Cash-flow tranching and the Macroeconomy

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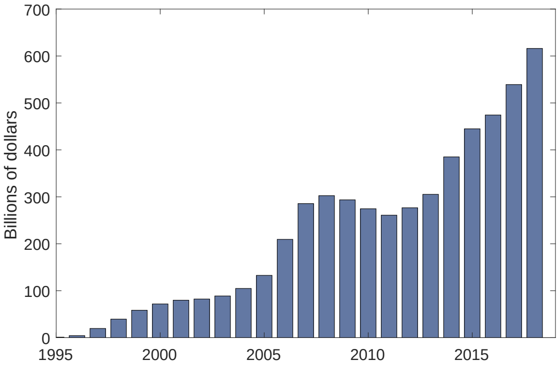
MOTIVATION

U.S. Collateralized Loan Obligations Outstanding



- The volume of business loan securitization – **cash-flow tranching** – has increased markedly

- *Transformation of cash-flows to create securities that cater to the needs of heterogenous investors* (Allen and Gale, 1988)

QUESTIONS

1. What is behind the recent business loan securitization boom?
    - Lower securitization costs? (Technological improvements; Regulatory arbitrage)
    - Increased demand for safer securities? (Global saving glut)
2. What is the impact of securitization booms on macroeconomic aggregates?

A dynamic model of costly security creation

We develop a model that can quantitatively answer these questions

Producers finance projects by issuing securities to investors with heterogeneous preferences

- Issuing one type of security is free
- Issuing several types (repackaging cash flows) is costly

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The amount of securitization depends on:

1. Securitization costs
2. Distribution of investor types

We shock both, in turn, to cause changes in securitization and quantify the impact on output, capital formation and TFP

Preview of main results

1. Lower securitization costs and increased demand for riskless securities can both lead to more securitization
2. While both have modestly positive effects on output and wages, they have otherwise diverse implications:
    - Lower securitization costs (counterfactually) cause yields to rise
    - Increased appetite for safe securities replicates the fall in yields and the increase in rents associated with cash-flow transformation, but can lead to lower household welfare

Literature

Theory: Allen and Gale (1988, 1994)

Applied theory: Jermann and Quadrini (2012), Gennaioli, Shleifer and Vishny (2013)

Empirics: Bernanke et al. (2011), Arcand et al. (2015), Philippon and Reshef (2012)

The environment

Time is discrete and infinite

Aggregate shock $\eta \in \{B, G\}$ with Markov transition matrix T

Two types of two-period lived **households**

- Mass θ are infinitely risk-averse (A)
- Mass $(1 - \theta)$ are risk-neutral (N)

Large mass of two-period lived **producers**

PRODUCERS

Producer type $z = (z_B, z_G) \sim \mu$ (public information)

Can **activate** project by paying entry fee e and installing capital k before state is realized

Producers

Producer type $z = (z_B, z_G) \sim \mu$ (public information)

Can **activate** project by paying entry fee e and installing capital k before state is realized

If $\eta \in \{B, G\}$ is realized, active producer type z_η produces $y(k, n; z_\eta) = z_\eta \left(k^\alpha n^{1-\alpha}\right)^\nu$

Producers' operational profit:

$$\Pi(k, w; z_\eta) \equiv \max_{n>0} y(k, n; z_\eta) - nw$$

Producer preferences

Producers order consumption plans $\left(c^P_{y,t}, c^P_{o,t+1}(B), c^P_{o,t+1}(G)\right)$ according to:

$$c^P_{y,t} + \epsilon E\left(c^P_{o,t+1}(\eta)|\eta_{t-1}\right),$$

where ϵ is a small but positive number

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Young producer timing

1. Decision to operate or not
2. Sell securities to finance production
3. Consume
4. Aggregate state is realized
5. Produce, pay wages and security returns

Old producer timing

1. Consume

Producer problem preliminaries

Producers finance project by selling claims to households

Selling to one type is free

Selling to both types carries a fixed cost ζ

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Producers take the households' **willingness to pay** for securities as given

Let $q_{i,t}\left(x(B), x(G)\right)$ denote price of security returning $\left(x(B), x(G)\right) \geq (0,0)$ to $i = A, N$

Producer problem

Active producer $z = (z_B, z_G)$ solves:

$$\max_{k_t \geq 0, x_{i,t}(\eta) \geq 0} c^P_{y,t} + \epsilon E\left(c^P_{o,t+1}(\eta) | \eta_{t-1}\right)$$

$$\begin{aligned}
c^P_{y,t} &\leq q_{A,t}\left(x_{A,t}(B), x_{A,t}(G)\right) + q_{N,t}\left(x_{N,t}(B), x_{N,t}(G)\right) - k_t - e - \zeta \mathbb{1}_{x_{A,t} \neq 0, x_{N,t} \neq 0}, \\
c^P_{o,t+1}(B) &\leq \Pi(k_t, w_t(B); z_B) - x_{A,t}(B) - x_{N,t}(B), \\
c^P_{o,t+1}(G) &\leq \Pi(k_t, w_t(G); z_G) - x_{A,t}(G) - x_{N,t}(G), \\
c^P_{y,t}, c^P_{o,t+1}(\eta) &\geq 0.
\end{aligned}$$

Households

Young household timing

1. Aggregate state realized
2. Work and receive wages
3. Consume

Old household timing

1. Invest available savings
2. Aggregate state realized
3. Consume

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Households of type $i \in \{A, N\}$ have available a menu of gross returns

$$R_{i,t}(z,\eta) = \frac{x_{i,t}(\eta)}{q_{i,t}(x_{i,t}(B), x_{i,t}(G))}$$

they take as given on securities issued by producers of type z

Type N household problem

$$\max_{a_t^N(z), c_{y,t}^N, c_{o,t+1}^N \geq 0} \log c_{y,t}^N + \beta \log \left\{ E\left(c_{o,t+1}^N(\eta) | \eta_t \right) \right\}$$

subject to:

$$\begin{aligned} c_{y,t}^N &\leq w_t - \int_{Z_t} a_t^N(z) d\mu, \\ c_{o,t+1}^N(B) &\leq \int_{Z_t} a_t^N(z) R_{N,t}(z,B) d\mu, \\ c_{o,t+1}^N(G) &\leq \int_{Z_t} a_t^N(z) R_{N,t}(z,G) d\mu. \end{aligned}$$

Pricing kernel for type N households

Letting

$$\bar{R}_{N,t} = \max_z T\left(B|\eta_{t-1}\right) R_{N,t}(z,B) + T\left(G|\eta_{t-1}\right) R_{N,t}(z,G),$$

old N households are willing to pay

$$q_{N,t}(x(B),x(G)) = \frac{T\left(B|\eta_{t-1}\right) x(B) + T\left(G|\eta_{t-1}\right) x(G)}{\bar{R}_{N,t}}$$

for a marginal investment in a security with payoff $(x(B),x(G))$.

Type A household problem

$$\max_{a_t^A(z),c_{y,t}^A,c_{o,t+1}^A\geq 0} \log c_{y,t}^A + \beta \log \left\{ \min\left\{ c_{o,t+1}^A(B), c_{o,t+1}^A(G) \right\} \right\}$$

subject to:

$$\begin{aligned} c_{y,t}^A &\leq w_t - \int_{Z_t} a_t^A(z) d\mu, \\ c_{o,t+1}^A(B) &\leq \int_{Z_t} a_t^A(z) R_{A,t}(z,B) d\mu, \\ c_{o,t+1}^A(G) &\leq \int_{Z_t} a_t^A(z) R_{A,t}(z,G) d\mu. \end{aligned}$$

Pricing kernel for type A households

Letting

$$\bar{R}_{A,t} = \frac{\min\{c^A_{o,t}(B), c^A_{o,t}(G)\}}{a^A_{t-1}},$$

old A households are willing to pay

$$q_{A,t}(x(B), x(G)) = \frac{\min(x(B), x(G))}{\bar{R}_{A,t}} \quad \text{if} \quad c^A_{o,t}(B) = c^A_{o,t}(G),$$

$$q_{A,t}(x(B), x(G)) = \frac{x(G)}{\bar{R}_{A,t}} \quad \text{if} \quad c^A_{o,t}(B) > c^A_{o,t}(G),$$

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for a marginal investment in a security with payoff $(x(B), x(G))$.

Market clearing

Goods market clearing:

$$\begin{aligned}\int_{Z_t} y(k_t(z)_t, w_t(\eta); z) d\mu &= \theta \left(c^A_{y,t} + c^A_{o,t} \right) + (1-\theta) \left(c^N_{y,t} + c^N_{o,t} \right) + c^P_{y,t} + c^P_{o,t} \\ &+ \int_{Z_{t+1}} k_{t+1}(z) + e + \zeta 1_{\{x(z)_{A,t+1}>0, x(z)_{N,t+1}>0\}} d\mu;\end{aligned}$$

Labor market clearing:

$$\int_{Z_t} n(k_t, w_t(\eta); z) d\mu = 1;$$

Securities markets clearing:

$$\begin{aligned}\int_{Z_t} x_{A,t}(z,\eta) d\mu &= \theta \int_{Z_t} a^A_t(z) R_{A,t}(z,\eta) d\mu; \\ \int_{Z_t} x_{N,t}(z,\eta) d\mu &= (1-\theta) \int_{Z_t} a^N_t(z) R_{N,t}(z,\eta) d\mu.\end{aligned}$$

EQUILIBRIUM

Given initial conditions $\{a^i_{-1}, \eta_{-1}\}$, an equilibrium is, for all dates t,

- Quantities: security payoffs $\{x_{i,t}(z,\eta_t)\}$ for each household type producer type and aggregate shock, consumption plans and security purchases $\{c^i_{y,t}, c^i_{o,t+1}(B), c^i_{o,t+1}(G), a^i_t(z)\}$ for each household type and $\left\{c^P_{y,t}, c^P_{o,t+1}(\eta)\right\}$ for each producer type, and capital $\{k_t(z)\}$ for each active producer.
- Prices: security returns $\{R_{i,t}(z,\eta_t)\}$ and corresponding security pricing kernels $\{q_{A,t}, q_{N,t}\}$ and wage rates $\{w_t(\eta_t)\}$.
- Policies: the project activation decision results in a set $Z_t \in \mathcal{Z}$ of active producers.

such that:

1. All agents optimize given prices;
2. Markets clear as above;
3. Pricing kernels are consistent with households' willingness to pay for marginal payoffs.

Lemma

Risk-averse households only purchase risk-free securities. Furthermore, risk neutral agents enjoy a positive risk-premium: $\bar{R}_{N,t} \geq \bar{R}_{A,t}$.

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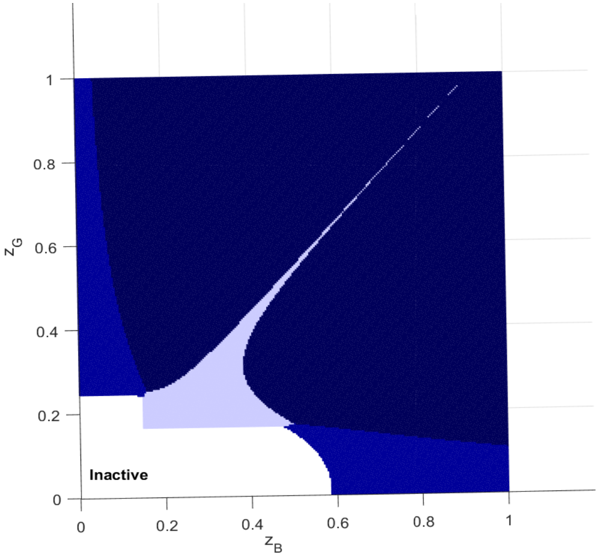
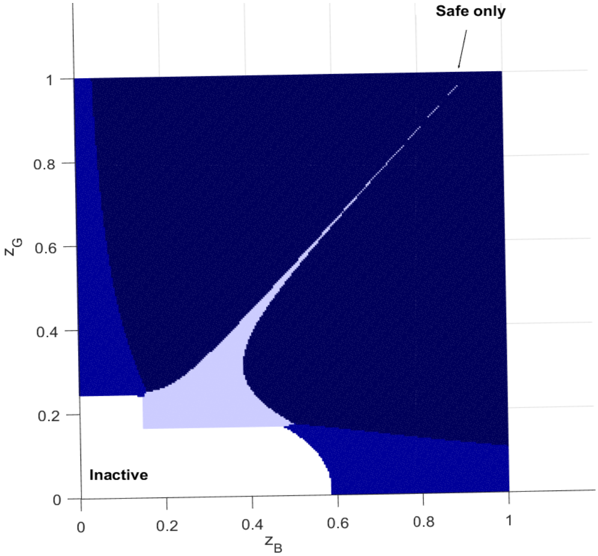
Proposition

Active producers either issue no safe securities $x_A(z) = 0$ *or they issue as much of it as possible* $x_A(z) = \underline{\Pi}(z)$.

Understanding producer security policies



- Projects that cannot afford to pay entry costs are left inactive



- Projects that cannot afford to pay entry costs are left inactive
- Projects with sufficiently similar profits across states issue safe securities only

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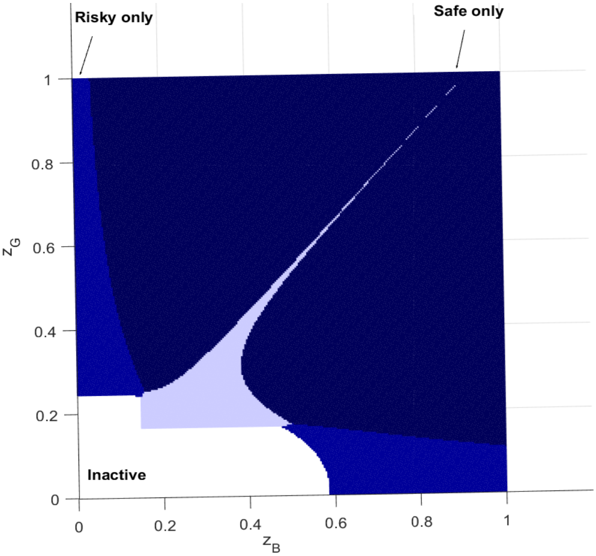
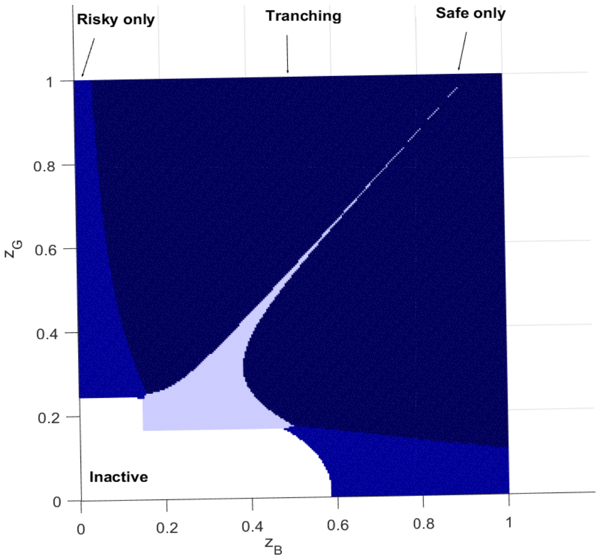


- Projects that cannot afford to pay entry costs are left inactive
- Projects with sufficiently similar profits across states issue safe securities only
- Projects with sufficiently disparate profits across states issue risky securities only

UNDERSTANDING PRODUCER SECURITY POLICIES



- Projects that cannot afford to pay entry costs are left inactive
- Projects with sufficiently similar profits across states issue safe securities only
- Projects with sufficiently disparate profits across states issue risky securities only
- Projects that can afford to pay security creation cost tranche

Calibration

Parameters set exogenously:

- Capital share $\alpha = 0.4$; Transition probabilities $T_{GG} = .9$ and $T_{BB} = .12$
- $\mu \sim \log \mathcal{N}\left(\bar{z}, (\bar{z}\varsigma)^2\right)$, normalize $\bar{z}_B = 0.05$

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Set remaining parameters jointly so as to match relevant U.S. economy moments:

Parameters	**Targets**
$\beta = 0.68$	Risk-free rate: 2%
$\theta = 0.52$	Risky spread: 3.5%
$\bar{z}_G = 0.047$	Drop in output: 15%
$e = 0.025$	Entry costs to output: 1%
$\nu = 0.73$	Producer rents to output: 10%
$\varsigma = 12.5$	Employment share in 50% smallest projects: 5%

EXPERIMENTS

We perform **two** experiments:

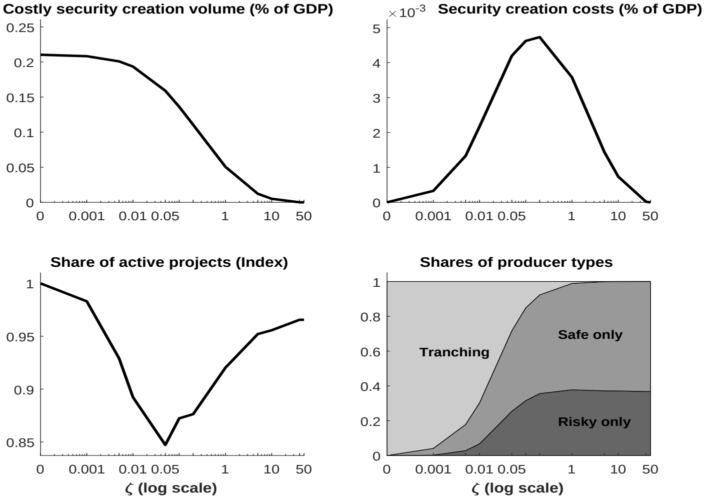
1. A change in security creation costs ζ: a proxy for changes in regulatory arbitrage
2. A change in the share of foreign risk-averse agents γ: a proxy for the effects of the global saving glut

MCMC

- Draw sequence of shocks $\{\eta_t\}_{t=1}^{T}$
- Compute invariant distributions

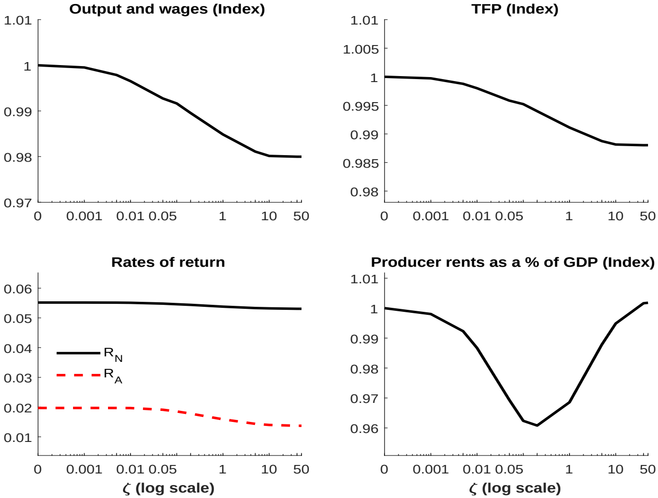
▸ Algorithm

MEASURES OF SECURITIZATION (ζ)



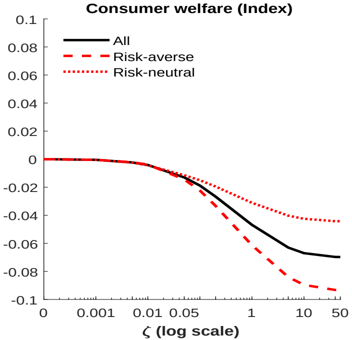
- As ζ falls, securitization increases
- Security creation costs are reasonable
- The measure of producers is non-monotonic
- Eventually, all producers tranche

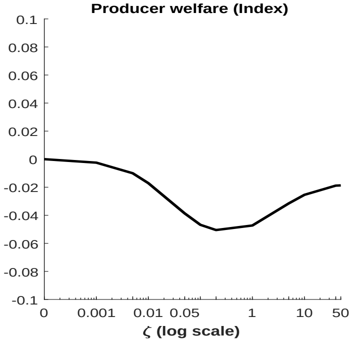
Macroeconomic outcomes (ζ)



- As ζ falls, output rises by at most 2%
- Intensive and extensive margins take turns as ζ falls
- At high levels of financial development output gains are very scarce
- Interest rates counterfactually rise

Welfare (ζ)





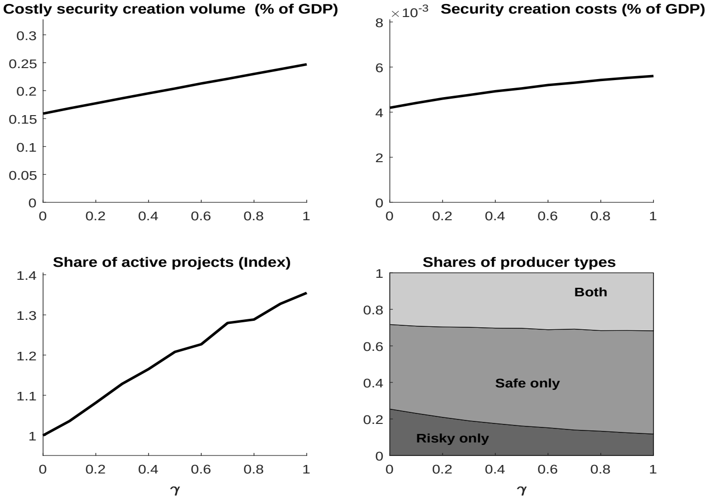
- Household welfare is monotonically increasing in ζ
- Diverse interest rate behavior induces welfare differences between household types
- Producer welfare mimics rents

The global saving glut

"Given the strength of demand for safe U.S. assets, it would have been surprising had there not been a corresponding increase in their supply."

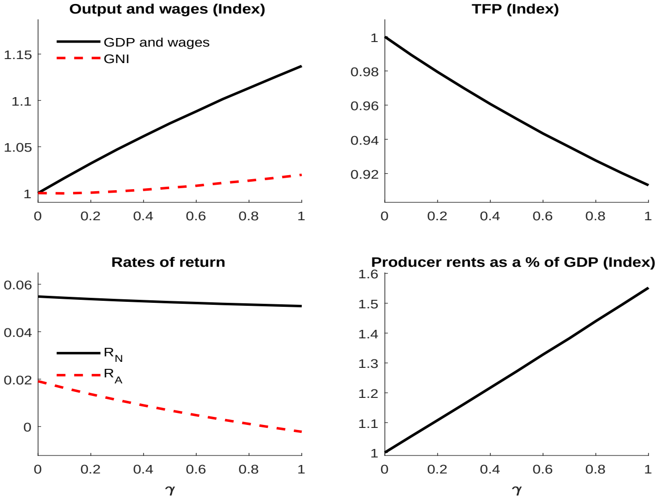
Bernanke et al. (2011)

MEASURES OF SECURITIZATION (γ)



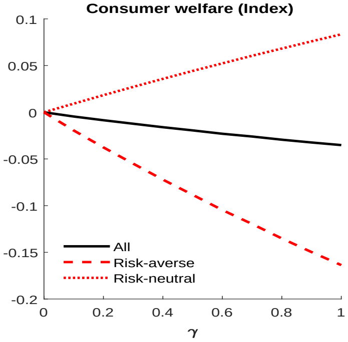
- A foreign savings glut can generate a substantial securitization boom
- The measure of active projects rises significantly
- The mass of producers issuing risky securities in exclusivity drops

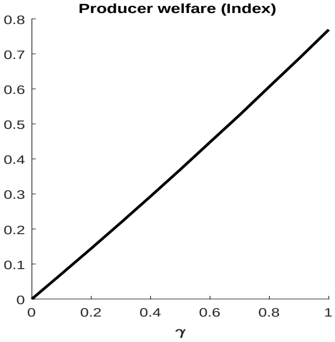
Macroeconomic outcomes (γ)



- The savings glut results in a substantial GDP increase while GNP rises more modestly
- TFP drops considerably as increasingly less productive projects are activated
- Producer (intermediary) rents increase substantially
- Interest rates fall and spread widens

WELFARE (γ)





- The foreign saving glut has very distinct welfare implications
- Risk averse agents are hurt while risk-neutral types benefits substantially
- The rise in producer (intermediary) rents drives welfare up

Conclusion

Lowering securitization costs has limited positive impact on output but counterfactual implication for interest rates.

Current securitization boom most likely a consequence of global saving glut with important redistributive impact.

Our model abstracts from asymmetric information frictions and specific changes in the regulatory environment.

Nonetheless, some key findings likely robust

- falling safe yields imply ambiguous welfare consequences for investors emphasizing safe assets;
- rents associated with cash-flow transformation activities should rise regardless of ultimate cause

Appendix

Tranching example

▸ Back

Entrepreneur needs to finance a project with uncertain returns: $x(G) = 2$ and $x(B) = 1$

Financing alternatives if investors are either risk-neutral (N) or infinitely risk averse (A)

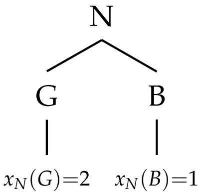
Tranching example

Back

Entrepreneur needs to finance a project with uncertain returns: $x(G) = 2$ and $x(B) = 1$

Financing alternatives if investors are either risk-neutral (N) or infinitely risk averse (A)

1. Sell a risky security to N



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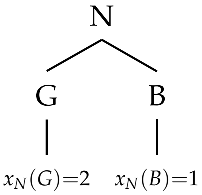
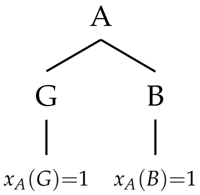


2. Sell a riskless security to A and eat remainder if G



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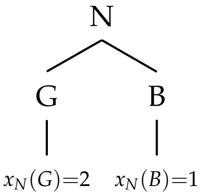

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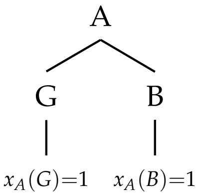
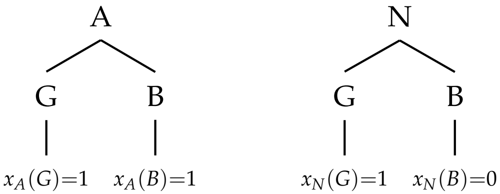


3. Tranche cash-flow: sell a riskless security to A and a risky one to N



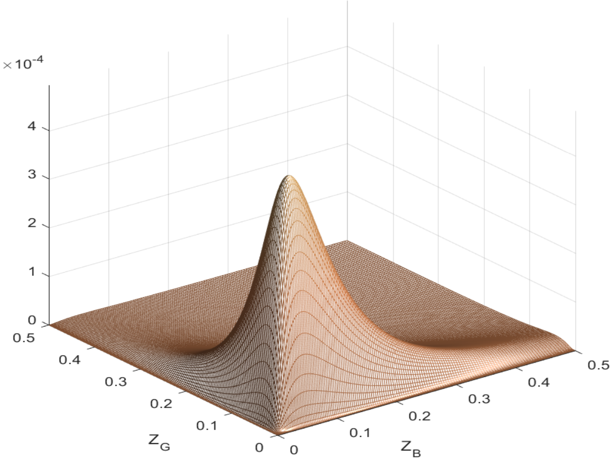
ALGORITHM

▸ BACK

1. Given parameters, solve for households' and producers' policy functions for every possible aggregate state of the economy;
2. Draw a 100-period sequence of aggregate shocks $\{\eta_t\}_{t=1}^{100}$ using the Markov transition matrix T and record the value of all endogenous variables starting from an arbitrary value of aggregate wealth;
3. After dropping the first 10 periods, so that assumed initial conditions have at most a negligible effect on the value of endogenous variables, compute average values for all endogenous variables.

Productivity distribution

▸ Back



PRODUCERS' SECURITIES POLICIES (ζ)

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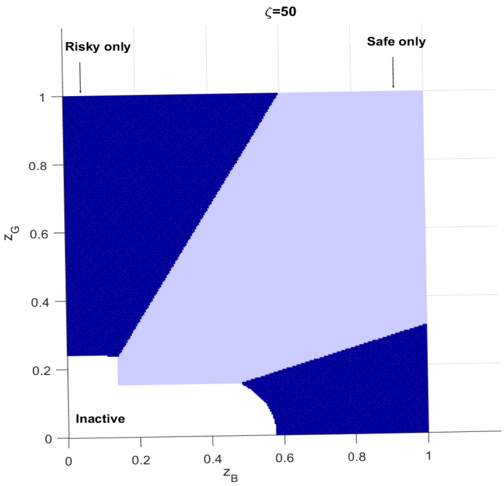

- For a prohibitively high security creation cost ζ, no producers issue both securities

PRODUCERS' SECURITIES POLICIES (ζ)

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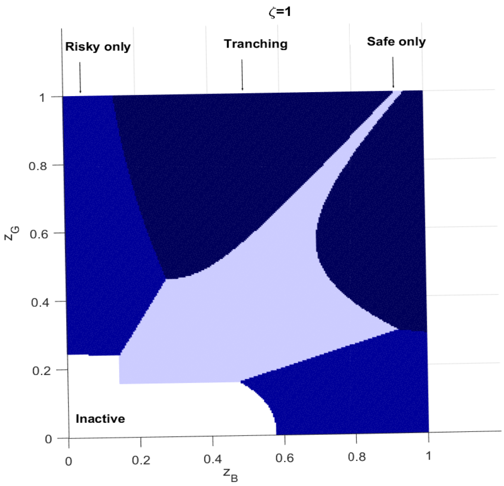

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- As ζ drops, highly productive projects start tranching

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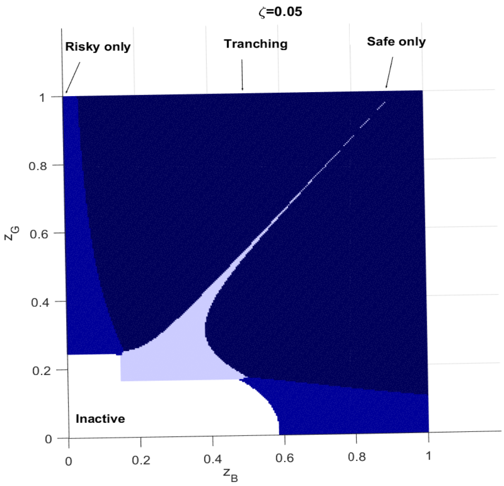

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- Eventually, the measure issuing exclusively riskless securities vanishes

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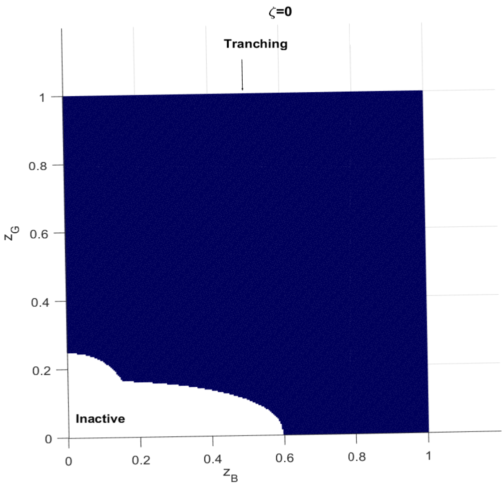

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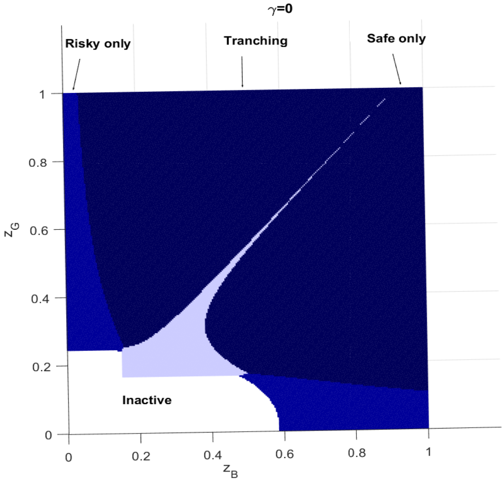

- As γ rises the mass of active producers increases
- The mass of producers issuing risky securities in exclusivity drops

PRODUCERS' SECURITIES POLICIES (γ)

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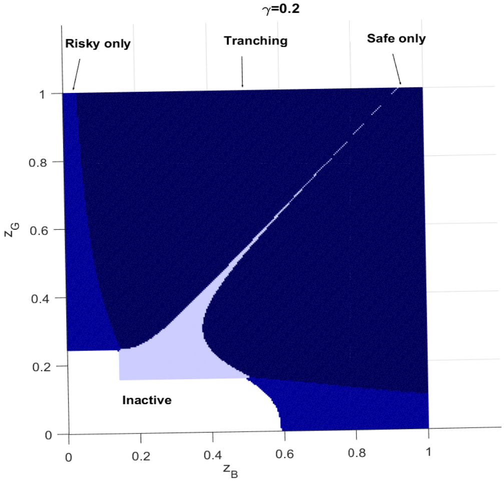

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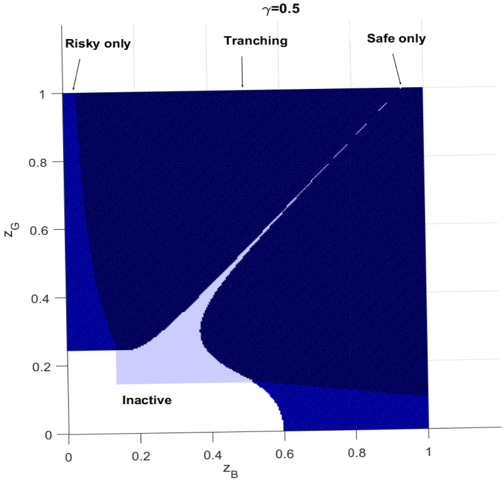
PRODUCERS' SECURITIES POLICIES (γ)

▸ BACK



- As γ rises the mass of active producers increases
- The mass of producers issuing risky securities in exclusivity drops

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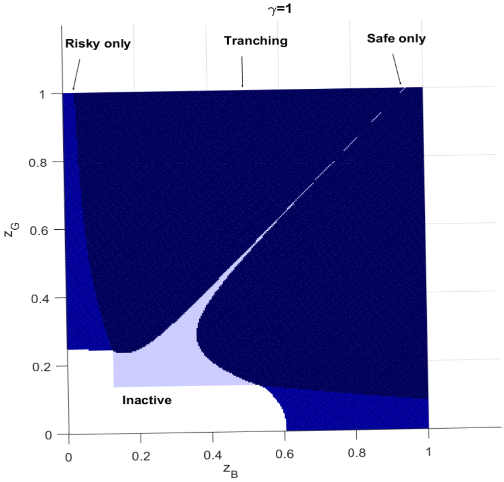

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