MARGINAL PROPENSITIES TO CONSUME WITH BEHAVIOURAL AGENTS

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Motivation

• Marginal propensity to consume (MPC) used to
  - **Quantify consumption response** to fiscal & monetary policy (e.g. Kaplan-Violante-14, Kaplan-Moll-Violante-18)
  - **Discriminate between models** of consumption behaviour

1. MPCs are too high [Parker-et-al-2013, Fagereng-et-al-2021, Crawley-Kuchler-2023]
4. Sign asymmetry: Larger consumption response to income losses than gains ⇒ Individual explanations exist, but no unifying framework
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   → Find MPC out of losses > MPC out of gains, irrespective of liquid wealth

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2. Develop consumption **model with mental accounting**
   • Funds are categorized into mental accounts (income or savings)
   • Consuming out of mental account for savings is costly
   → Higher MPC out of income losses than gains
   → Lower MPC out of income news and wealth
   → High MPC out of income gains for unconstrained households
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3. Conduct **redistributive fiscal experiment** in quantitative life-cycle model
   → Low (PE) aggregate consumption response with high MPC out of losses
Empirical evidence
Measuring MPC asymmetries

• **Data**: FED Survey of Consumer Expectations (2015-2018)

• MPC measure:
  
  - "Suppose next year you were to find your household with 10 percent more income than you currently expect. What would you do with the extra income?"
  
  - Response options: **spending**, **saving** or **paying down debt** in %
  
  - Same question for **losses**
MPC DISTRIBUTION HIGHLY ASYMMETRIC

MPC distribution from annual 10% income gain/loss

Note: MPCs from survey questions about hypothetical scenarios from NY FED Survey of Consumer Expectations.
MPCs asymmetric irrespective of liquid wealth

MPCs across net liquid wealth

Note: Net liquid wealth defined as bank deposits + stocks + bonds - debt excl. mortgages
MPC evidence through the lens of a one-asset model

Consumption as a function of cash-on-hand

- Poor household
- Wealthy household
Asymmetric MPCs difficult to rationalize

- Standard extensions:
  - Two-asset model
  - Consumption adjustment costs
  - Asymmetric portfolio adjustment costs
  - Discount-factor or return rate heterogeneity

- Behavioural extensions:
  - Present bias
  - Rational inattention
  - Temptation preferences
  - Reference-dependence and loss aversion
THEORETICAL FRAMEWORK
A BEHAVIOURAL CONSUMPTION MODEL

- Consumption model with **mental accounting**: [Shefrin-Thaler-1988, Thaler 1990]
  - Different mental accounts for income and savings
  - Breaks fungibility of money [Hastings-Shapiro-2013, 2018]
  - E.g. due to self-control problems or imperfect information [Thaler-Shefrin-1981, Lian-2021]
A behavioural consumption model

• Consumption model with mental accounting: [Shefrin-Thaler-1988, Thaler 1990]
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• Implementation: [McDowall-2020]
  - Consuming out of savings account costly

  - Savings rule partitions mental accounts
Mental Accounting Preferences

• Modified utility function:

\[ u^{MA}(c) = u(c) - \lambda d(a', \ a^{plan}) \]

\[ d(a', a^{plan}) = \begin{cases} 
0 & \text{if } a' \geq a^{plan} \\
 u(a') - u(a^{plan}) & \text{if } a' < a^{plan} 
\end{cases} \]

• \( \lambda \in [0, 1] \)

• Consuming out of savings account costly:
Two-period model

• Setup:

\[
\max_{c_0, c_1} \quad \log(c_0) - \lambda d(a_o, a_o^{plan}) + \beta \log(c_1)
\]

s.t. \quad c_0 + a_o = y_0; \quad c_1 = Ra_o

• Savings rule: optimal savings with \( \lambda = 0 \)
**Two-period model**

- **Setup:**
  \[
  \max_{c_0, c_1} \quad \log(c_0) - \lambda d(a_0, a_0^{\text{plan}}) + \beta \log(c_1)
  \]
  \[
  \text{s.t.} \quad c_0 + a_0 = y_0; \quad c_1 = Ra_0
  \]

- **Savings rule:** optimal savings with \(\lambda = 0\)

- **MPC:**
  1. **Unanticipated** proportional income shock \(\epsilon\)
  2. Shock **classified mentally as income** (rigid savings rule)

\[
MPC = \frac{\Delta c_0}{\epsilon y_0} = \begin{cases} 
  \frac{1}{1+\beta} \quad & \text{if } \epsilon \geq 0 \\
  \frac{1}{1+\beta} \left( \frac{1 + \epsilon}{\epsilon} \left( 1 + \frac{\beta}{1-\lambda} \right) - \frac{1}{\epsilon} \right) \quad & \text{if } \epsilon < 0 
\end{cases}
\]
Mechanism

\[ c_{plan}^{plan} = y_o - a_{plan}^{plan} \]
Mechanism - positive shock

$$c_{plan}^0 = y_0 - a_{plan}^0$$
**Mechanism - negative shock**

\[ c_{plan} = y_0 - a_{plan} \]
Quantitative model
Model overview

• **Life-cycle model** with idiosyncratic income risk + borrowing constraints

• **Mental accounting** preferences

• Savings rule depending on age, income and wealth

• Mental accounting motive allowed to vary with wealth [Stango-Zinman-2023]
HOUSEHOLD PROBLEM

- Recursive problem:

\[ V(j, z, e, a) = \max_c u(c) - \lambda(a)d(a', a^{plan}) + \beta E V(j + 1, z', e', a') \] (1)

s.t. \[ c + a' = (1 + r)a + \exp(z + e)y_j, \quad a' \geq 0 \] (2)

- Savings rule:

\[ a^{plan} = \tilde{a}^* (j, z, e = 0, a) \] (3)

\[ \tilde{V}(j, z, e, a) = \max_c u(c) + \beta E \tilde{V}(j + 1, z', e', a') \] s.t. (2) (4)

- Mental accounting:

\[ \lambda(a) = \lambda_0 \exp(a \lambda_1) \] (5)
HOUSEHOLD PROBLEM

• Recursive problem:

\[ V(j, z, e, a) = \max_c u(c) - \lambda(a)d(a', a^{plan}) + \beta\mathbb{E}V(j + 1, z', e', a') \]  \hspace{1cm} (1)

s.t. \quad c + a' = (1 + r)a + \exp(z + e)y_j, \quad a' \geq 0 \hspace{1cm} (2)

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\[ a^{plan} = \tilde{a}^*(j, z, e = 0, a) \]  \hspace{1cm} (3)

\[ \tilde{V}(j, z, e, a) = \max_c u(c) + \beta\mathbb{E}\tilde{V}(j + 1, z', e', a') \quad \text{s.t.} \]  \hspace{1cm} (2)

• Mental accounting:

\[ \lambda(a) = \lambda_0 \exp(a\lambda_1) \]  \hspace{1cm} (5)
Household problem

- Recursive problem:

\[
V(j, z, e, a) = \max_c u(c) - \lambda(a)d(a', a^{plan}) + \beta \mathbb{E} V(j + 1, z', e', a')
\]

s.t.
\[
c + a' = (1 + r)a + \exp(z + e)y_j, \quad a' \geq 0
\]

- Savings rule:

\[
a^{plan} = \tilde{a}^*(j, z, e = 0, a)
\]

\[
\tilde{V}(j, z, e, a) = \max_c u(c) + \beta \mathbb{E} \tilde{V}(j + 1, z', e', a') \quad \text{s.t.}
\]

- Mental accounting:

\[
\lambda(a) = \lambda_0 \exp(a\lambda_1)
\]
### Calibration

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<th>Parameter</th>
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<td>$r$</td>
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<td>$a$</td>
<td>Borrowing limit</td>
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| **Internal** |                                    |       |                               |
| $\beta$     | Discount factor                    | 0.93  | Avg. net wealth-to-income     |
| $\lambda_0$ | Mental accounting - level          | 0.70  | Avg. $MPC^-$                  |
| $\lambda_1$ | Mental accounting - decay          | -0.0195 | Top-bottom ratio of households with savings plan |
Model vs Data MPCs

(a) Model

(b) Data

Income Constant $\lambda$

MPC

Percentiles of wealth distribution

MPC

Percentiles of net liquid wealth distribution

MPC+
Other results

- MPC distribution
- Lower MPCs out of wealth
- Lower MPCs out of income news
- Size-dependence
- Consumption-savings dynamics
Fiscal experiment
• Policy experiment:

  1. **Targeted transfers** to bottom half of income distribution of $500

  2. Financed by **one-off tax** on top 25%

% change in aggregate consumption after policy

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<th>Without MA</th>
<th>With MA</th>
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<td>Income tax</td>
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<tr>
<td>Wealth tax</td>
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</table>
• Disconnect between MPCs measured in data and predicted by models

• Mental accounting model provides unified framework to rationalize asymmetry and other MPC puzzles

• Implications for fiscal policy:
  - Certain types of redistributive policies potentially less stimulative
  - Fiscal contractions more powerful than expansions? [Barnichon-et-al-2021]
**Response scheme for MPC question**

- **Qualitative:**
  1. Save or invest all of it
  2. Spend or donate all of it
  3. Use all of it to pay down debts
  4. Spend some and save some
  5. Spend some and use part of it to pay down debts
  6. Save some and use part of it to pay down debts
  7. Spend some, save some and use some to pay down debts

- **Quantitative (if previously 4-7):**
  1. Save or invest: %
  2. Spend or donate: %
  3. Pay down debts: %
**MPC⁺**: "Suppose next year you were to find your household with 10 percent more income than you currently expect. What would you do with the extra income?"

**MPC⁻**: "Now imagine that next year you were to find yourself with 10 percent less household income. What would you do?"
MPC DISTRIBUTION HIGHLY ASYMMETRIC

MPC distribution from 10% annual income gain

(a) Gains
(b) Losses
MPC asymmetry ($MPC^- - MPC^+$) across net liquid wealth

Note: Net liquid wealth defined as bank deposits + stocks + bonds - debt excl. mortgages
MPC asymmetries across wealth distribution

The graph illustrates the MPC asymmetry across different percentiles of the wealth distribution. The graph shows the relationship between percentiles of the distribution and the MPC asymmetry for total net wealth, net liquid wealth to income, and bank holdings.
MPC ASYMMETRY ACROSS OTHER DIMENSIONS

(a) Age  
(b) Housing status  
(c) Income
MPCs by debtor/creditor status

(a) $MPC^+$

(b) $MPC^-$
Robustness: Financial literacy of respondents

MPC asymmetry for most literate subsample

Note: Financial literacy is measured through seven questions testing quantitative skills. Most literate subsample only includes respondents that got all questions right (1/3 of sample).
Robustness: MPCs out of tax refunds

The diagram illustrates the fraction of households across different MPC values, comparing MPC+ and MPC+ tax scenarios. The x-axis represents MPC values ranging from 0 to 1, while the y-axis shows the fraction of households. The graph highlights the distribution differences between the two scenarios.
Model MPC distribution

![Histograms showing MPC distribution](image)

- MPC+ distribution
- MPC- distribution

![Histogram showing MPC asymmetry](image)
MODEL MPCs OUT OF WEALTH AND INCOME NEWS

The diagram illustrates the marginal propensity to consume (MPC) in response to changes in income, income news, and wealth. The y-axis represents the MPC, ranging from 0.0 to 1.0. The x-axis categorizes the stimuli as Income, Income news, and Wealth. The graph shows a significant increase in MPC for Income news compared to Income and Wealth.
Wealth and consumption distribution

(a) Wealth

(b) Consumption
LIFE-CYCLE PROFILE OF CONSUMPTION AND SAVINGS
Model MPCs by shock size

- ε = +30%
- ε = +3%
- ε = -30%
- ε = -3%

MPC vs Percentiles of wealth distribution

0-20 20-40 40-60 60-80 80+
Model MPCs by income
Model MPCs with constant $\lambda$
Calibrated level of mental accounting

The graph shows the level of dis-saving aversion (λ(a)) and the average level of dis-saving aversion (avg. λ) as a function of wealth. The level of dis-saving aversion decreases with increasing wealth.
### Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Std. dev.</th>
<th>Min</th>
<th>Max</th>
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<td>Liquid assets</td>
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### Regression Results

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<td>(0.017)</td>
<td>(0.010)</td>
<td>(0.014)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.636***</td>
<td>0.769***</td>
<td>0.145**</td>
<td>0.260***</td>
<td>0.782***</td>
<td>1.029***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.011)</td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.014)</td>
<td>(0.089)</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.03</td>
<td>0.04</td>
<td>0.02</td>
<td>0.04</td>
<td>0.02</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>3444</td>
<td>3341</td>
<td>3444</td>
<td>3341</td>
<td>3444</td>
<td>3341</td>
<td></td>
</tr>
</tbody>
</table>
Robustness: Planned vs actual expenditure

- How well do households predict their expenses?
- Compare predicted with realized expenditure

<table>
<thead>
<tr>
<th></th>
<th>(1) Appliances</th>
<th>(2) Electronics</th>
<th>(3) Furniture</th>
<th>(4) Home repairs</th>
<th>(5) Car</th>
<th>(6) Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPM</td>
<td>0.0030***</td>
<td>0.0037***</td>
<td>0.0039***</td>
<td>0.0048***</td>
<td>0.0041***</td>
<td>0.0056***</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Logit</td>
<td>0.0020***</td>
<td>0.0031***</td>
<td>0.0023***</td>
<td>0.0037***</td>
<td>0.0025***</td>
<td>0.0044***</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>R-squared LPM</td>
<td>0.04</td>
<td>0.05</td>
<td>0.08</td>
<td>0.13</td>
<td>0.07</td>
<td>0.21</td>
</tr>
<tr>
<td>R-squared Logit</td>
<td>0.04</td>
<td>0.04</td>
<td>0.09</td>
<td>0.11</td>
<td>0.07</td>
<td>0.17</td>
</tr>
<tr>
<td>Observations</td>
<td>5704</td>
<td>5693</td>
<td>5683</td>
<td>5691</td>
<td>5673</td>
<td>5690</td>
</tr>
</tbody>
</table>
## Savings plans and MPCs in the data

Households with savings plan have more asymmetric MPCs

<table>
<thead>
<tr>
<th></th>
<th>MPC Asymmetry</th>
<th>MPC+</th>
<th>MPC-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps budget</td>
<td>0.092***</td>
<td>-0.043***</td>
<td>0.049***</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.011)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Has savings/debt repayment plan only</td>
<td>0.047*</td>
<td>-0.042***</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.012)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.06</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Observations</td>
<td>3341</td>
<td>3341</td>
<td>3341</td>
</tr>
</tbody>
</table>
## Savings plans

Share of households with savings or debt repayment plan in SCE

<table>
<thead>
<tr>
<th>Percentile of net liquid wealth distribution</th>
<th>0-20</th>
<th>20-40</th>
<th>40-60</th>
<th>60-80</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps budget (in %)</td>
<td>68.5</td>
<td>66.3</td>
<td>70.8</td>
<td>65.8</td>
<td>59.8</td>
</tr>
<tr>
<td>Has savings/debt repayment plan (in %)</td>
<td>68.9</td>
<td>66.5</td>
<td>59.5</td>
<td>64.5</td>
<td>53.5</td>
</tr>
</tbody>
</table>
### Data versus model moments

<table>
<thead>
<tr>
<th>Model Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average wealth-to-income ratio</td>
<td>4.28</td>
<td>4.28</td>
</tr>
<tr>
<td>Average MPC out of losses</td>
<td>0.73</td>
<td>0.73</td>
</tr>
<tr>
<td>Ratio of households with savings plan/dissaving-aversion ratio</td>
<td>1.29</td>
<td>1.29</td>
</tr>
<tr>
<td>between bottom and top quintile of wealth distribution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Low MPC out of wealth and income news

- **MPC out of wealth:**
  
  \[ MPC^{\text{wealth}} = \frac{\Delta c_0}{\epsilon^{w_0}w_0} \leq MPC^{\text{income}} \text{ if } \frac{\partial a_o^{\text{plan}}}{\partial \epsilon^{w_0}} = \epsilon^{w_0}w_0 \]

- **MPC out of income news:**
  
  \[ MPC^{\text{news}} = \frac{\Delta c_0}{\epsilon^{y_1}y_1} \leq MPC^{\text{income}} \text{ if } \frac{\partial a_o^{\text{plan}}}{\partial \epsilon^{y_1}} = 0 \]
The MPC out of a wealth shock is smaller than the MPC out of an income shock if the savings rule moves one-to-one with wealth.

$$MPC^{+,\text{wealth}} = \max \left\{ \frac{1}{1+\beta} \left( \frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 0 \right\} \leq \frac{1}{1+\beta} = MPC^+$$

$$MPC^{-,\text{wealth}} = \frac{1}{1+\beta} \leq \min \left\{ \frac{1}{1+\beta} \left( \frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 1 \right\} = MPC^-$$
The MPC out of income news is smaller than the MPC out of current income changes if the savings rule does not respond to news.

\[
MPC^{+,\text{news}} = \max \left\{ \frac{1}{1+\beta} \left( \frac{1+\epsilon}{R\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{R\epsilon} \right), 0 \right\} \leq \frac{1}{1+\beta} = MPC^+
\]

\[
MPC^{-,\text{news}} = \frac{1}{R(1+\beta)} \leq \min \left\{ \frac{1}{1+\beta} \left( \frac{1+\epsilon}{\epsilon} \frac{1+\beta}{1+\frac{\beta}{1-\lambda}} - \frac{1}{\epsilon} \right), 1 \right\} = MPC^-
\]
Validity

How reliable are MPCs from hypothetical survey questions?

1. Results hold for most financially literate households

2. MPC distribution similar to distribution of MPCs out of tax refunds

3. Stated spending plans predict realized spending

4. Literature: Different methods produce comparable estimates for same household
   - Hypothetical vs reported MPCs [Bunn et al-2018]
   - Reported vs estimated MPCs [Parker Souleles-2019; Parker et al-2020]
Mental accounting utility function

\[ c_{plan}^{plan} = y_0 - a_{o}^{plan} \]

\[ \lambda = 0 \]

\[ \lambda = 0.5 \]

\[ \lambda = 1 \]

Utility

Consumption
## MPC Asymmetries in the Literature

<table>
<thead>
<tr>
<th>Study</th>
<th>Avg. $MPC^+$</th>
<th>Avg. $MPC^-$</th>
<th>Bot.$MPC^+$</th>
<th>Bot.$MPC^-$</th>
<th>Top$MPC^+$</th>
<th>Top$MPC^-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunn-et-al-2018</td>
<td>0.14</td>
<td>0.64</td>
<td>0.15</td>
<td>0.72</td>
<td>0.14</td>
<td>0.65</td>
</tr>
<tr>
<td>Christelis-et-al-2019</td>
<td>0.14</td>
<td>0.24</td>
<td>0.16</td>
<td>0.27</td>
<td>0.15</td>
<td>0.22</td>
</tr>
<tr>
<td>Fuster-et-al-2021</td>
<td>0.07</td>
<td>0.32</td>
<td>0.05</td>
<td>0.38</td>
<td>0.12</td>
<td>0.17</td>
</tr>
<tr>
<td>Bracha-Cooper-2014*</td>
<td>0.60</td>
<td>0.90</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sahm-et-al-2015*</td>
<td>0.14</td>
<td>0.55</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
**Contribution**

   - Asymmetries are large and broad-based

   - Provide unified theoretical framework

   - Mental accounting also explains MPC asymmetry

   - Micro-level mechanism explaining aggregate asymmetries