

Consumption-Based Asset Pricing (4)

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Outline

- Limited participation
- Consumption-based asset pricing with production
- Consumption-based asset pricing and the cross section of stock returns

Limited Participation in a Static Model

- To understand the effect of limited participation, consider a static (one-period or iid) model with a representative agent.
- Optimal risky share

$$\alpha = \frac{EP}{\gamma\sigma^2}.$$

- With full participation, equilibrium requires $\alpha = 1$. Hence,

$$EP = \gamma\sigma^2.$$

- With a constant consumption-wealth ratio,

$$\text{Var}(\Delta c) = \sigma^2.$$

Limited Participation in a Static Model

- Now suppose only a fraction k of wealth belongs to investors who can hold stocks (*participants*).
- The remaining wealth belongs to *nonparticipants* who can only hold safe assets (lend to participants).
- Equilibrium requires $\alpha = 1/k$ for participants. Hence,

$$EP = \frac{\gamma\sigma^2}{k}.$$

- With a constant consumption-wealth ratio,

$$\text{Var}(\Delta c_P) = \frac{\sigma^2}{k^2}.$$

Limited Participation in a Static Model

$$EP = \frac{\gamma\sigma^2}{k}.$$

- With a constant consumption-wealth ratio,

$$\text{Var}(\Delta c_P) = \frac{\sigma^2}{k^2}.$$

- Suppose aggregate consumption $c = kc_P + (1 - k)c_{NP}$. Then

$$\text{Var}(\Delta c) = k^2 \text{Var}(\Delta c_P) = \sigma^2.$$

- The equity premium is higher by a factor $1/k$ without any increase in aggregate risk.
- Limited participation is equivalent to a decline in aggregate risk tolerance.

Is Limited Participation Important?

- How big is the effect?
- It is more powerful for low values of k .
- The calculation should be done on a wealth-weighted basis.
- How can we make the effect large?

Making Limited Participation Important

- How can we make the effect large?
- Constantinides, Donaldson, and Mehra (QJE 2002):
 - ▶ Human capital (claim to future labor income) is an important component of wealth. Participants' share of total wealth is much smaller than their share of financial wealth.
 - ▶ Young people are borrowing-constrained, and this limits their risktaking capacity.
 - ▶ Three-period OLG model in which middle-aged people bear all the equity risk.

Making Limited Participation Important

- How can we make the effect large?
- Guvenen (Econometrica 2009):
 - ▶ Exogenous nonparticipation.
 - ▶ Nonparticipants have low EIS, participants have high EIS (consistent with empirical evidence in Vissing-Jorgensen 2002).
 - ▶ Technology shocks affect labor income as well as capital income.
 - ▶ Nonparticipants use the bond market to smooth their income, so participants' consumption is highly procyclical even if the wealth share of nonparticipants is small on average.
- Gomes and Michaelides (RFS 2008):
 - ▶ Nonparticipation from fixed participation cost, so nonparticipants have lower wealth than participants.
 - ▶ Nonparticipants have low EIS, participants have high EIS (intuitive).
 - ▶ Nonparticipants have low RRA, participants have high RRA (counterintuitive).
 - ▶ Equity premium from idiosyncratic risk among participants, more than from limited participation itself.

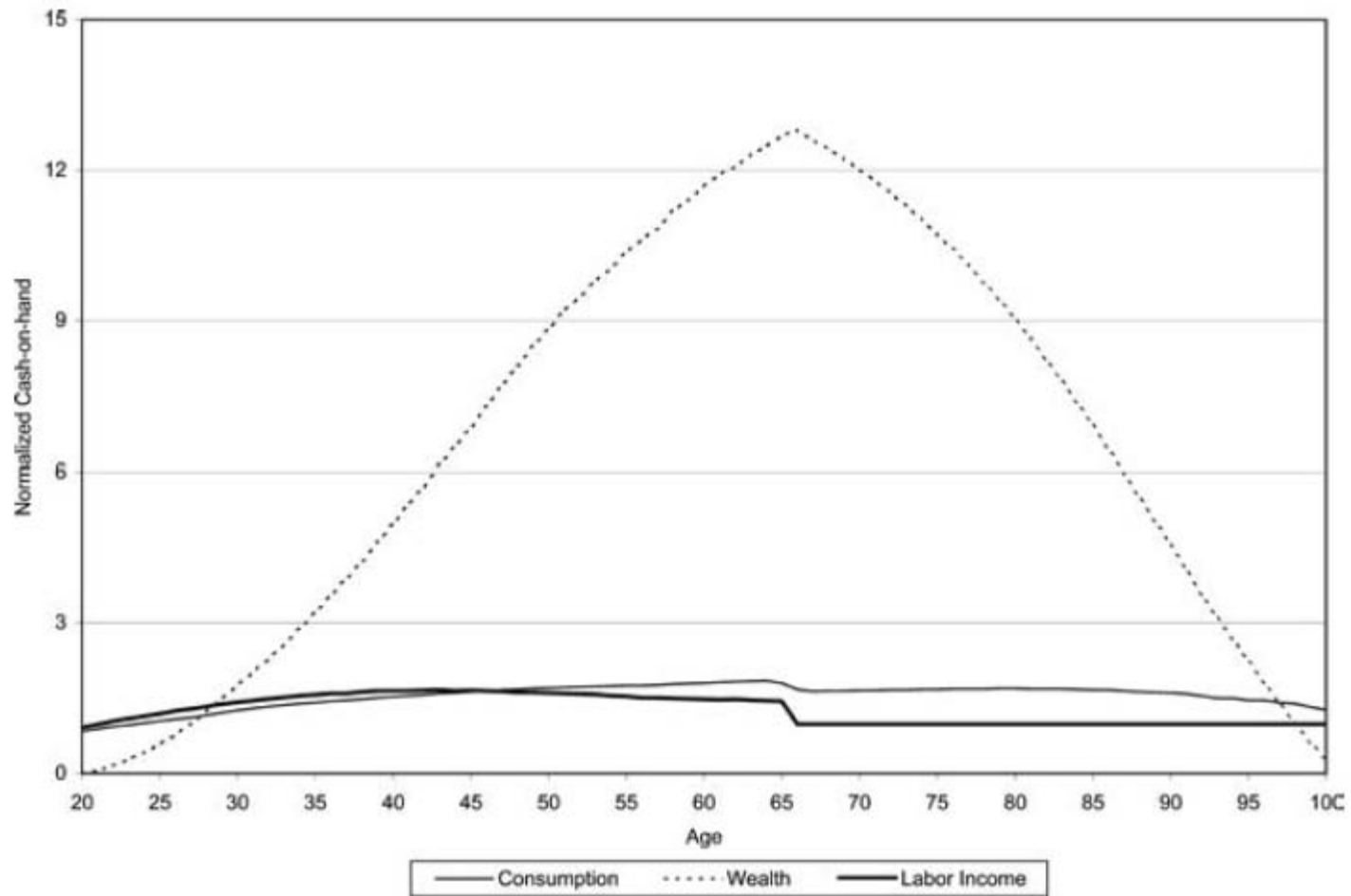


Figure 1
Life-cycle wealth accumulation, labor income, and consumption

Gomes and Michaelides, RFS 2008

Table 1
Moments from the wealth-to-income ratio distribution

	Model	Data
25th percentile	0.63	0.33
Median	2.81	1.75
75th percentile	5.47	5.25

The table reports values from the baseline model and the data (2001 Survey of Consumer Finances). Income is defined as the sum of wages and salaries, unemployment or worker's compensation, and pensions, annuities, or other disability or retirement programs. Wealth is defined as liquid assets plus home equity. Liquid wealth is made up of all types of transaction accounts, certificates of deposit, total directly held mutual funds, stocks, bonds, total quasi-liquid financial assets, savings bonds, the cash value of whole life insurance, other managed assets (trusts, annuities, and managed investment accounts), and other financial assets. Home equity is defined as the value of the home less the amount still owed on the 1 and 2nd/3rd mortgages and the amount owed on home equity lines of credit.

Table 2
Stock market participation rates (\bar{P})

	\bar{P} (%)
Data	51.9
Model (average)	53.1
Model (type- <i>A</i>)	7.4
Model (type- <i>B</i>)	98.8

The second row reports data from the 2001 Survey of Consumer Finances; the third row reports the unconditional results from baseline model; and the fourth and fifth rows report the average participation rates for each type of agent. Type-*A* agents have risk aversion equal to 1.1, and elasticity of intertemporal substitution equal to 0.1, and type-*B* agents have risk aversion equal to 5 and elasticity of intertemporal substitution equal to 0.4.

- It is natural to embed consumption-based asset pricing models in standard macro RBC models
 - ▶ Asset prices are not just "puzzles", they can guide the development of DSGE theory
- The main challenge is to get volatile asset prices
 - ▶ Standard RBC model, like standard consumption-based model, has stable stock returns
 - ▶ Adding habit formation does not fix the problem by itself, because people use investment to smooth consumption more when risk aversion goes up
 - ▶ Capital adjustment costs help, because now Tobin's q can vary (Jermann JME 1998)
 - ▶ Alternative "time to adjust" between sectors in a two-sector model (Boldrin-Christiano-Fisher AER 2001) to better fit cyclicity of labor supply
 - ▶ Stochastic depreciation is an alternative modelling trick (Gomes-Michaelides RFS 2008).

Table 1
Business cycles and asset returns

Model version/Moments	σ_{AC}/σ_{AY}	σ_{AI}/σ_{AY}	$E(r^f)$	$E(r^e - r^f)$	$\text{Std}(r^f)$	$\text{Std}(r^e)$	$E(r^b - r^f)$
Benchmark	0.49	2.64	0.82	6.18	11.46	19.86	5.69
Standard RBC model (No habit, no adj. costs)	0.77	1.54	4.26	0.02	0.62	1.02	0.04
Risk aversion = 10, no habit, no adj. costs	0.78	1.53	3.36	0.26	0.76	2.90	0.29
Habit, no adjustment costs	0.33	3.00	4.20	0.03	0.59	1.21	0.08
Adjustment cost, no habit	1.14	0.68	3.91	0.67	0.61	6.09	0.45
Random walk productivity	0.55	2.57	0.03	6.39	11.98	18.80	5.09
Data	0.51	2.65	0.80	6.18	5.67	16.54	1.70

The symbols have the following meaning: σ_{AY} , standard deviation of quarterly output growth rates; σ_{AC} , standard deviation of quarterly consumption growth rates; σ_{AI} , standard deviation of quarterly investment growth rates; r^f , risk-free interest rate; r^e , return to equity; r^b , return to a perpetual bond in model, long-term government bond in the data. Business cycle growth rate data is from the NIPA, 54.1–89.2, GNP for output, Consumption of nondurables and services for consumption, Fixed investment for investment. Equity and short-term bond returns are from Mehra and Prescott (1985) long term government bond returns are from Ibbotson (1994). Business cycle data is quarterly and asset return data is annualized, both are in percentage terms. Business cycle data and risk-free rates are (computed) population moments, the remaining asset return moments are averages of 100 simulations each 200 periods long.

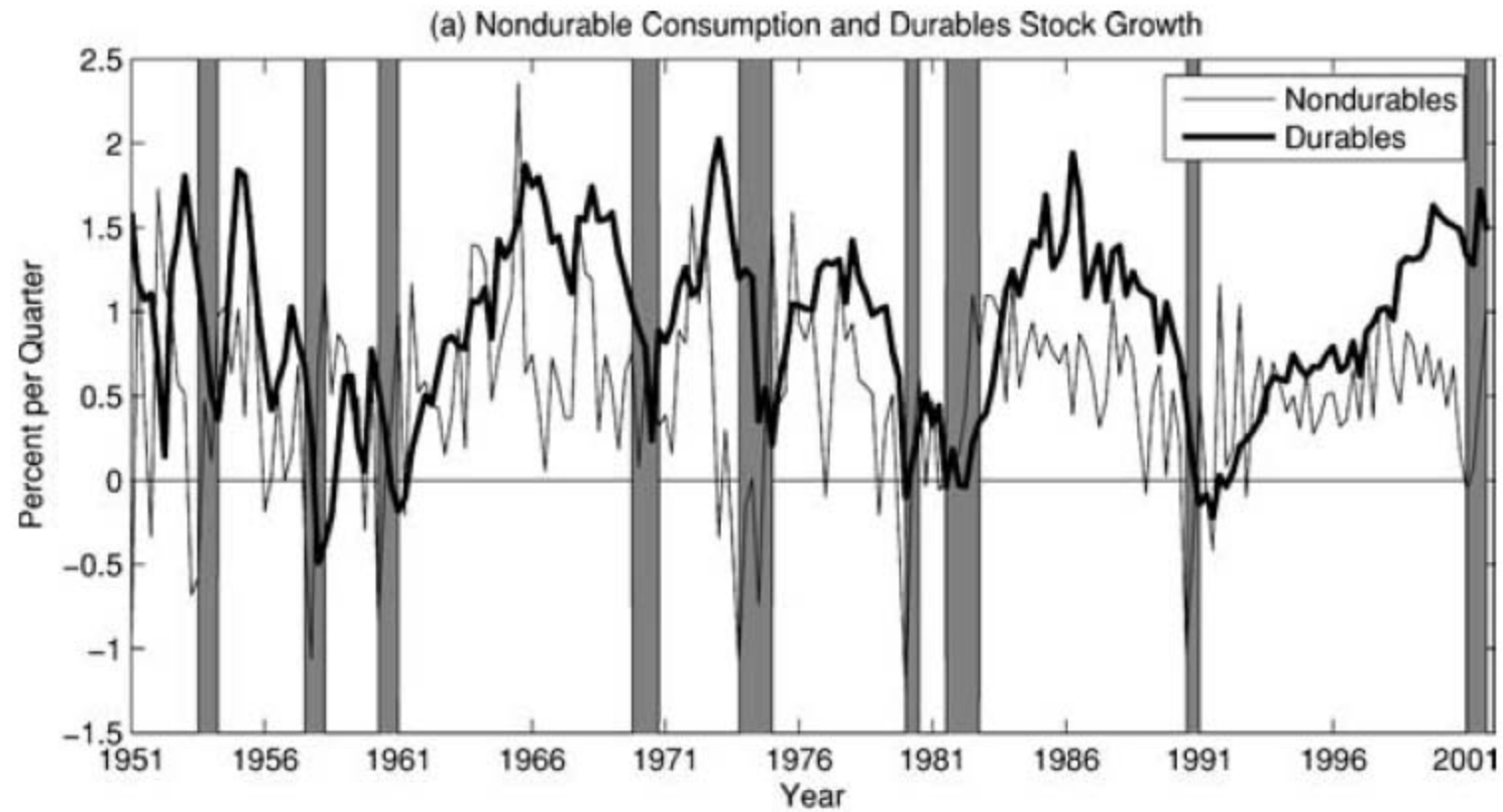
Jermann, JME 1998

CBAP and the Cross-Section of Stock Returns

- Lettau and Ludvigson (Review of Economic Dynamics 2009) argue that the cross-sectional fit of consumption-based asset pricing models is poor, as measured by Euler equation errors $E[M_{t+1}(1 + R_{i,t+1}) - 1]$.
- Test assets: bill rate, aggregate stock index, 6 portfolios sorted by size and B/M.
- Models considered:
 - ▶ Power utility.
 - ▶ Habit formation utility (Campbell-Cochrane 1999) modified by Menzly, Santos, and Veronesi (2004).
 - ▶ Long-run risk model (Bansal-Yaron 2004).
 - ▶ Guvenen (2009) limited participation model.
- Probable reason for poor performance: these models shoot at equity premium and volatility puzzles but do not have sufficiently important multiple shocks (factors) to generate a cross-sectional spread in equity risks.

CBAP and the Cross-Section of Stock Returns

- Recent literature has tried to use cross-sectional returns to estimate the parameters of consumption-based asset pricing models with multiple factors.
- A good example: Yogo (JF 2006):
 - ▶ Instantaneous utility is CES in nondurables and durables, with α weight on durables and ρ elasticity of substitution between them
 - ▶ Intertemporal utility is Epstein-Zin with RRA γ and EIS σ .
 - ▶ If $\sigma < \rho$, then marginal utility of nondurables is declining in the stock of durables.
 - ▶ Value stock returns correlate positively with the durables stock, so the model with $\sigma < \rho$ generates a value premium.
- Dhume (2010) shows that the same model works well for pricing commodity futures returns.



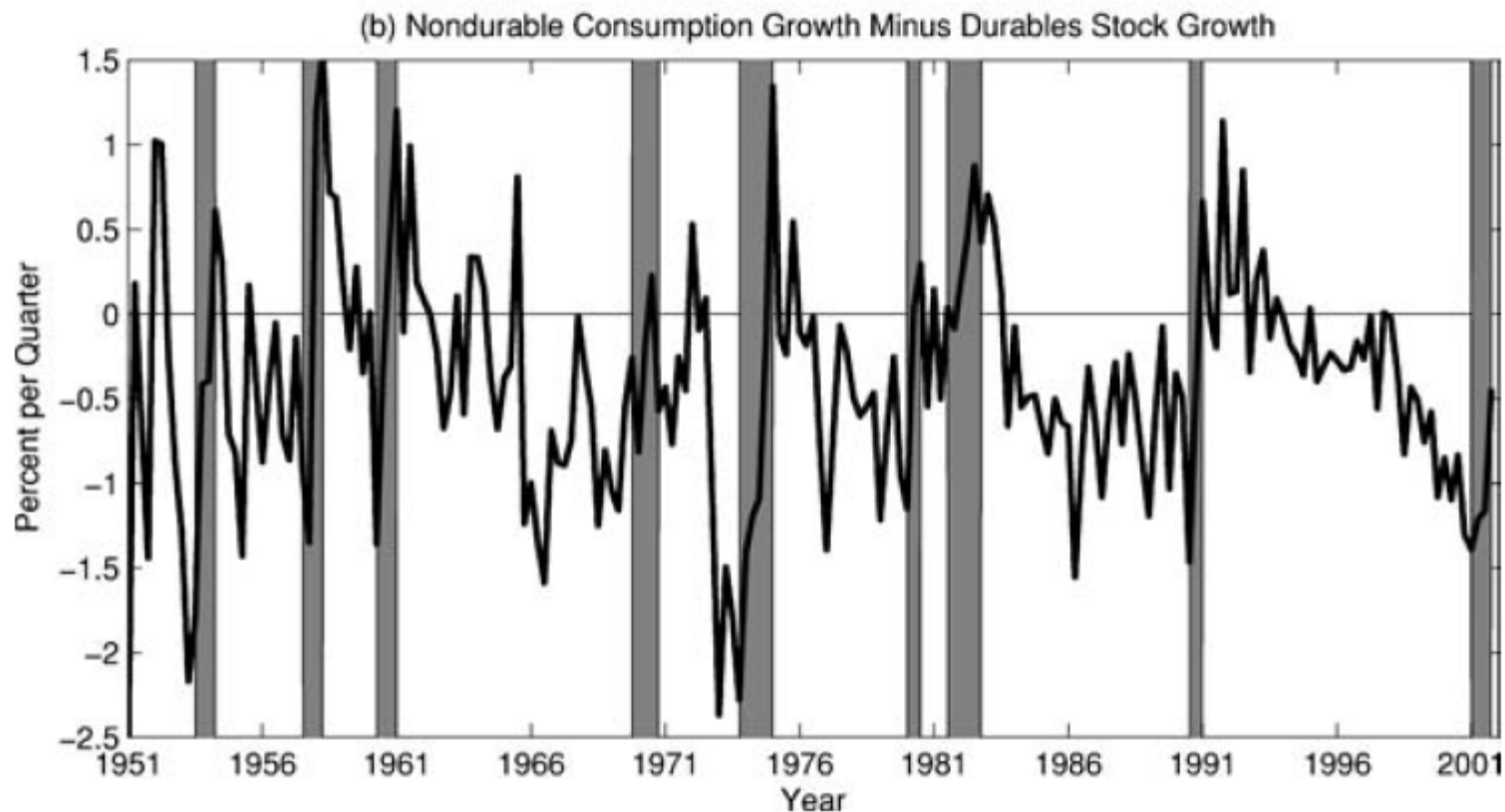


Figure 2. Nondurable and Durable Consumption Growth. The figure is a time-series plot of (a) the real growth rates of nondurable consumption and the stock of durables and (b) the difference in the growth rates. The sample period is 1951:1–2001:4; the shaded regions are NBER recessions.

(b) Durables Stock Growth

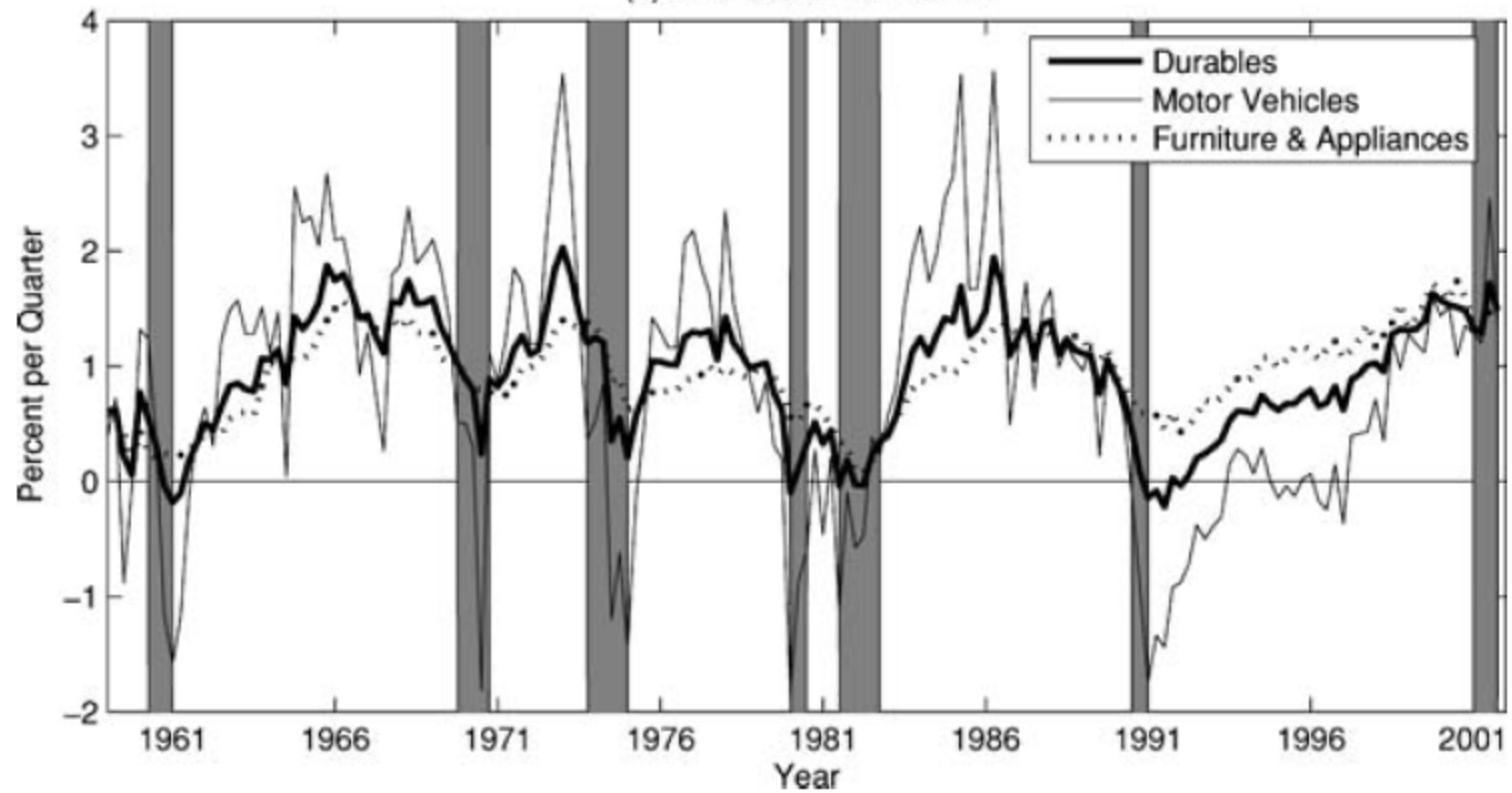


Table II
Estimation of the Preference Parameters
through the Euler Equations

Panel A reports preference parameters for the durable consumption model estimated through the unconditional moment restrictions. From left to right, the test assets are 25 Fama–French portfolios sorted by size and book-to-market equity, 24 portfolios sorted by book-to-market equity within industry, 25 portfolios sorted by market and HML betas, and all 74 portfolios. Panel B reports preference parameters estimated through the conditional moment restrictions. The test assets are the market portfolio, SMB portfolio, and HML portfolio. The instruments are second lags of nondurable and durable consumption growth, dividend-price ratio, size spread, value spread, yield spread, and a constant. All estimates include the Euler equation for the three-month T-bill and the intratemporal FOC as additional moment restrictions. Estimation is by two-step GMM. HAC standard errors are in parentheses. The p -values for the Wald test for additive separability ($\sigma = \rho$), the Wald test for time separability ($\sigma = 1/\gamma$), and the J -test (test of overidentifying restrictions) are in parentheses.

Parameter	Panel A: Unconditional Moments				Panel B: Conditional Moments
	Fama–French	Industry & BE/ME	Beta-Sorted	All Portfolios	
σ	0.024 (0.009)	0.023 (0.007)	0.024 (0.009)	0.023 (0.002)	0.023 (0.005)
γ	191.438 (49.868)	199.496 (44.280)	185.671 (43.924)	205.905 (11.785)	174.455 (23.340)
ρ	0.520 (0.544)	0.554 (0.604)	0.870 (1.955)	0.700 (0.247)	0.554 (0.026)
α	0.827 (0.089)	0.821 (0.091)	0.786 (0.156)	0.802 (0.027)	0.816 (0.006)
β	0.900 (0.055)	0.935 (0.054)	0.926 (0.057)	0.939 (0.018)	0.884 (0.030)
Test for $\sigma = \rho$	0.817 (0.366)	0.768 (0.381)	0.187 (0.666)	7.510 (0.006)	375.185 (0.000)
Test for $\sigma = 1/\gamma$	5.594 (0.018)	8.424 (0.004)	4.637 (0.031)	140.620 (0.000)	12.385 (0.000)
J -test	12.050 (0.956)	9.583 (0.984)	1.866 (1.000)	5.065 (1.000)	42.500 (0.065)

A. Approximating the Durable Consumption Model

Appendix C shows that the unconditional Euler equation (11) can be approximated as a linear factor model

$$\begin{aligned}\mathbf{E}[R_{it} - R_{0t}] &= b_1 \text{Cov}(\Delta c_t, R_{it} - R_{0t}) + b_2 \text{Cov}(\Delta d_t, R_{it} - R_{0t}) \\ &\quad + b_3 \text{Cov}(r_{Wt}, R_{it} - R_{0t}),\end{aligned}\tag{18}$$

where the risk prices are given by

$$b = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} = \begin{bmatrix} \kappa [1/\sigma + \alpha(1/\rho - 1/\sigma)] \\ \kappa \alpha (1/\sigma - 1/\rho) \\ 1 - \kappa \end{bmatrix}.\tag{19}$$

Table III

Estimation of Linear Factor Models with the Fama–French Portfolios

The table reports the estimated factor risk prices for the CAPM, the Fama–French three-factor model, the CCAPM, and the durable consumption model. The test assets are the 25 Fama–French portfolios sorted by size and book-to-market equity. Estimation is by two-step GMM. HAC standard errors are in parentheses. The mean absolute pricing error (MAE) and R^2 are based on the first-stage estimate. The p -values for the J -test (test of overidentifying restrictions) are in parentheses.

Factor Price	CAPM	Fama–French	CCAPM	Durable Model
Market	4.268 (0.510)	4.632 (0.841)		0.659 (0.849)
SMB		−0.860 (1.154)		
HML		6.072 (1.198)		
Nondurables			142.073 (25.409)	17.898 (31.280)
Durables				170.569 (15.561)
σ				0.002 (0.004)
γ				189.127 (35.259)
α				0.907 (0.147)
MAE (%)	0.602	0.235	0.338	0.122
R^2	−0.620	0.716	0.350	0.935
J -test	72.414 (0.000)	54.920 (0.000)	46.785 (0.004)	23.170 (0.392)

Table IV
Average Returns and Consumption Betas for the Fama–French
Portfolios

Panel A reports average excess returns (per quarter) on the 25 Fama–French portfolios sorted by size and book-to-market equity. Panels B and C report nondurable and durable consumption betas, implied by the first-stage GMM estimate of the durable consumption model, respectively. The last row reports the difference between small and big stocks, and the last column reports the difference between high and low book-to-market stocks.

Size	Book-to-Market Equity					
	Low	2	3	4	High	High–Low
Panel A: Average Excess Return (%)						
Small	1.121	2.448	2.531	3.160	3.464	2.343
2	1.458	2.225	2.716	2.929	3.150	1.692
3	1.707	2.345	2.313	2.756	2.937	1.230
4	1.896	1.797	2.417	2.568	2.725	0.829
Big	1.686	1.652	2.015	1.987	2.140	0.454
Small–Big	–0.565	0.796	0.516	1.173	1.324	
Panel B: Nondurable Consumption Beta						
Small	6.512	6.126	5.814	5.438	6.216	–0.296
2	6.071	5.119	5.241	5.436	5.899	–0.172
3	5.457	5.142	5.057	5.159	5.926	0.469
4	4.923	4.302	4.465	5.225	5.061	0.137
Big	4.759	3.547	2.974	4.242	3.967	–0.792
Small–Big	1.754	2.578	2.841	1.196	2.249	
Panel C: Durable Consumption Beta						
Small	0.317	1.209	1.638	2.271	2.502	2.185
2	0.120	1.089	1.838	1.834	1.967	1.847
3	0.517	1.193	1.434	1.857	1.979	1.461
4	0.904	0.676	1.347	1.798	1.838	0.934
Big	0.956	0.750	1.268	1.396	1.325	0.368
Small–Big	–0.640	0.459	0.370	0.875	1.177	