Present bias and consumption

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65–74 year old households surveyed in 2007 Survey of Consumer Finances

Median holding of financial assets is $68,100
“Leakage” (excluding loans) among households ≤ 55 years old

For every $2 that flows into US retirement savings system $1 leaks out

(Argento, Bryant, and Sabelhouse 2012)

Is the U.S. retirement system optimal?
Present-biased discounting

Current utils get full weight

Future utils weighted $\beta \delta^t$

$u_t + \beta \delta u_{t+1} + \beta \delta^2 u_{t+2} + \beta \delta^3 u_{t+3} + \beta \delta^4 u_{t+4} + \ldots$

$u_t + \beta [ \delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \delta^4 u_{t+4} + \ldots ]$
Some Predictions

- Households will have few liquid assets (hand to mouth)
- Households will have substantial illiquid assets
- Households will have a high MPC (0.30+) out of:
  - predictable and unpredictable liquidity shocks
  - predictable and unpredictable income
  - predictable and unpredictable liquid wealth
- Households will have a much lower MPC out of:
  - predictable and unpredictable illiquid wealth
- The choice architecture of savings institutions will make a big difference (e.g., opt-in vs. opt-out; ease of enrollment)
Households live hand to mouth
Lusardi and Tufano (2009)

How confident are you that you could come up with $2,000 if an unexpected need arose within the next month?

- I am certain...I could
- I could probably...
- I probably could not...
- I am certain...I could not
- Do not know.

47%
53%
High MPC’s out of predictable income changes
Shapiro (2005)

• For food stamp recipients, caloric intake declines by 10-15% over the food stamp month.

• To be explained by exponential discounting, requires an annual discount factor of

\[ 0.23 = \exp(-1.47). \]
High MPC’s out of Social security
Mastrobuoni and Weinberg (2009)

• Individuals with substantial savings smooth consumption over the monthly pay cycle
• Individuals without savings consume 25 percent fewer calories the week before they receive SS checks relative to the week after
Lifecycle simulations (Angeletos et al 2001)

- Mortality
- Dependents
- Retirement/Social Security
- Three educational groups: NHS, HS, COLL
- Stochastic labor income
- Credit limit: (.30)(permanent income)
- 3 state variables: liquid and illiquid wealth, income.
- 2 choice variables: liquid and illiquid wealth investment
Preferences

• Constant relative risk aversion = 2
• For exponential discounting economy:
  \( \beta = 1 \)
  \( \delta = 0.94 \) (match median ‘W/Y’ of 3.9 ages 50-59)
• For quasi-hyperbolic discounting economy:
  \( \beta = 0.7 \)
  \( \delta = 0.96 \) (match median ‘W/Y’ of 3.9 ages 50-59)
## Predictions (HS education)

<table>
<thead>
<tr>
<th></th>
<th>Exponential</th>
<th>Hyperbolic</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>% with at least 1 month of income in liquid assets</td>
<td>73%</td>
<td>40%</td>
<td>42%</td>
</tr>
<tr>
<td>mean [\frac{\text{liquid assets}}{\text{total assets}}]</td>
<td>0.50</td>
<td>0.39</td>
<td>0.08</td>
</tr>
<tr>
<td>% with revolving credit</td>
<td>19%</td>
<td>51%</td>
<td>70%</td>
</tr>
<tr>
<td>mean credit card borrowing</td>
<td>$900</td>
<td>$3408</td>
<td>&gt;$5000</td>
</tr>
<tr>
<td>MPC out of predictable movements in income</td>
<td>0.03</td>
<td>0.17</td>
<td>0.23</td>
</tr>
</tbody>
</table>
Laibson, Repetto, and Tobacman (2012)

Use MSM to estimate discounting parameters:
- Substantial illiquid retirement wealth: W/Y = 3.9.
- Extensive credit card borrowing:
  - 68% didn’t pay their credit card in full last month
  - Average credit card interest rate is 14%
  - Credit card debt averages 13% of annual income
- Consumption-income comovement:
  - Marginal Propensity to Consume = 0.23
    (i.e. consumption tracks income)
LRT Results:

\[ U_t = u_t + \beta [\delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + ...] \]

- \( \beta = 0.70 \) (s.e. 0.11)
- \( \delta = 0.96 \) (s.e. 0.01)
- Null hypothesis of \( \beta = 1 \) rejected (t-stat of 3).
- Specification test accepted.
LRT Intuition

• Long run discount rate is $-\ln(\delta) = 4\%$, so save in long-run (illiquid) assets.
• Short-run discount rate is $-\ln(\beta\delta) = 40\%$, so borrow on your credit card today.
Some papers on commitment

- Strotz (1957)
- Thaler and Shefrin (1981)
- Schelling (1984)
- Ainslie (1992)
- Laibson (1997)
- Wertenbroch (1998)
- Laibson, Repetto, Tobacman (1998)
- Angeletos et al. (2001)
- Gul and Pesendorfer (2001)
- Ariely and Wertenbroch (2002)
- Ashraf, Karlan, and Yin (2006)
- Amador, Werning, and Angeletos (2006)
- Fudenberg and Levine (2006)
- Karlan, Gine, and Zinman (2009)
- Kauer, Kremer, and Mullainathan (2010)
- Houser, Schunk, Winter and Xiao (2010)
- Royer, Stehr, and Sydnor (2011)
- Alsan, Armstrong, Beshears, Choi, del Rio, Laibson, Madrian, Marconi (2011)

Homer (700 BC): “If you supplicate your men and implore them to set you free, then they must tie you fast with even more lashings.”
Ashraf, Karlan, and Yin (2006)

• Offered a commitment savings product to randomly chosen clients of a Philippine bank
• **28.4%** take-up rate of commitment product (either date-based goal or amount-based goal)
• Subjects with more present-bias are more likely to take up the product
Gine, Karlan, Zinman (2009)

- Tested a voluntary commitment product (CARES) for smoking cessation.
- Smokers offered a savings account in which they deposit funds for six months, after which take urine tests for nicotine and cotinine.
- If they pass, money is returned; otherwise, forfeited
- **11%** of smokers offered CARES take it up, and smokers randomly *offered* CARES were 3 percentage points more likely to pass the 6-month test than the control group
- Effect persisted in surprise tests at 12 months.
Kaur, Kremer, and Mullainathan (2010):

Compare two piece-rate contracts:

1. Linear piece-rate: $w$ per unit produced

2. Linear piece-rate with penalty if worker does not achieve production target $T$ (“Commitment”)
   - Earn $w/2$ for each unit produced if production $< T$
   - Jump up at $T$, returning to baseline contract
Kaur, Kremer, and Mullainathan (2010):

- Demand for Commitment: Commitment contract (Target > 0) chosen **35%** of the time
- Effect on Production: Being *offered* commitment contract increases average production by 2.3 percentage points relative to control
What are the features that make a savings account attractive?

- Liquidity?
- Illiquidity?
  - Present-biased preferences
- If people like illiquidity, what kind of illiquidity is most effective?
  - 10% penalty?
  - 20% penalty?
  - Complete illiquidity?
Allocate across two accounts
Beshears, Choi, Harris, Laibson, Sakong (2014)

<table>
<thead>
<tr>
<th>Freedom Account</th>
<th>Goal Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>❖ Liquid – can withdraw money any time within the period of experiment (1 year)</td>
<td>❖ Subject picks a goal date</td>
</tr>
<tr>
<td>❖ 22% interest per year</td>
<td>❖ <strong>Illi</strong>quid before goal date</td>
</tr>
<tr>
<td></td>
<td>❖ 10% early withdrawal penalty</td>
</tr>
<tr>
<td></td>
<td>❖ Liquid after goal date, just like freedom account</td>
</tr>
<tr>
<td></td>
<td>❖ 22% interest per year</td>
</tr>
</tbody>
</table>
Initial investment in goal account

- **Goal Account 10% penalty**
  - Freedom Account: 65%
  - Goal Account: 35%

- **Goal account 20% penalty**
  - Freedom Account: 57%
  - Goal Account: 43%

- **Goal account No withdrawal**
  - Freedom Account: 44%
  - Goal Account: 56%
# Follow-up experiment

Subject allocates $100 between…

<table>
<thead>
<tr>
<th>Freedom Account</th>
<th>Goal Account(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Liquid – can withdraw money any time within the period of experiment</td>
<td>• Subject picks a goal and a goal date</td>
</tr>
<tr>
<td>• 22% interest per year</td>
<td>• <strong>Illiquid</strong> before goal date; liquid after goal date, just like Freedom Account</td>
</tr>
<tr>
<td>• 22% interest per year</td>
<td>• 22% interest per year</td>
</tr>
</tbody>
</table>

…at the end, 50% of subjects get all $100 in Freedom Account.
4 study arms:

<table>
<thead>
<tr>
<th>Arm</th>
<th>Goal Account characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm 1</td>
<td>10% Penalty before goal date</td>
</tr>
<tr>
<td>Arm 2</td>
<td>No Withdrawal before goal date</td>
</tr>
</tbody>
</table>
| Arm 3 | • 10% Penalty  
     | • No Withdrawal                                       |
|       |  \[ \text{Two goal accounts} \]                      |
| Arm 4 | Safety Valve – no withdrawal before goal date, \textit{except} in case of a financial emergency as determined by the subject |
## Goal amount by study arm (out of $100$)

<table>
<thead>
<tr>
<th>#</th>
<th>Variation</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10% Penalty</td>
<td>100</td>
<td>$45.8</td>
</tr>
<tr>
<td>2</td>
<td>No Withdrawal</td>
<td>150</td>
<td>$53.7</td>
</tr>
<tr>
<td>3</td>
<td>Two Goal Accounts</td>
<td>150</td>
<td>$50.1</td>
</tr>
<tr>
<td></td>
<td>A (10% Penalty)</td>
<td></td>
<td>$16.2</td>
</tr>
<tr>
<td></td>
<td>B (No Withdrawal)</td>
<td></td>
<td>$33.9</td>
</tr>
<tr>
<td>4</td>
<td>Safety Valve</td>
<td>150</td>
<td>$45.3</td>
</tr>
</tbody>
</table>
Theory

Generalizations of Amador, Werning and Angeletos (2001), hereafter AWA:

1. Present–biased preferences
2. Short–run taste shocks.
3. A general commitment technology.
Timing

Period 0. An initial period in which a commitment mechanism is set up by self 0.

Period 1. A taste shock, $\theta$, is realized and privately observed. Consumption ($c_1$) occurs.

Period 2. Final consumption ($c_2$) occurs.
Preferences

\[ U_0 = \beta \delta \theta \ u_1(c_1) + \beta \delta^2 \ u_2(c_2) \]
\[ U_1 = \theta \ u_1(c_1) + \beta \delta \ u_2(c_2) \]
\[ U_2 = u_2(c_2) \]
Self 0 hands self 1 a budget set (subset of blue region)

Interpretation: when $1$ is transferred from $c_2$ to $c_1$ no more then $\pi$ are lost in the exchange.
Two-part budget set

\[ c_1^* + c_2^* \]

slope = \(-1\)

\[ \left( c_1^*, c_2^* \right) \]

slope = \(-\frac{1}{1 - \pi}\)

\[ c_1^* + c_2^*(1 - \pi) \]
Theorem 1

Assume:
- CRRA utility.
- Early consumption penalty bounded above by $\pi$.

Then, self 0 will set up two accounts:
- Fully liquid account
- Illiquid account with penalty $\pi$. 
Theorem 2:

Assume log utility.

Then the amount of money deposited in the illiquid account rises with the early withdrawal penalty.
Initial investment in goal account

<table>
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<tr>
<td>10% penalty</td>
<td>35%</td>
</tr>
<tr>
<td>20% penalty</td>
<td>43%</td>
</tr>
<tr>
<td>No withdrawal</td>
<td>56%</td>
</tr>
</tbody>
</table>
Theorem 3 (AWA):

Assume self 0 can pick any consumption penalty.

Then self 0 will set up two accounts:
- fully liquid account
- fully illiquid account (no withdrawals in period 1)
Corollary

Assume there are three accounts:

- one liquid
- one with an intermediate withdrawal penalty
- one completely illiquid

Then all assets will be allocated to the liquid account and the completely illiquid account.
When three accounts are offered

<table>
<thead>
<tr>
<th>Goal account</th>
<th>Freedom Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>No withdrawal</td>
<td>33.9%</td>
</tr>
<tr>
<td></td>
<td>49.9%</td>
</tr>
<tr>
<td>Goal Account</td>
<td>16.2%</td>
</tr>
<tr>
<td>10% penalty</td>
<td></td>
</tr>
</tbody>
</table>
Open questions

- House money vs. own money
- Interest rates
- Demand effect (?)
- Stakes
- Short-run vs. Long-run
- Trust
Extensions

- Potential implications for the design of a retirement saving system?
- Theoretical framework needs to be generalized:
  1. Allow penalties to be transferred to other agents
  2. Heterogeneity in sophistication/naivite
  3. Heterogeneity in present–bias
Extension: Interpersonal Transfers

- If a household spends less than its endowment, the unused resources are given to other households.
- E.g. penalties are collected by the government and used for general revenue.
- This introduces an externality, but only when penalties are paid in equilibrium.
- Now the two–account system with maximal penalties is no longer socially optimal.
- AWA’s main result does not generalize.
Formally:

- Government picks an optimal triple \( \{x,z,p\} \):
  - \( x \) is the allocation to the liquid account
  - \( z \) is the allocation to the illiquid account
  - \( p \) is the penalty for the early withdrawal
- Endogenous withdrawal/consumption behavior generates overall budget balance.

\[
x + z = 1 + pE(w)
\]

where \( w \) is the equilibrium quantity of early withdrawals.
Socially optimal penalty on illiquid account (truncated Gaussian taste shocks)

Present bias parameter: $\beta$
Two key properties

- The optimal penalty almost eliminates early withdrawals.
  - This engenders an asymmetry: better to set the penalty above its optimum then below its optimum.
- Welfare losses are in $(1 - \beta)^2$.
  - Getting the penalty right for low $\beta$ agents has much greater welfare consequences than getting it right for high $\beta$ agents.
Expected Utility Given A Fixed Penalty Level: $\beta=0.6$

Penalty for Early Withdrawal
Expected Utility Given A Fixed Penalty Level: $\beta = 0.1$
Expected Utility Given A Fixed Penalty Level

Penalty for Early Withdrawal

\[ \beta = 1.0 \]
\[ \beta = 0.9 \]
\[ \beta = 0.8 \]
\[ \beta = 0.7 \]
\[ \beta = 0.6 \]
\[ \beta = 0.5 \]
\[ \beta = 0.4 \]
\[ \beta = 0.3 \]
\[ \beta = 0.2 \]
\[ \beta = 0.1 \]
To paraphrase Lucas:

Once you start thinking about low $\beta$ households, nothing else matters.
Consequently, very large penalties are optimal if there is substantial heterogeneity in $\beta$. 
Government picks an optimal triple \( \{x,z,p\} \):
- \( x \) is the allocation to the liquid account
- \( z \) is the allocation to the illiquid account
- \( p \) is the penalty for the early withdrawal

Endogenous withdrawal/consumption behavior generates overall budget balance.

\[
    x + z = 1 + pE(w)
\]

- \( \beta \) uniform in \{.1, .2, .3, .4, .5, .6, .7, .8, .9, 1\}
- Then expected utility is increasing in the penalty until \( p \approx 100\% \).
Conclusions

- Our three-period model and experimental evidence imply that optimal retirement systems have highly illiquid retirement accounts.

- Good news: Almost all countries in the world have a system like this: A public social security system plus **illiquid** supplementary retirement accounts (either DB or DC or both).

- Bad news: The U.S. doesn’t – our defined contribution retirement accounts are essentially **liquid**.