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.

Literature

- 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
  - Heidhues and Koszegi (2010, 2017), Eliaz and Spiegler (2006)
- 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

What We Do

- 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.

Why Over-Optimism?

1. Substantial work documenting some form of over-optimism

- About income (Arabsheibani, de Meza, Maloney, and Pearson, 2000, Dawson and Henley, 2012, Balasuriya and Vasileva, 2014)
- 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

$$y_j^T = \overline{e}_j z_j \eta_j^T$$

$\overline{e}_j$ – Life cycle pattern of effective labor endowment
z – Persistent shock, Markov with finite support
η – 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:

$$c + d + \kappa \leqslant y_j + q(d', z, j, s)d'$$

Over-Optimists

- Face different transitory income process (lower mean): $\mathbb{E}\eta^B < \mathbb{E}\eta^R$.
- (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 ξ (social stigma)
- Fraction γ of income garnished
  - Lenders recover (γy_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 Markets

- Financial intermediaries can borrow and save at exogenous rate r^s.
- Accept deposits and make loans.
- Pay proportional transaction costs τ on loans.
- Observe household's debt, income (z, η), expense shock (κ) 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.
  $\textit{Type Score} \equiv \Pr(\text{Rational})$
- 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

$s =$ 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

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

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

Consumer Problem

$$
\begin{aligned}
&V_j^T(d, z, \eta, \kappa, s) \\
&\quad = \max_{c, d'} \left[u\left(\frac{c}{n_j}\right) + \beta \mathbb{E}^T \max\left\{ V_{j+1}^T(d', z', \eta', \kappa', s'), \overline{V}_{j+1}^T(z', \eta', s') \right\} \right] \\
&\quad \text{s.t. } c + d + \kappa \leqslant y_j + q(d', z, j, s) d'
\end{aligned}
$$

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

$$
\begin{aligned}
&\overline{V}_j^T(z, \eta, s) \\
&\quad = u\left(\frac{c}{n_j}\right) - \xi + \beta \mathbb{E}^T \max\left\{ V_{j+1}^T(0, z', \eta', \kappa', s'), \bar{W}_{j+1}^T(z', \eta', \kappa', s') \right\} \\
&\quad \text{s.t. } c = (1 - \gamma) y_j
\end{aligned}
$$

and $\bar{W}$ value of defaulting immediately following bankruptcy.

Equilibrium

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

- 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:
  - γ – recovery rate during bankruptcy
  - ξ – utility cost of bankruptcy
  - τ – transaction cost of lending
  - $\bar{r}$ – interest rate ceiling
  - λ – fraction over-optimists
  - ψ – probability of bad transitory shock for over-optimists relative to rational.

Moments

Moment	Data	Model
chapter 7 filings	0.83%	0.89%
average borrowing r	11-13%	12%
debt/income	9%	9.2%
charge-off rate	4.8%	5%
repeat filings	25%	21%
CV (interest rate)	0.56	0.56

Calibrated Parameters

γ	ξ	τ	$\bar{r}$	λ	ψ
0.3024	0.0171	0.03	0.99	0.23	1.7

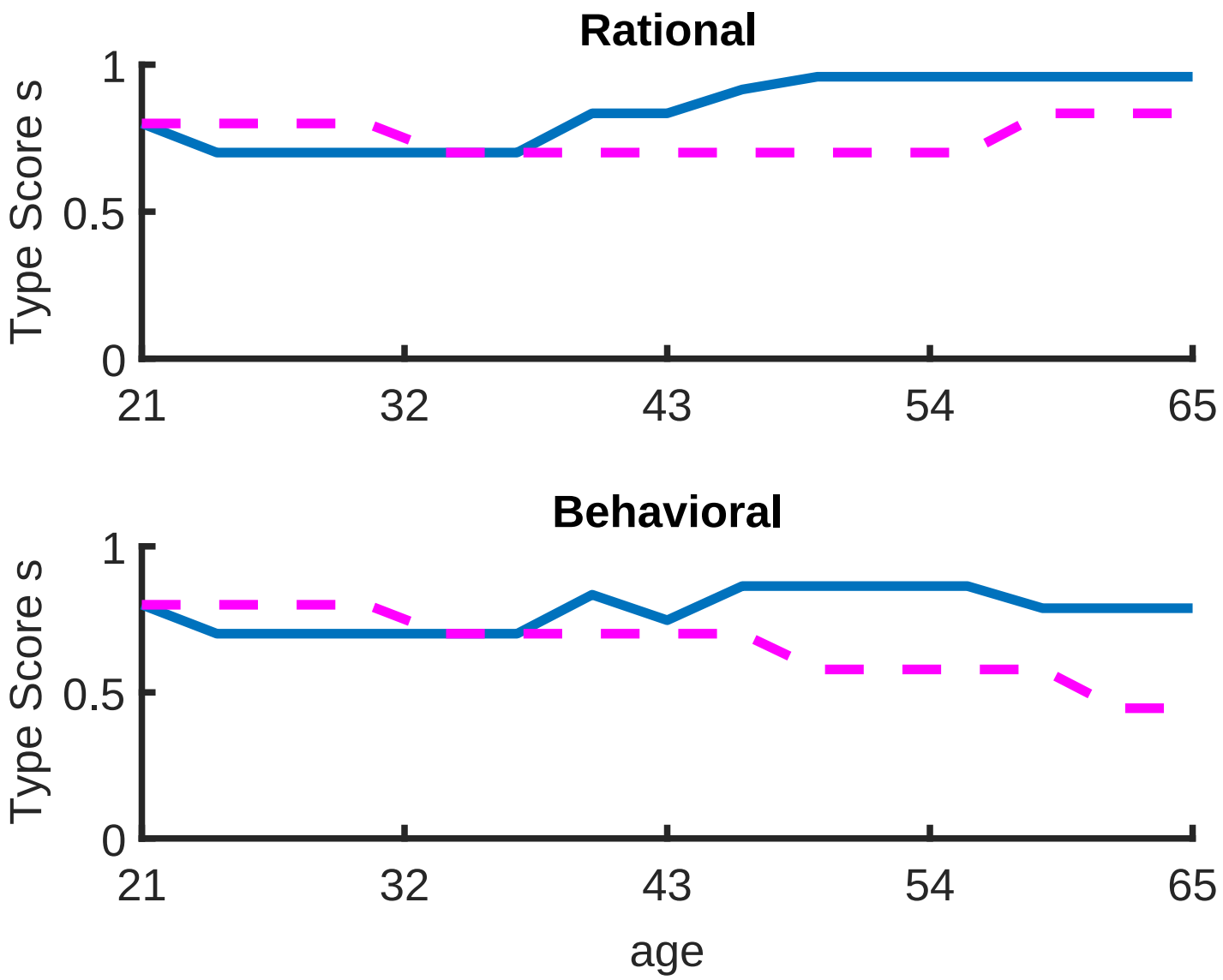
Transitory income shocks

Aggregate	
η	$[0.6, 1, 1.6]$
$Pr(\eta)$	$[10\%, 80\%, 10\%]$
Behavioral	
$Pr(\eta)$	$[14.7\%, 80\%, 5.3\%]$
Rational	
$Pr(\eta)$	$[8.6\%, 80\%, 11.4\%]$

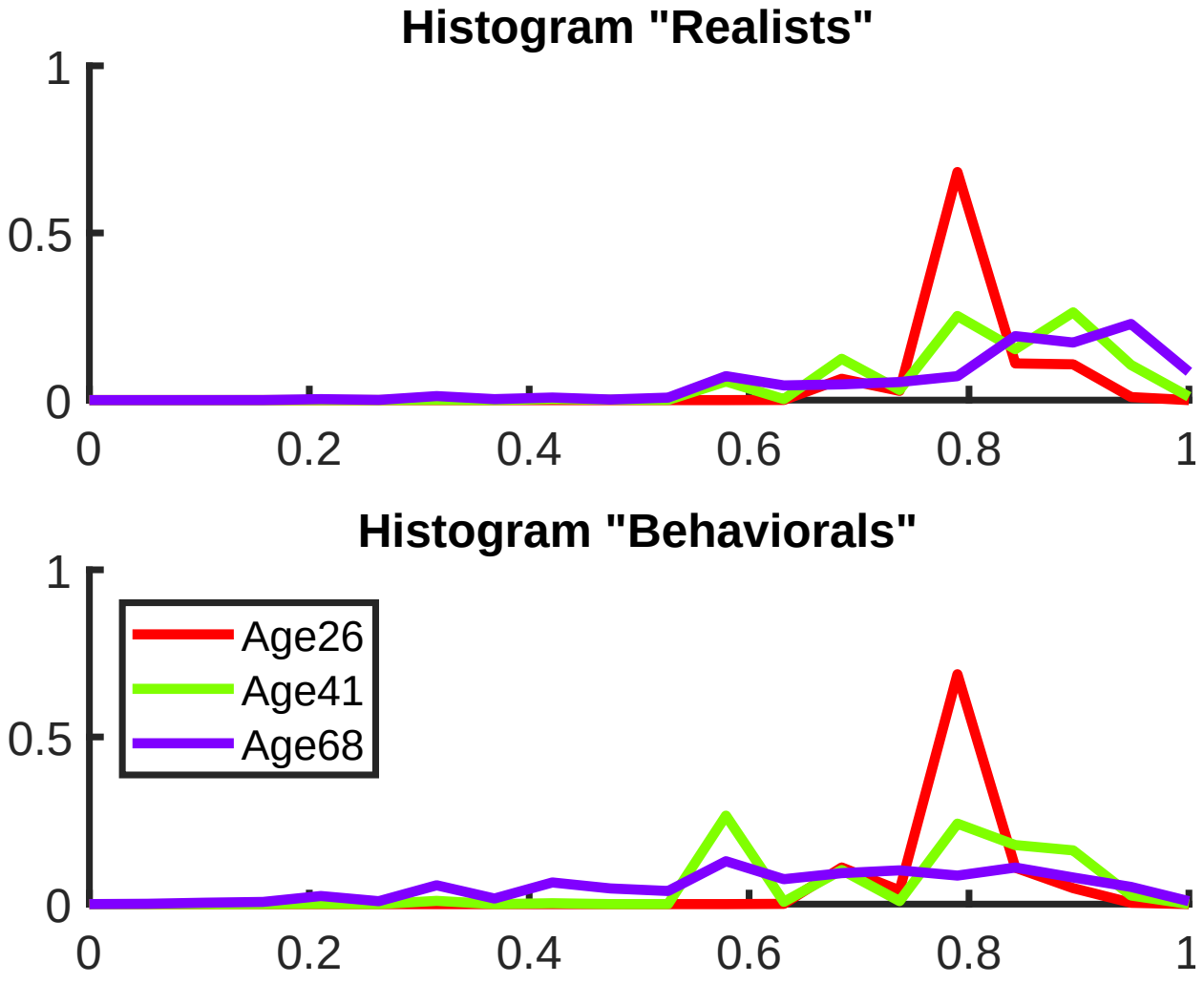
Behavioral vs. Rational Consumers and Effect on Aggregates

Debt-to-income	Rational	9.05%
	Behavioral	13.16%
	Aggregate	9.88%
Filings	Rational	0.79%
	Behavioral	1.11%
	Aggregate	0.86%
Interest Rates	Rational	10.48%
	Behavioral	12.42%
	Aggregate	10.87%
Borrowers	Rational	26.38%
	Behavioral	33.05%
	Aggregate	27.71%

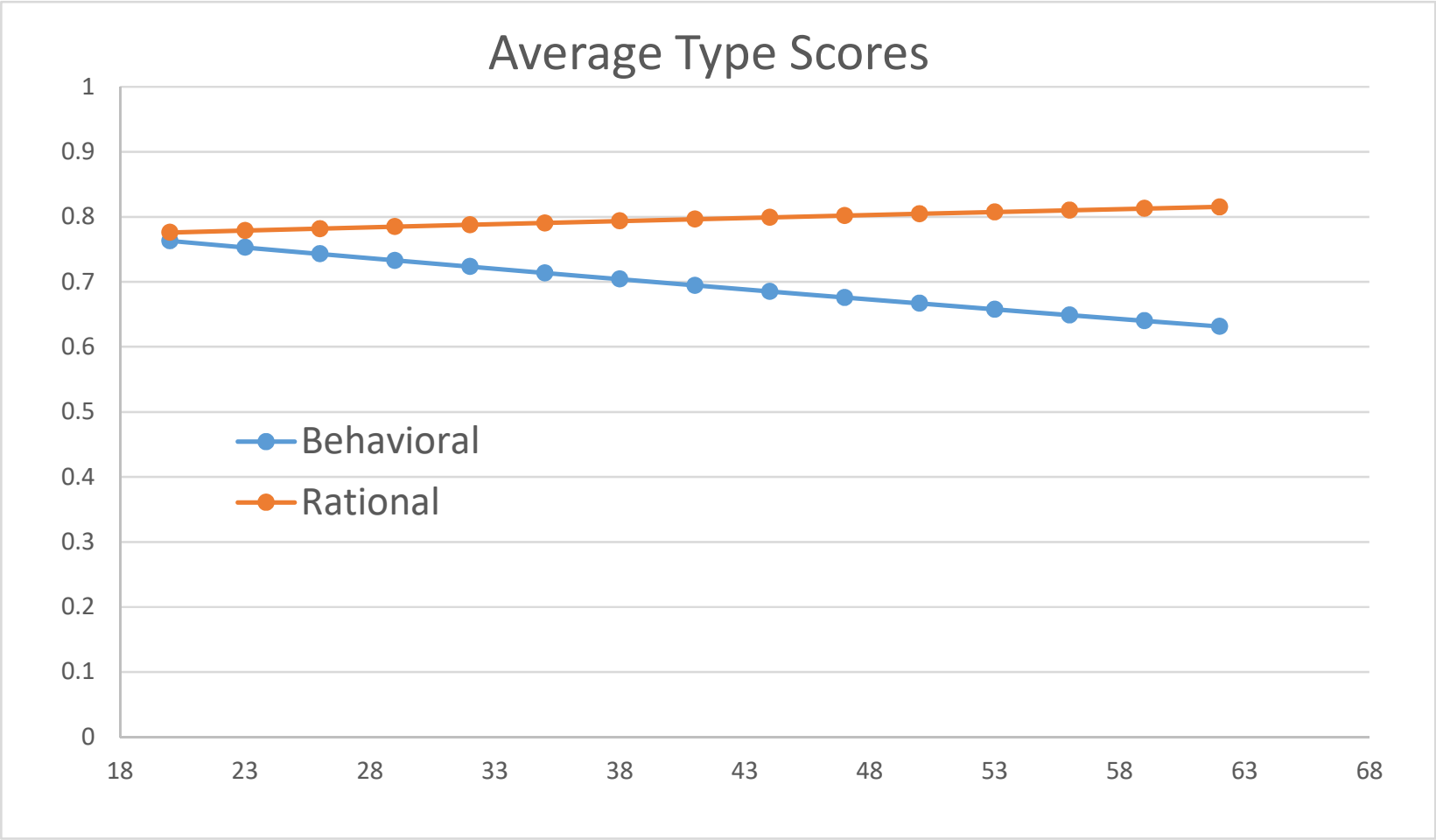
Type Scoring over the Life Cycle – Examples



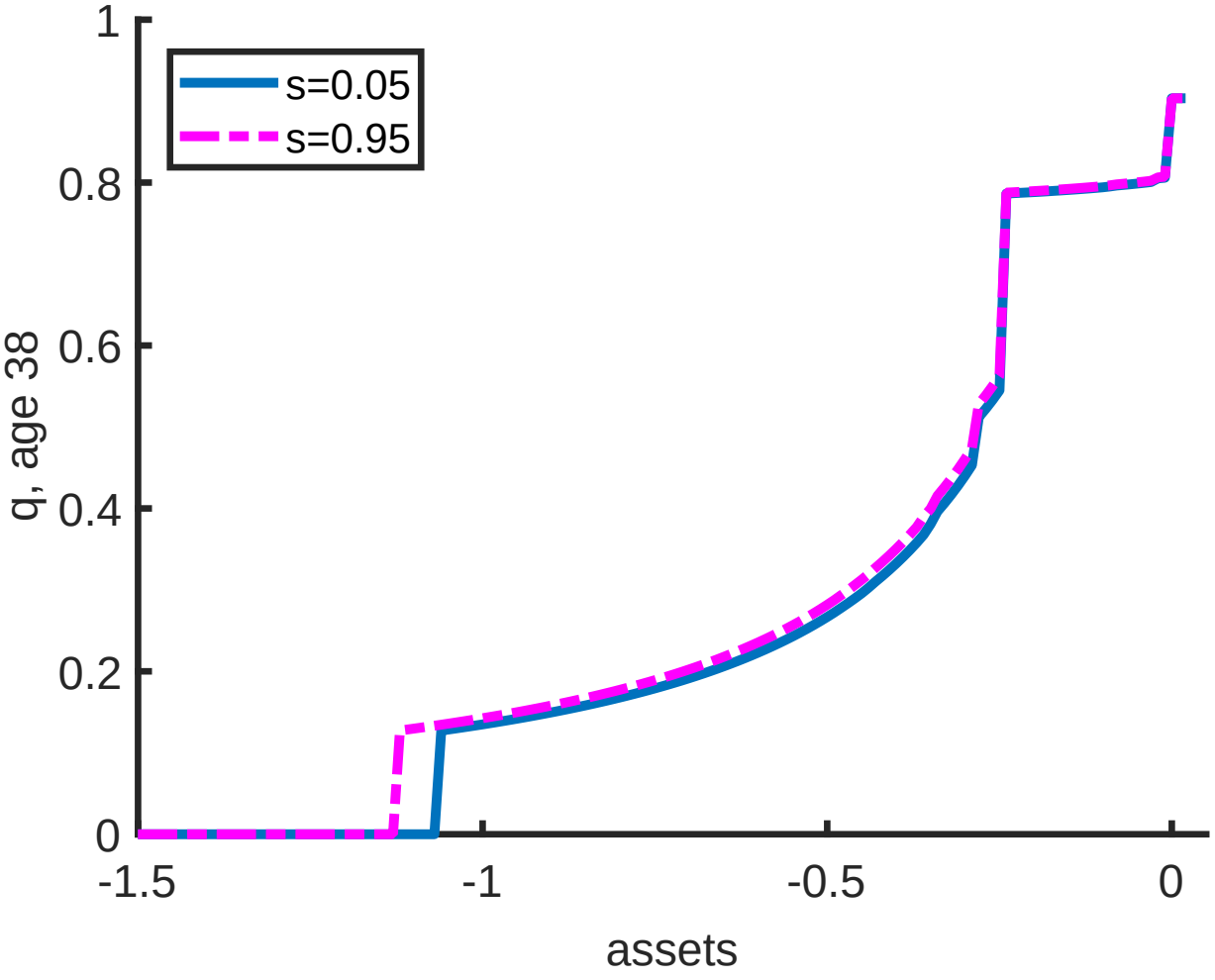
Type Score Distribution



Pooling Declines with Age



Loan Price Schedules by Score



Understanding Over-Optimists

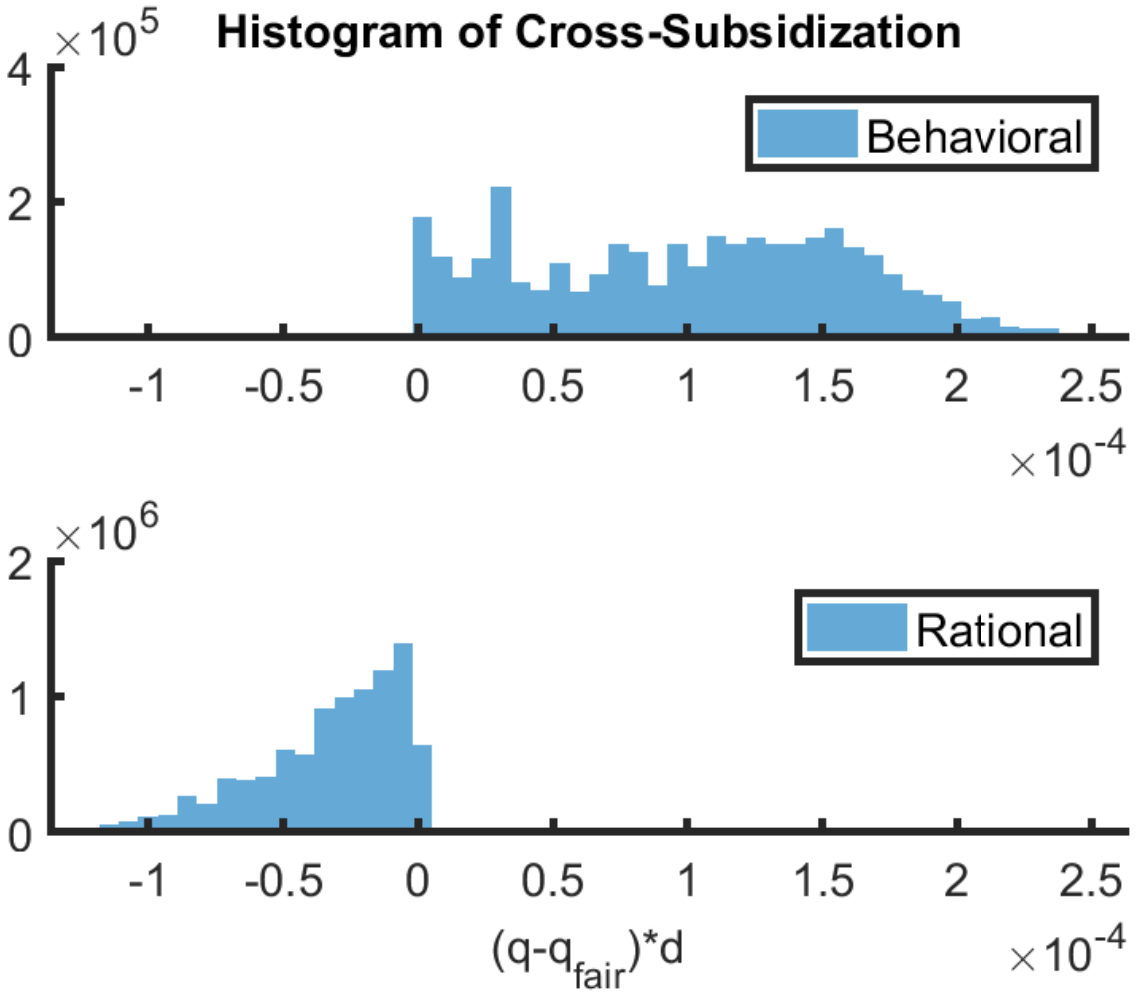
Fundamental Difference: 5.5% lower average income.

	rational low risk (alone)	rational high risk (alone)	over-opt high risk (alone)	over-opt high risk (pooled)
Debt/Earnings	8.4%	8.3%	12.3%	12.3%
Filings	0.85%	0.90%	1.05%	1.13%
Interest Rates	12.93%	13.93%	10.80%	13.46%
Filings per Borrower	3.12%	3.31%	3.07%	3.32%
Total Borrowers	27%	27%	34%	34%
Debt/Earnings of defaulters	287%	298%	270%	304%

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 file enough. An additional 0.94% 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



Policies: What could be done to address these frictions?

1. Behavioral people file too little/late, perhaps default should be made easier.
   $\rightarrow$ we lower garnishment γ
2. Behavioral people over-borrow, perhaps borrowing should be taxed
   $\rightarrow$ increase transaction costs of loans τ (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.
   $\rightarrow$ Financial literacy education (caveat: how to implement this?)

Key: policies also affect cross-subsidization!

1. Lower Default Costs

		$\gamma = 0.2$	BM($\gamma = 0.3$)
Paternalistic Welfare	Rational	-0.092%	
	Behavioral	-0.094%	
Bankruptcy filings	Rational	1.35%	0.82%
	Behavioral	1.93%	1.13%
Interest rates	Rational	16.89%	11.52%
	Behavioral	19.36%	13.46%
Debt-to-income	Rational	5.08%	8.38%
	Behavioral	7.55%	12.28%
Financial Mistakes	Filing too late	1.21%	0.94%
	Overborrowing	24.81%	6.87%

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

		Benchmark	Financial Literacy
Paternalistic Welfare	Rational		0.01%
	Behavioral		-0.16%
Financial Mistakes	Filing too late	0.94%	0
	Overborrowing	6.71%	0
Bankruptcy filings	Rational	0.82%	0.85%
	Behavioral	1.13%	0.90%
Interest rates	Rational	11.52%	12.93%
	Behavioral	13.46%	13.93%
Debt-to-income	Rational	8.38%	8.40%
	Behavioral	12.28%	8.35%

Predatory Lending?

- 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

		Benchmark	1% tax
Paternalistic Welfare	Rational		-0.37%
	Behavioral		-0.38%
Average interest rates	Rational	11.52%	13.87%
	Behavioral	13.46%	16.45%
Debt-to-income	Rational	8.38%	6.99%
	Behavioral	12.28%	10.44%
Bankruptcy filings	Rational	0.82%	0.80%
	Behavioral	1.13%	1.13%