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.
- 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)

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.
- NEW: two types of consumers: Rational and behavioral (\( T = R, B \)). Behavioral: worse income process BUT believes she has the good process.
Households

Maximize discounted expected life-time utility

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

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:

$$c + d + \kappa \leq y_j + q(d', z, j, s) d'$$
Face different transitory income process (lower mean): $\mathbb{E} \eta^B < \mathbb{E} \eta^R$.

(Specifically, they experience negative shocks more often and positive ones less often.)

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 rational.

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
- Experience utility cost $\xi$ (social stigma)
- 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 $(d' = 0)$
- Cannot borrow or save in the default period.
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
Lenders – Information

- 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) 
  → 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**

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

**Loan price schedule**

\[
q(d', z, j, s) = (1 - \theta(d', z, j, s))\bar{q} + \theta(d', z, j, s)E\left(\frac{\gamma y'}{d' + \kappa'}\right)\bar{q}
\]

where \( \theta \) is the equilibrium default probability, and \( \bar{q} = \frac{1}{1 + rs + \tau} \) 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.

\[ \bar{V}_j^T (z, \eta, s) \]

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

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.
Calibrate Model to recent US data.

Set income and expense shocks externally, like in our previous work.

$\beta = 0.94$ and $\sigma = 2$ in line with the literature.

Saving rate: $r^s = 3.44\%$

Choose remaining 6 parameters to match data moments:

- $\gamma$ – recovery rate during bankruptcy
- $\xi$ – utility cost of bankruptcy
- $\tau$ – transaction cost of lending
- $\bar{r}$ – interest rate ceiling
- $\lambda$ – fraction over-optimists
- $\psi$ – probability of bad transitory shock for over-optimists relative to rational.
<table>
<thead>
<tr>
<th>Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>chapter 7 filings</td>
<td>0.83%</td>
<td>0.89%</td>
</tr>
<tr>
<td>average borrowing $r$</td>
<td>11-13%</td>
<td>12%</td>
</tr>
<tr>
<td>debt/income</td>
<td>9%</td>
<td>9.2%</td>
</tr>
<tr>
<td>charge-off rate</td>
<td>4.8%</td>
<td>5%</td>
</tr>
<tr>
<td>repeat filings</td>
<td>25%</td>
<td>21%</td>
</tr>
<tr>
<td>CV (interest rate)</td>
<td>0.56</td>
<td>0.56</td>
</tr>
</tbody>
</table>
### Calibrated Parameters

<table>
<thead>
<tr>
<th>$\gamma$</th>
<th>$\xi$</th>
<th>$\tau$</th>
<th>$\bar{r}$</th>
<th>$\lambda$</th>
<th>$\psi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3024</td>
<td>0.0171</td>
<td>0.03</td>
<td>0.99</td>
<td>0.23</td>
<td>1.7</td>
</tr>
</tbody>
</table>

### Transitory income shocks

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Behavioral</th>
<th>Rational</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta$</td>
<td>[0.6, 1, 1.6]</td>
<td>[14.7%, 80%, 5.3%]</td>
<td>[8.6%, 80%, 11.4%]</td>
</tr>
<tr>
<td>$Pr(\eta)$</td>
<td>[10%, 80%, 10%]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Behavioral vs. Rational Consumers and Effect on Aggregates

<table>
<thead>
<tr>
<th></th>
<th>Rational</th>
<th>Behavioral</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Debt-to-income</strong></td>
<td>9.05%</td>
<td>13.16%</td>
<td>9.88%</td>
</tr>
<tr>
<td><strong>Filings</strong></td>
<td>0.79%</td>
<td>1.11%</td>
<td>0.86%</td>
</tr>
<tr>
<td><strong>Interest Rates</strong></td>
<td>10.48%</td>
<td>12.42%</td>
<td>10.87%</td>
</tr>
<tr>
<td><strong>Borrowers</strong></td>
<td>26.38%</td>
<td>33.05%</td>
<td>27.71%</td>
</tr>
</tbody>
</table>
Type Scoring over the Life Cycle – Examples

Rational

Behavioral

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Type Score Distribution

Histogram "Realists"

Histogram "Behaviorals"

Age 26
Age 41
Age 68
Pooling Declines with Age

Average Type Scores

- Behavioral
- Rational

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Tel-Aviv
Understanding Over-Optimists

Fundamental Difference: 5.5% lower average income.

<table>
<thead>
<tr>
<th></th>
<th>rational low risk (alone)</th>
<th>rational high risk (alone)</th>
<th>over-opt high risk (alone)</th>
<th>over-opt high risk (pooled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt/Earnings</td>
<td>8.4%</td>
<td>8.3%</td>
<td>12.3%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Filings</td>
<td>0.85%</td>
<td>0.90%</td>
<td>1.05%</td>
<td>1.13%</td>
</tr>
<tr>
<td>Interest Rates</td>
<td>12.93%</td>
<td>13.93%</td>
<td>10.80%</td>
<td>13.46%</td>
</tr>
<tr>
<td>Filings per Borrower</td>
<td>3.12%</td>
<td>3.31%</td>
<td>3.07%</td>
<td>3.32%</td>
</tr>
<tr>
<td>Total Borrowers</td>
<td>27%</td>
<td>27%</td>
<td>34%</td>
<td>34%</td>
</tr>
<tr>
<td>Debt/Earnings of defaulters</td>
<td>287%</td>
<td>298%</td>
<td>270%</td>
<td>304%</td>
</tr>
</tbody>
</table>
Behavioral Consumers’ Mistakes

Behavioral people make mistakes (compared to a fully aware version of themselves):

- They over-borrow. Would borrow about 7% less if suddenly made aware.
- Do not save enough. An additional 0.94% of consumers would save 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

- Behavioral

- Rational

$q - q_{fair}^*d$ 

$10^{-4}$
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 $\tau$ (not surprisingly, will make everyone worse off, won’t show today).

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

$\gamma = 0.2 \quad \text{BM}(\gamma = 0.3)$

<table>
<thead>
<tr>
<th></th>
<th>Rational</th>
<th>Behavioral</th>
<th>Rational</th>
<th>Behavioral</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paternalistic Welfare</strong></td>
<td>-0.092%</td>
<td>-0.094%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bankruptcy filings</strong></td>
<td>1.35%</td>
<td>1.93%</td>
<td>0.82%</td>
<td>1.13%</td>
</tr>
<tr>
<td><strong>Interest rates</strong></td>
<td>16.89%</td>
<td>19.36%</td>
<td>11.52%</td>
<td>13.46%</td>
</tr>
<tr>
<td><strong>Debt-to-income</strong></td>
<td>5.08%</td>
<td>7.55%</td>
<td>8.38%</td>
<td>12.28%</td>
</tr>
<tr>
<td><strong>Financial Mistakes</strong></td>
<td>Filing too late 1.21%</td>
<td>0.94%</td>
<td>Overborrowing 24.81%</td>
<td>6.87%</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).
3. Financial Literacy Education

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>
<thead>
<tr>
<th>Category</th>
<th>Benchmark Rational</th>
<th>Financial Literacy Rational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paternalistic Welfare</td>
<td>0.01%</td>
<td>-0.16%</td>
</tr>
<tr>
<td>Financial Mistakes</td>
<td></td>
<td></td>
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<tr>
<td>Filing too late</td>
<td>0.94%</td>
<td>0</td>
</tr>
<tr>
<td>Overborrowing</td>
<td>6.71%</td>
<td>0</td>
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<tr>
<td>Bankruptcy filings</td>
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<tr>
<td>Rational</td>
<td>0.82%</td>
<td>0.85%</td>
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Lenders are better informed than borrowers.

Does this lead to “predatory lending”?

Bond, Musto and Yilmaz (2009) define “predatory lending” as: *A loan a borrower would decline if he had same information as lender.*

In our model: 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 very happy to accept such contracts.
Summary

- Tractable model of consumer credit to explore interaction between rational and behavioral consumers.
- Endogenous type scores.
- Explicit treatment of default is critical for model predictions: Behavioral borrowers are cross-subsidized in our model, not “taken advantage of.”
- 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 – e.g. financial literacy education benefits rational at expense of behavioral.
## 2. Taxing Loans

<table>
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<tr>
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<th>Benchmark</th>
<th>1% tax</th>
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<tbody>
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<td><strong>Paternalistic Welfare</strong></td>
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<td>-0.37%</td>
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<td></td>
<td>Behavioral</td>
<td>-0.38%</td>
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<tr>
<td><strong>Average interest rates</strong></td>
<td>Rational</td>
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