Financial Engineering and the Macroeconomy

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Definition

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

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- We shock both to cause changes in the quantity of costly security creation ...
- ... and quantify the impact on output, capital formation, TFP, and welfare

Preview of main results

- When security creation costs fall:
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- Impact on output, and capital formation is small . . .
- . . . and can in fact be negative
- TFP and output tend to move in opposite direction
- When increases in financial engineering are caused by changes in the distribution of investor types, the impact on output is even more likely to be negative

Literature

- King and Levine (1993), Rajan and Zingales (1998) ...
- Amaral and Quintin (2010), Midrigan and Xu (2014), Moll (2014) ...
- Berkes, Panizza and Arcand (2012), Gennaioli, Shleifer and Vishny (2012)
- Allen and Gale (1989, 1991), Corbae and Quintin (2016)

Other related papers

The environment

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- Binary aggregate shock η drawn each period from $\{B, G\}$ with transition matrix T

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- Mass θ_A of households are type A, θ_N are type N
- Households supply one unit of labor when young
- Large mass of two-period lived producers

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- Can activate a project in the first period of their life by installing a unit of capital
- Aggregate conditions are drawn
- An active producer of talent $z \in \{z_B, z_G\}$ transforms labor n into the consumption good according to

  $$z^{1-\alpha} n^{\alpha}$$

  where $\alpha \in (0, 1)$
- Define:

  $$\Pi(w; z) \equiv \max_{n>0} z^{1-\alpha} n^{\alpha} - nw$$

Producer preferences

- Producers consume at the start of either period of their life
- They order consumption plans $\left(c_{1,t}^{P}, c_{2,t}^{P}(B), c_{2,t}^{P}(G)\right)$ according to:

$$c_{1,t}^{P} + \epsilon E\left(c_{2,t}^{P}(\eta)|\eta_{t-1}\right),$$

where ϵ is a small but positive number

Producer problem (in words, first)

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Producer problem (in words, first)

- Producers finance their investment by selling claims to households
- Selling securities to one household type is free
- Selling securities to both types carries a fixed cost ζ
- They take the market value of securities as given

Producer problem

Active producers of type (z_B, z_G) maximize:

$$q_{A,t}\left(x_{A,t}(B), x_{A,t}(G)\right) + q_{N,t}\left(x_{N,t}(B), x_{N,t}(G)\right) + \epsilon E\left(c^P_{2,t}(\eta)|\eta_{t-1}\right) - 1 - \zeta 1_{\{x_{A,t}\neq 0, x_{N,t}\neq 0\}}$$

subject to:

$$\begin{aligned}
x_{A,t}(B) + x_{N,t}(B) + c^P_{2,t}(B) &\leq \Pi(w_t(B); z_B), \\
x_{A,t}(G) + x_{N,t}(G) + c^P_{2,t}(G) &\leq \Pi(w_t(G); z_G), \\
q_{A,t}\left(x_{A,t}(B), x_{A,t}(G)\right) + q_{N,t}\left(x_{N,t}(B), x_{N,t}(G)\right) &\geq 1 + \zeta 1_{\{x_{A,t}\neq 0, x_{N,t}\neq 0\}}, \\
x_A, x_N, c^P_2 &\geq 0
\end{aligned}$$

Security menus

From the point of view of households, the security menu is a set of available returns

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

on the securities issued by producers of type $z = (z_B, z_G) \in R_+^2$ for household type $i \in \{A, N)$

Type N households

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

subject to:

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

Pricing kernel for type N securities

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 risk-neutral agents 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 $(x(B),x(G))$ at date t.

Type A households

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

subject to:

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

Pricing kernel for type A securities

Letting

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

1. $q_{A,t}(x(B), x(G)) = \frac{\min(x(B),x(G))}{\bar{R}_{A,t}}$ if $c^A_{o,t}(B) = c^A_{o,t}(G)$,
2. $q_{A,t}(x(B), x(G)) = \frac{x(G)}{\bar{R}_{A,t}}$ if $c^A_{o,t}(B) > c^A_{o,t}(G)$,
3. $q_{A,t}(x(B), x(G)) = \frac{x(B)}{\bar{R}_{A,t}}$ if $c^A_{o,t}(B) < c^A_{o,t}(G)$

Equilibrium

An equilibrium consists of wage rates, security menus and returns, pricing kernels, and policies for all agents such that, at all dates and histories:

1. All agents optimize given prices
2. The market for labor clears
3. The market for each security clears
4. Pricing kernels assumed by producers are consistent with household decisions given the resulting securities menu

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Proposition

An equilibrium exists.

Financial policies (1)

Lemma

In any equilibrium, risk-averse households only purchase risk-free securities. Furthermore, $\bar{R}_{N,t} \geq \bar{R}_{A,t}$.

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So producers maximize:

$$\frac{x_A}{\bar{R}_{A,t}} + \frac{T(G|\eta_{t-1})x_N(G) + T(B|\eta_{t-1})x_N(B)}{\bar{R}_{1,t}}$$
$$-1 - \zeta 1_{\{x_A>0 \text{ and } x_N>0\}} + \epsilon E(c_2^P|\eta_{t-1}),$$

where:

$$\begin{aligned} x_A &\leq \min\{\Pi(w(B); z_B), \Pi(w(B); z_G)\}, \\ x_A + x_N(B) + c_2^P(B) &\leq \Pi(w(B); z_B), \\ x_A + x_N(G) + c_2^P(G) &\leq \Pi(w(G); z_G). \end{aligned}$$

Financial policies (2)

Proposition

Among active projects and μ-almost surely:

1. *Either* $x_A = 0$ *or* $x_A = \underline{\Pi}(z)$*;*

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Proposition

Among active projects and μ-almost surely:

1. *Either $x_A = 0$ or $x_A = \underline{\Pi}(z)$;*
2. *Producers pay ζ to sell securities in two markets when:*

$$\frac{T(G|\eta_{t-1})\left(\bar{\Pi}(z) - \underline{\Pi}(z)\right)}{\bar{R}_{N,t}} + \frac{\underline{\Pi}(z)}{\bar{R}_{A,t}} - \zeta \quad > \quad \epsilon\left(\bar{\Pi}(z) - \underline{\Pi}(z)\right) + \frac{\underline{\Pi}(z)}{\bar{R}_{A,t}} \text{, and,}$$

$$\frac{T(G|\eta_{t-1})\left(\bar{\Pi}(z) - \underline{\Pi}(z)\right)}{\bar{R}_{N,t}} + \frac{\underline{\Pi}(z)}{\bar{R}_{A,t}} - \zeta \quad > \quad \frac{T(G|\eta_{t-1})\bar{\Pi}(z) + T(B|\eta_{t-1})\underline{\Pi}(z)}{\bar{R}_{N,t}}.$$

Aggregation

Let K be the aggregate quantity of capital used to operate active projects. Then:

$$K = \int_{Z_\ominus} d\mu.$$

Furthermore,

$$F(\eta, K, N) = \bar{z}(\eta)^{1-\alpha} K^{1-\alpha} N^{\alpha},$$

where $\bar{z}$ is the average productivity of active projects.

A simple case (constant $\frac{z_G}{z_B}$)

Assume that

$$z_G = zA_G$$

while

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where $z > 0$ is the producer's idiosyncratic skill level. Then,

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2. Output, capital formation and TFP are only a function of $\underline{z}_t$
3. A change in ζ, holding prices constant, only affects the upper-threshold
4. It takes general equilibrium effects to move the lower threshold

The quantity of financial engineering

Three measures:

1. The mass of producers that bear the security creation cost
2. The market value of those producers
3. The resources spent on security creation:

$$\int_{Z_\ominus} \zeta 1_{\{x_A > 0 \text{ and } x_N > 0\}} d\mu$$

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Two shocks to the environment that move these quantities:

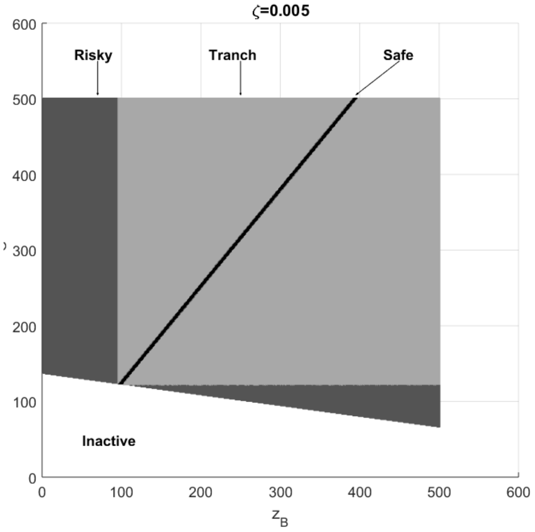
1. A drop in ζ
2. A increase in θ_A

Parametrization

- One period= 25 years
- $\theta_A = \theta_N = 0.5$
- $\beta = 0.68$
- $\alpha = 0.60$
- $T_{BB} = .2$, $T_{GG} = .9$
- μ is is specified to imply:
  1. Average output difference of 15% between good and bad times
  2. A ratio of producer rents to value added of around 10%
- Specifically, μ is a bivariate normal on $[0, 1]^2$ with mean $(\bar{\mu}_B, \bar{\mu}_G) = (0.1, 0.11)$
- Common coefficient of variation $\varsigma = \frac{\bar{\mu}_i}{\sigma_i} = 0.8$

Algorithm

Producer policies



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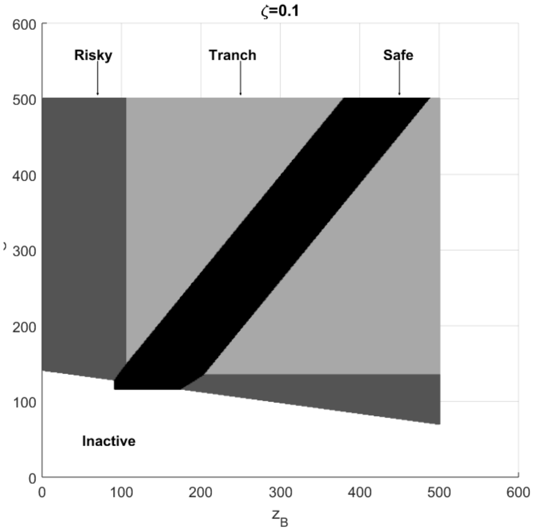

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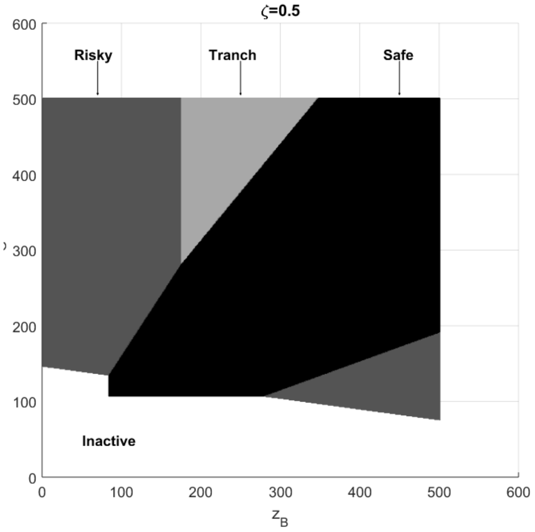

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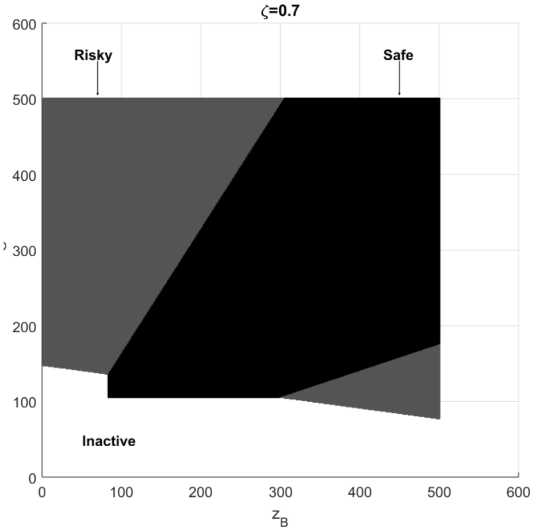
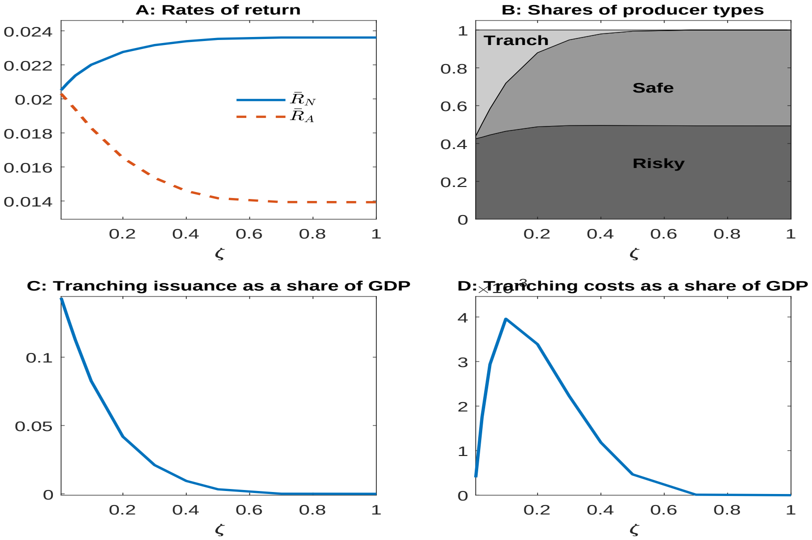


Measures of financial engineering



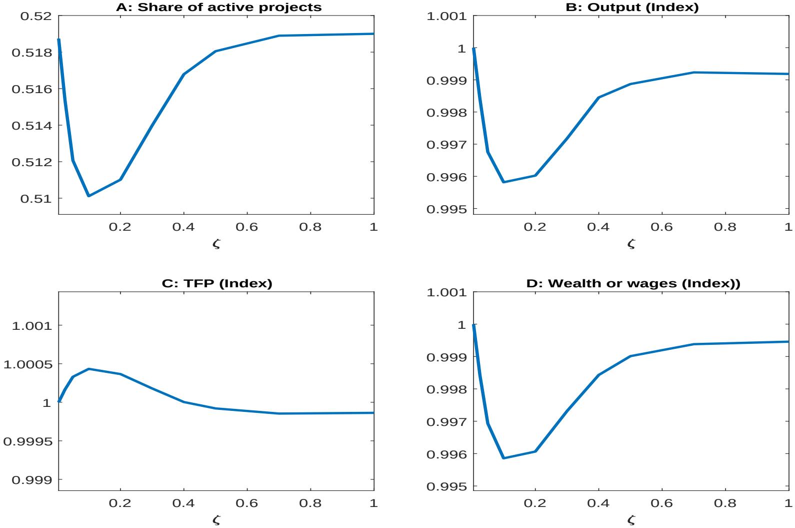
Comparative statics for capital formation

$$\Delta \text{ capital formation} = \Delta \text{ spending on securities}$$

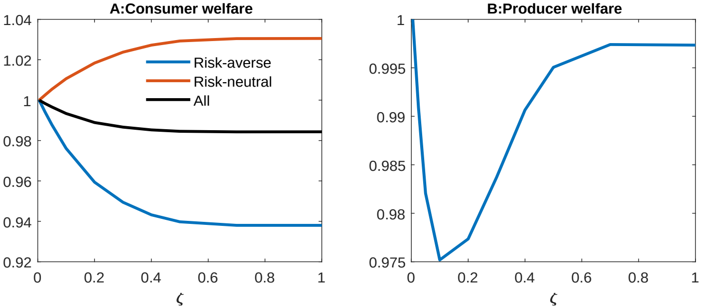
Comparative statics for capital formation

$$
\begin{aligned}
\Delta \text{ capital formation} &= \Delta \text{ spending on securities} \\
&- \Delta \text{ security creation expenditures} \\
&- \Delta \text{ producer rents.}
\end{aligned}
$$

Macroeconomic outcomes

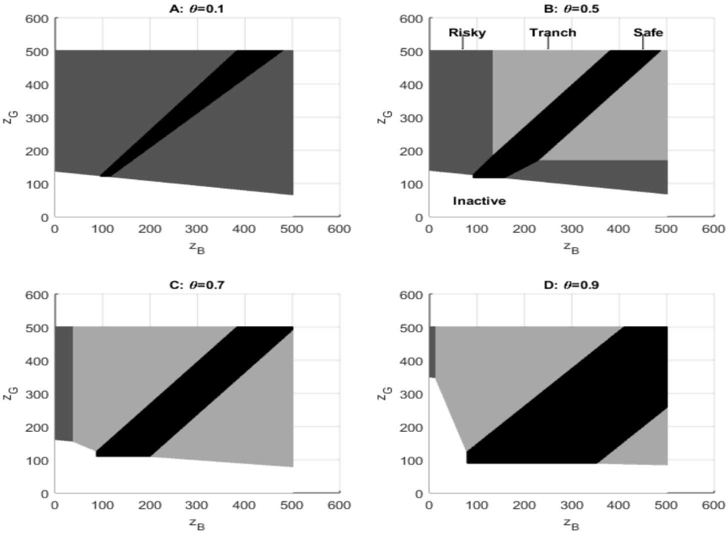


Welfare

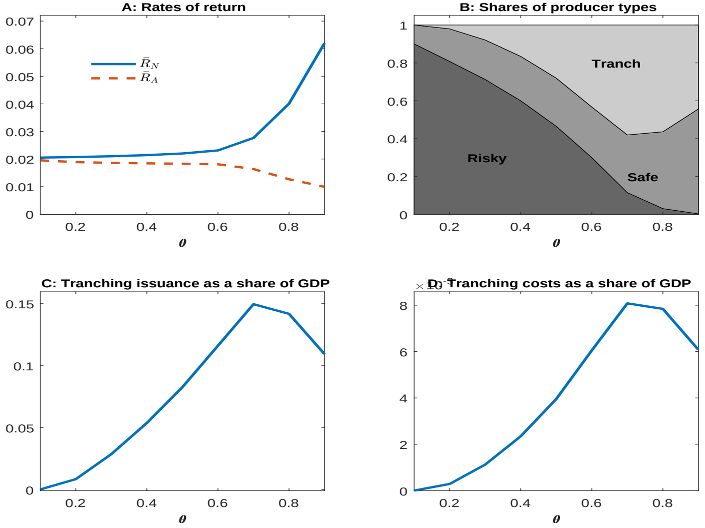


A:Consumer welfare
1.04
1.02
1
0.98
0.96
0.94
0.92
0
0.2
0.4
0.6
0.8
1
ζ
Risk-averse
Risk-neutral
All
B:Producer welfare
1
0.995
0.99
0.985
0.98
0.975
0
0.2
0.4
0.6
0.8
1
ζ

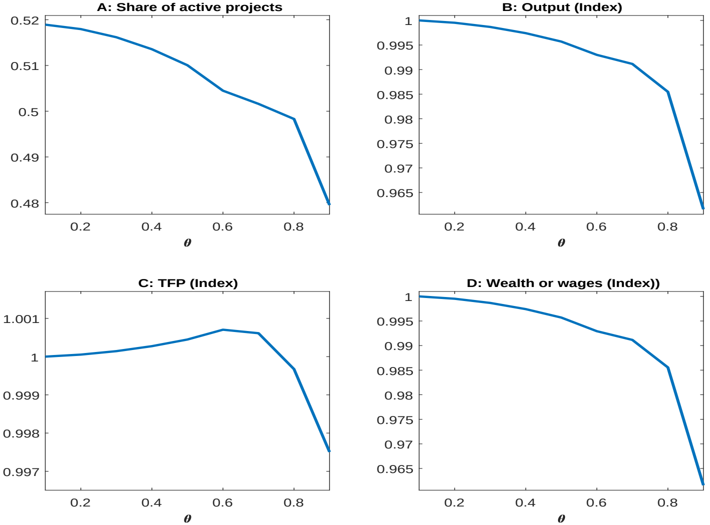
Producers' securities policies (θ)



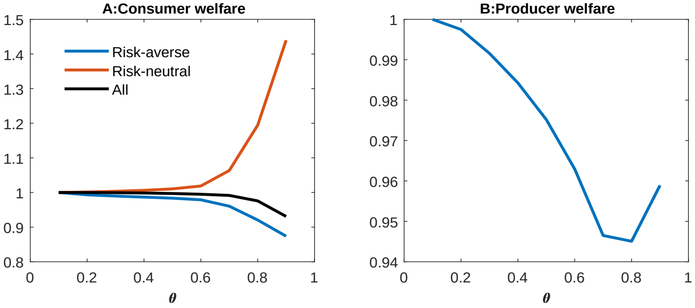
Measures of financial engineering (θ)



Macroeconomic outcomes (θ)



Welfare (θ)

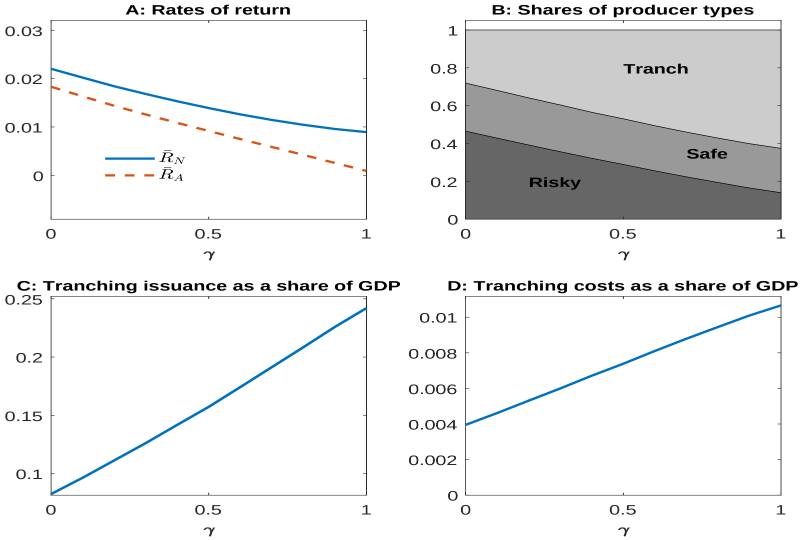


The global saving glut

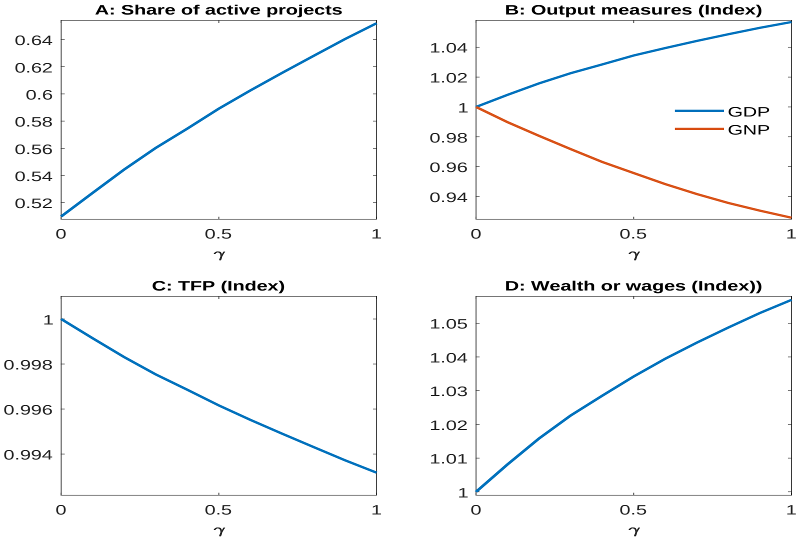
"Given the strength of demand for safe U.S. assets, it would have been surprising had there not been a corresponding increase in their supply."

Bernanke et al. (2011)

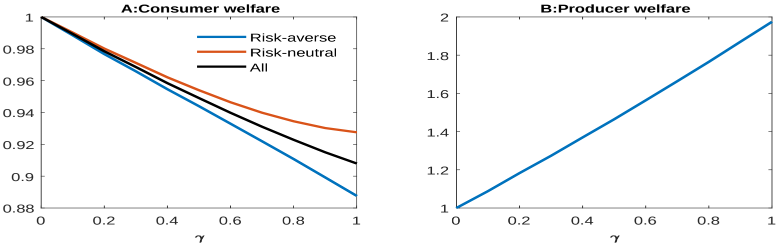
Measures of financial engineering (γ)



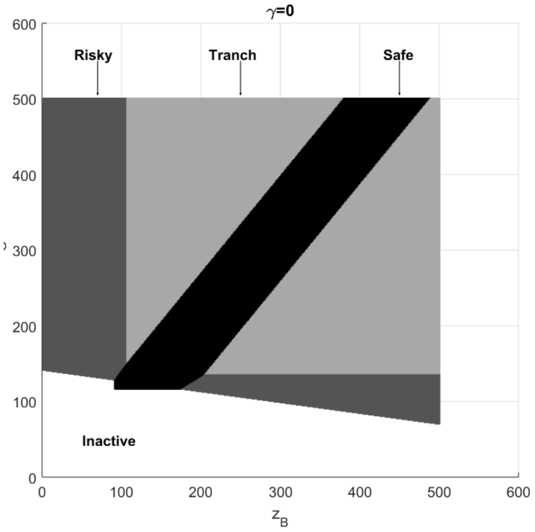
Macroeconomic outcomes (γ)



Welfare (γ)



Producer policies



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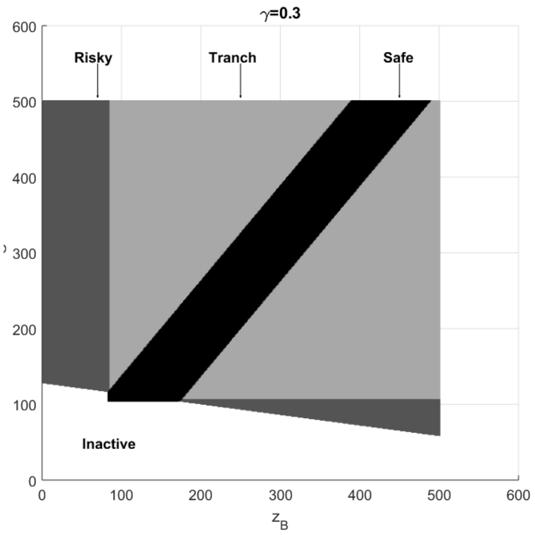

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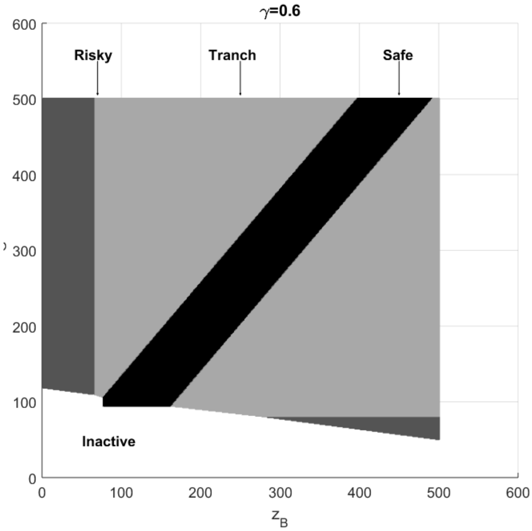

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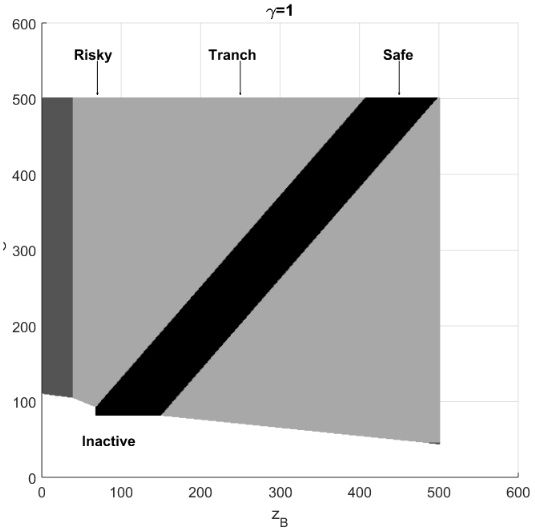
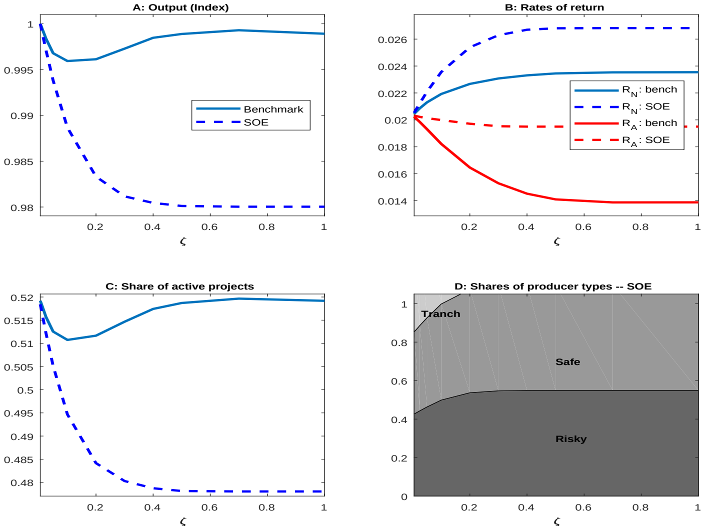


A small open economy $r^* = 0.0195$



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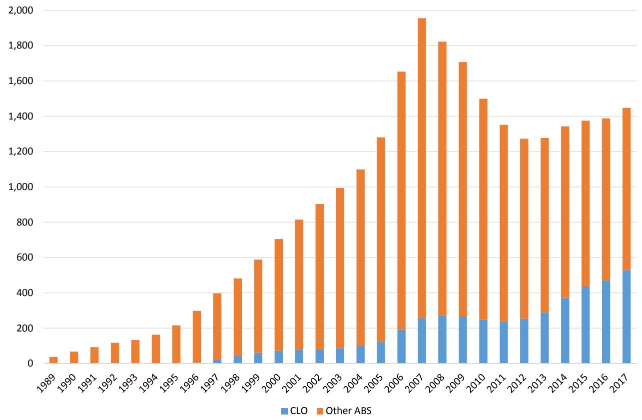
  1. Initially, institutional gains enable constrained producers to become active and/or operate more effectively.
  2. In economies with already well functioning markets, financial innovation tends to take the form of repackaging
- First phase delivers potentially high output and TFP gains
- Second phase probably not so much, if any

More papers

- Goldsmith (1969), McKinnon (1973) and Shaw (1973)
- Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Banerjee and Newman (1993), Khan (2001), Amaral and Quintin (2006)
- Erosa (2001), Jeong and Townsend (2007), Erosa and Cabrillana (2008), Quintin (2008), Buera, Kaboski, and Shin (2011), Buera and Shin (2013), Caselli and Gennaioli (2013)

Go back

US Asset-Backed Securities Outstanding



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Algorithm

1. Given parameters, solve for household and intermediary policy functions for every possible aggregate state of the economy;
2. Draw a 1000-period sequence of aggregate shocks $\{\eta_t\}_{t=1}^{1000}$ 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 100 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.

Go back

Welfare

Go back