Collateral Requirements and Asset Prices

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Motivation

- Two old ideas:
  - Borrowing on collateral might enhance volatility of prices (e.g. Geanakoplos (1997) or Aiyagari and Gertler (1999)).
  - Prices of assets that can be used as collateral are above their 'fundamental value'
- Three issues:
  - Quantitative importance of effect is unclear
  - Collateral requirements play a crucial role. What determines them?
  - Some assets can easily be used as collateral, others not. What are the general equilibrium effects?

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- Take Lucas asset pricing model with heterogeneous agents and incomplete markets, add collateral constraints and model default and collateral requirements as in Geanakoplos and Zame (2002)
- Pick (reasonable) parameters so that effects of collateral on asset prices are potentially large (Barro's (2011) consumption disaster calibration)
- Explore general equilibrium effects of different ways to 'set' margin requirements:
    - Two trees with identical cash-flows but different margin requirements. One tree's margin requirements are exogenously regulated

The Economy

- Discrete time t=0,..., one perishable commodity, exogenous shocks follow Markov-process with finite support.
- 2 agents, h=1,2, and 2 trees, a=1,2.
- Aggregate endowments are $\bar{e}(\sigma) = \sum_{h \in \mathcal{H}} e^h(\sigma) + \sum_{a \in \mathcal{A}} d_a(\sigma).$
- Preferences are Epstein-Zin with

$$U^h_{s^t}(c) = \left\{ \left[c^h(s^t)\right]^{\rho^h} + \beta \left[\sum_{s_{t+1}} \pi(s_{t+1}|s_t) \left(U^h_{s^{t+1}}(c)\right)^{\alpha^h}\right]^{\frac{\rho^h}{\alpha^h}} \right\}^{\frac{1}{\rho^h}}$$

Financial Markets

- In addition to the trees there are J bonds that distinguish themselves by their collateral requirements.
- Assume that trees have to be held as collateral in order to establish a short position in the bonds

Tree holding, θ_a^h, and bond holdings, ϕ_j^h, must satisfy

$$\theta_a^h(s^t) + \sum_{j \in \mathcal{J}} k_a^j(s^t)[\phi_j^h(s^t)]^- \geq 0, \quad a = 1, \ldots, A.$$

- What determines the collateral requirement?

Collateral and Default

- Make the strong assumption that all loans are non-recourse and that there are no penalties for defaulting

- Borrower hands over collateral whenever promise exceeds value of collateral

$$f_j(s^t) = \min\left\{1, \sum_{a \in \mathcal{A}} k_a^j(s^{t-1}) \Big(q_a(s^t) + d_a(s^t) \Big) \right\}.$$

Default is Costly

- Campbell et al. (2010) find an average 'foreclosure discount' of 27 percent

- We assume that part of the payment of the borrower is lost and that the loss is proportional to the difference between the face value of the debt and the value of collateral.

The loss is given by: $\lambda\Big(1 - k_a^j(s^{t-1})\Big(q_a(s^t) + d_a(s^t)\Big)\Big)$

Margin-Requirements

- We consider two determinants for k:
  - As in Geanakoplos and Zame (2002) all contracts are available for trade. With moderate default costs only one is traded in equilibrium. More...
  - The margin requirement is exogenously fixed

$$h_a^j(s^t) = \frac{k_a^j q_a(s^t) - p_j(s^t)}{k_a^j q_a(s^t)}$$

Calibration I

- Aggregate endowments grow at a stochastic rate

$$\frac{\bar{e}(s^{t+1})}{\bar{e}(s^t)} = g(s_{t+1})$$

- We assume there are 6 possible shocks

	1	2	3	4	5	6
Prob	0.005	0.005	0.024	0.065	0.836	0.065
g	0.566	0.717	0.867	0.966	1.025	1.089

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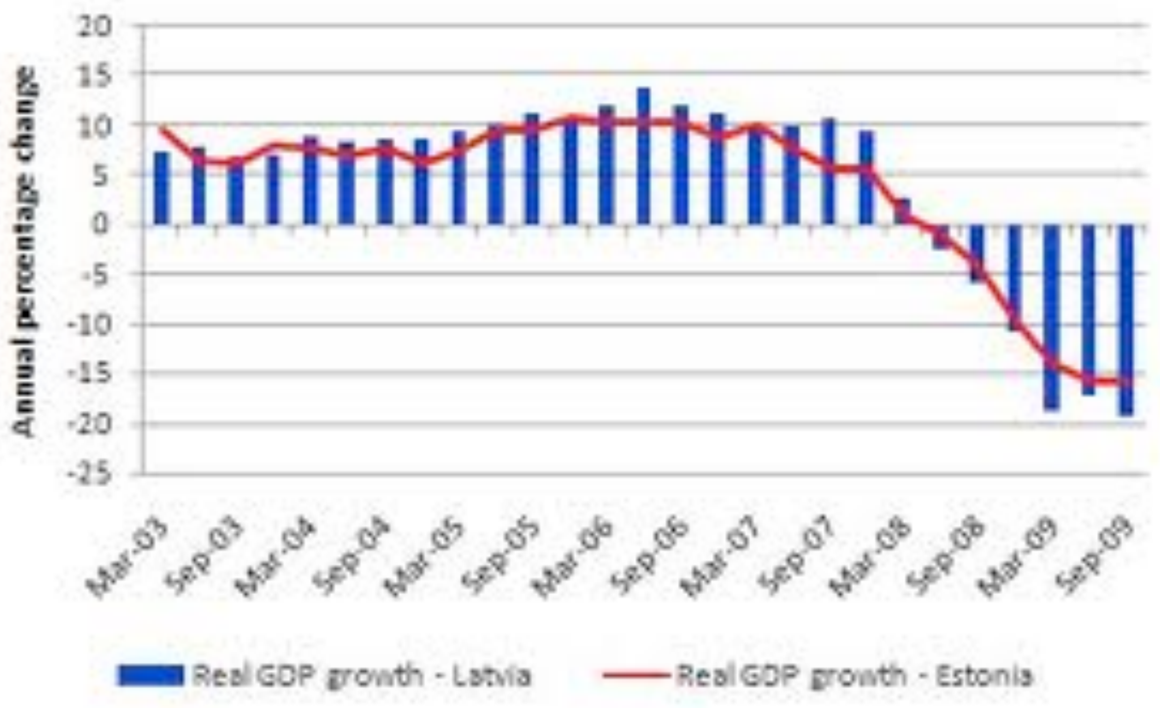
Disasters

- Consumption disaster calibration is from Barro and Jin (2011)



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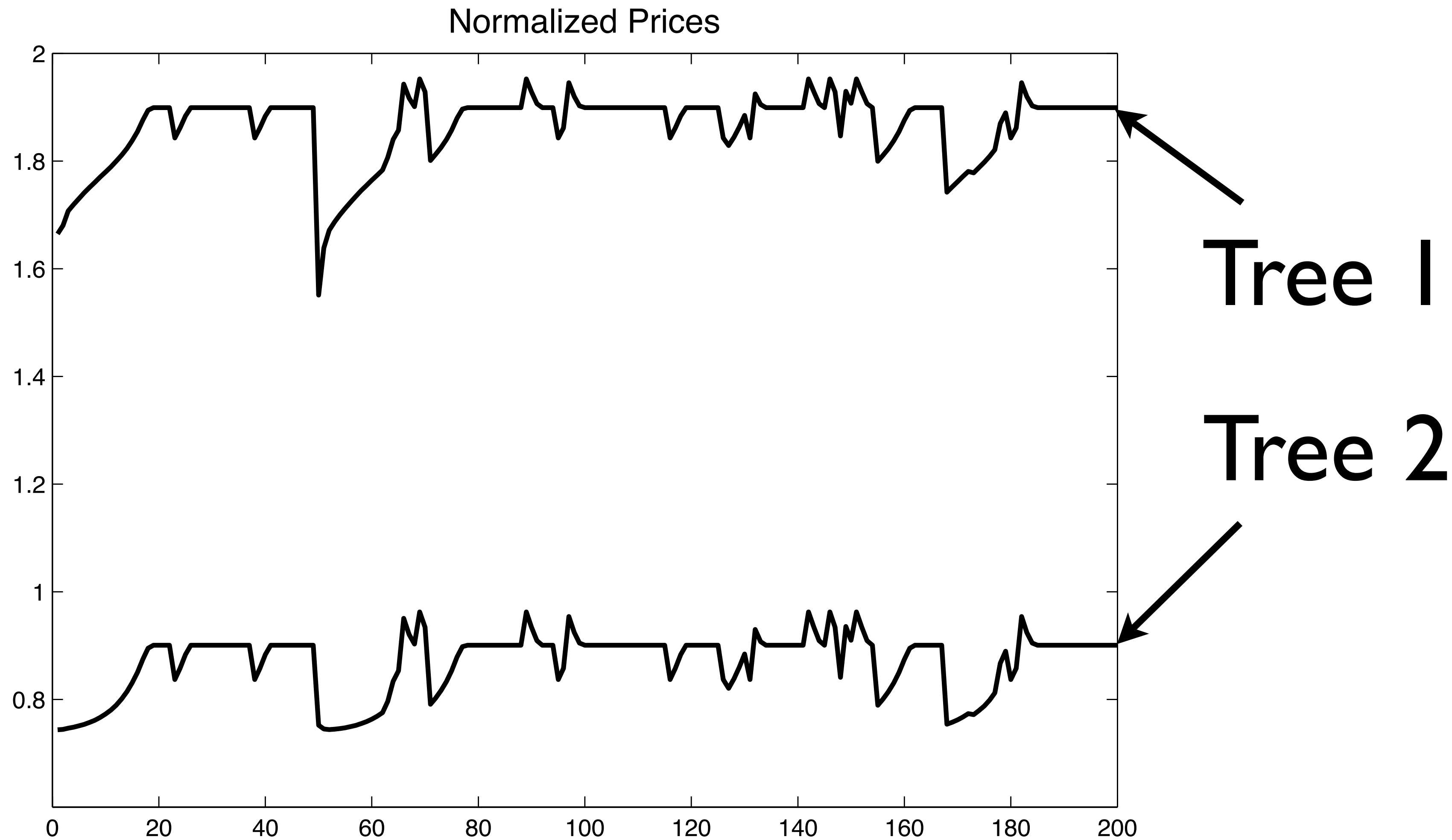
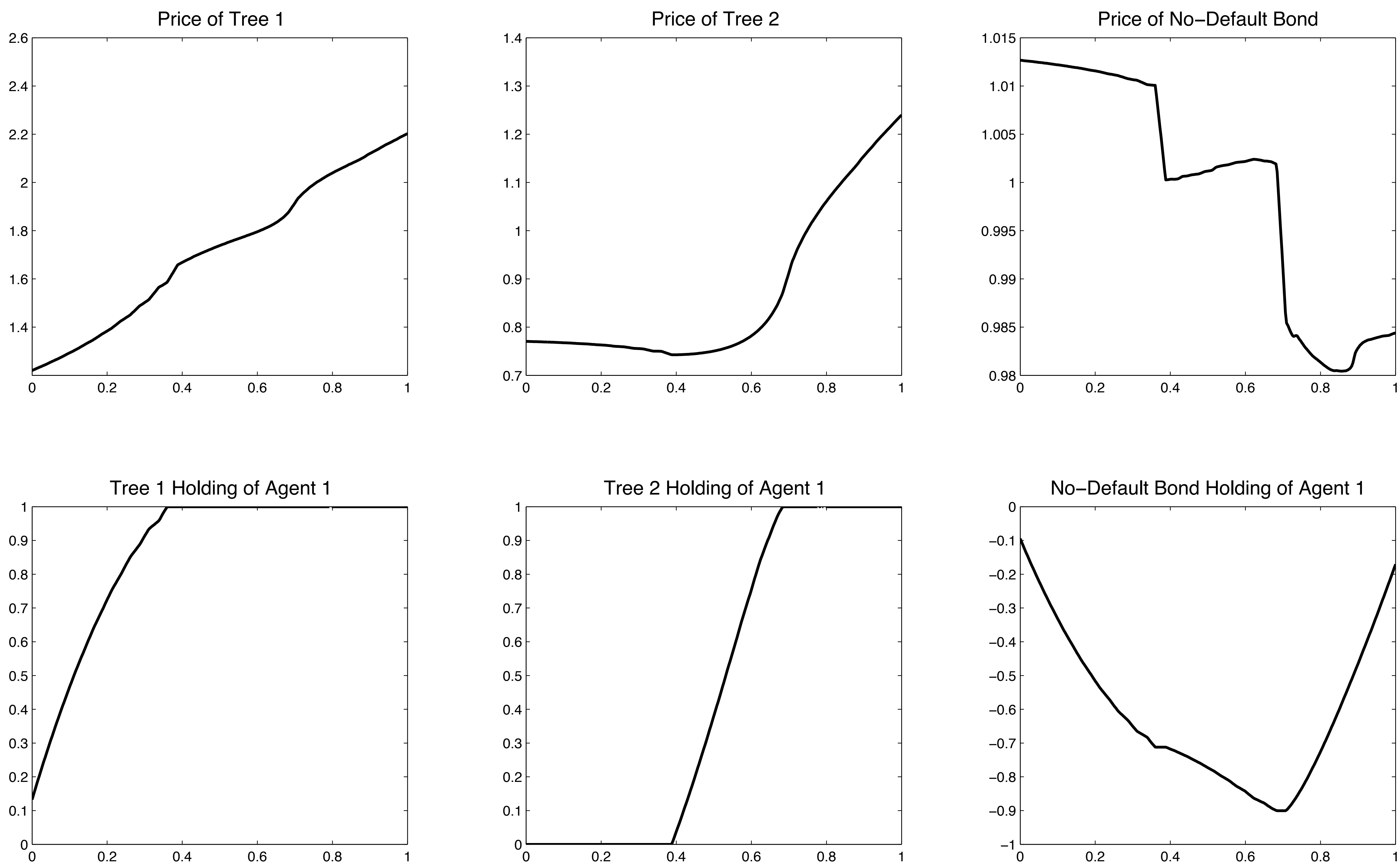
- The two trees each pay 4 percent of aggregate endowments as dividends

Results A

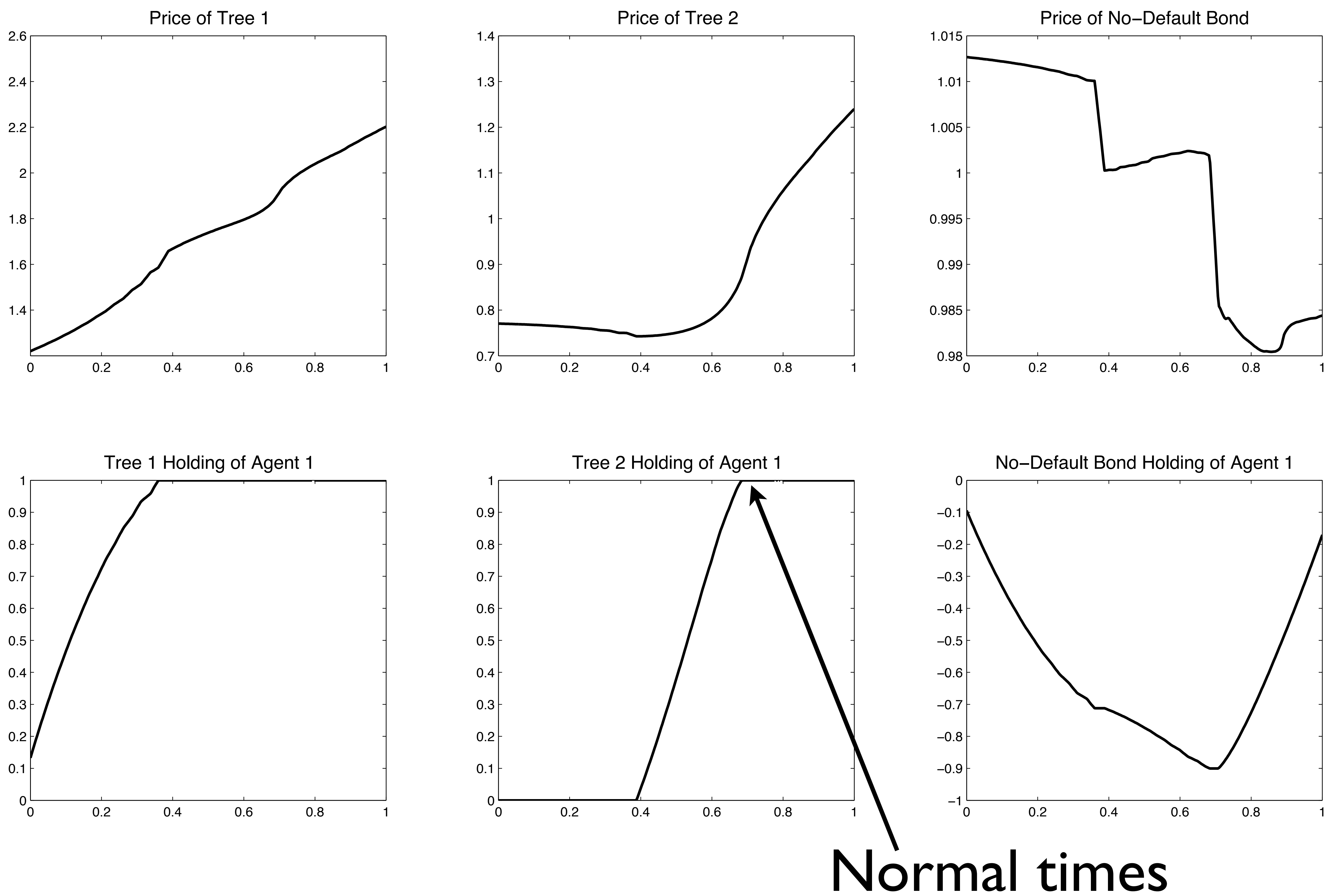
- Suppose first tree 1 can be held as collateral with endogenous collateral requirement while tree 2 cannot be used to secure short positions in bonds



Results A


Price of Tree 1
Price of Tree 2
Price of No−Default Bond
Tree 1 Holding of Agent 1
Tree 2 Holding of Agent 1
No−Default Bond Holding of Agent 1

Results A



Price of Tree 1
Price of Tree 2
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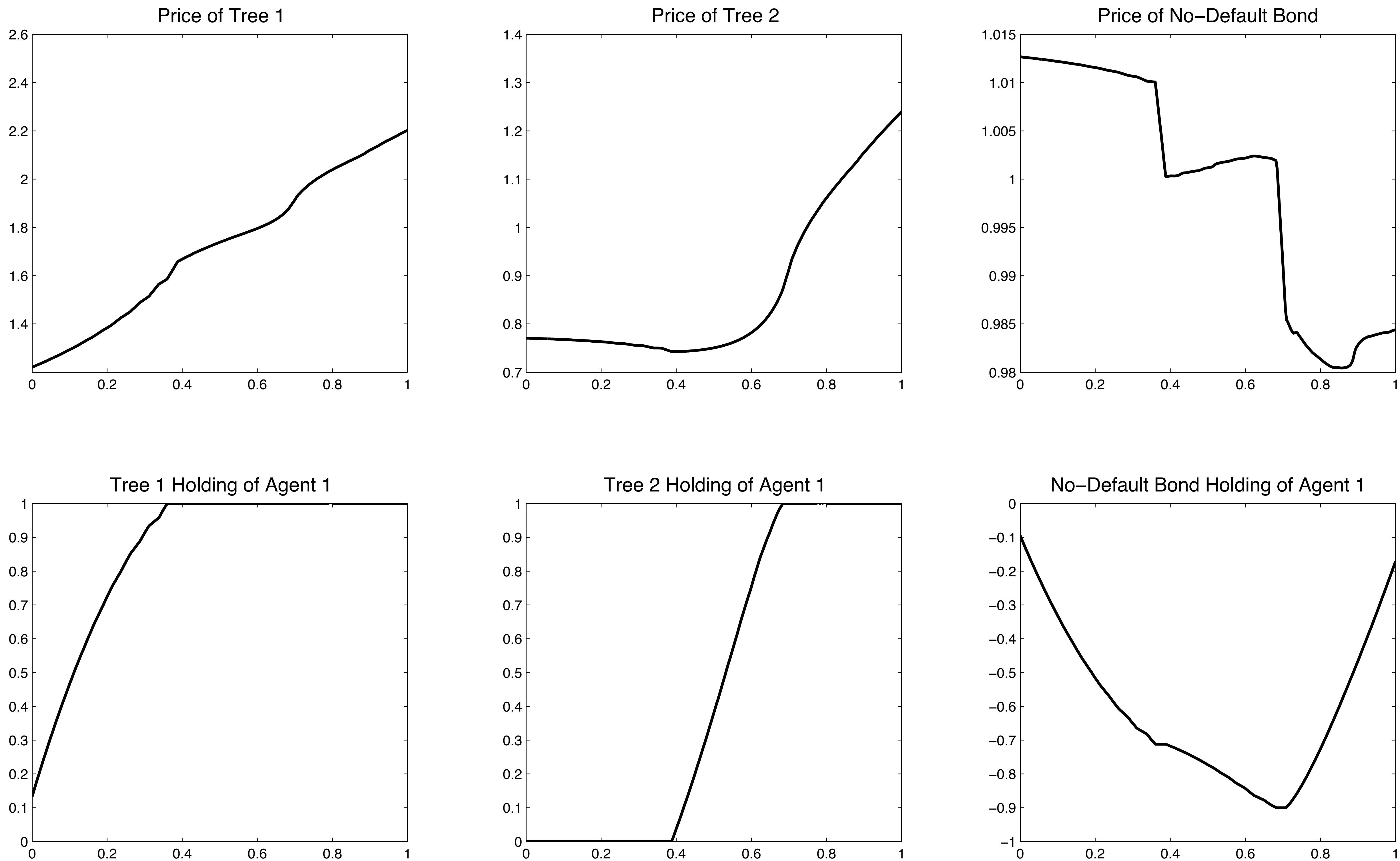
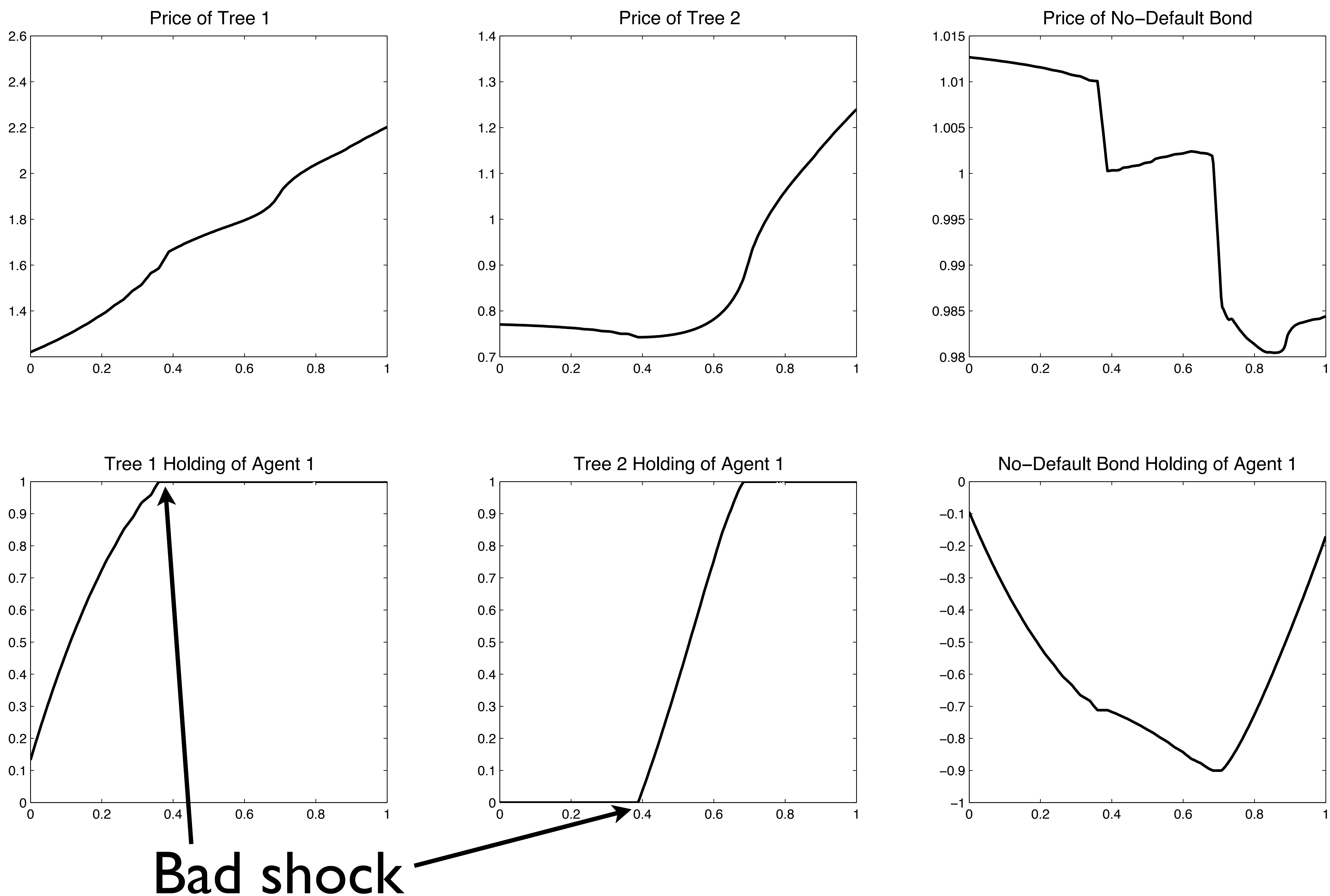
Tree 1 Holding of Agent 1
Tree 2 Holding of Agent 1
No−Default Bond Holding of Agent 1
Normal times

Results A



Price of Tree 1
2.6
2.4
2.2
2
1.8
1.6
1.4
0
0.2
0.4
0.6
0.8
1
Price of Tree 2
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
Price of No−Default Bond
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
Tree 1 Holding of Agent 1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Tree 2 Holding of Agent 1
No−Default Bond Holding of Agent 1
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1

Results A



Price of Tree 1
Price of Tree 2
Price of No−Default Bond
Tree 1 Holding of Agent 1
Tree 2 Holding of Agent 1
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Bad shock

Results A: Moments

- In order to quantify the results consider first and second moments of tree returns. Two benchmarks: An economy with no borrowing (B1) and an economy with natural debt constraints (B2)

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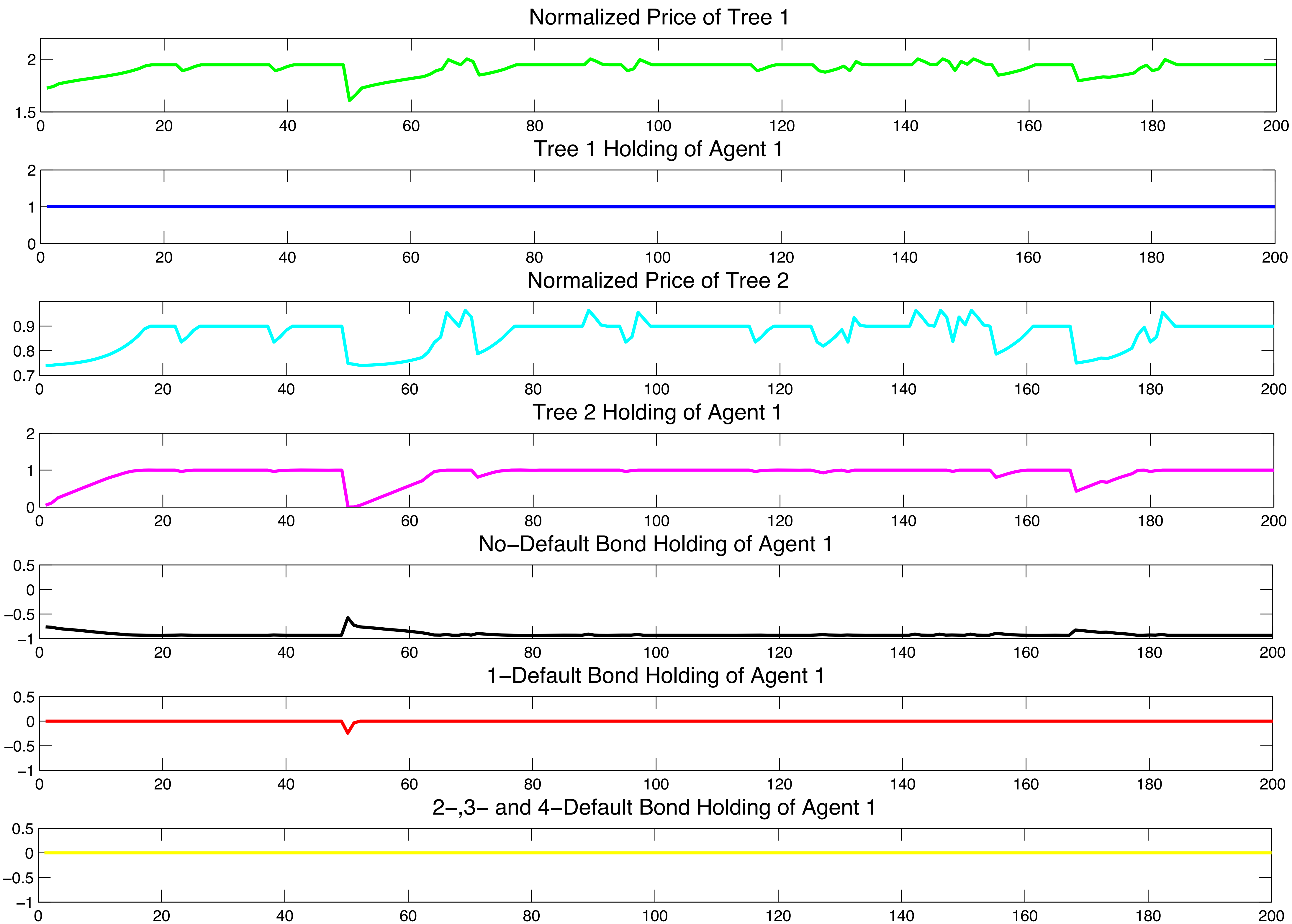

Normalized Price of Tree 1
Tree 1 Holding of Agent 1
Normalized Price of Tree 2
Tree 2 Holding of Agent 1
No−Default Bond Holding of Agent 1
1−Default Bond Holding of Agent 1
2−,3− and 4−Default Bond Holding of Agent 1

Endogenous Margins

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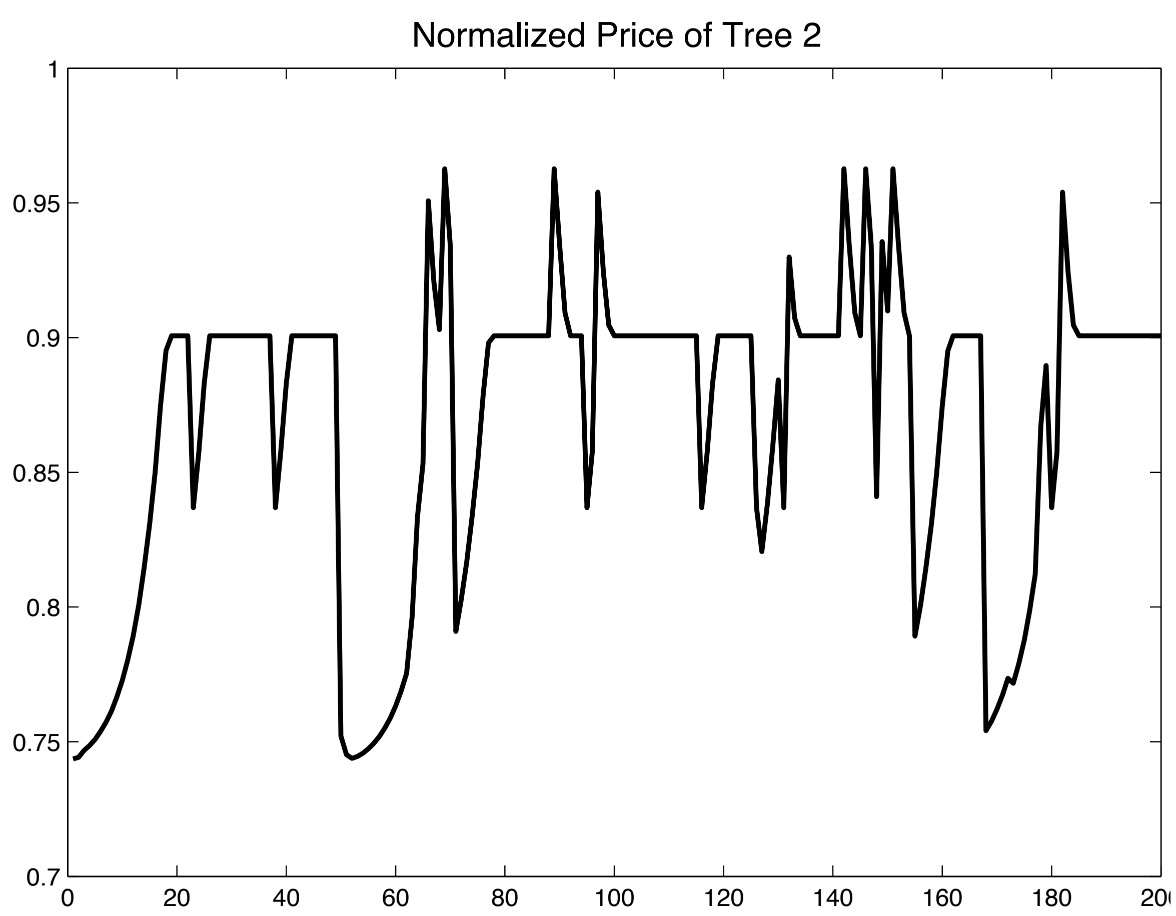
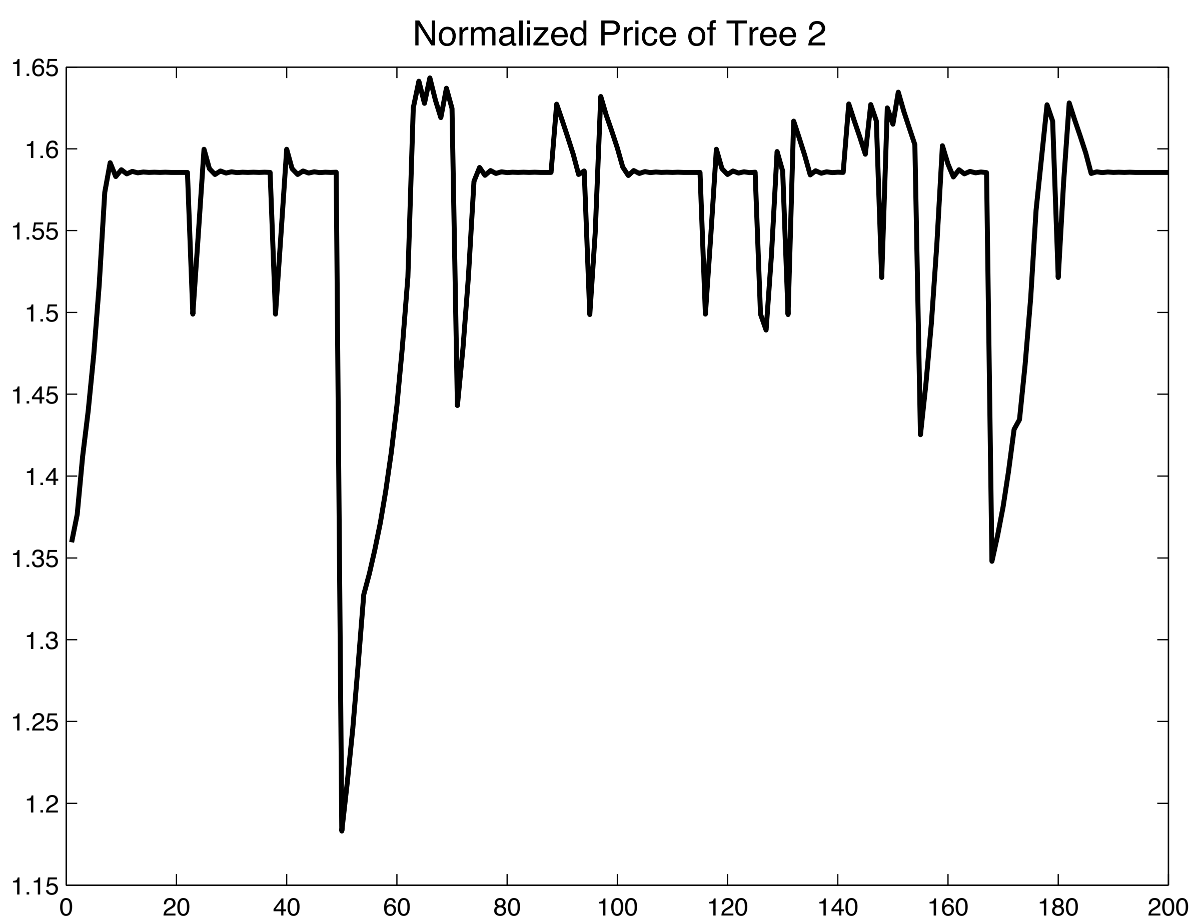
- Even if default costs are zero only risk-free bond is traded at normal times
- Default bonds are only traded in (or after) disaster shocks
- Default costs of 10 percent suffice to uniquely determine margin-requirements: Only the risk-free bond is traded
- Obviously not a good theory of why people default since we have no idiosyncratic risk

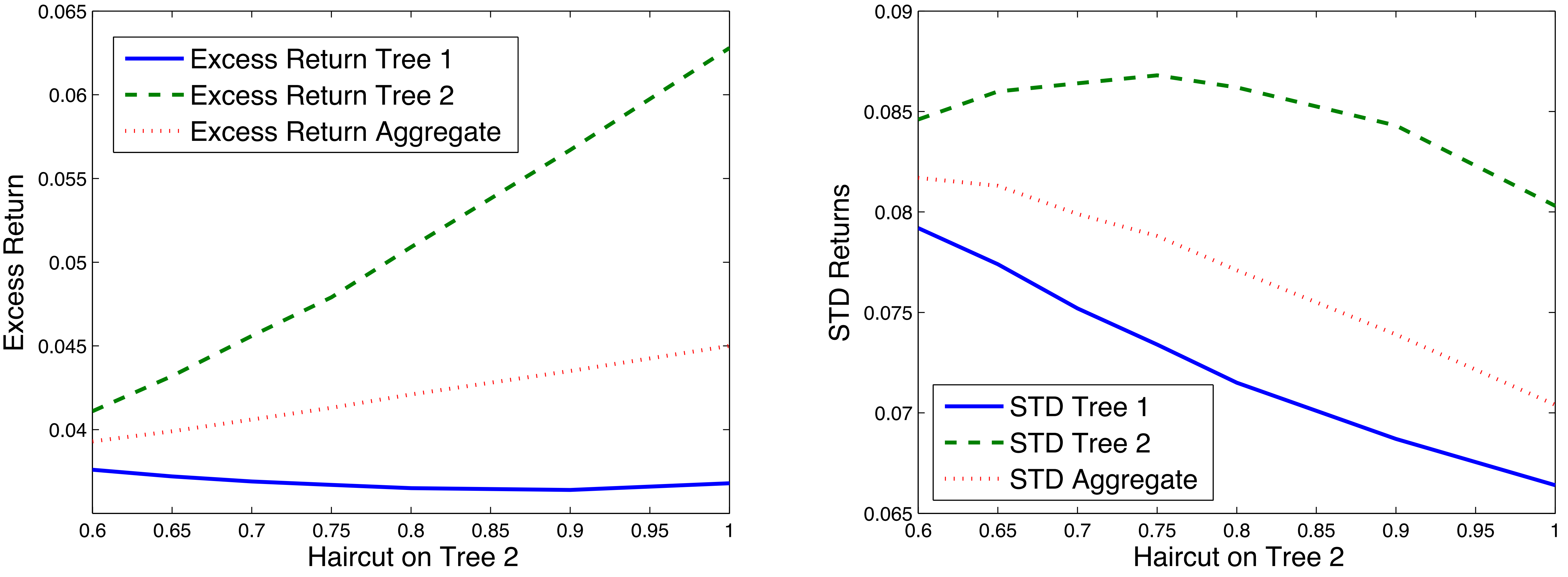
Results B

- Now suppose tree 2 can also be held as collateral but that margin requirement is exogenously set. Price-dynamics of the tree will obviously depend on the margin requirement...





First and Second Moments



Sensitivity Analysis

- Results are relative robust with respect to IES and size of trees
- Disaster shocks are obviously a dubious assumption and might seem to drive results...
  - Halve the size of disaster shocks

	s=1	s=2	s=3
old g	0.566	0.717	0.867
new g	0.783	0.8585	0.9335

  - But increase second agent's risk aversion to 10

Sensitivity analysis 2

- As before, take as benchmark an economy with no borrowing (B1)
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	B1	aggr.	Tree 1	Tree 2
Std Returns	3.42	5.05	4.41	6.68
Avg Exc Returns	NA	1.02	0.77	1.65

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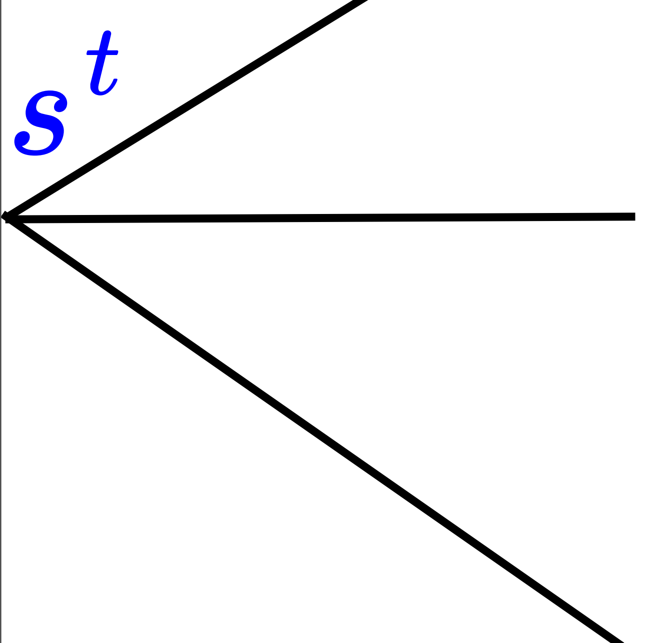
- These effects occur because of changes in the wealth distribution due to uninsurable shocks
- We assume that only tree can be used as collateral, what happens if bonds can be used to secure short-positions in the tree?

Endogenous Margins

- Instead of having infinitely many bonds, it suffices to focus on S basic ones.



Bond 1	Bond 2	Bond 3
$k_a^1(s^t)\Big(q_a(s^t,1)+d_a(s^t,1)\Big)$	$k_a^2(s^t)\Big(q_a(s^t,1)+d_a(s^t,1)\Big)$	1
$k_a^1(s^t)\Big(q_a(s^t,2)+d_a(s^t,2)\Big)$	1	1
1	1	1

back