Temptation and Self-Control: Some Evidence and Applications

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- Consider a "diner's dilemma"...

Background

- Standard decision theory does not account for self-control problems
- Gul and Pesendorfer (2001, 2004) propose a theory of temptation and self control
- GP theory has potential implications for many issues, including those considered "puzzles" in standard theory.

Some Applications of GP Theory

- Consumption-savings choice and welfare: GP (2004)
- Asset pricing: Krusell-Kuruscu-Smith (2002), DeJong-Ripoll (2003)
- Taxation policy: KKS (2003)
- Nonlinear pricing: Esteban-Miyagiwa-Shum (2003)
- Survey design: Ameriks, et al (2004)
- Harmful addition: GP (2005)
- Preference reversal: GP (2004)

Is temptation present and real?

- Are the implications of the GP theory quantitatively important?
- It depends on how strong temptations are.

Goals

1. Estimate the strength of temptation using CEX data.
2. Explore quantitative implications of GP theory (with temptation measured) for some asset pricing and welfare issues.
3. To clarify: we do NOT test the empirical relevance of GP theory vs. the hyperbolic discounting theory. To do that would require a different set up.

Standard Preferences vs. Self-Control Preferences

- Self-control preferences depend on what an agent consumes and what he could have consumed: preferences over decision problems
- Standard preferences (defined over decision problems) (Kreps, 1979):
  $A \succeq B \Rightarrow A \sim A \bigcup B$
- Self-control preferences (GP):
  $A \succeq B \Rightarrow A \succeq A \bigcup B \succeq B$ (*set betweenness*)

Utility Representation: a static case (GP 2001)

With *set-betweenness* and other standard axioms, there exist two von Neumann-Morgenstern utility functions u and v such that $\succeq$ can be represented by the function U defined as

$$U(A) = \max_{x \in A}(u(x) + v(x)) - \max_{y \in A} v(y)$$

u: Commitment ranking
v: temptation ranking
$\max_{y \in A} v(y) - v(x) \geq 0$: cost of self-control

Dynamic Self Control: an infinite-horizon consumption problem (IHCP)

- H households; I assets; a single consumption good
- Preference over decision problems for household h:

$$W(z(\mathbf{b}^h)) = \max_{c^h, \tilde{\mathbf{b}}^h} \left\{ u(c^h) + v(c^h) + \delta \mathrm{E} W(z(\tilde{\mathbf{b}}^h)) - v(w^h) \right\},$$

$$c^h + \sum_{i=1}^{I} q^i \tilde{b}^{ih} = w^h$$

$$w^h = e^h + \sum_{i=1}^{I} (q^i + d^i) b^{ih}.$$

$$\mathbf{b}^h = (b^{1h}, b^{2h}, \ldots, b^{Ih})'$$

A More Formal Statement of the IHCP

- Budget set:

$$B_t(q,d,e,b)=\left\{(c,\tilde{b})|c+q'_t\cdot\tilde{b}=e+(q'_t+d'_t)\cdot b,\ \ c\in\mathcal{C},\tilde{b}\geq 0\right\}$$

- The IHCP (the decision problem):

$$z_t(q,d,e,b)=\left\{(c,z_{t+1}(q,d,e,\tilde{b}))|(c,\tilde{b})\in B_t(q,d,e,b)\right\}$$

- Preference over the IHCP $z_t(q,d,e,b)$:

$$W(z_t(q,d,e,b))=\max_{(c,\tilde{b})\in B_t(q,d,e,b)}\{u(c)+v(c)+$$
$$\delta\mathrm{E}W(z_{t+1}(q,d,e,\tilde{b}))-v(e+(q'_t+d'_t)\cdot b)\},$$

$$q=(q_1,\ldots,q_t,\ldots)'\in(\mathcal{R}^I_{++})^\infty,\quad d=(d_1,\ldots,d_t,\ldots)'\in(\mathcal{R}^I_+)^\infty$$

Pricing Kernel and Euler Equation

- Asset pricing kernel

$$m_{t+1}^h = \frac{\delta[u'(c_{t+1}^h) + v'(c_{t+1}^h) - v'(w_{t+1}^h)]}{u'(c_t^h) + v'(c_t^h)}.$$

$m_{t+1} > 0$ if $v(\cdot)$ is concave (since $c \leq w$).

- Euler equation

$$1 = \mathrm{E}_t m_{t+1}^h R_{t+1}^i$$

for all h that holds i, where $R_{t+1}^i = (q_{t+1}^i + d_{t+1}^i)/q_t^i$.

Parameterization

- Utility

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}, \quad , v(c) = \lambda u(c),$$

λ: strength of temptation

- Without temptation:

$$m_{t+1} = \delta \left(\frac{c_{t+1}}{c_t} \right)^{-\gamma}$$

- With temptation:

$$m_{t+1} = \delta \left(\frac{c_{t+1}}{c_t} \right)^{-\gamma} \left[1 - \frac{\lambda}{1+\lambda} \left(\frac{w_{t+1}}{c_{t+1}} \right)^{-\gamma} \right].$$

Pricing Kernel and Value of Commitment

Consider an n-period risk-free bond:

- If re-tradable, the state price for the bond is given by

$$q_t(n) = m_{t,t+1} \cdots m_{t+n-1,t+n}$$

- If not re-tradable (commitment asset), then the state price is given by

$$q_t^{com}(n) = m_{t,t+n},$$

where

$$m_{t,t+j} = \delta \left(\frac{c_{t+j}}{c_t} \right)^{-\gamma} \left[1 - \frac{\lambda}{1+\lambda} \left(\frac{w_{t+j}}{c_{t+j}} \right)^{-\gamma} \right]$$

If $\lambda \geq 0$, then $q_t^{com}(n) \geq q_t(n)$ for all $n \geq 1$.

Measurement Errors

Euler equation

$$1 = \mathrm{E}_t \delta \left(\frac{c_{t+1}^h}{c_t^h} \right)^{-\gamma} \left[1 - \frac{\lambda}{1+\lambda} \left(\frac{w_{t+1}^h}{c_{t+1}^h} \right)^{-\gamma} \right] R_{t+1}.$$

One way to obtain consistent estimates for γ and λ is to assume

1. Measurement errors in c and w are multiplicative and proportional to each other
2. They are independent of true c and w
3. They are independent of asset returns and instruments

These are stringent conditions. We consider log-linearized Euler equations instead (with some general caveats discussed by Carroll (2001)).

Data

1. The CEX survey (BLS): 1984:Q1 to 2002:Q1
2. Comprehensive consumption data (more than food stuffs)
3. Pseudo panel based on birth-year cohorts with five-year intervals (e.g., Attanasio-Weber, 1989, 1995; Browning, Deaton, and Irish, 1985; Deaton, 1985)

Why Micro Data?

1. Individual heterogeneity helps identify temptation: tempted individuals have desire for commitment
2. Uninsurable idiosyncratic risks
   Cogley (2002); Constantinides (2002); Jacobs and Wang (2004)
3. Limited asset market participation (sample selection)
   Attanasio, et al. (2002); Brav, et al. (2002); Vissing-Jorgensen (2002).
4. Theory-consistent aggregation

Sample Selection Criteria

- Asset holders (about 42% of households): (i) stocks, bonds, mutual funds, etc.; (ii) IRA or Keogh contributions; (iii) dividend or interest income.
- Positive consumption level; no outliers in consumption growth
- No missed interviews; complete income reports
- Urban residents in non-student housing
- No abnormal jumps in household head's age between interviews.
- Correct for mismatch in household ID numbers in 1986 and 1996.

Consumption Growth Rate

- Consumption: nondurable goods and services (consistent with NIPA definition)
- Deflate by CPI for nondurables, 1982-84 = 100
- Semi-annual consumption growth rate

$$\frac{c_3^h + c_4^h}{c_1^h + c_2^h}$$

- Aggregation: average of consumption growth rates across HH in each birth-year cohort.
- With overlapping quarterly interviews, we obtain monthly time series of semi-annual consumption growth rates for 1983:10 - 2001:03.

Wealth

- Wealth includes income and market value of liquid financial assets.
- Asset categories:
  1. Checking accounts, brokerage accounts, etc. –zero net returns
  2. Savings accounts, U.S. savings bonds, etc. –30-day T-bill return
  3. Stocks, bonds, mutual funds, etc. –NYSE value-weighted return

  All return data are from CRSP and deflated by CPI for urban households.

Imputation of Wealth

- CEX reports asset holdings at the end of interviews and changes in asset holdings in the past 12 months
- Value of assets in the beginning of decision period t can be inferred: $\sum_{i=1}^{I} q_t^i b_t^{ih}$
- Need w_{t+1}^h, wealth at beginning of decision period $t+1$
- Impute value of assets at $t+1$ (assume buy-and-hold)

$$w_{t+1}^h = y_{t+1}^h + \sum_{i=1}^{I} R_{t+1}^i q_t^i b_t^{ih}$$

where $y_{t+1}^h = e_{t+1}^h + \sum_{i=1}^{I} d_{t+1}^i b_{t+1}^{ih}$ is reported income for $t+1$.

Aggregation

- Consumption growth rate:

$$cg_{t+1}^{j} = \frac{1}{H_t^j} \sum_{h=1}^{H_t^j} \ln\left(\frac{c_{t+1}^{jh}}{c_t^{jh}}\right).$$

- Wealth-consumption ratio:

$$\chi_{t+1}^{j} = \frac{1}{H_t^j} \sum_{h=1}^{H_t^j} \ln\left(\frac{w_{t+1}^{jh}}{c_{t+1}^{jh}}\right).$$

- Monthly time series of semi-annual consumption growth and wealth-consumption ratios for each cohort (indexed by j) from 1983:10 - 2001:03

Estimation Equation

$$cg^j_{t+1} = \sigma \ln(R_{t+1}) + \phi \chi^j_{t+1} + \alpha \frac{1}{H^j_t} \sum_{h=1}^{H^j_t} \Delta \ln F^{jh}_{t+1} + \sum_{m=1}^{12} \delta_m D_m + \mu^j_{t+1},$$

where $\phi = \frac{\lambda}{(1+\lambda)(w/c)^{\gamma} - \lambda}$.

Identifying Temptation

Desire for commitment: tell GP theory apart from

1. Habit formation (e.g., Constantinides, 1990; Campbell-Cochrane, 1999)
2. Non-expected utility (e.g., Epstein-Zin, 1989, 1991);
3. Capitalist spirit (e.g., Bakshi-Chen, 1996; Carroll, 2000)

Commitment Assets

"Give me a good kick if I don't do such and such..."

- Properties:
  - Not re-tradable
  - Cannot be used as a collateral for borrowing
- Examples: education, pension.
- Other examples: Life insurance; health-club membership; housing and consumer durables (?); long-term savings bonds and CDs (?); marriage

Interaction Between Temptation and Education

- Introduce an education dummy and an interaction term:

$$\phi = \phi_0 + \phi_1 EDUC$$

- Estimation equation with the interaction term:

$$cg_{t+1}^{j} = \sigma \ln(R_{t+1}) + \phi_0 \chi_{t+1}^{j} + \\ \phi_1 \frac{1}{H_t^j} \sum_{h=1}^{H_t^j} EDUC^{jh} \times \ln\left(\frac{w_{t+1}^{jh}}{c_{t+1}^{jh}}\right) + \alpha \frac{1}{H_t^j} \sum_{h=1}^{H_t^j} \Delta \ln F_{t+1}^{jh} \\ + \sum_{m=1}^{12} \delta_m D_m + \mu_{t+1}^{j}$$

- Moment conditions:

$$E_t Z_t \mu_{t+1} = 0$$

Instrumental Variables

- Error term μ_{t+1} summarizes (i) expectation errors; (ii) approximation errors; (iii) measure errors in consumption growth and wealth-consumption ratio
- Instruments for asset returns: (i) dividend-price ratio; (ii) lagged value-weighted NYSE returns; (iii) lagged 30-day T-bill returns. All with sufficient lags to take care of serial correlations in error term.
- Instruments for wealth-consumption ratio: lagged wealth-income ratio ($\ln(w_t/y_t)$): since w_{t+1} is constructed under a "buy-and-hold" assumption, it should be correlated with w_t.

First-Stage Regression Results

	Simple Cohort		Synthetic Cohort Panel	
	Variables being instrumented			
	$\log \frac{w_{t+1}}{c_{t+1}}$	educ$\times \log \frac{w_{t+1}}{c_{t+1}}$	$\log \frac{w_{t+1}}{c_{t+1}}$	educ$\times \log \frac{w_{t+1}}{c_{t+1}}$
$\log \frac{w_t}{y_t}$	0.993***	0.582***	0.760***	0.405***
	(0.066)	(0.106)	(0.028)	(0.066)
educ$\times \log \frac{w_t}{y_t}$		-0.242		-0.292***
		(0.149)		(0.089)
Observations	199	199	988	988

Estimation Procedure

- GMM estimation: HAC adjusted
- Simple cohort vs. birth-year cohorts (e.g., Attanasio-Weber, 1995)
- Unrestricted vs. restricted model (restriction: $\phi = 0$)
- Test the null of $\phi = 0$: Wald statistic with a $\chi^2(1)$ distribution.

Results based on simple cohort

$\hat{\sigma}$	0.516	0.730	0.440
	(0.499)	(0.525)	(0.441)
ϕ_0		0.023	-0.113
		(0.023)	(0.119)
ϕ_1			0.237
			(0.212)
Obs	199	199	199
Hansen's J test	2.27	1.20	1.87
P-value	0.32	0.55	0.39
Model Restriction Test:			
Wald Stat (χ^2)		1.04	1.89
P-value		0.31	0.39

Results based on synthetic cohorts

	Joint Returns			Stock Returns		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\sigma}$	0.519	0.905**	0.999**	0.259	0.505*	0.598**
	(0.393)	(0.430)	(0.449)	(0.238)	(0.265)	(0.283)
ϕ_0		0.031**	-0.044		0.031**	-0.048
		(0.015)	(0.043)		(0.015)	(0.044)
ϕ_1			0.162*			0.173*
			(0.089)			(0.093)
Hansen's J	5.35	1.98	0.14	5.79	2.43	0.19
P-value	0.07	0.37	0.93	0.06	0.30	0.91
Wald Stat		4.38	7.25		4.19	7.11
P-value		0.04	0.03		0.04	0.03

Education Levels and Pension Contributions

	Contribution > 0	Mean contribution (share of income)	
		all	Contribution > 0
Full sample	34.55%	2.06%	5.95%
$<$ Bachelor	30%	1.77%	5.90%
$\geq$ Bachelor	40.59%	2.44%	6.00%
Differences		-0.67%***	-0.10%

	Contribution > 0	Mean contribution: share of income	
		all	Contribution > 0
Wealth less than \$25,000 *(28.17% of whole sample)*			
Subsample	25.96%	1.91%	7.34%
< Bachelor	23.32%	1.71%	7.32%
≥ Bachelor	33.11%	2.45%	7.40%
Wealth between \$25,000 *and* \$50,000 *(32.14% of whole sample)*			
Subsample	33.36%	1.62%	4.86%
< Bachelor	30.97%	1.44%	4.65%
≥ Bachelor	36.72%	1.87%	5.10%
Wealth above \$50,000 *(39.69% of whole sample)*			
Subsample	41.62%	2.51%	6.04%
< Bachelor	36.76%	2.19%	5.97%
≥ Bachelor	45.51%	2.77%	6.09%

Temptation and Welfare

- Consumption and wealth processes:

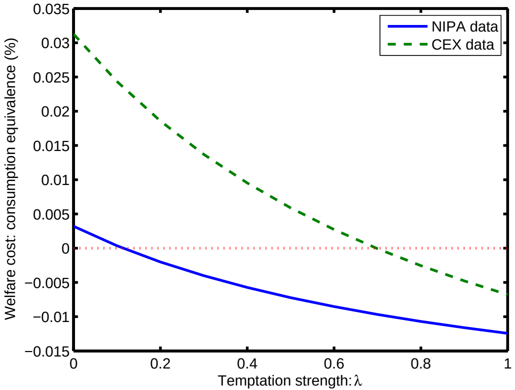
$$\log c_t = \log c + \mu t - \frac{1}{2}\sigma_z^2 + z_t, \quad \log w_t = \log w + \mu t - \frac{1}{2}\sigma_u^2 + u_t.$$

- Welfare cost of uncertainties in terms of consumption equivalence (log-utility):

$$\exp\left[\tfrac{1}{2}\sigma_z^2 - \tfrac{\lambda}{2(1+\lambda)}\sigma_u^2\right] - 1$$

- Dislike consumption risk, but like wealth risk (variations in wealth lower average utility at temptation point)

Temptation and Welfare



Temptation and Excess Volatility

- The Hanson-Jagannathan (HJ) bound:

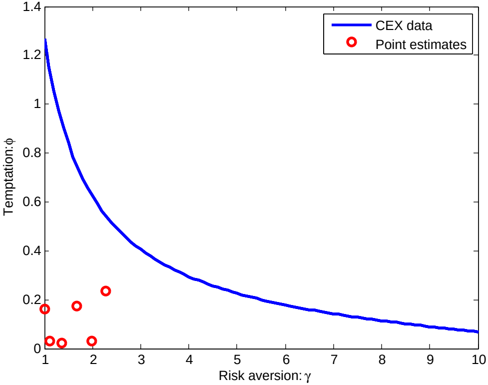
$$\frac{|E(R^e)|}{\sigma(R^e)} \leq \frac{\sigma(m)}{E(m)} \approx \sigma(\ln m).$$

- Pricing kernel:

$$m_{t+1} = \delta \left(\frac{c_{t+1}}{c_t}\right)^{-\gamma} \left[1 - \frac{\lambda}{1+\lambda} \left(\frac{w_{t+1}}{c_{t+1}}\right)^{-\gamma}\right].$$

- Without temptation, $\sigma(\ln m) = \gamma\sigma(\Delta \ln c)$
- With temptation, $\sigma(\ln m) = \gamma\sqrt{var(\Delta \ln c - \phi \ln(w/c)))}$
- U.S. data: $\frac{|E(R^e)|}{\sigma(R^e)} = 0.5$

Temptation and Excess Volatility



Conclusion

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- GP preferences are *economically* important for issues such as welfare cost of business cycles and excess asset-price volatility.

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  1. Declining saving rate
  2. Market incompleteness: dislike financial innovations?
  3. Social security reform: tradeoff between intertemporal transfer and intratemporal risk sharing
  4. Forecasting asset returns with wealth-consumption ratio as a pricing factor.