Stabilization vs. Growth

Miguel Faria-e-Castro
FRB St. Louis

Pascal Paul
FRB San Francisco

Juan M. Sánchez
FRB St. Louis

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Motivation

- Advanced economies operate with some form of **soft credit** [Kornai, 1980]
  - Ex-post interventions that support firms in distress
  - Lending arrangements: evergreening (Japan 90s), restructuring (Chapter 11)
  - Fiscal interventions: business support, guarantee programs (COVID-19 recession)
- Possible trade-off: Stabilization vs. Business dynamism & growth
- Question: what are the effects of soft credit in a model of fluctuations & growth?
- **Challenges**:
  - Typical macro-models not designed to study this trade-off
    $\Rightarrow$ requires framework with business cycles, firm heterogeneity, endogenous growth
  - Key model parameters must be estimated for quantitative results

This paper: overview

Literature

What we do:

1. Develop GE model w/ firm heterogeneity, aggregate fluctuations, and endogenous growth
2. Parametrize the model w/ mix of calibration & estimation using micro data
3. Compare alternative economies:
   - Hard vs. soft credit (evergreening, restructuring, credit guarantees)
   - Study effects on growth, volatility, welfare
   - How does optimal policy differ under commitment vs. discretion?

Main findings:

1. Soft credit reduces volatility & makes economy more resilient, but reduces growth
2. Soft credit reduces firm exit, stabilizes production, weakens selection + GE effects
3. Eliminating soft credit in the U.S.: GDP growth $\uparrow$ (2%$\rightarrow$2.39%); std. dev. GDP growth $\uparrow$ (2.03$\rightarrow$2.81)
4. Policymaker with commitment eliminates soft credit, but discretion makes it worse!

Roadmap

Model

Calibration and estimation

Quantitative results

Welfare and policy

Roadmap

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Model structure

- Time is discrete and infinite $t = 0, 1, 2, \ldots$
- Demographics:
  - **Firms:** unit mass, intra-period heterogeneity via idiosyncratic shock ε
  - **Lenders:** unit mass, risk-neutral, matched one-to-one with firms
  - **Household**: representative, supplies labor and deposits, owns all claims ▸ details
- Key Features:
  1. Aggregate shocks $\Rightarrow$ business cycles
  2. Endogenous innovation (R&D) $\Rightarrow$ long-run growth
  3. Institutional arrangements in lender-borrower relationships:
     - hard credit: repay or default/exit
     - soft credit: allows some firms that would have otherwise defaulted to continue

Firms: technology and productivity

Production (decreasing returns):

$$y = a^{1-\eta}(\zeta k)^{\alpha} n^{\eta}, \quad a = z \cdot \varepsilon$$

- ζ = AR(1) capital quality shocks [e.g., Brunnermeier & Sannikov, 2014]
- z = fundamental productivity (same for all firms in eq.)
- $\varepsilon \sim F[0, \infty)$ is idiosyncratic productivity, i.i.d. across time and firms

Innovation (choice of z'):

$$\text{R\&D costs} = \phi \left(\frac{z'}{z^{1-\rho}(a^*)^{\rho}} \right)^{\kappa}, \qquad a^* = Z \times \mathbb{E}[\varepsilon | \text{incumbent}]$$

- ρ: learning spillovers from average productivity a^* [Monge-Naranjo, 2019]
- κ: curvature of R&D costs / innovation elasticity [Greenwood, Han, and Sánchez, 2022]

Firms: financial frictions

Debt instruments:

1. Intraperiod debt (working capital): firm borrows ℓ, repays $(1+i)\ell$ within period

$$\ell \geq wn$$

2. Interperiod debt: firm borrows qb', repays b' next period, s.t. collateral constraint

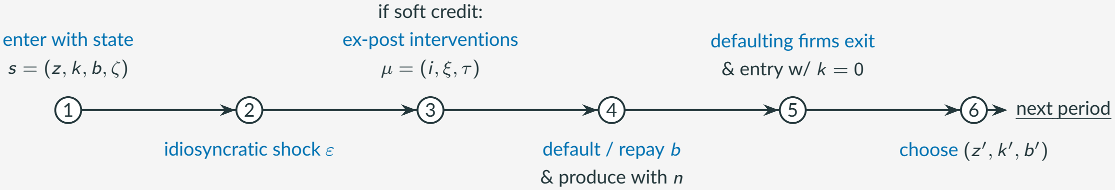
$$b' \leq \theta k'$$

Limited liability and default:

- Default at the start of the period, after shocks, before production
- In default, lender recovers

$$(1-\lambda)\zeta k$$

Timeline within a period



Ex-post soft credit interventions $\mu \rightarrow$ conditional on (s, ε):

- Evergreening: lenders may extend cheaper intraperiod credit $i \geq i^{reg}$
- Restructuring: lenders may write off fraction $\xi \leq \xi^{reg}$ of existing debt b
- Credit guarantees: government may issue targeted loan guarantee $\tau \leq \tau^{reg}$

Model structure: intra-period heterogeneity via ε + intertemporal aggregation

- Dynamic choices (z', k', b') remain identical across firms

Firm problem

1. **Enter period with $s \equiv (z, k, b, \zeta)$, observe ε and $\mu = (i, \xi, \tau)$, choose default iff:**

$$V_0(s, \varepsilon; \mu) < 0 \Leftrightarrow \varepsilon < \bar{\varepsilon}(s; \mu)$$

2. **If repay, pay fixed cost ν, hire labor n, borrow ℓ, produce $\rightarrow$ payout:**

$$V_0(s, \varepsilon; \mu) = \max_{n,\ell} (z\varepsilon)^{1-\eta} (\zeta k)^{\alpha} n^{\eta} - wn + \ell - (1 + i)\ell - \nu - b(1 - \xi) + (1 - \delta)\zeta k + \tau + V_1(s)$$

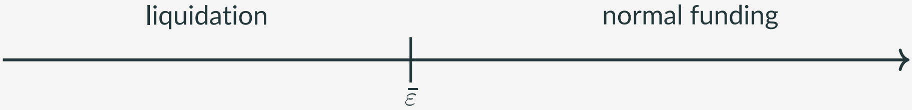
$$\text{s.t.} \quad \ell \geq wn$$

3. **Exiting firms replaced with entrants; all firms choose (z', k', b'):**

$$V_1(s) = \max_{z',k',b'} -\phi \left(\frac{z'}{z^{1-\rho}(a^*)^{\rho}} \right)^{\kappa} - k' + qb' + \mathbb{E}[M \cdot \max\{0, V_0(s', \varepsilon'; \mu')\}]$$

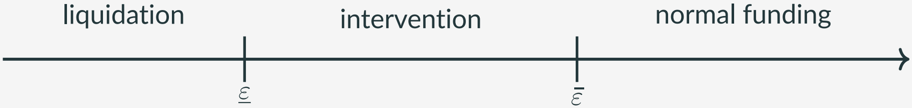
$$\text{s.t.} \quad b' \leq \theta k'$$

Intraperiod equilibrium: hard vs. soft credit



Soft Credit: interventions occur after shock ε is observed

1. Evergreening (interest-rate support): $i(s,\varepsilon) \in [i^{reg}, \omega]$
2. Restructuring (debt write-off) : $\xi(s,\varepsilon) \leq \xi^{reg}$
3. Loan guarantee (fiscal support): $\tau(s,\varepsilon) \leq \tau^{reg}$



Soft credit and growth: three transmission channels

eq. definition | balanced growth path

$$\underbrace{\frac{z'}{z}}_{\text{prod. growth}} = \underbrace{\left[\frac{(\varepsilon^*)^{\rho\kappa}}{\kappa\tilde{\phi}}\right]^{\frac{(1-\alpha)}{\kappa(1-\alpha)-(1-\eta)}}}_{\text{innovation costs}} \times \underbrace{\left\{\mathbb{E}\left[M \cdot \int_{\bar{\varepsilon}(s')}^{\infty} \frac{\partial V_0}{\partial z'} \, \mathrm{d}F(\varepsilon')\right]\right\}^{\frac{(1-\alpha)}{\kappa(1-\alpha)-(1-\eta)}}}_{\text{innovation benefits}}$$

(1) Spillovers:
Soft credit keeps low-ε firms alive, $\varepsilon^* \downarrow \Rightarrow$ higher innovation costs

(2) Congestion: More firms $\Rightarrow$ labor demand $\uparrow \Rightarrow$ wages $\uparrow \Rightarrow$ profits $\downarrow$

(3) Debt overhang: Larger "rescue" zone $\Rightarrow$ private innovation benefits $\downarrow$

Soft credit $\longrightarrow$ Innovation becomes more expensive & Payoffs get smaller $\longrightarrow$ Slower growth

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Calibration strategy

- Calibrate the model to annual U.S. data
- Benchmark: **evergreening economy**
  - based on evidence in Faria-e-Castro, Paul & Sánchez (2024)
- **Proceed in three steps**:
  1. External calibration of standard parameters ▸ details
  2. Direct estimation of parameters related to R&D cost and externality using micro data (κ, ρ)
  3. Internal calibration of remaining parameters to match moments of the U.S. economy

Estimating the R&D Cost Function

Model R&D Cost Function for firm i in industry s:

$$\mathrm{R\&D}_{i,s,t} = \phi_t \left(\frac{z_{i,s,t+1}}{z_{i,s,t}^{1-\rho} \, (a^*_{s,t})^{\rho}} \right)^{\kappa},$$

Objects in the data:

- $z_{i,s,t}$: firm productivity
- $a^*_{i,s,t}$: peer productivity (industry s excluding i)
- ϕ_t: common R&D cost trend

Take logs and re-arrange:

$$\log z_{i,s,t+1} - \log z_{i,s,t} = \frac{1}{\kappa} \left(\log \mathrm{R\&D}_{i,s,t} - \log \phi_t \right) + \rho \log \left(\frac{a^*_{i,s,t}}{z_{i,s,t}} \right)$$

Parameters to be identified: $1/\kappa$ and ρ

Empirical specification & identification

▸ TFP Estimation ▸ Details & Robustness

Empirical specification uses predetermined productivity terms & time FEs

$$\log z_{i,s,t+1} - \log z_{i,s,t-1} = \mu_t + \beta_1 \log \mathrm{R\&D}_{i,s,t} + \beta_2 \log\left(\frac{a^*_{s,t-1}}{z_{i,s,t-1}}\right) + u_{i,s,t}$$

- **Endogeneity concern**: $\mathrm{R\&D}$ correlated with unobservables (e.g. expected growth)
- IV approach: state-level R&D tax credits [Wilson, 2009; Bloom et al., 2013]
- **First stage**: higher credits $\Rightarrow$ higher reported firm R&D; F-stat $\approx$ 15–20
- **Data:** annual Compustat, sample: 1982–2023; obtain firm-level TFP estimates

Results: $\hat{\beta}_1 = 0.33^{***}$, $\hat{\beta}_2 = 0.30^{***} \Rightarrow \hat{\kappa} \approx 1/\hat{\beta}_1 \approx 3, \quad \hat{\rho} \approx 0.30$

- Magnitude: 1% more R&D or 1% larger peer gap $\Rightarrow$ 0.3% higher prod. growth
- Robustness: baseline lies near middle of range $\beta_1 \in [0.22, 0.51]$, $\beta_2 \in [0.23, 0.41]$

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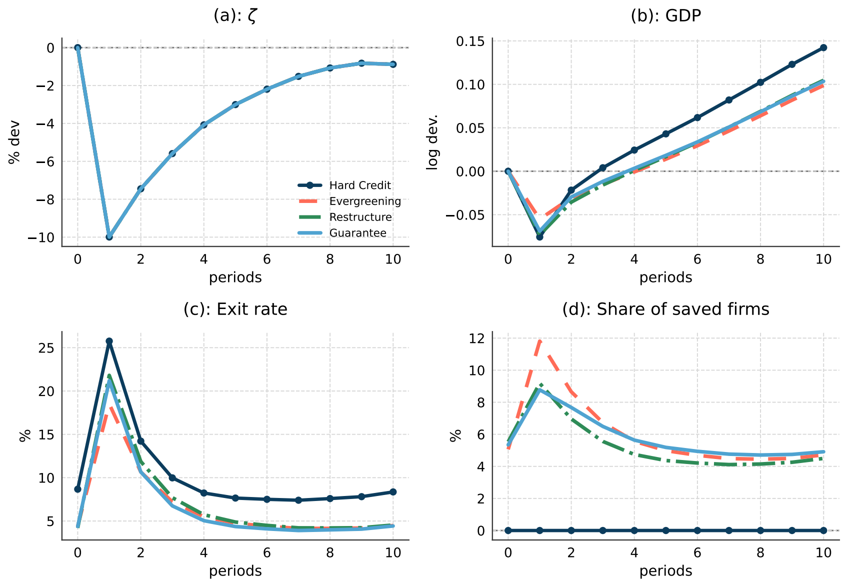
Impact of soft credit on balanced growth path

PD ε | policy functions

Moment	Hard Credit	Evergreening	Restructure	Guarantee
Share of subsidized firms, %	0.00	5.00	5.00	5.00
Exit rate, %	8.86	4.91	4.92	4.96
Wage	0.73	0.78	0.78	0.78
Average iid productivity, ε^*	1.05	1.03	1.03	1.03
GDP growth	2.39	2.00	2.05	2.06
std. dev. GDP growth	2.81	2.03	2.27	2.25
$corr(\mathrm{R\&D}, Y)$	0.69	0.90	0.85	0.90

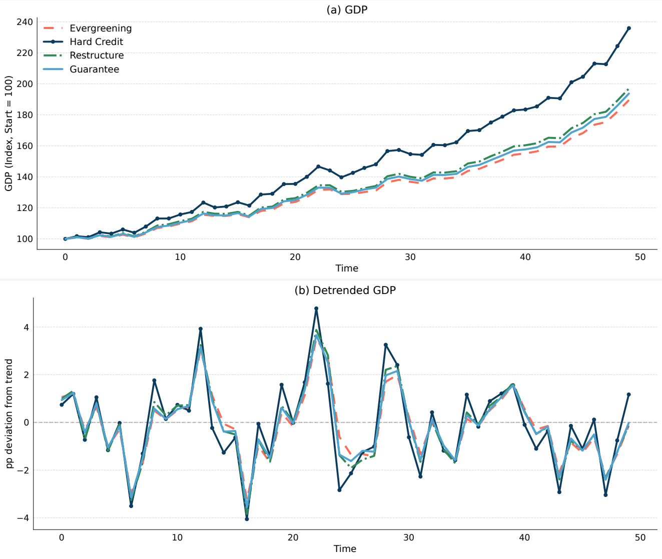
Hard credit features more exit, stronger selection, faster growth, and more volatile GDP.

IRF to capital quality shock: soft credit economies more resilient



Hard credit: faster growth, more volatile business cycles

recession episodes



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Welfare effects of soft credit

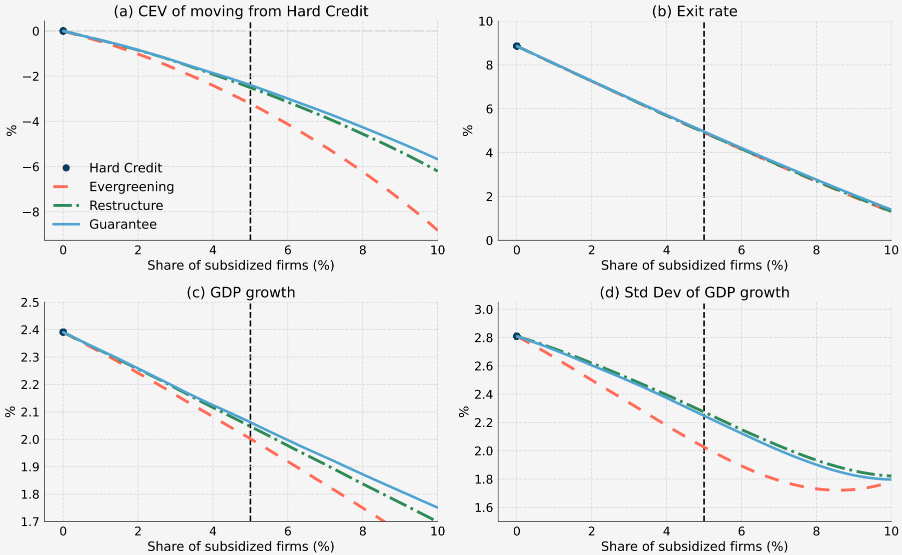
▸ welfare measurement ▸ details on welfare comparison ▸ transitional dynamics

CEV of moving from Hard Credit to...	Evergreening	Restructuring	Guarantee
CEV, total	-3.13	-2.47	-2.32
CEV, mean	-2.37	-1.82	-1.62
CEV, volatility	-0.76	-0.65	-0.70
CEV, cyclical volatility	0.10	-0.01	0.09
CEV, trend volatility	-0.52	-0.31	-0.52
CEV, volatility from $\text{Cov}(x, z)$	-0.28	-0.27	-0.22

Soft credit lowers welfare because weaker growth and a less stable stochastic trend dominate cyclical stabilization gains.

Optimal policy: commitment to a constant policy

▸ Comparative statics ρ



Hard credit is always optimal!

Optimal policy: discretion

details

Moment	Hard Credit	Evergreening	Restructuring	Guarantee
Share of subsidized firms (%)	0.00	7.21	7.37	7.47
Exit rate (%)	8.86	3.22	2.98	2.94
Detrended wage, $\tilde{w}$	0.73	0.80	0.80	0.80
Average iid productivity, ε^*	1.05	1.02	1.02	1.02
GDP growth	2.39	1.82	1.85	1.88
std. dev. GDP growth	2.81	2.03	2.01	1.99
CEV, total		-5.22	-4.59	-4.22

Under discretion, policymakers choose more soft credit, lowering exit and volatility but further reducing growth and welfare.

Conclusion

- **Research Question**: What are the effects of ex-post interventions (“soft credit”)?
- **Approach**: Develop and calibrate tractable general equilibrium model with business cycles, firm heterogeneity, and endogenous growth.
- **Key channel**: Soft credit allows low-productivity firms to survive, which affects productivity of other firms due to innovation externalities.
- This stabilizes the economy in the short run, but slows down long-run growth.
- “Soft credit” tends to arise when a benevolent government acts under discretion
  - Direct government intervention, i.e. credit guarantees [Kornai, Maskin & Roland, 2003]
  - Financial system architecture, i.e. evergreening [Faria-e-Castro, Paul & Sánchez, 2024]

APPENDIX

Literature

back

1. The soft budget constraint: Kornai (1980, 1986); Dewatripont & Maskin (1995); Kornai, Maskin, and Roland (2003)
   - Microfound the SBC in a model of business cycles and endogenous growth
2. Innovation, finance & growth: Howitt and Levine (2018); Celik (2023); Ottonello and Winberry (2024); Aghion, Bergeaud, Dewatripont & Matt (2025)
   - Interactions between financial frictions and endogenous innovation; business cycles & endogenous growth
3. Cleansing effects of recessions: Caballero and Hammour (1994), Barlevy (2003), Ouyang (2009)
   - New mechanism for the cleansing effect of recessions + features that can mute this mechanism
4. Technology spillovers: Hall (2011); Bloom, Schankerman and Van Reenen (2013); Monge-Naranjo (2019); Atkeson and Burstein (2019), Akcigit, Hanley and Stantcheva (2022)
   - Complementary estimates for spillovers of R&D investment across firms
5. Welfare costs of business cycles: Lucas (1987, 2003)
   - Policymaker without commitment may value stabilization over long-run growth

Representative Household

back

- Representative household maximizes PDV of period utility with discount factor β
- Flow utility follows King, Plosser & Rebelo (1988), required for balanced growth

$$u(X) = \frac{X^{1-\sigma}}{1-\sigma}$$

where X is a consumption-labor composite

$$X(C,N) = C\left[1 + (\sigma - 1)\chi\frac{N^{1+\varphi}}{1+\varphi}\right]^{\frac{\sigma}{1-\sigma}}$$

- Budget constraint:

$$C + Q^d D' = wN + D + \Psi - T$$

- Ψ are firm and intermediary profits
- T are lump-sum taxes: government runs balanced budget in the economy with guarantees

Lenders: intraperiod problem

- Lenders raise deposits at price Q^d to competitively offer interperiod debt at q ▸ dynamic problem
- Lenders raise resources at linear cost ω to fund intraperiod lending
- Hard credit: lend at $i = \omega \rightarrow$ free entry of new lenders creates upper bound
- Evergreening and Restructuring: internalize effects of i and ξ on default decision

$$W_0(s,\varepsilon) = \max_{i \geq i^{reg}, \xi \leq \xi^{reg}} \underbrace{\mathbf{1}[\varepsilon \geq \bar{\varepsilon}(s; i, \xi)]}_{\text{no default}} \{\underbrace{b(1-\xi) + (i-\omega)wn(s,\varepsilon; i)}_{\text{lend, continue}}\}$$

$$+ \underbrace{\mathbf{1}[\varepsilon < \bar{\varepsilon}(s; i, \xi)]}_{\text{default}} \underbrace{(1-\lambda)\zeta k}_{\text{recovery}}$$

Lenders: dynamic problem

back

- Each firm maintains a relationship with a risk-neutral lender
- Lender chooses deposits d' and price of debt q s.t. funding constraint

$$W_1(s) = \max_{q,d'} \mathbb{E}_{\zeta',\varepsilon'}\{M \cdot [W_0(z'(s;q), k'(s;q), b'(s;q), \zeta', \varepsilon') - d']\} \quad \text{s.t.} \quad qb'(s;q) \leq Q^d d'$$

- **Free entry**: zero expected profits

$$W_1(s) = 0 \Rightarrow q = \frac{\mathbb{E}[M \cdot W_0(z'(s;q), k'(s;q), b'(s;q), \zeta', \varepsilon')]}{b'(s;q)}$$

- Ex-post profits/losses are rebated lump-sum to household

Intraperiod equilibrium w/. evergreening

back

Define the following objects:

1. $i^{\max}(s, \varepsilon)$: max rate for which firm does not default

$$i^{\max}(s, \varepsilon) = \max\{i : \bar{\varepsilon}(s; i) = \varepsilon\}$$

2. $i^{\min}(s, \varepsilon)$: min rate for which lender is indifferent between lending or liquidating

$$i^{\min}(s, \varepsilon) = \min\{i : W_0(s, \varepsilon; i) = (1 - \lambda)\zeta k\}$$

Intraperiod equilibrium w/. evergreening

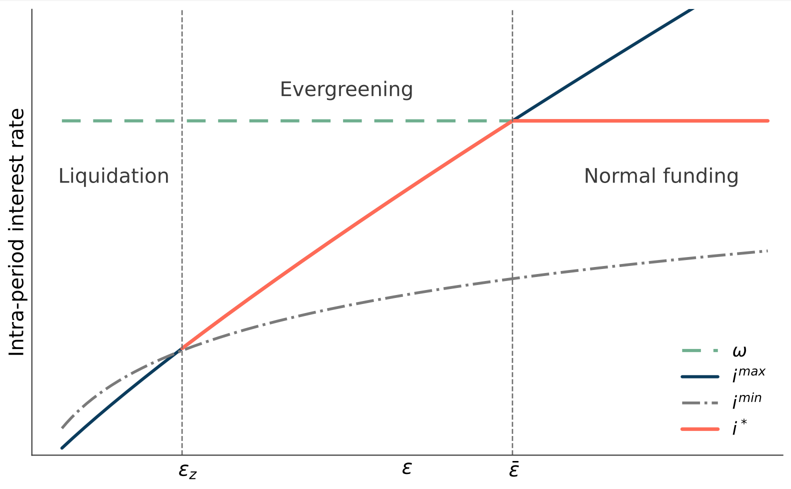
back

The intraperiod equilibrium can be characterized in terms of a distress threshold $\bar{\varepsilon}(s)$ and a liquidation threshold $\underline{\varepsilon}_z(s)$ for idiosyncratic productivity:

1. If $\varepsilon > \bar{\varepsilon}(s)$, the firm is in the normal funding region and $i = \omega$ (not distressed)
2. If $\varepsilon \in [\underline{\varepsilon}_z(s), \bar{\varepsilon}(s)]$, the firm is the evergreening region and $i \in [i^{reg}, \omega)$ (distressed)
3. If $\varepsilon < \underline{\varepsilon}_z(s)$, the firm is liquidated.

Example: evergreening

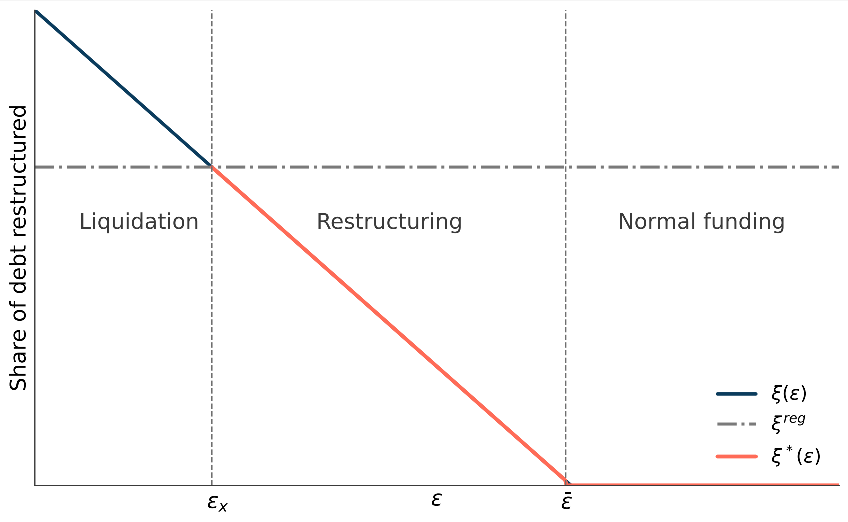
▸ back



- **Evergreening:** lender takes losses on intraperiod loan to recover legacy b
- Subsidized interest rates $\Rightarrow$ lower WK costs $\Rightarrow$ higher labor demand for low-prod. firms

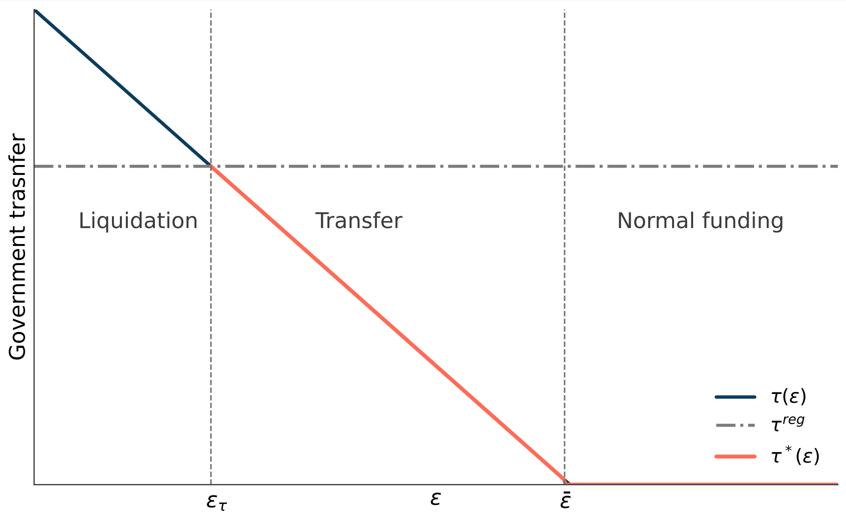
Intraperiod equilibrium with restructuring

back



Intraperiod equilibrium with guarantees

back



Competitive equilibrium

back

Allocations $(C_t, N_t, D_{t+1}, z_{t+1}, k_{t+1}, b_{t+1}, n_t, \ell_t)$, prices (w_t, q_t), and thresholds $(\underline{\varepsilon}_t, \bar{\varepsilon}_t)$ such that:

1. Households
   - choose $\{C_t, N_t, D_{t+1}\}$ to maximize utility
   - subject to the budget constraint, taking prices and firm behavior as given
2. Firms
   - choose inputs (n_t, ℓ_t) and dynamic policies $(z_{t+1}, k_{t+1}, b_{t+1})$
   - maximize firm value given prices, lending terms, and thresholds
   - Symmetry: all firms follow the same policy, $s_t = S_t$
3. Lenders
   - choose contract terms and debt prices (i_t, ξ_t, q_t)
   - subject to regulation, funding constraints, and free entry
   - thresholds satisfy firms' indifference conditions
4. Markets clear
   - labor, goods, deposits, intraperiod debt, interperiod debt

Balanced growth path

back

- Economy admits a BGP with detrending factor

$$z_t^{\frac{1-\eta}{1-\alpha}}$$

- We solve for a detrended version of the model, where for each variable X_t:

$$X_t = x_t \cdot z_t^{\frac{1-\eta}{1-\alpha}}$$

- Letting $G_{z,t} \equiv z_{t+1}/z_t$, all real quantities in the economy grow at gross rate

$$G_{z,t}^{\frac{1-\eta}{1-\alpha}}$$

External calibration

back

Parameter	Description	Value	Target/Reason
β	Discount factor	0.98	Acemoglu et al., 2018
σ	Inverse EIS	2	Acemoglu et al., 2018
φ	Inv. Frisch elasticity	1	Standard
α	Capital share	$0.36 \times \psi$	Standard
η	Labor share	$0.64 \times \psi$	Standard
δ	Depreciation rate	0.08	Standard
θ	Collateral constraint	1	Debt / fixed-assets $\simeq$ 1, Y-14
λ	Loss given default	0.35	Y-14 data
ω	Lending cost	0.02	2% annual, Gilchrist & Zakrajsek, 2012

Internally calibrated parameters

back

Parameter	Description	Value	Moment	Source	Data	Model
σ_ε	Variance of prod.	0.406	TFP of exiting/continuing firms	Lee & Mukoyama (2015)	0.65	0.65
ν	Fixed cost	-0.226	Exit/default rate	Crane et al. (2022)	5.0%	4.9%
i^{reg}	Lower bound int. rate	-0.105	Credit spread	Y-14 data	2.0%	2.0%
ψ	Returns to scale	0.860	EBITDA/Value Added	Compustat	30.0%	30.0%
$\tilde{\phi}$	Level cost of R&D	0.358	GDP pc growth	U.S. data	2%	2%
ρ_ζ	Capital quality persistence	0.736	GDP growth rate, AR	U.S. data	0.16	0.16
σ_ζ	Capital quality volatility	0.035	GDP growth rate, SD	U.S. data	0.02	0.02

TFP Estimation

back

- Use annual firm data from S&P's Compustat for years 1982-2023
- Use perpetual inventory method to estimate capital stock [Ottonello & Winberry, 2020]

$$\log(\text{value added}_{i,t}) = \alpha + \beta_{1,s} \cdot \log(\text{capital}_{i,t-1}) + \beta_{1,s} \cdot \log(\text{employees}_{i,t}) + u_{i,t},$$

where we allow β_1 and β_2 to vary by industry s

- Recover the log-TFP estimates as

$$\log(TFP_{i,t}) = (\hat{\alpha} + \hat{u}_{i,t})/(1-\eta).$$

- Divide by calibrated $(1-\eta)$ to align estimates with assumed production function.

Estimates R&D Cost Function (1)

back

	(i) Baseline	(ii) Fixed Effects	(iii) TFP-Def.	(iv) Learning	(v) Capital	(vi) ACF-2015
$\beta_1\ (= 1/\kappa)$	0.35***	0.52***	0.41***	0.53***	0.24***	0.22***
	(0.09)	(0.13)	(0.12)	(0.14)	(0.07)	(0.06)
$\beta_2\ (= \rho)$	0.29***	0.39***	0.39***	0.39***	0.23***	0.40***
	(0.02)	(0.03)	(0.05)	(0.04)	(0.01)	(0.04)
Time FE	✓		✓	✓	✓	✓
Industry-Time FE		✓				
First-Stage F-Stat	19	18	15	16	24	15
R-squared	0.12	0.17	0.12	0.14	0.11	0.14
Observations	34,556	34,243	34,556	34,556	35,519	38,868
Number of Firms	4,847	4,823	4,847	4,847	5,380	5,010
Number of Industries	46	41	46	46	47	47

Estimates R&D Cost Function (2)

back

	(i) Baseline (IV)	(ii) Baseline (OLS)	(iii) Knowledge Stock (IV)	(iv) Knowledge Stock (OLS)	(v) R&D Intensity (IV)	(vi) R&D Intensity (OLS)
β_1 $(= 1/\kappa)$	0.35***	0.04***	0.19***	0.06***	0.55***	0.00
	(0.09)	(0.00)	(0.05)	(0.01)	(0.12)	(0.03)
β_2 $(= \rho)$	0.29***	0.23***	0.30***	0.27***	0.17***	0.18***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Time FE	✓	✓	✓	✓	✓	✓
First-Stage F-Stat	19		51		227	
R-squared	0.12	0.12	0.15	0.15	0.09	0.09
Observations	34,556	34,556	21,406	21,409	69,908	70,028
Number of Firms	4,847	4,847	3,471	3,472	9,045	9,057
Number of Industries	46	46	46	46	50	50

Estimates R&D Cost Function (3)

back

	(i) Baseline	(ii) h=2	(iii) h=3	(iv) LP	(v) Bootstrap
β_1 $(= 1/\kappa)$	0.35***	0.41***	0.51***	0.17***	0.36***
	(0.09)	(0.12)	(0.18)	(0.04)	(0.12)
β_2 $(= \rho)$	0.29***	0.34***	0.40***	0.33***	0.29***
	(0.02)	(0.03)	(0.04)	(0.03)	(0.03)
Time FE	✓	✓	✓	✓	✓
First-Stage F-Stat	19	15	11	19	19
R-squared	0.12	0.14	0.13	0.1	0.12
Observations	34,556	29,033	24,641	39,238	34,556
Number of Firms	4,847	4,518	3,824	5,789	4,847
Number of Industries	46	46	46	47	46

Estimates R&D Cost Function (4)

back

	(i) Baseline	(ii) P50	(iii) P75	(iv) P90	(v) Patents
β_1 $(= 1/\kappa)$	0.35***	0.49***	0.43***	0.41***	0.43***
	(0.09)	(0.13)	(0.11)	(0.11)	(0.12)
β_2 $(= \rho)$	0.29***	0.37***	0.36***	0.34***	0.30***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Time FE	✓	✓	✓	✓	✓
First-Stage F-Stat	19	16	17	18	15
R-squared	0.12	0.14	0.14	0.13	0.13
Observations	34,556	34,556	34,556	34,556	24,136
Number of Firms	4,847	4,847	4,847	4,847	2,857
Number of Industries	46	46	46	46	42

Probability distribution function of idiosyncratic productivity

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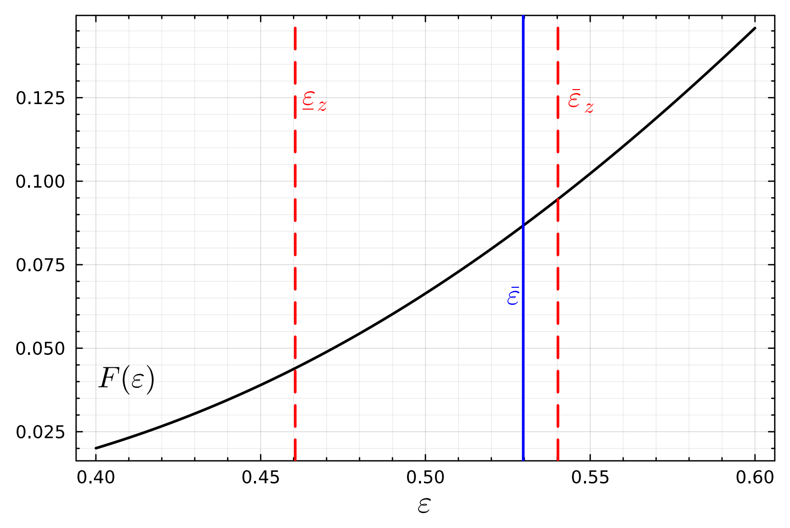
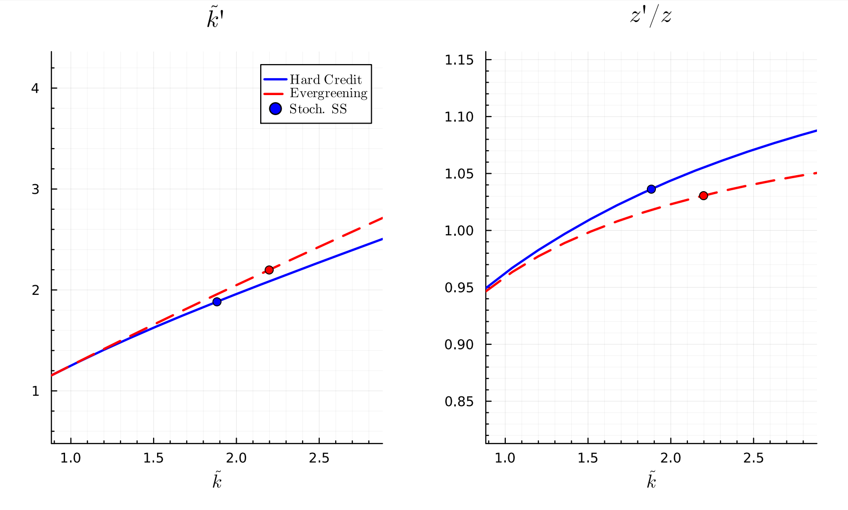


Firm policy functions for physical capital and R&D

back



Average recession episodes

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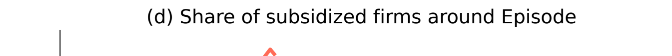

Measuring welfare

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- Expected PDV of flow utility for rep. household in economy k details

$$\mathcal{U}^k = \mathbb{E} \sum_{t=0}^{\infty} \beta^t u(X_t^k)$$

- X is the consumption-labor composite good in King, Plosser & Rebelo (1988) preferences

$$X_t^k = \underbrace{x_t^k}_{\text{cyclical part}} \times \underbrace{(z_t^k)^{\frac{1-\eta}{1-\alpha}}}_{\text{stochastic trend}}, \qquad z_t^k = \prod_{s=0}^{t-1} G_{z,s}^k$$

- Second-order approximation of welfare:

$$\mathcal{U}^k \simeq \mathcal{U}_{\text{mean}}^k + \mathcal{U}_{\text{vol}}^k$$

- Further approximate volatility component as:

$$\mathcal{U}_{\text{vol}}^k = \mathcal{U}_{\text{vol,cyclical}}^k + \mathcal{U}_{\text{vol,trend}}^k + \mathcal{U}_{\text{vol,cov}}^k$$

Details on Welfare Comparisons

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- Welfare differences reported in terms of consumption-equivalent variation [Lucas, 2003]

$$\lambda = 100 \times \left(\frac{\mathcal{U}^{HC}}{\mathcal{U}^{SC}} - 1 \right)$$

- Assume that all economies start out with the same set of states:

$$z_0 = 1, \qquad k_0 = k^*_{HC}, \qquad \zeta_0 = 1$$

where k^*_{HC} is the stochastic SS of the hard credit economy

- Accounts for transition dynamics

Transitional Dynamics: Hard Credit vs. Evergreening

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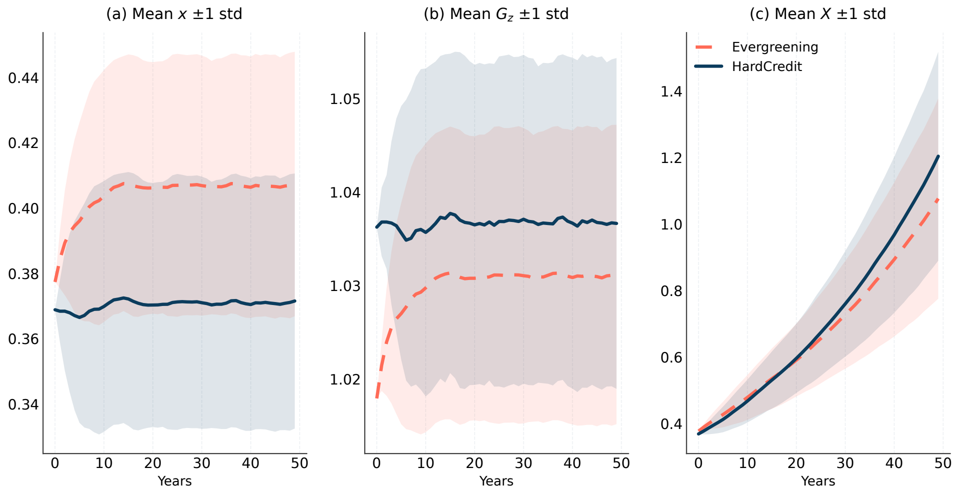
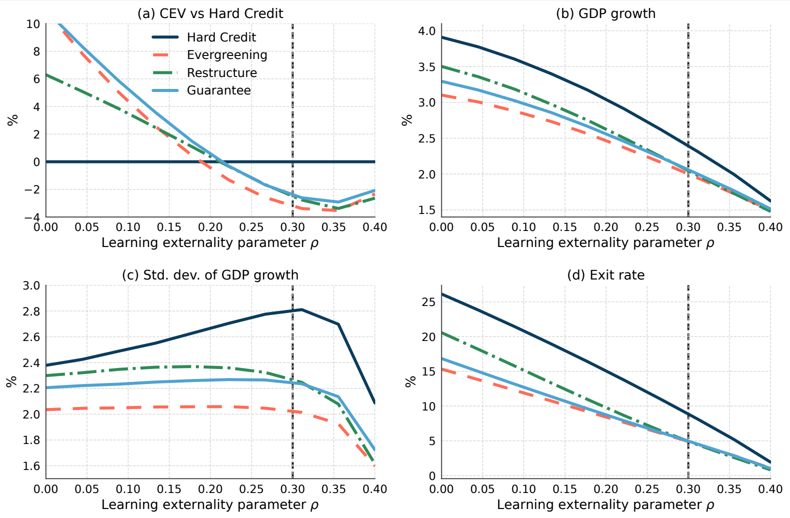


Comparative statics w.r.t. ρ

back



- Welfare comparisons invert when $\rho \to 0$, but stabilization-growth trade-off remains

Optimal policy without commitment

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Assume policymaker solves the following problem

$$\tilde{\mathcal{U}}(\tilde{k}, \zeta) = \max_{\varpi^{reg}} u(\tilde{C}, N) + \beta G_z^{(1-\sigma)\frac{1-\eta}{1-\alpha}} \mathbb{E}[\tilde{\mathcal{U}}(\tilde{k}', \zeta')]$$
$$\text{s.t.} \;\; (\tilde{C}, N, \tilde{k}', G_z) \in \mathcal{Y}(\tilde{k}, \zeta; \varpi^{reg})$$

where

- $\tilde{\mathcal{U}}$ is a recursive formulation of detrended welfare
- $\varpi^{reg} \in \{i^{reg}, \xi^{reg}, \tau^{reg}\}$ is the choice of policy
- $\mathcal{Y}(\tilde{k}, \zeta; \varpi^{reg})$ is the set of equilibrium allocations