extending Dozens of Practical Examples. World Scientific, Hackensack, NJ (in press).

Whittle, Peter 1983. Prediction and Regulation by Linear Least Square Methods, 2nd Ed. Minneapolis, Minnesota: University of Minnesota Press.

Yalta, Talha 2007. Household Saving Behavior Under Liquidity Constraints. A Fordham University Economics Department dissertation.

Zeldes, S. P. 1989. Optimum Consumption with Stochastic Income: Deviations from Certainty Equivalence, Quarterly Journal of Economics 103, 275–298.