Increasing Borrowing Costs and the Equity Premium

Jasmina Hasanhodzic

Boston University

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Equity Premium Puzzle

- Equity premium: difference between the mean return on equity and the return on a safe asset

- Data: equity premium = 6%, risk-free rate = 1%

- Mehra and Prescott ('85):

  In standard representative-agent models

  equity premium = 0.35%, risk-free rate = 4%

Some Attempts to "Resolve" the Puzzle

- Alternative preferences: Epstein and Zin ('91), Abel ('90), Ju and Miao ('12), Liu and Miao ('14), …
- Alternative shocks: Rietz ('88), Barro ('06), ...
- Behavioral: Barberis, Huang, and Santos ('01), …
- Hard borrowing constraints only on the young: Constantinides, Donaldson, and Mehra ('02)
  - 3-period OLG, partial equilibrium, pure exchange
  - suggest result would hold in more realistic models

Outline

- My contribution
  - The model
- Solving the model
- Results

Soft Borrowing Constraints

- Soft, but rising borrowing costs seem more realistic than hard constraints

- Empirical evidence (Scott, '96):
  - consumers can always borrow more, but at ever higher interest rates

- Theoretical predictions (Milde and Riley, '88; Chatterjee, Corbae, Nakajima, and Rios-Rull, '07):
  - interest rates increase with the size of the loan

Main Results

- Soft borrowing costs which increase in the loan size in a standard overlapping generations model produce a sizable equity premium

- Borrowing costs on all generations are needed

  Counters Constantinides, Donaldson, & Mehra ('02)

Average Equity Premium

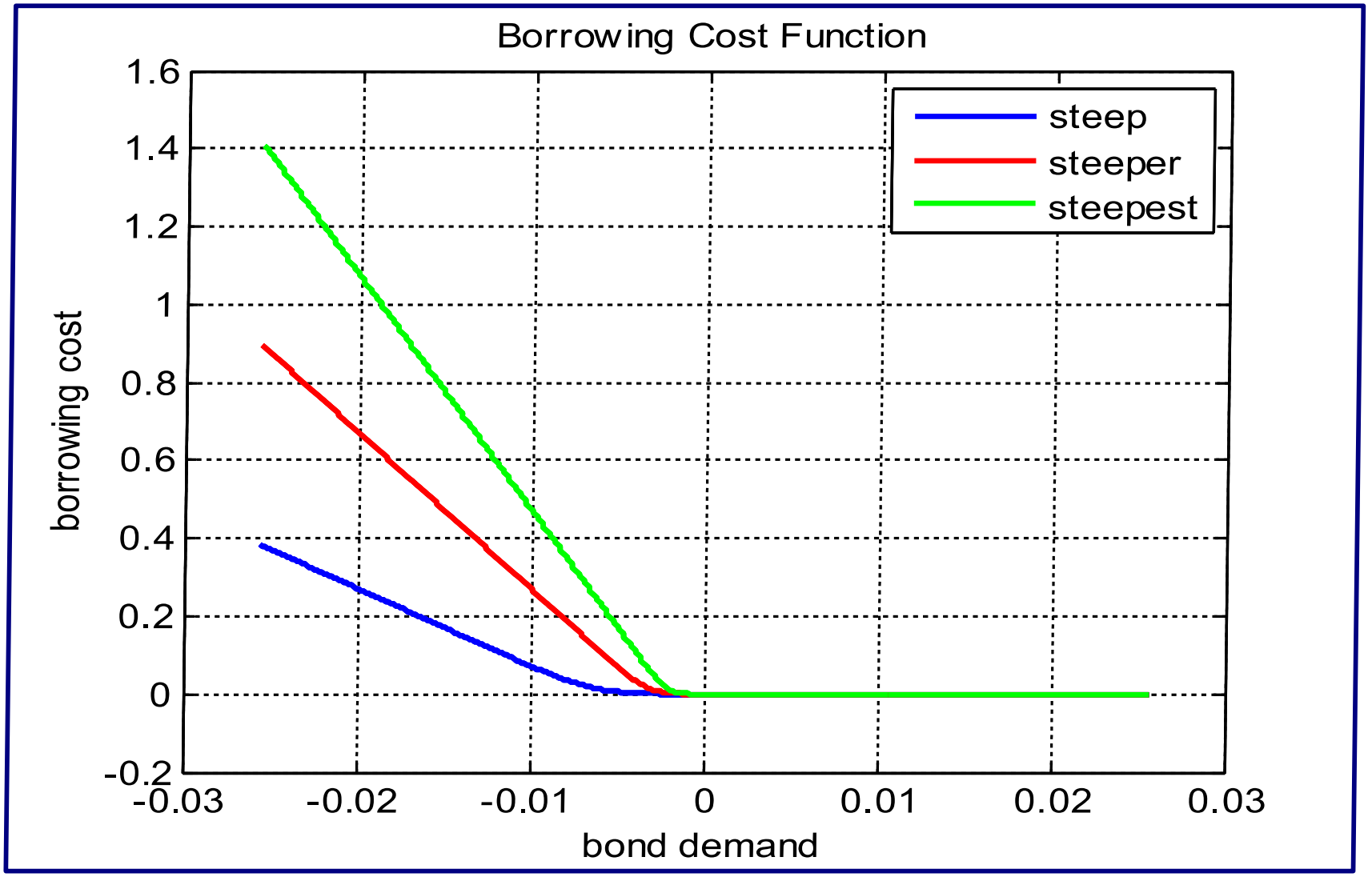
Borrowing Cost Type	Annual Equity Premium (%)
none	0.037
steep	1.743
steeper	3.597
steepest	5.634

"Steepest" case:

Equilibrium borrowing cost to risk-free rate = 10 to 1

(~ 20% credit-card rate vs. 1-2% risk-free rate)

Borrowing Cost Function



- Function is differentiable, close to zero for positive bond holdings, rising for negative bond holdings

The Model

- 10-period overlapping generations model
  - Isoelastic preferences, risk aversion of 2
  - Cobb-Douglas technology with realistic shocks
  - Bond market: one-period safe bonds
- First time multi-period OLG model with aggregate risk and borrowing constraints is solved

Fiscal Policy

- Transfer policy:

  takes from each worker and

  gives equally to retirees

  - Fixed giving:

    Give 20% of mean wage to old, payroll tax on young

  - Proportional taking:

    Take 20% of wage from young, give proceeds to old

- Government consumption: 20% of GDP

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Solving OLG Model with Aggregate Shocks

- Bottleneck: Dimensionality curse due to many state variables

- Prior solution methods
  - Log-linearization (Rios-Rull, '94)
  - Krusell-Smith in OLG (Gourinchas, '00; Storeletten et al. '01)
  - Smolyak (Krueger and Kubler, '06)

- This paper builds on Judd, Maliar, Maliar ('09, '11)

  Extends it to deal with bonds

Models Simulated

Gen #	Bond	AR1 TFP	Rare Disaster TFP	Random Walk TFP	Stoch. Deprec.	Max Risk Aversion	Borrow Cost
80	✗	✓	✓	✗	✗	5	✗
40	✓	✓	✓	✗	✗	5	✗
20	✓	✓	✓	✓	✓	20	✗
10	✓	✓	✓	✓	✓	3	✓

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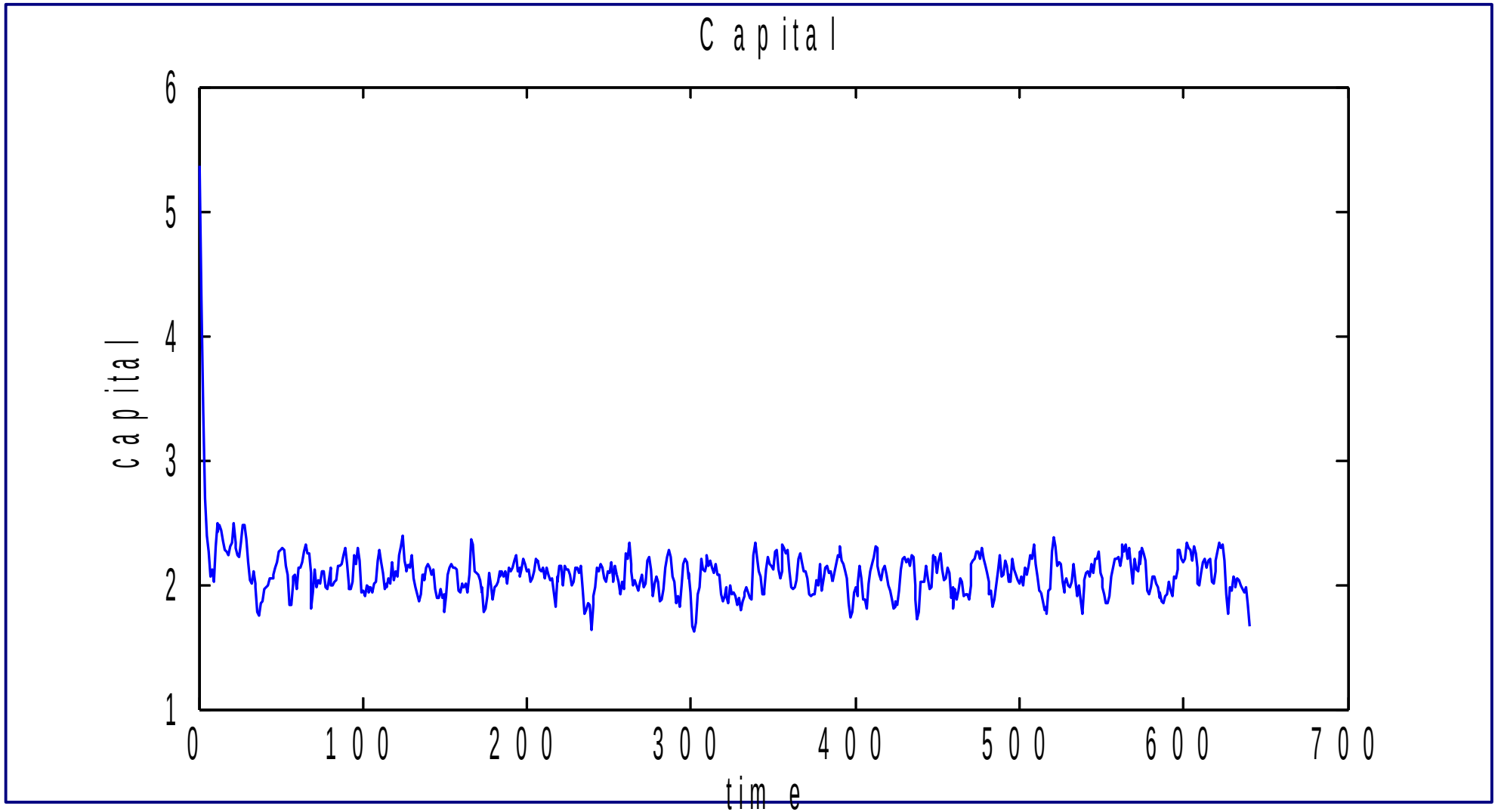
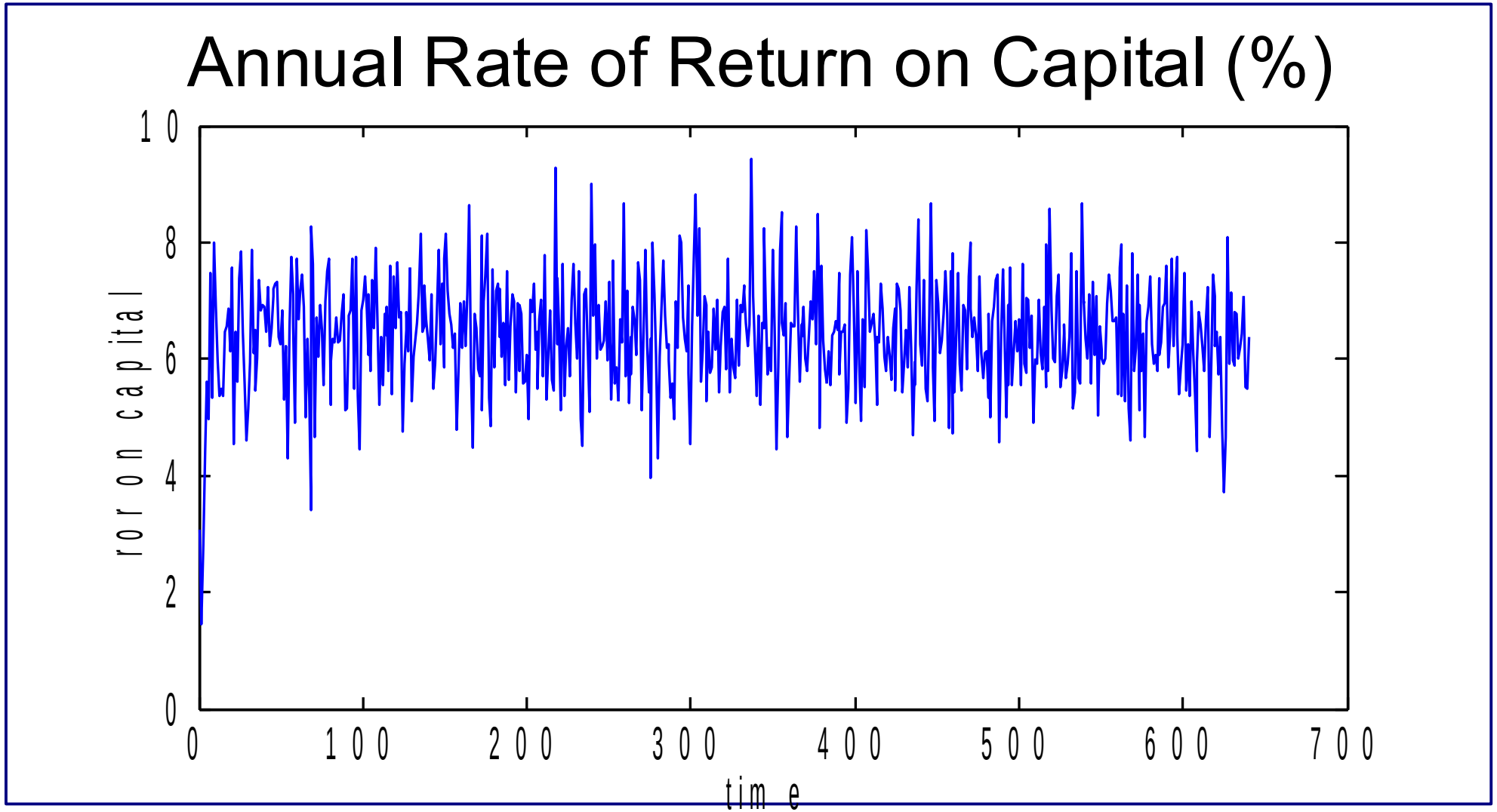
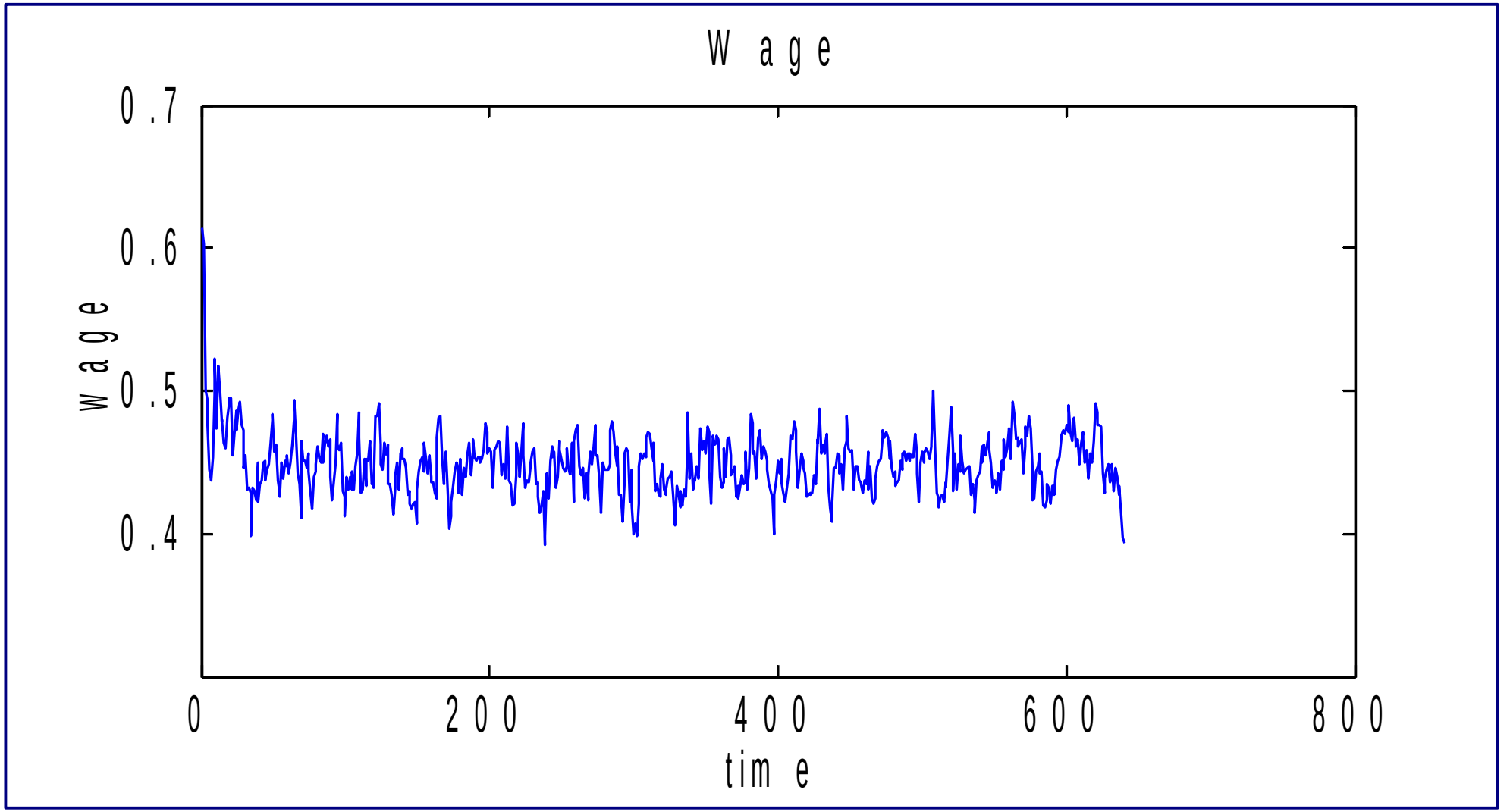
Capital



Rate of Return on Capital

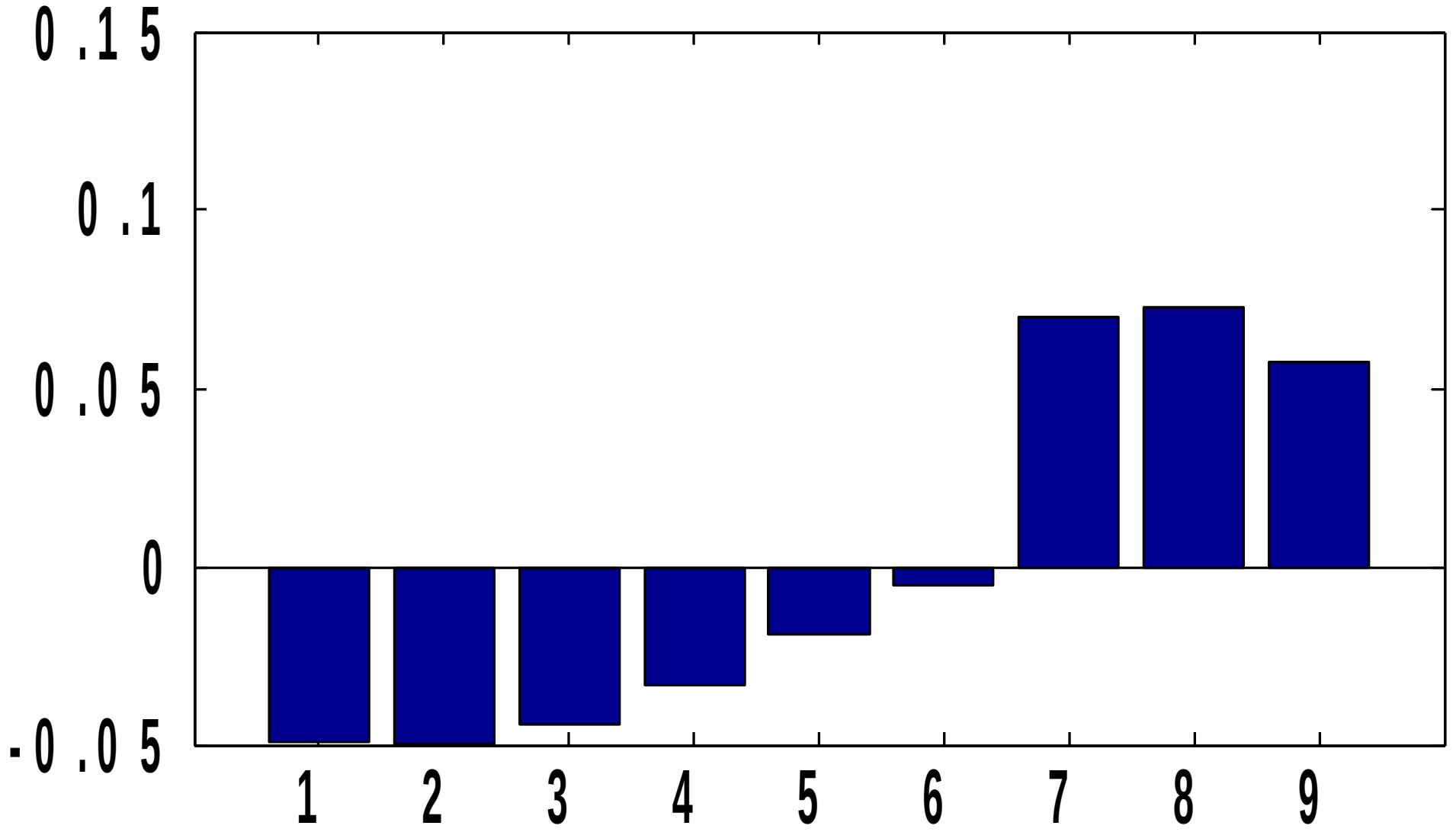


Wage



Model Without Borrowing Costs

Average Bond Demands by Age



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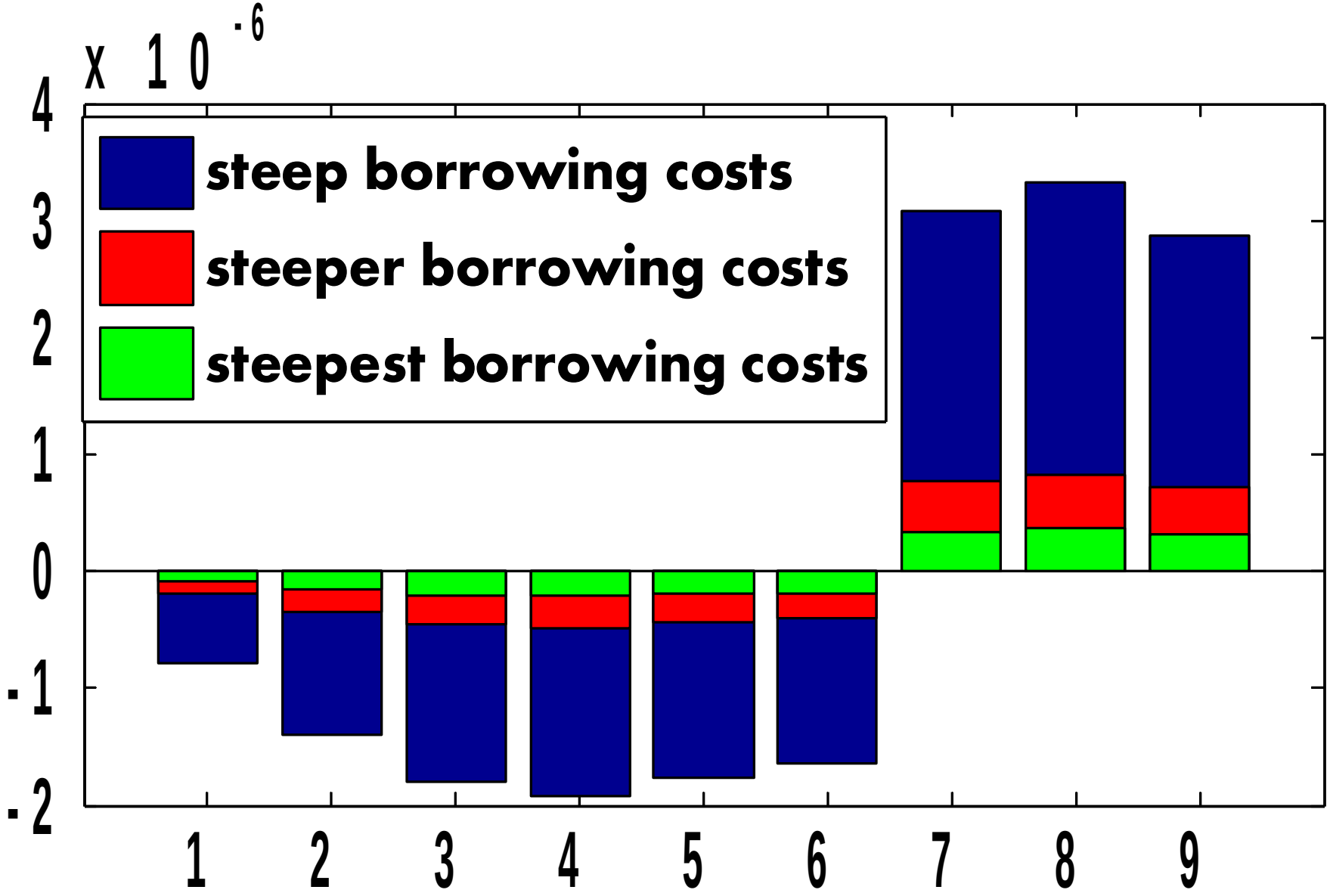
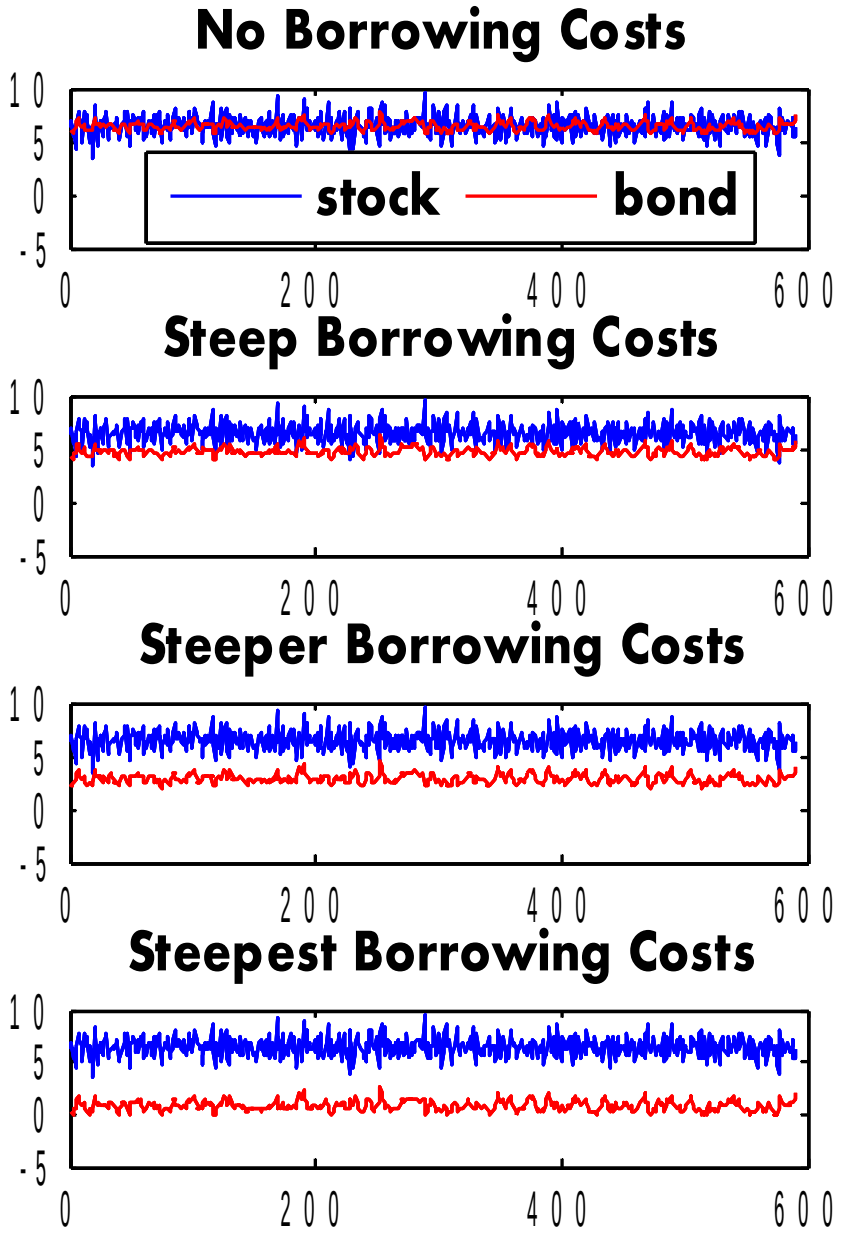
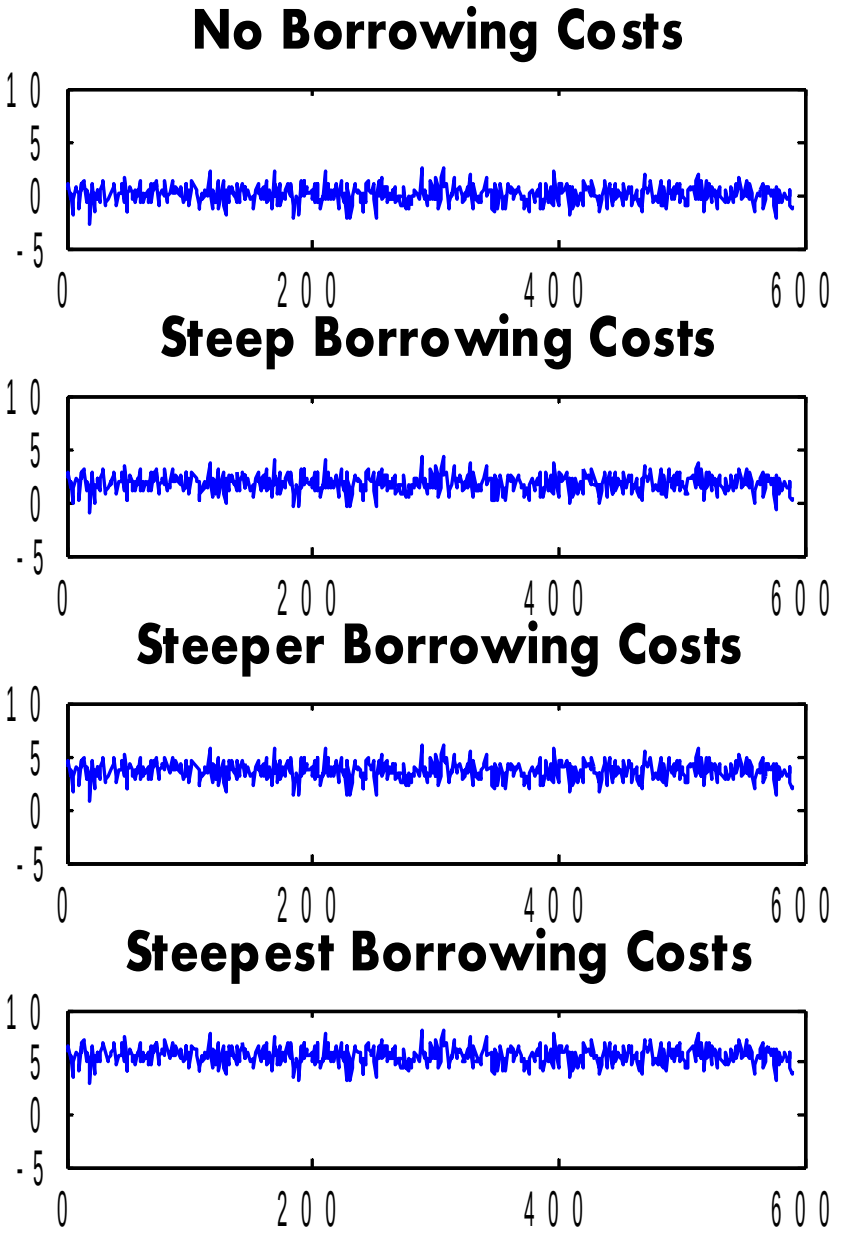


Realized Equity Premium

Returns

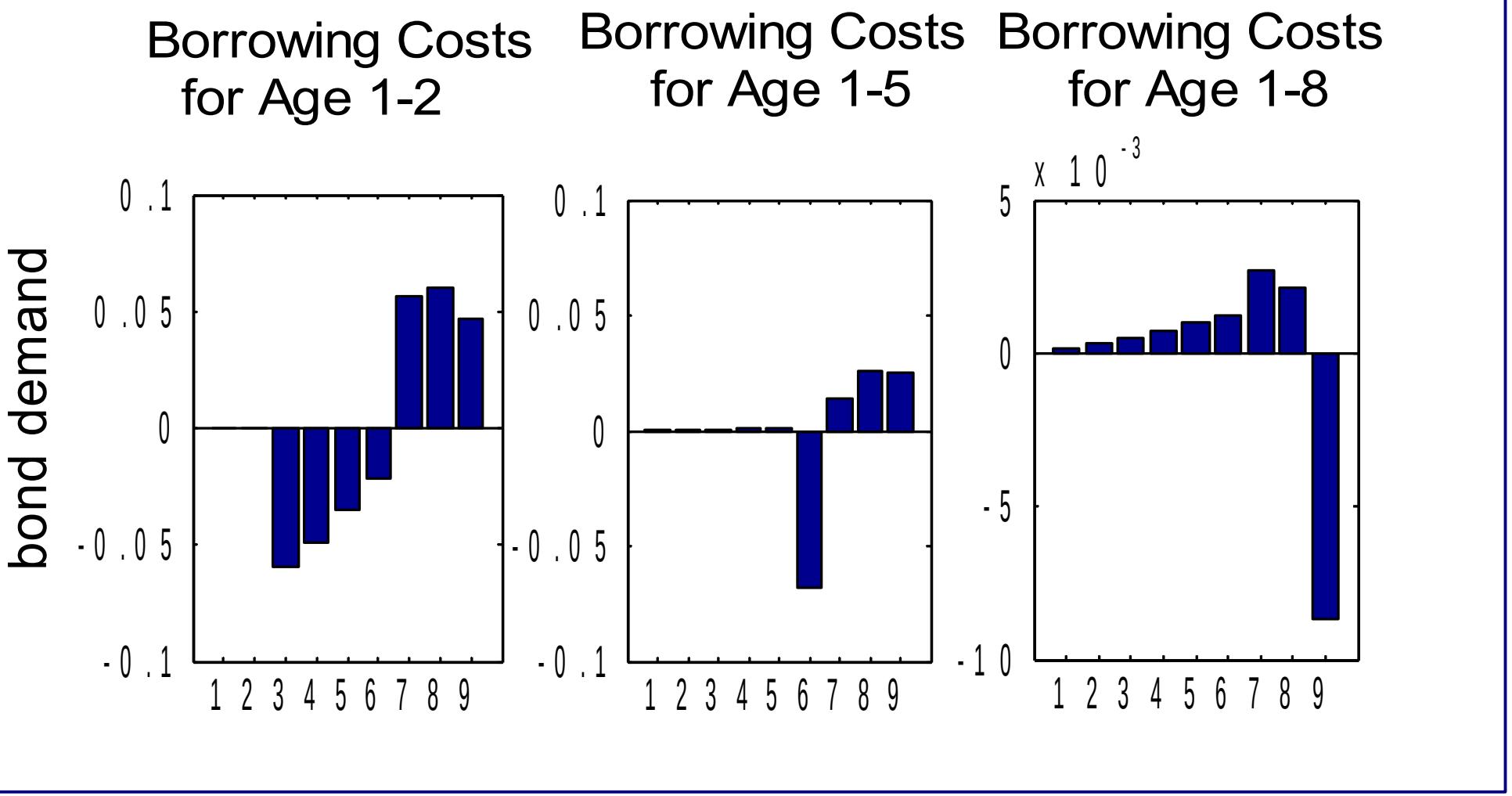


Equity Premium



Borrowing Costs on Subset of Generations

Average Bond Demands by Age



- Equity premium < 0.05%

Conclusion

- Building on Judd, Maliar, and Maliar ('09, '11)

  can solve large-scale OLG models for the first time

- Soft, but rising borrowing costs produce a sizable equity premium in a standard OLG model

- Other applications (Hasanhodzic and Kotlikoff):
  - Generational risk in an 80-period OLG model
  - Valuing government obligations when markets are incomplete

Thank you!