Consumer Credit with Over-Optimistic Borrowers

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Motivation

- Rapid growth of consumer credit and defaults.
- Debate on whether/how to regulate consumer credit products.
- Consumer Financial Protection Bureau created in 2010 → mandate to regulate consumer credit products.
- Borrowers’ cognitive biases often mentioned:
  - “Sellers of credit products have learned to exploit the lack of information and cognitive limitations of consumers” (Bar-Gill and Warren 2008)
  - “Financial regulators face a difficult trade-off between the benefits of regulation to households that make mistakes, and the costs of regulation to other financial market participants.” Richard T. Ely Lecture (Campbell 2016)
- Little theoretical (or quantitative) work to assess these arguments.
Quantitative models of debt and default with risk-based pricing, but no behavioral consumers
- Chatterjee, Corbae, Nakajima and Rios-Rull (2007), Livshits, MacGee and Tertilt (2007)

Theoretical papers on behavioral biases and lending, but no default

Self-control/temptation preferences in models with borrowing and default
- Laibson, Repetto and Tobacman (2000) and Nakajima (2012)

Co-existence of behavioral and rational borrowers
- Nakajima (2017) – closest to ours, but no interaction between the types
Focus on particular type of behavioral consumers: over-optimistic borrowers.

Introduce behavioral consumers into structural model of unsecured lending and default.

Competitive lenders, risk-based pricing.

Spill-overs between rational and behavioral people arise endogenously.

Theoretical and quantitative effects of behavioral borrowers.

Analyze how regulation affects both types of consumers.
1. **Substantial work documenting some form of over-optimism**
   - Self-employed particularly over-optimistic (Åstebro 2003 and Arabsheibani et al 2000)
   - About survival (Puri and Robinson, 2007)
   - Time it takes to complete everyday tasks (Buehler et al 1994)
   - People generally underestimate probability of negative events for themselves (Weinstein 1980)
   - Evidence of unforeseen expenditures (Gathergood 2012)
   - Literature on impulse buying (Beatty and Ferrell 1998, Verplanken and Sato 2011)

2. **Over-optimism gives rise to a tractable model of credit scoring and spill-overs between behavioral and rational borrowers.**
The Environment

Standard incomplete market, heterogeneous agent, life-cycle model with bankruptcy (Livshits, MacGee and Tertilt (2007, 2010))

- Stochastic life-cycle model.
- Idiosyncratic uncertainty: about earnings and unforeseen expenses.
- Incomplete markets: non-contingent debt only.
- Consumers decide on saving, borrowing and whether to file for bankruptcy.
- Equilibrium interest rate incorporates default risk.
- Small open economy: risk free rate $r^s$ exogenous.
Households

Maximize discounted expected life-time utility

\[ E^T \sum_{j=1}^{J} \beta^{j-1} u \left( \frac{c_j}{n_j} \right) \]

Risky income

\[ y_j^T = \bar{e}_j z_j \eta_j^T \]

- \( \bar{e}_j \) – Life cycle pattern of effective labor endowment
- \( z \) – Persistent shock, Markov with finite support
- \( \eta \) – Transitory shock, iid, finite support

Expense shocks

- Exogenous increase in household’s debt
- \( \kappa \in K = \{0, \kappa_1, \kappa_2\} \), iid

Budget constraint if not in default:

\[ c + d + \kappa \leq y_j + q(d', z, j, s)d' \]
Over-Optimists

- Face different transitory income process (lower mean): $\mathbb{E}\eta^B < \mathbb{E}\eta^R$.
- But they do not realize that. Believe they are just like everyone else, just unlucky: $\mathbb{E}^B \eta^B = \mathbb{E}\eta^R$.
- No Bayesian updating for consumers, as everyone is convinced they are realists.
- This naturally leads to pooling. Behavioral consumers behave like (unlucky) rational people.
- Impossible to design screening contracts to separate them. No adverse selection issues.
Bankruptcy

- Households can choose to default
- Default as in Chapter 7 (Fresh Start) bankruptcy.

**Consequences**

- Fraction $\gamma$ of income garnished
  - Lenders recover ($\gamma y_j$),
- Cannot file next (model) period
  - Exclusion for 6 years (model period = 3 years)
- All debts discharged ($d' = 0$)
Financial intermediaries can borrow and save at exogenous rate $r^s$. Accept deposits and make loans. Pay proportional transaction costs $\tau$ on loans. Observe household’s debt, income $(z, \eta)$, expense shock $(\kappa)$ and age. Behavioral consumers not directly observable, but shock history contains information. Perfectly competitive financial markets:
- Zero expected profits on each loan
- Law of large numbers $\Rightarrow$ zero ex-post profits
Bankers are smarter than consumers: create type scores.
Observe shocks, debt & histories.
Update beliefs about likelihood HH is a rational type.

Type Score $\equiv \Pr(\text{Rational})$

Equilibrium interest rate incorporates default risk:
depends on type score, age, current income, debt.

Conditional on observables and type scores,
behavioral and rational people are pooled.

Type scores become more accurate with age (= longer histories)
$\rightarrow$ less and less pooling as people get older.
Type Scoring and Loan Prices

$s = \text{probability of being rational. Prior: } s_0 = 1 - \lambda.$

**Type scores: Bayesian Updating**

$$s'(\eta', j + 1, s) = \frac{Pr^R(\eta') \cdot s}{Pr^R(\eta') \cdot s + Pr^B(\eta') \cdot (1 - s)}$$

**Loan price schedule**

$$q(d', z, j, s) = (1 - \theta(d', z, j, s))\overline{q} + \theta(d', z, j, s)E(\frac{\gamma y'}{d' + \kappa'})\overline{q}$$

where $\theta$ is the equilibrium default probability, and $\overline{q} = \frac{1}{1 + r^s + \tau}$ is the price of a safe loan.
Consumer Problem

\[ V_j^T (d, z, \eta, \kappa, s) = \max_{c, d'} \left[ u \left( \frac{c}{n_j} \right) + \beta \mathbb{E}^T \max \left\{ V_{j+1}^T (d', z', \eta', \kappa', s'), \bar{V}_{j+1}^T (z', \eta', s') \right\} \right] \]

s.t. \( c + d + \kappa \leq y_j + q(d', z, j, s)d' \)

where \( \bar{V} \) is value of filing for bankruptcy.

\[ \bar{V}_j^T (z, \eta, s) = u \left( \frac{c}{n_j} \right) + \beta \mathbb{E}^T \max \left\{ V_{j+1}^T (0, z', \eta', \kappa', s'), \bar{W}_{j+1}^T (z', \eta', \kappa', s') \right\} \]

s.t. \( c = (1 - \gamma) y_j \)

and \( \bar{W} \) value of defaulting immediately following bankruptcy.
An equilibrium is a set of value functions, decision rules for consumption $c^T(\cdot)$, debt $d^T(\cdot)$, and default $I^T(\cdot)$ for the consumer, default probabilities $\theta(\cdot)$, and bond price schedules $q^b(\cdot)$, such that

- households optimize, taking the bond price schedule as given.
- bond prices are actuarially fair, given default probabilities.
- default probabilities are consistent with household decision rules.

The model is solved numerically iterating backwards.
Quantitative Analysis

- Use calibration from our previous work.
- Add 20% behavioral consumers.
- Explore implications for
  -Aggregate outcomes
  -Behavioral consumers
  -Policy analysis
Calibration
(Livshits, MacGee, and Tertilt, 2007)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Period Length</td>
<td>3 years</td>
</tr>
<tr>
<td>Discount Factor ( \beta )</td>
<td>0.94</td>
</tr>
<tr>
<td>CRRA Coefficient ( \sigma )</td>
<td>2</td>
</tr>
<tr>
<td>Wage Autocorrelation ( \rho )</td>
<td>0.95</td>
</tr>
<tr>
<td>Persistent Wage Var ( \sigma^2_\varepsilon )</td>
<td>0.025</td>
</tr>
<tr>
<td>Transitory Wage Var ( \sigma^2_\eta )</td>
<td>0.05</td>
</tr>
<tr>
<td>Risk Free Rate ( r^s )</td>
<td>3.44%</td>
</tr>
<tr>
<td>Roll-over Rate ( r^r )</td>
<td>20%</td>
</tr>
<tr>
<td>Transaction costs ( \tau )</td>
<td>2.56%</td>
</tr>
<tr>
<td>Garnishment ( \gamma )</td>
<td>0.319</td>
</tr>
</tbody>
</table>
Over-optimists experience negative transitory income shocks more often (and positive ones less often), but are ignorant about it.

<table>
<thead>
<tr>
<th>Category</th>
<th>$\eta$</th>
<th>$Pr(\eta)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>$[0.6, 1, 1.6]$</td>
<td>$[10%, 80%, 10%]$</td>
</tr>
<tr>
<td>Behavioral</td>
<td></td>
<td>$[15%, 80%, 5%]$</td>
</tr>
<tr>
<td>Rational</td>
<td>$[8.75%, 80%, 11.25%]$</td>
<td></td>
</tr>
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</table>
Type Scoring over the Life Cycle – Examples

"Realist"

Type Scores

"Behavioral"

Type Scores

Michèle Tertilt

Consumer Credit & Over-Optimists

CEMFI
Histogram "Realists"

Histogram "Behaviorals"

- Red: Age26
- Green: Age41
- Purple: Age68
Pooling Declines with Age

![Graph showing the decline in pooling with age for Realists and Over-optimists. The graph plots Type Score on the y-axis against Age on the x-axis. The Realists line is shown in blue and decreases gradually, while the Over-optimists line is shown in red and decreases more steeply.](image-url)
Interest Rates Drift Apart with Age

Interest Rates

- Behavioral
- Normal
### Behavioral vs. Rational Consumers and Effect on Aggregates

<table>
<thead>
<tr>
<th>Category</th>
<th>Rational</th>
<th>Behavioral</th>
<th>Aggregate</th>
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<tbody>
<tr>
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<td>9.05%</td>
<td>13.16%</td>
<td>9.88%</td>
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<tr>
<td>Filings</td>
<td>0.79%</td>
<td>1.11%</td>
<td>0.86%</td>
</tr>
<tr>
<td>Interest Rates</td>
<td>10.48%</td>
<td>12.42%</td>
<td>10.87%</td>
</tr>
<tr>
<td>Borrowers</td>
<td>26.38%</td>
<td>33.05%</td>
<td>27.71%</td>
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</table>
## Decomposition: Bias vs. Extra Risk?

<table>
<thead>
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<th></th>
<th>Benchmark</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>biased pooled</td>
<td>not pooled</td>
<td>not biased pooled</td>
</tr>
<tr>
<td>Debt-to-income</td>
<td>Rational</td>
<td>9.05%</td>
<td>9.08%</td>
<td>9.08%</td>
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<tr>
<td></td>
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<td>13.16%</td>
<td>13.14%</td>
<td>9.05%</td>
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<tr>
<td>Filings</td>
<td>Rational</td>
<td>0.79%</td>
<td>0.82%</td>
<td>0.82%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>1.11%</td>
<td>1.00%</td>
<td>0.86%</td>
</tr>
<tr>
<td>Interest Rates</td>
<td>Rational</td>
<td>10.48%</td>
<td>11.16%</td>
<td>11.16%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>12.42%</td>
<td>10.09%</td>
<td>12.08%</td>
</tr>
<tr>
<td>Filings per Borrower</td>
<td>Rational</td>
<td>3.01%</td>
<td>3.09%</td>
<td>3.09%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>3.36%</td>
<td>3.00%</td>
<td>3.19%</td>
</tr>
<tr>
<td>Borrowers</td>
<td>Rational</td>
<td>26.38%</td>
<td>26.35%</td>
<td>26.35%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>33.05%</td>
<td>33.28%</td>
<td>26.96%</td>
</tr>
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</table>
Behavioral Consumers’ Mistakes

- Behavioral people make mistakes (compared to a fully aware version of themselves):
  - They over-borrow. Would borrow about 5% less if suddenly made aware.
  - Do not file enough. An additional 1.08% of consumers would file if suddenly made aware.

- Reason: Too optimistic about future ability to repay debt.

- But they benefit from cross-subsidization: interest rate lower than actuarially fair one.
Cross Subsidization

Histogram of Cross-Subsidization, all ages

\[ (q - q_{fair})^d \times 10^4 \]

Legend:
- Behavioral
- Rational
Policies: What could be done to address these frictions?

1. Behavioral people file too little/late, perhaps default should be made easier.
   → we lower garnishment $\gamma$

2. Behavioral people over-borrow, perhaps borrowing should be taxed
   → increase transaction costs of loans $\tau$

3. Behavioral people make financial mistakes, perhaps they should be informed about their type.
   → Financial literacy education (caveat: how to implement this?)

Key: policies also affect cross-subsidization!
1. Lower Default Costs

<table>
<thead>
<tr>
<th></th>
<th>BM (0.32)</th>
<th>$\gamma = 0.2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paternalistic Welfare</strong></td>
<td>Rational</td>
<td>-0.16%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>-0.15%</td>
</tr>
<tr>
<td><strong>Bankruptcy filings</strong></td>
<td>Rational</td>
<td>0.79%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>1.11%</td>
</tr>
<tr>
<td><strong>Interest rates</strong></td>
<td>Rational</td>
<td>10.48%</td>
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<tr>
<td></td>
<td>Behavioral</td>
<td>13.16%</td>
</tr>
<tr>
<td><strong>Financial Mistakes</strong></td>
<td>Filing too late</td>
<td>1.07%</td>
</tr>
<tr>
<td></td>
<td>Overborrowing</td>
<td>3.89%</td>
</tr>
</tbody>
</table>

Opposite from Nakajima (2017) who finds that borrowers with self-control problems benefit from lower garnishment (they prefer the resulting tighter borrowing constraints).
2. Taxing Loans

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>1% tax</th>
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</thead>
<tbody>
<tr>
<td><strong>Paternalistic Welfare</strong></td>
<td>Rational</td>
<td>-0.41%</td>
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<td>Behavioral</td>
<td>-0.44%</td>
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<tr>
<td><strong>Average interest rates</strong></td>
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<tr>
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<td>12.42%</td>
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<tr>
<td><strong>Bankruptcy filings</strong></td>
<td>Rational</td>
<td>0.79%</td>
</tr>
<tr>
<td></td>
<td>Behavioral</td>
<td>1.11%</td>
</tr>
</tbody>
</table>

- Taxing loans lowers over-borrowing. But at a too high cost (deadweight loss). Everyone worse off.
Financial literacy

- Often argued to improve financial outcomes and welfare
- Supposed to prevent financial mistakes
- Education policy, reporting standards, standardized contracts, etc.

Experiment

- Perfectly inform agents about true transitory income risks
- Behavioral consumers perfectly identified to themselves and lenders

Two effects in model:

1. Avoid financial mistakes
2. Break-down of cross-subsidization
### 3. Financial Literacy

<table>
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<tr>
<th></th>
<th>Benchmark</th>
<th>Financial Literacy</th>
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<td>-0.18%</td>
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<tr>
<td><strong>Financial Mistakes</strong></td>
<td>Filing too late</td>
<td>1.07%</td>
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<td></td>
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<td>Behavioral</td>
<td>13.16%</td>
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</table>

Rational consumers benefit from the policy! Behavioral consumers worse off: Benefit of avoiding mistakes (filing earlier/reduced over-borrowing) does not compensate for losing cross-subsidization.
Lenders are better informed than borrowers.

Yet model does not lead to “predatory lending” as defined by Bond, Musto and Yilmaz (2009): A loan a borrower would decline if he had same information as lender.

Over-optimists consider themselves unlucky and their type score unfair.

However, if made aware, over-optimists would understand that their contracts were actually subsidized by rational types. Hence, they would be more than happy to accept such contracts.
Explicit treatment of default is critical for model predictions: Behavioral borrowers are cross-subsidized in our model not “taken advantage of” – as in Heidhues and Koszegi (2010, 2017)

Over-optimists make mistakes: they borrow too much and file too late. Mistakes can be quantitatively large.

Realists are affected by the presence of behavioral borrowers
  - Not just by mis-pricing (cross-subsidization)
  - Transitory shocks have persistent affects by changing type-score and affecting future prices

Policies may affect behavioral and rational people in opposite directions.

Financial literacy benefits rational at expense of behavioral consumers.
Back-up Slides
1. Higher Default Costs

<table>
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<th>$\gamma = 0.2$</th>
<th>BM (0.32)</th>
<th>$\gamma = 0.5$</th>
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<tbody>
<tr>
<td><strong>Bankruptcy filings</strong></td>
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<tr>
<td>Realistic</td>
<td>1.42%</td>
<td>0.79%</td>
<td>0.31%</td>
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<tr>
<td>Behavioral</td>
<td>2.10%</td>
<td>1.11%</td>
<td>0.44%</td>
</tr>
<tr>
<td><strong>Interest rates</strong></td>
<td></td>
<td></td>
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<tr>
<td>Realistic</td>
<td>20.16%</td>
<td>10.48%</td>
<td>7.06%</td>
</tr>
<tr>
<td>Behavioral</td>
<td>24.41%</td>
<td>12.42%</td>
<td>7.23%</td>
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<td><strong>Debt-to-income</strong></td>
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<tr>
<td>Realistic</td>
<td>4.98%</td>
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<td>14.78%</td>
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<tr>
<td>Behavioral</td>
<td>7.32%</td>
<td>13.16%</td>
<td>21.78%</td>
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<tr>
<td><strong>Paternalistic Welfare</strong></td>
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<tr>
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<td></td>
<td>0.17%</td>
</tr>
<tr>
<td><strong>Financial Mistakes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filing too late</td>
<td>1.12%</td>
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<td>0.41%</td>
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<td>Overborrowing</td>
<td>7.42%</td>
<td>3.89%</td>
<td>0.39%</td>
</tr>
</tbody>
</table>

Even behavioral consumers benefit from an increase in default costs.
Suppose instead people were over-optimistic about expense shocks.

Here behavioral people make fewer mistakes, while cross-subsidization is quite important.

This leads to somewhat different policy implications:

- Disagreement between rational and behavioral borrowers on financial literacy continues.
- Disagreement about optimal bankruptcy law:
  - Rationals want stricter garnishment due to the commitment value.
  - Behaviorals want laxer rules to dispose of expense shocks more easily.
Theoretical Insight

- Explicit treatment of default is critical for model predictions:
- Behavioral borrowers are cross-subsidized in our model
- Not “taken advantage of,” as in Heidhues Koszegi (2010, 2017)
- Since behavioral agents are more “risky” than realists
  - Within any pool, conditional on all other info
- They pay less than actuarially fair risk premia
Behavioral borrowers borrow too much (relative to aware selves)
  - not too little, as in Hynes (2004)
and file too little (too late)
Surprisingly, these “mistakes” are quantitatively large only for income shocks, not for expense shocks confusion

Aggregates are mostly affected by confusion
While welfare is affected by pooling

Realists are affected by the presence of behavioral borrowers
  - Not just by mis-pricing (cross-subsidization)
  - Transitory shocks have persistent affects now
  - by changing type-score and affecting future prices