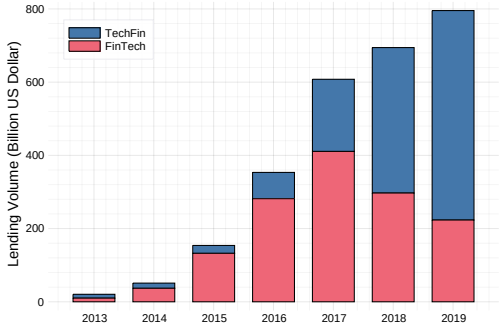
The Macroeconomics of TechFin

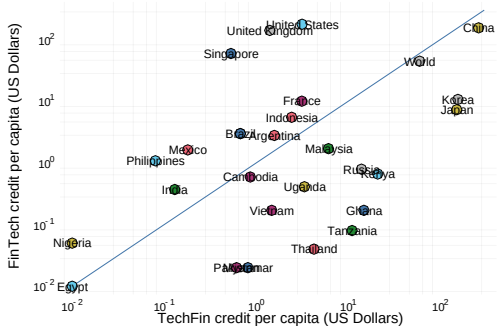
Dan Su

CKGSB

EEA-ESEM 2022

Rise of New Financial Intermediaries





- **FinTech**: digital lending facilitated by online platforms (e.g., P2P, ...)
- **TechFin/BigTech**: large tech companies lend in the credit markets (e.g., Ant Group, WeBank, ...)

- **a growing empirical literature, but theoretical implications?**

Research Question: role of TechFin in macroeconomy

- **Existing literature: banks**
  - **key characteristic**: collateral-based borrowing constraint ("financial frictions")
  - **macro implications**: aggregate productivity losses; financial accelerator mechanism
- **This paper**
  1. **what is the key difference between banks and BigTech in lending behaviors?**
  2. **how different are these macro implications with TechFin?**

- why TechFin instead of FinTech: TechFin is more bank-like (Stulz, 2019; King, 2019)

Bank v.s. TechFin: macro perspective

- **Banking sector**: collateral-based borrowing constraint
- **TechFin sector**: earnings-based borrowing constraint
- **Microfoundation** of incomplete-collateralization contract: Townsend (1979); Bernanke and Gertler (1989); ...
  1. technology story: tech advantages $\rightarrow$ reduced cost of state verification
  2. intangible capital story: intangible capital $\rightarrow$ low liquidation value
- **Empirical evidence**: Gambacorta et al. (2020); Beck et al. (2020)
- **Other possible difference**: fast data processing ability (Fuster et al., 2019); new credit-sorting models (Gambacorta et al., 2019); ...

Preview of Model and Results

- **Key elements**: Moll (2014) with two types of entrepreneurs
  1. heterogeneous agent model with incomplete markets
  2. two types of borrowing constraints
  3. two types of economic fundamental shocks
- **Main conclusions** on the rise of TechFin
  1. smaller aggregate productivity losses in the steady state
  2. accelerator role of financial market is still there
  3. amplification and propagation of both first-moment level and second-moment uncertainty shocks

Model

- **Two types of entrepreneurs**

  i a continuum of entrepreneurs borrowing from the banking sector **B**
  ii a continuum of entrepreneurs borrowing from the TechFin sector **F**

- **Preference**: $\mathbb{E}_0 \int_0^\infty e^{-\rho t} \log c(t)\, dt$

- **Production function**: $y = (zk)^\alpha l^{1-\alpha}$

- **Stochastic productivity process**: $dlogz = \theta(\bar{\mu} - logz) + \sigma\sqrt{\theta} dW$

- **State of the economy**: $\{\omega_F(t,a,z), \omega_B(t,a,z)\}$

  - wealth definition: $a \equiv k - b$
  - wealth changes from t to $t + dt$: $da_t = (y_t - w_t l_t - \delta k_t - r_t b_t - c_t)\, dt$

Two Types of Borrowing Constraints

- **Banking sector**: collateral-based borrowing constraint

$$(1+r)\,b \leq \lambda_B k \Rightarrow b \leq \frac{\lambda_B}{1+r-\lambda_B} a$$

- **TechFin sector**: earnings-based borrowing constraint

$$(1+r)\,b \leq \lambda_F \pi = \lambda_F (y - wl) \Rightarrow b \leq \frac{\lambda_F \xi z}{1+r-\lambda_F \xi z} a$$

where $\xi = \alpha\left(\frac{1-\alpha}{w}\right)^{\frac{1-\alpha}{\alpha}}$

Similarity and Difference

- **Similarity**: corporate debt capacity depends essentially on their net worth

$$\textbf{debt capacity} = \phi \times \textbf{verifiable net worth}$$

? "With cash flow-based lending and EBCs, we find that asset price feedback through firms' balance sheets could diminish significantly."(Lian and Ma, 2021)

? "This evidence implies that a greater use of big tech credit could reduce the importance of collateral in credit markets and potentially weaken the financial accelerator mechanism." (Gambacorta et al., 2020)

- **Difference**: productive firms get to use more leverage in TechFin
  - asymmetric wealth growth rate for firms with different productivity

Optimal Policy Functions

- **Banking sector**

$$b_B(a,z) = \begin{cases} \frac{\lambda_B a}{1+r-\lambda_B} & z \geq \underline{z} \\ -a & z < \underline{z} \end{cases}$$

$$k_B(a,z) = \begin{cases} \frac{(1+r)a}{1+r-\lambda_B} & z \geq \underline{z} \\ 0 & z < \underline{z} \end{cases}$$

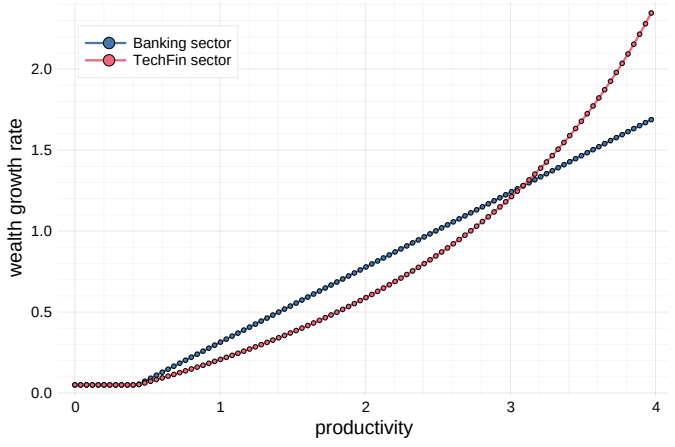
- **TechFin sector**

$$b_F(a,z) = \begin{cases} \frac{\lambda_F \xi z a}{1+r-\lambda_F \xi z} & z \geq \underline{z} \\ -a & z < \underline{z} \end{cases}$$

$$k_F(a,z) = \begin{cases} \frac{(1+r)a}{1+r-\lambda_F \xi z} & z \geq \underline{z} \\ 0 & z < \underline{z} \end{cases}$$

where $\underline{z} = \frac{r+\delta}{\xi}$

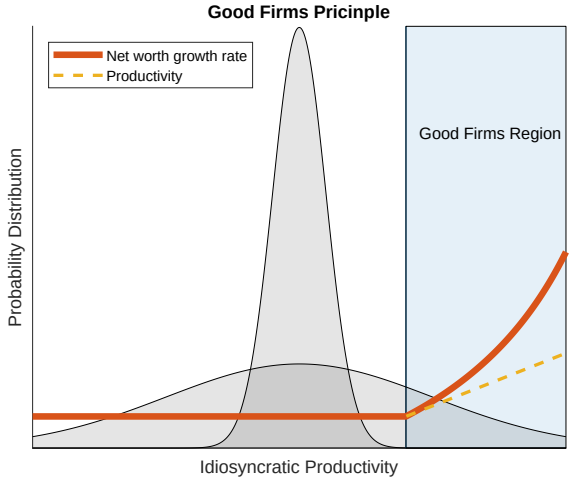
Wealth Dynamics



$$da_B = \left\{\mathbb{1}_{z\geq\underline{z}} \times \left[\frac{(1+r)(\xi z - r - \delta)}{1 + r - \lambda_B} + r - \rho\right] + \mathbb{1}_{z<\underline{z}} \times (r-\rho)\right\} a_B dt \equiv \Gamma_B(z)\, a_B dt$$

$$da_F = \left\{\mathbb{1}_{z\geq\underline{z}} \times \left[\frac{(1+r)(\xi z - r - \delta)}{1 + r - \lambda_F \xi z} + r - \rho\right] + \mathbb{1}_{z<\underline{z}} \times (r-\rho)\right\} a_F dt \equiv \Gamma_F(z)\, a_F dt$$

Uncertainty and TechFin



- **positive impacts of uncertainty**: Oi-Hartman-Abel effects

Distribution Dynamics

$$\frac{\partial \omega_j(t,a,z)}{\partial t} = -\frac{\partial\left[\Gamma_j(z)\, a\omega_j(t,a,z)\right]}{\partial a} - \frac{\partial\left[\theta(\bar{\mu} - log z)\, z\omega_j(t,a,z)\right]}{\partial z} + \frac{1}{2}\frac{\partial^2\left[\theta\sigma^2 z^2 \omega_j(t,a,z)\right]}{\partial z^2}, j \in \{B, F\}$$

✗ **wealth share approach**: Caselli and Gennaioli (2013); Moll (2014); ...

✗ **(adaptive) sparse grid approach**: Brumm and Scheidegger (2017); ...

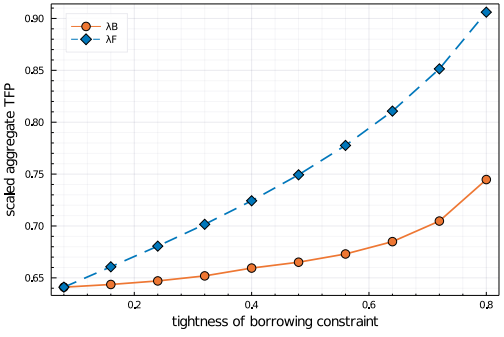
✓ **deep learning approach**: Han and E (2016); Raissi, Perdikaris and Karniadakis (2019); Fernandez-Villaverde et al. (2020); Chen, Didisheim and Scheidegger (2021); ...

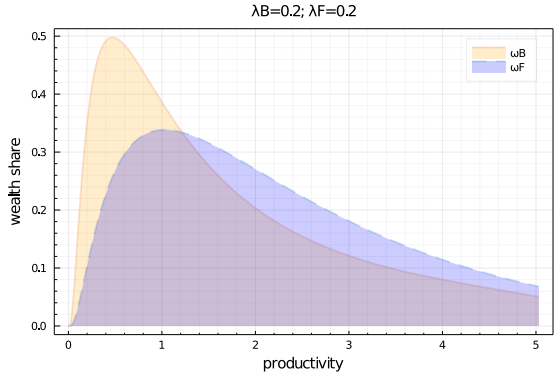
Parametrization

Parameter	Description	Value	Source/Reference
ρ	rate of time preference	0.05	
α	capital share	0.33	Moll (2014)
$\overline{L}$	labor market size	1.0	
δ	capital depreciation rate	0.06	BEA-FAT
χ	death rate	0.05	Moll (2012)
$\overline{\mu}$	log idiosyncratic productivity mean	0.0	
θ	autocorrelation $e^{-\theta}$	0.16 (corr = 0.85)	Asker, Collard-Wexler and Loecker (2014)
σ	log idiosyncratic productivity s.d.	0.56	
$\bar{\phi}$	upper boundary for corporate leverage	10.0	

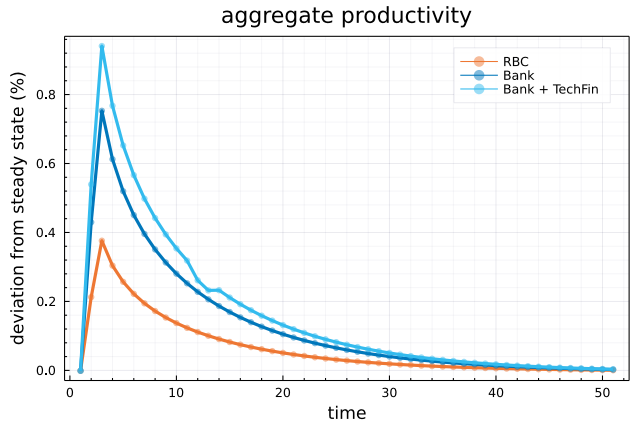
		Experimentation	Question
λ_B	tightness of constraint in banking	$0 \sim 0.8$	
λ_F	tightness of constraint in TechFin	$0 \sim 0.8$	1. steady-state TFP
$\Delta\overline{\mu}$	fundamental shocks to productivity	$\pm 0.1 \sim \pm 0.5$	2. business cycles
$\Delta\sigma$	fundamental shocks to micro uncertainty	$\pm 0.1\sigma \sim \pm 0.5\sigma$	

Productivity Losses in Steady-State

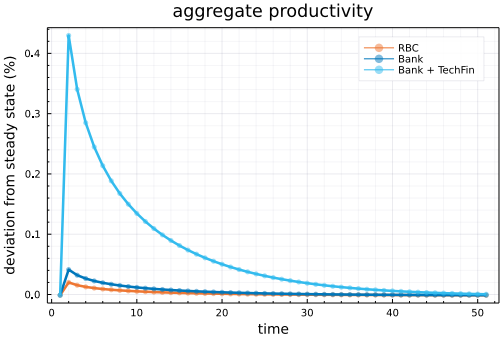


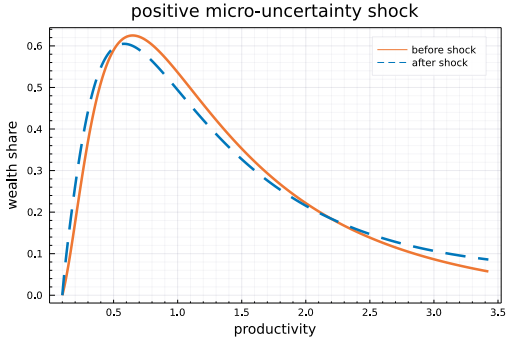


Business Cycles: First-Moment Shocks



Business Cycles: Second-Moment Shocks





Conclusion

- **Research question**: introduce TechFin into the existing macro-finance literature
- **Key take-away**:
  - two different credit systems ⇒ two types of borrowing constraints
  - financial friction still matters
  - TechFin: less misallocation but more sensitive to uncertainty shocks

Related Literature

- **Empirical FinTech/TechFin**: Gambacorta et al. (2020); Tang (2019); Hau et al. (2018); Cornelli et al. (2020); ...
- **Financial frictions and macroeconomy**: Kiyotaki and Moore (1997); Bernanke and Gertler (1989); Brunnermeier and Sannikov (2014); Di Tella (2017); He and Krishnamurthy (2013); Fernandez-Villaverde, Hurtado and Nuno (2019); ...
- **Distributional macro**: Moll (2014); Fernandez-Villaverde, Hurtado and Nuno (2019); Achdou et al. (Forthcoming); ...
- **Earnings-based borrowing constraint**: Lian and Ma (2021); Greenwald (2019); Drechsel (2019); ...

References I

Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll. Forthcoming. "Income and Wealth Distribution in Macroeconomics: A Continuous-Time Approach." Review of Economic Studies.

Asker, John, Allan Collard-Wexler, and Jan De Loecker. 2014. "Dynamic Inputs and Resource (Mis)Allocation." *Journal of Political Economy*, 122(5): 1013–1063.

Beck, Thorsten, Robin Döttling, Thomas Lambert, and Mathijs A. Van Dijk. 2020. "Liquidity Creation, Investment, and Growth." Unpublished working paper.

Bernanke, Ben, and Mark Gertler. 1989. "Agency costs, net worth, and business fluctuations." *American Economic Review*, 79(1): 14–31.

Bloom, Nicholas, Max Floetotto, Nir Jaimovich, Itay Saporta-Eksten, and Stephen J. Terry. 2018. "Really Uncertain Business Cycles." *Econometrica*, 86(3): 1031–1065.

Brumm, Johannes, and Simon Scheidegger. 2017. "Using Adaptive Sparse Grids to Solve High - Dimensional Dynamic Models." *Journal of Machine Learning Research*, 85(5): 1575–1612.

Brunnermeier, Markus K., and Yuliy Sannikov. 2014. "A Macroeconomic Model with a Financial Sector." *American Economic Review*, 104(2): 379–421.

Caselli, Francesco, and Nicola Gennaioli. 2013. "Dynastic Management." *Economic Inquiry*, 51(1): 971–996.

References II

Chen, Hui, Antoine Didisheim, and Simon Scheidegger. 2021. "Deep Structural Estimation: With an Application to Option Pricing."

Cornelli, Giulio, Jon Frost, Leonardo Gambacorta, Raghavendra Rau, Robert Wardrop, and Tania Ziegler. 2020. "Fintech and big tech credit: a new database." BIS Working Papers No. 887.

Di Tella, Sebastian. 2017. "Uncertainty Shocks and Balance Sheet Recessions." *Journal of Political Economy*, 125(6): 2038–2081.

Drechsel, Thomas. 2019. "Earnings-Based Borrowing Constraints and Macroeconomic Fluctuations." Unpublished working paper.

Fernandez-Villaverde, Jesus, Galo Nuno, George Sorg-Langhans, and Maximilian Vogler. 2020. "Solving High-Dimensional Dynamic Programming Problems using Deep Learning." Unpublished working paper.

Fernandez-Villaverde, Jesus, Samuel Hurtado, and Galo Nuno. 2019. "Financial Frictions and the Wealth Distribution." NBER Working Paper No. 26302.

Fuster, Andreas, Matthew Plosser, Philipp Schnabl, and James Vickery. 2019. "The Role of Technology in Mortgage Lending." *Review of Financial Studies*, 32: 1854–1899.

References III

Gambacorta, Leonardo, Yiping Huang, Han Qiu, and Jingyi Wang. 2019. "How do machine learning and non-traditional data affect credit scoring? New evidence from a Chinese fintech firm." BIS Working Paper No. 834.

Gambacorta, Leonardo, Yiping Huang, Zhenhua Li, Han Qiu, and Shu Chen. 2020. "Data vs collateral." BIS Working Papers No. 881.

Greenwald, Daniel. 2019. "Firm Debt Covenants and the Macroeconomy: The Interest Coverage Channel." MIT Sloan Research Paper No. 5909-19.

Han, Jiequn, and Weinan E. 2016. "Deep Learning Approximation for Stochastic Control Problems." NIPS workshop.

Hau, Harald, Yi Huang, Hongzhe Shan, and Zixia Sheng. 2018. "FinTech Credit and Entrepreneurial Growth." Unpublished Working Paper.

He, Zhiguo, and Arvind Krishnamurthy. 2013. "Intermediary Asset Pricing." *American Economic Review*, 103(2): 732–770.

King, Michael R. 2019. "The Competitive Threat from TechFins and BigTech in Financial Services." The Technological Revolution in Financial Services.

Kiyotaki, Nobuhiro, and John Moore. 1997. "Credit Cycles." *Journal of Political Economy*, 105(2): 211–248.

References IV

Lian, Chen, and Yueran Ma. 2021. "Anatomy of Corporate Borrowing Constraints." *Quarterly Journal of Economics*, 136: 229 – 291.

Moll, Benjamin. 2012. "Inequality and Financial Development: A Power-Law Kuznets Cruve."

Moll, Benjamin. 2014. "Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation?" *American Economic Review*, 104(10): 3186–3221.

Raissi, M., P. Perdikaris, and G. E. Karniadakis. 2019. "Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations." *Journal of Computational Physics*, 378(1): 686–707.

Stulz, Rene M. 2019. "FinTech, BigTech, and the Future of Banks." *Journal of Applied Corporate Finance*, 31(4): 86–97.

Tang, Huan. 2019. "Peer-to-peer lenders versus banks: substitutes or complements?" *Review of Financial Studies*, 32(5): 1900 – 1938.

Townsend, Robert. 1979. "Optimal contracts and competitive markets with costly state verification." *Journal of Economic Theory*, 21(2): 265–293.