Using Elasticities to Derive Optimal Bankruptcy Exemptions

Eduardo Dávila

Yale and NBER

CEPR Public Economics Annual Symposium 2019
Public Finance: Macro Insights
6/20/2019

Motivation

Question

How large should bankruptcy exemptions be?

- **Exemption**: dollar amount borrower gets to keep after defaulting
- Substantial variation on exemptions across regions/time
- One million US households file for bankruptcy every per year

Motivation

Question

How large should bankruptcy exemptions be?

- **Exemption**: dollar amount borrower gets to keep after defaulting
- Substantial variation on exemptions across regions/time
- One million US households file for bankruptcy every per year

This paper

- **Test** to determine whether to increase or decrease exemptions
  - Knowledge of four variables is sufficient (sufficient statistics)
- **Empirical implementation** for US states
  - Increasing exemption levels improves overall welfare
  - Substantial variation across U.S. states and income quintiles

Outline

1. **Baseline Environment**
   - Main characterization
   - Comparative statics
2. **General Environment**
   - Recursive approach
3. **Empirical Implementation**
4. **Additional Channels**

Outline

1. **Baseline Environment**
   - Main characterization
   - Comparative statics
2. **General Environment**
   - Recursive approach
3. **Empirical Implementation**
4. **Additional Channels**

- Existing work
  - GE with Incomplete Markets (DGS05)
  - Structural/Macro (CCNR07 and LMT06)
  - Reduced Form Work (many papers)

Baseline Environment

- Two dates $t = 0, 1$

Baseline Environment

- Two dates $t = 0, 1$
- **Risk averse borrower**

$$W(m) = \max_{b_1} u(c_0) + \beta \mathbb{E}\left[\max\left\{u\left(c_1^{\mathcal{N}}(s)\right), u\left(c_1^{\mathcal{D}}(s)\right)\right\}\right]$$

Baseline Environment

- Two dates $t = 0, 1$
- **Risk averse borrower**

$$W(m) = \max_{b_1} u(c_0) + \beta \mathbb{E}\left[\max\left\{u\left(c_1^{\mathcal{N}}(s)\right), u\left(c_1^{\mathcal{D}}(s)\right)\right\}\right]$$

- Budget constraints

$$c_0 = n_0 + \overbrace{Q_0(b_1, m)}^{q_0(b_1,m)b_1} \qquad \begin{aligned} c_1^{\mathcal{N}}(s) &= n(s) - b_1 \\ c_1^{\mathcal{D}}(s) &= \min\{n(s), m\} \end{aligned}$$

Baseline Environment

- Two dates $t = 0, 1$
- **Risk averse borrower**

$$W(m) = \max_{b_1} u(c_0) + \beta \mathbb{E}\left[\max\left\{u\left(c_1^{\mathcal{N}}(s)\right), u\left(c_1^{\mathcal{D}}(s)\right)\right\}\right]$$

- Budget constraints

$$c_0 = n_0 + \overbrace{Q_0(b_1, m)}^{q_0(b_1,m)b_1} \qquad \begin{array}{l} c_1^{\mathcal{N}}(s) = n(s) - b_1 \\ c_1^{\mathcal{D}}(s) = \min\{n(s), m\} \end{array}$$

- **Risk neutral competitive lenders** $\Rightarrow$ zero profit

$$Q_0(b_1, m) = \frac{\delta \int_{\mathcal{D}} \max\{n(s) - m, 0\} dF(s) + b_1 \int_{\mathcal{N}} dF(s)}{1 + r^{\ell}}$$

Baseline Environment

- Two dates $t = 0, 1$
- **Risk averse borrower**

$$W(m) = \max_{b_1} u(c_0) + \beta \mathbb{E}\left[\max\left\{u\left(c_1^{\mathcal{N}}(s)\right), u\left(c_1^{\mathcal{D}}(s)\right)\right\}\right]$$

- Budget constraints

$$c_0 = n_0 + \overbrace{Q_0(b_1, m)}^{q_0(b_1,m)b_1} \qquad \begin{aligned} c_1^{\mathcal{N}}(s) &= n(s) - b_1 \\ c_1^{\mathcal{D}}(s) &= \min\{n(s), m\} \end{aligned}$$

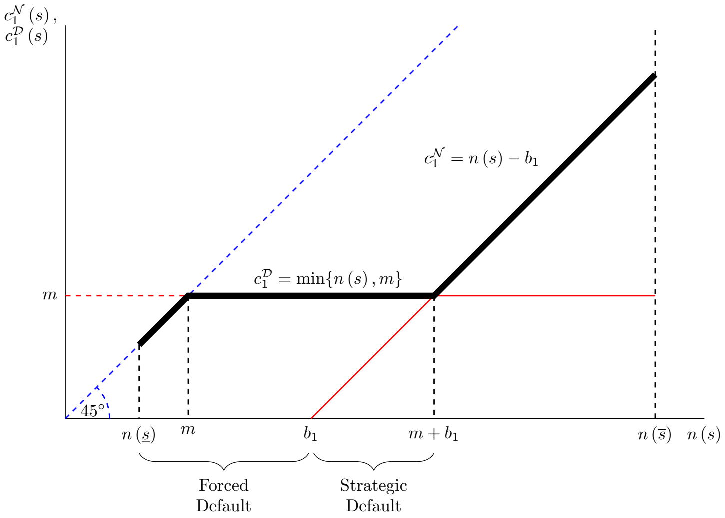
- **Risk neutral competitive lenders** $\Rightarrow$ zero profit

$$Q_0(b_1, m) = \frac{\delta \int_{\mathcal{D}} \max\{n(s) - m, 0\}\, dF(s) + b_1 \int_{\mathcal{N}} dF(s)}{1 + r^{\ell}}$$

- Remarks
  - Stochastic endowment $n(s)$
  - Fixed repayment debt b_1 (contract as primitive, GEI)
  - Constant exemption m
  - Regularity conditions to guarantee $b_1 > 0$
  - *Equilibrium notion*: borrowers internalize $Q_0(b_1, m)$

Borrower's Problem

- Two economic decisions
  - Default (given b_1)
  - Borrowing b_1



Borrower's Problem

- Two economic decisions
  - Default (given b_1)
  - Borrowing b_1

$$u'(c_0)\frac{\partial Q_0}{\partial b_1} = \beta \int_{\hat{s}}^{\bar{s}} u'\left(c_1^{\mathcal{N}}(s)\right) dF(s)$$

Borrower's Problem

- Two economic decisions
  - Default (given b_1)
  - Borrowing b_1

$$u'(c_0)\frac{\partial Q_0}{\partial b_1} = \beta \int_{\hat{s}}^{\bar{s}} u'\left(c_1^{\mathcal{N}}(s)\right) dF(s)$$

- Sign of $\frac{db_1}{dm}$ ambiguous

$$\text{sign}\left(\frac{db_1}{dm}\right) = \text{sign}\left(\underbrace{u''(c_0)\frac{\partial Q_0}{\partial m}\frac{\partial Q_0}{\partial b_1}}_{\text{Income effect } (>0)} + \underbrace{u'(c_0)\frac{\partial^2 Q_0}{\partial b_1 \partial m}}_{\text{Substitution effect } (<0)} + \underbrace{\beta u'(m) f(m)}_{\text{Direct effect } (>0)}\right)$$

Main Results

- Social welfare $W(m)$ is given by borrowers indirect utility

Directional test for a change in the exemption level m

The welfare change induced by a marginal change in the bankruptcy exemption m is given by:

$$\frac{dW}{dm} = u'\left(c_0\right)\frac{\partial q_0}{\partial m}b_1 + \beta \int_{\tilde{s}}^{\hat{s}} u'\left(c_1^{\mathcal{D}}\left(s\right)\right) dF\left(s\right)$$

- Marginal cost: change in interest rate
- Marginal benefit: appropriately valued cash flow

Main Results

- Social welfare $W(m)$ is given by borrowers indirect utility

Directional test for a change in the exemption level m

The welfare change induced by a marginal change in the bankruptcy exemption m is given by:

$$\frac{\frac{dW}{dm}}{u'(c_0)} = \frac{\partial q_0}{\partial m} b_1 + \pi_m \mathbb{E}_m \left[\frac{\beta u'\left(c_1^{\mathcal{D}}\right)}{u'(c_0)} \right]$$

- Marginal cost: change in interest rate
- Marginal benefit: appropriately valued cash flow

Main Results

- Social welfare $W(m)$ is given by borrowers indirect utility

Directional test for a change in the exemption level m

The welfare change induced by a marginal change in the bankruptcy exemption m is given by:

$$\frac{\frac{dW}{dm}}{u'(c_0)} = \frac{\partial q_0}{\partial m} b_1 + \pi_m \mathbb{E}_m \left[\frac{\beta u'\left(c_1^{\mathcal{D}}\right)}{u'(c_0)} \right]$$

- Marginal cost: change in interest rate
- Marginal benefit: appropriately valued cash flow
- Key insight: borrowing and default decisions are optimal
  - Logic extends
- Note that $\frac{\partial q_0}{\partial m}$ is partial, not total derivative

Main Results

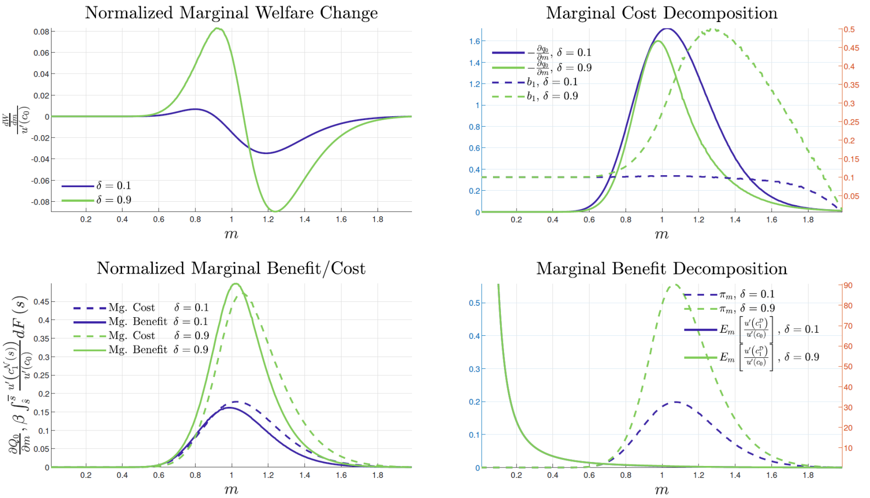
Sufficient statistics

1. Debt position, b_1
2. Credit supply sensitivity to a change in the exemption level, $\frac{\partial q_0}{\partial m}$
3. Probability of filing for bankruptcy while claiming the full exemption, π_m
4. Expected value of a exemption dollar when claimed $\mathbb{E}_m\left[\frac{\beta u'\left(c_1^{\mathcal{D}}\right)}{u'(c_0)}\right]$

- Possible to construct measurable counterparts

Numerical Simulation: Comparative Statics

- Compare default DWL $\delta = 0.1$ and $\delta = 0.9$



General Environment

- $t = 0, 1, \ldots, T$
- $i = 1, \ldots, |I|$ different types of households in the economy

General Environment

- $t = 0, 1, \ldots, T$
- $i = 1, \ldots, |I|$ different types of households in the economy
- Set J of assets, indexed by $j = 1, \ldots, |J|$
- Set K of contracts, indexed by $k = 1, \ldots |K|$

General Environment

- $t = 0, 1, \ldots, T$
- $i = 1, \ldots, |I|$ different types of households in the economy
- Set J of assets, indexed by $j = 1, \ldots, |J|$
- Set K of contracts, indexed by $k = 1, \ldots |K|$
- State variables for type i household $\Psi_i = \{\boldsymbol{a}_i, \boldsymbol{b}_i, \boldsymbol{x}_i\}$
  - $\boldsymbol{a}_i$ denotes a $|J| \times 1$ vector of assets
  - $\boldsymbol{b}_i$ denotes a $|K| \times 1$ vector of liabilities
  - $\boldsymbol{x}_i$ denotes a vector of other endogenous non-financial state variables (bankruptcy indicator, human capital, etc.)

General Environment

- $t = 0, 1, \ldots, T$
- $i = 1, \ldots, |I|$ different types of households in the economy
- Set J of assets, indexed by $j = 1, \ldots, |J|$
- Set K of contracts, indexed by $k = 1, \ldots |K|$
- State variables for type i household $\Psi_i = \{\boldsymbol{a}_i, \boldsymbol{b}_i, \boldsymbol{x}_i\}$
  - $\boldsymbol{a}_i$ denotes a $|J| \times 1$ vector of assets
  - $\boldsymbol{b}_i$ denotes a $|K| \times 1$ vector of liabilities
  - $\boldsymbol{x}_i$ denotes a vector of other endogenous non-financial state variables (bankruptcy indicator, human capital, etc.)
- Endogenous and exogenous states denoted by $\Omega_i = \{\Psi_i, \boldsymbol{s}_i\}$
- Utility $u_{i,t}\left(c_{i,t}, h_{i,t}; \Omega_i\right)$

General Environment

- Value function when deciding

$$V_{i,t}\left(\Omega_i; m\right) = \max\left\{V_{i,t}^{\mathcal{D}}\left(\Omega_i; m\right), V_{i,t}^{\mathcal{N}}\left(\Omega_i; m\right)\right\}$$

General Environment

- Value function when deciding

$$V_{i,t}\left(\Omega_i;m\right)=\max\left\{V^{\mathcal{D}}_{i,t}\left(\Omega_i;m\right),V^{\mathcal{N}}_{i,t}\left(\Omega_i;m\right)\right\}$$

- Value function repaying

$$V^{\mathcal{N}}_{i,t}\left(\Omega_i;m\right)=\max u_{i,t}\left(c_{i,t},h_{i,t};\Omega_i\right)+\beta_i\mathbb{E}_t\left[V_{i,t+1}\left(\Omega_i';m\right)\right]$$

subject to

$$\sum_j a^j_{i,t+1}+c_{i,t}=y_{i,t}\left(\boldsymbol{x}_i,\boldsymbol{s}_i\right)+w_{i,t}\left(\boldsymbol{x}_i,\boldsymbol{s}_i\right)h_{i,t}+\sum_j z_j\left(\boldsymbol{s}_i\right)a^j_{i,t}-\sum_k z_k\left(\boldsymbol{s}_i\right)b^k_{i,t}+\sum_k q^k_{i,t}\left(\Psi_i',\Omega_i,m\right)b^k_{i,t+1}$$

General Environment

- Value function when deciding

$$V_{i,t}\left(\Omega_i;m\right)=\max\left\{V^{\mathcal{D}}_{i,t}\left(\Omega_i;m\right),V^{\mathcal{N}}_{i,t}\left(\Omega_i;m\right)\right\}$$

- Value function repaying

$$V^{\mathcal{N}}_{i,t}\left(\Omega_i;m\right)=\max u_{i,t}\left(c_{i,t},h_{i,t};\Omega_i\right)+\beta_i\mathbb{E}_t\left[V_{i,t+1}\left(\Omega_i';m\right)\right]$$

subject to

$$\sum_j a^j_{i,t+1}+c_{i,t}=y_{i,t}\left(\boldsymbol{x}_i,\boldsymbol{s}_i\right)+w_{i,t}\left(\boldsymbol{x}_i,\boldsymbol{s}_i\right)h_{i,t}+\sum_j z_j\left(\boldsymbol{s}_i\right)a^j_{i,t}-\sum_k z_k\left(\boldsymbol{s}_i\right)b^k_{i,t}+\sum_k q^k_{i,t}\left(\Psi_i',\Omega_i,m\right)b^k_{i,t+1}$$

- Value function filing for bankruptcy

$$V^{\mathcal{D}}_{i,t}\left(\Omega_i;m\right)=\max u_{i,t}\left(c_{i,t},h_{i,t};\Omega_i\right)+\beta_i\mathbb{E}_t\left[V^{\mathcal{N}}_{i,t+1}\left(\Omega_i';m\right)\right]$$

subject to

$$\sum_j a^j_{i,t+1}+c_{i,t}=\mathcal{W}\left(m;\boldsymbol{a}_i,\boldsymbol{x}_i,\boldsymbol{s}_i\right)-f\left(\Omega_i\right)$$

- $\mathcal{W}\left(m;\cdot\right)=\min\left\{m,\circ\right\}$ and $f\left(\Omega_i\right)\geq 0$ models a filing fee

General Environment

- The function $\mathcal{W}(\cdot)$ models alternative penalties/bankruptcy systems:

$$\mathcal{W}(m; \boldsymbol{a}_i, \boldsymbol{x}_i, \boldsymbol{s}_i) = \min\left\{m, \max\{y_{i,t}(\boldsymbol{x}_i, \boldsymbol{s}_i), 0\} + w_{i,t}(\boldsymbol{x}_i, \boldsymbol{s}_i) h_{i,t} + \sum_{j=1}^{J} z_j(\boldsymbol{s}_i) a_i^j\right\} \tag{Wildcard}$$

$$\mathcal{W}(m; \boldsymbol{a}_i, \boldsymbol{x}_i, \boldsymbol{s}_i) = \min\left\{m, z_1(\boldsymbol{s}_i) a_i^1\right\}. \tag{Homestead}$$

General Environment

- The function $\mathcal{W}(\cdot)$ models alternative penalties/bankruptcy systems:

$$\mathcal{W}(m; \boldsymbol{a}_i, \boldsymbol{x}_i, \boldsymbol{s}_i) = \min\left\{m, \max\{y_{i,t}(\boldsymbol{x}_i, \boldsymbol{s}_i), 0\} + w_{i,t}(\boldsymbol{x}_i, \boldsymbol{s}_i) h_{i,t} + \sum_{j=1}^{J} z_j(\boldsymbol{s}_i) a_i^j\right\} \quad \text{(Wildcard)}$$

$$\mathcal{W}(m; \boldsymbol{a}_i, \boldsymbol{x}_i, \boldsymbol{s}_i) = \min\left\{m, z_1(\boldsymbol{s}_i) a_i^1\right\}. \quad \text{(Homestead)}$$

- Lenders'

$$\sum_k q_{i,t}^k(\Psi_i', \Omega_i, m) b_{i,t+1}^k = \frac{\delta \int_{\mathcal{D}_{t+1}} \mathcal{W}^{\mathcal{L}}(m; \boldsymbol{a}_i', \boldsymbol{x}_i', \boldsymbol{s}_i') dF(\boldsymbol{s}_i' | \Omega_i) + \int_{\mathcal{N}_{t+1}} \sum_k z_k(\boldsymbol{s}_i') b_{i,t}^k dF(\boldsymbol{s}_i' | \Omega_i)}{1 + r^{\ell}}$$

- Lenders can condition credit supply on future state variables Ψ_i'
- Credit supply cannot depend on the other households' actions

Main Result: General Model

Directional test for a change in the exemption level m

Denote by $W_{i,\tau} = V^{\mathcal{N}}_{i,\tau}(\Omega_i; m)$ the value function of a given household i that has not declared bankruptcy in period t. Then

$$\frac{dW_{i,\tau}}{dm} = \sum_{t=\tau}^{T} \beta_i^{t-\tau} \pi^{\mathcal{N}}_{\tau,t} \mathbb{E}^{\mathcal{N}}_{\tau} \left[\frac{\partial u_{i,t}}{\partial c_{i,t}} \frac{\partial \sum_k q^k_{i,t} b^k_{i,t+1}}{\partial m} \right] + \sum_{t=\tau}^{T} \beta_i^{t-\tau+1} \pi^{\mathcal{D}}_{\tau,t+1} \mathbb{E}^{\mathcal{D}}_{\tau} \left[\frac{\partial u_{i,t+1}}{\partial c_{i,t+1}} \frac{\partial \mathcal{W}_{t+1}}{\partial m} \right]$$

- Extends the results of the baseline model
  - Same sufficient statistics
- Sequence formulation

Remarks

- *General Preferences*
- *General Income Dynamics*
- *Forced vs. Strategic Default*
- *Informal Default/Renegotiation*
- *Chapter 7 vs. Chapter 13*
- *Filing Fees*
- *Contract Selection*
- *Interpretation of Planning Problem*

Theory and Measurement

Empirical Implementation: Recursive Formulation

The $S \times 1$ vector of normalized welfare changes in an ergodic steady state for households that transition between S possible states

$$\frac{d\hat{W}}{dm} = \left(\frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^1)}{u'(c(\Omega^1))}, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^2)}{u'(c(\Omega^2))}, \quad \ldots, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^S)}{u'(c(\Omega^S))} \right)'$$

is given by

$$\frac{d\hat{W}}{dm} = A^{-1}F,$$

where $F_{S\times 1}$ and $A_{S\times S}$ are given by

$$F = Q_m + \beta \text{diag}\left(\Pi_{\mathcal{N}\to m} \times G'_{\mathcal{N}\to m}\right)$$
$$A = \mathbb{I}_S - \beta\left(\Pi_{\mathcal{N}\to\mathcal{N}} \odot G_{\mathcal{N}\to\mathcal{N}}\right) - \beta^2\left(\Pi_{\mathcal{N}\to\mathcal{D}} \odot G_{\mathcal{N}\to\mathcal{D}}\right) \times \left(\Pi_{\mathcal{D}\to\mathcal{N}} \odot G_{\mathcal{D}\to\mathcal{N}}\right)$$

Theory and Measurement

Empirical Implementation: Recursive Formulation

The $S \times 1$ vector of normalized welfare changes in an ergodic steady state for households that transition between S possible states

$$\frac{d\hat{W}}{dm} = \left(\frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^1)}{u'(c(\Omega^1))}, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^2)}{u'(c(\Omega^2))}, \quad \dots, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^S)}{u'(c(\Omega^S))} \right)'$$

is given by

$$\frac{d\hat{W}}{dm} = A^{-1}F,$$

where $F_{S\times 1}$ and $A_{S\times S}$ are given by

$$F = Q_m + \beta \text{diag}\left(\Pi_{\mathcal{N}\to m} \times G'_{\mathcal{N}\to m}\right)$$
$$A = \mathbb{I}_S - \beta\left(\Pi_{\mathcal{N}\to\mathcal{N}} \odot G_{\mathcal{N}\to\mathcal{N}}\right) - \beta^2\left(\Pi_{\mathcal{N}\to\mathcal{D}} \odot G_{\mathcal{N}\to\mathcal{D}}\right) \times \left(\Pi_{\mathcal{D}\to\mathcal{N}} \odot G_{\mathcal{D}\to\mathcal{N}}\right)$$

- $Q_m = \left(\frac{\partial Q}{\partial m}(\Omega^1), \frac{\partial Q}{\partial m}(\Omega^2), \dots, \frac{\partial Q}{\partial m}(\Omega^S)\right)'$ defines interest rate impact
- $\{\Pi_{\mathcal{N}\to\mathcal{N}}, \Pi_{\mathcal{N}\to\mathcal{D}}, \Pi_{\mathcal{D}\to\mathcal{N}}, \Pi_{\mathcal{N}\to m}\}$ define transition matrices
- $\{G_{\mathcal{N}\to\mathcal{N}}, G_{\mathcal{N}\to\mathcal{D}}, G_{\mathcal{D}\to\mathcal{N}}, G_{\mathcal{N}\to m}\}$ define valuation matrices

Theory and Measurement

Empirical Implementation: Recursive Formulation

The $S \times 1$ vector of normalized welfare changes in an ergodic steady state for households that transition between S possible states

$$\frac{d\hat{W}}{dm} = \left(\frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^1)}{u'(c(\Omega^1))}, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^2)}{u'(c(\Omega^2))}, \quad \ldots, \quad \frac{\frac{dV^{\mathcal{N}}}{dm}(\Omega^S)}{u'(c(\Omega^S))} \right)'$$

is given by

$$\frac{d\hat{W}}{dm} = A^{-1}F,$$

where $F_{S\times 1}$ and $A_{S\times S}$ are given by

$$F = Q_m + \beta \text{diag}\left(\Pi_{\mathcal{N}\to m} \times G'_{\mathcal{N}\to m}\right)$$
$$A = \mathbb{I}_S - \beta\left(\Pi_{\mathcal{N}\to\mathcal{N}} \odot G_{\mathcal{N}\to\mathcal{N}}\right) - \beta^2\left(\Pi_{\mathcal{N}\to\mathcal{D}} \odot G_{\mathcal{N}\to\mathcal{D}}\right) \times \left(\Pi_{\mathcal{D}\to\mathcal{N}} \odot G_{\mathcal{D}\to\mathcal{N}}\right)$$

- $Q_m = \left(\frac{\partial Q}{\partial m}(\Omega^1), \frac{\partial Q}{\partial m}(\Omega^2), \ldots, \frac{\partial Q}{\partial m}(\Omega^S)\right)'$ defines interest rate impact
- $\{\Pi_{\mathcal{N}\to\mathcal{N}}, \Pi_{\mathcal{N}\to\mathcal{D}}, \Pi_{\mathcal{D}\to\mathcal{N}}, \Pi_{\mathcal{N}\to m}\}$ define transition matrices
- $\{G_{\mathcal{N}\to\mathcal{N}}, G_{\mathcal{N}\to\mathcal{D}}, G_{\mathcal{D}\to\mathcal{N}}, G_{\mathcal{N}\to m}\}$ define valuation matrices
- **Key Idea**: Measure in the cross-section, combine with laws of motions

Measurement

- A period in the model maps to three-year period in the data (2008-2016)
- Income as the single state variable, classifying households by income quintiles in each state
- $\beta = (0.94)^3$ and $\gamma = 2$ as baseline parameters
- We need to recover A and F

Measurement

- A period in the model maps to three-year period in the data (2008-2016)
- Income as the single state variable, classifying households by income quintiles in each state
- $\beta = (0.94)^3$ and $\gamma = 2$ as baseline parameters
- We need to recover A and F

Table: Empirical Counterparts

Measured Variable	Data Source	Maps Into
Interest-Rate Sensitivity	RateWatch, Exemptions Dataset, Regional Controls (ACS/BLS/FHFA)	Q_m
Households' Liabilities	PSID	Q_m
Households' Expenditure	PSID	G
Income Transition Matrix	PSID	Π
Prob. of Bankruptcy	ID-FJC	$\Pi_{\mathcal{N}\to m}$, $\Pi_{\mathcal{N}\to\mathcal{D}}$
Prob. of No-Asset Bankruptcy	ID-FJC	$\Pi_{\mathcal{N}\to m}$

Measurement

1. Most variables are simply measured
   - Default probabilities
   - Income transition matrices
   - Liabilities and consumption expenditure
2. Credit supply sensitivity estimated via R1
   - Bank and time fixed-effects

$$\log\left(1 + r_{it}\right) = \alpha_i + \alpha_t + \psi m_{st} + \theta X_{st} + \varepsilon_{ist}, \qquad \text{(R1)}$$

Measurement

1. Most variables are simply measured
   - Default probabilities
   - Income transition matrices
   - Liabilities and consumption expenditure
2. Credit supply sensitivity estimated via R1
   - Bank and time fixed-effects

$$\log(1 + r_{it}) = \alpha_i + \alpha_t + \psi m_{st} + \theta X_{st} + \varepsilon_{ist}, \tag{R1}$$

- Same elasticity for all states/groups (main limitation)
- Low estimate: increasing the homestead bankruptcy exemption by $\$100k$ is associated with an increase in the interest rate charged on unsecured credit of roughly 7 basis points
- Every other variable varies by state/income quintile

Measurement: Main Findings

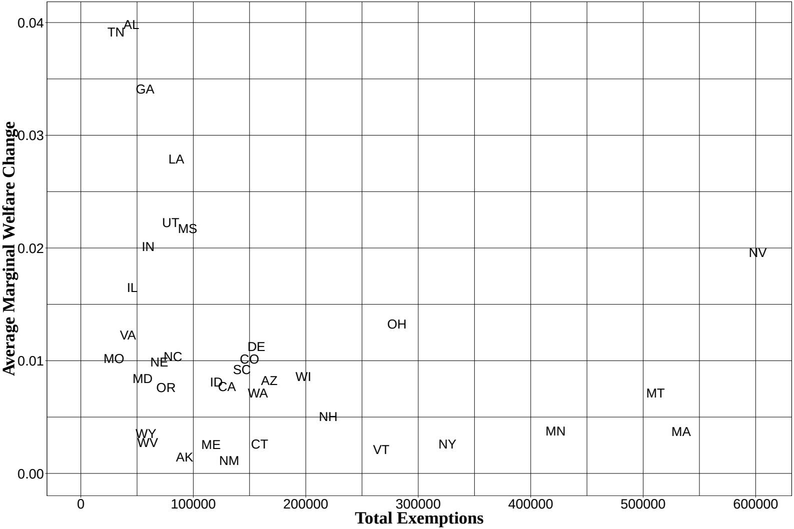


Figure: Average Marginal Welfare Changes and Exemption Levels

Measurement: Main Findings

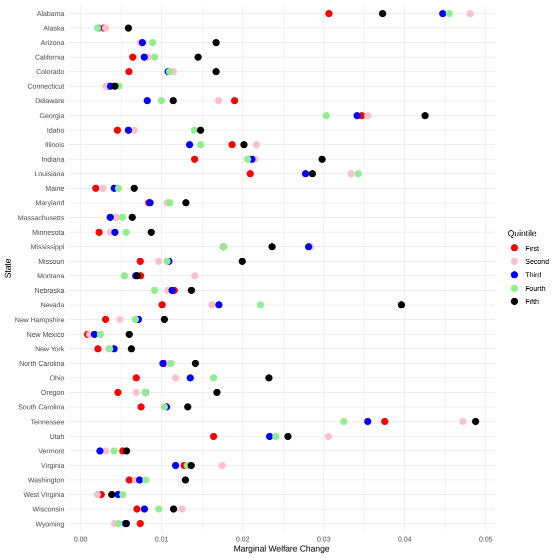


Figure: Marginal Welfare Changes by Income Quintile and State

Measurement: Explanation

1. Overall positive gains: low value of interest rate sensitivity

Measurement: Explanation

1. Overall positive gains: low value of interest rate sensitivity
2. Southern states (TN, AL, GA, etc):
   - high default rates
   - high level of asset bankruptcies
   - higher income risk (less important, similar findings with $\gamma \to 0$)

Measurement: Explanation

1. Overall positive gains: low value of interest rate sensitivity
2. Southern states (TN, AL, GA, etc):
   - high default rates
   - high level of asset bankruptcies
   - higher income risk (less important, similar findings with $\gamma \to 0$)
3. Magnitude: up to 4 cents on the dollar

Additional Channels

- Belief distortions

$$\frac{dW}{dm} = u'(c_0)\frac{\partial q_0}{\partial m} b_1 + \beta \int_{\tilde{s}}^{\hat{s}} u'\left(c_1^{\mathcal{D}}(s)\right) dF(s)$$
$$+ \underbrace{\beta\left(\int_{\hat{s}}^{\bar{s}} u'\left(c_1^{\mathcal{N}}(s)\right) dF(s) - \int_{\hat{s}}^{\bar{s}} u'\left(c_1^{\mathcal{N}}(s)\right) dF^i(s)\right)}_{\text{Households' Belief Distortion}} \frac{db_1}{dm}$$

- Lender's market power

$$W^\ell = \Pi^\ell(b_1, m) = \frac{\delta \int_{\mathcal{D}} \max\{n(s) - m, 0\} dF(s) + b_1 \int_{\mathcal{N}} dF(s)}{1 + r^\ell} - Q_0(b_1, m)$$

$$\frac{\frac{dW}{dm}}{u'(c_0)} + \frac{dW^\ell}{dm} = \frac{\partial q_0}{\partial m} b_1 + \pi_m \mathbb{E}_m\left[\frac{\beta u'\left(c_1^{\mathcal{D}}\right)}{u'(c_0)}\right] + \underbrace{\frac{d\Pi^\ell}{dm}}_{\substack{\text{Change in} \\ \text{Lenders' Profit}}}$$

Additional channels

- General equilibrium externalities

$$\frac{dW}{dm} = u'(c_0)\frac{\partial q_0}{\partial m}b_1 + \beta\int_{\mathcal{D}_m} u'\left(c_1^{\mathcal{D}}(s)\right)dF(s)$$
$$\underbrace{+\,u'(c_0)\frac{dp_0}{dm}(a_1 - a_0) + \beta\int_{\mathcal{D}_y} u'\left(c_1^{\mathcal{D}}(s)\right)\frac{dp_1}{dm}a_1 dF(s) + \beta\int_{\mathcal{N}} u'\left(c_1^{\mathcal{N}}(s)\right)\frac{dp_1}{dm}a_1 dF(s)}_{\text{Pecuniary Effects}},$$

- Other extensions in the paper
  - Long-term debt
  - Pooling and exclusion
  - Non-expected utility
  - Aggregate demand effects
  - Price-taking households

Conclusion

- This paper has shown how to optimally adjust bankruptcy exemptions
  - Identified and measured sufficient statistics
  - Recursive approach allows to account for dynamics (may be useful in other contexts)
  - Higher exemptions appear to be optimal
- Going forward
  - Improved measures of interest rate sensitivities are key

Extra Slides

Equilibrium definition: Given an exemption level m, an *equilibrium* is defined as a set of consumption, $c_{i,t}(\Omega_i; m)$, hours worked, $h_{i,t}(\Omega_i; m)$, assets, $\boldsymbol{a}_{i,t}(\Omega_i; m)$, liabilities, $\boldsymbol{b}_{i,t}(\Omega_i; m)$, other endogenous choices, $\boldsymbol{x}_{i,t}(\Omega_i; m)$, default decisions, and credit supply schedules $q^k_{i,t}\left(\Psi'_i, \Omega_i, m\right)$, $\forall k$, for each household i such that i) households make optimal decisions, internalizing the credit supply schedules, and ii) credit supply schedules offered by lenders satisfy a zero-profit condition.