Cyclical Fluctuations, Financial Frictions, and Productivity Differences Across Firms

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*The views expressed in this presentation are solely our responsibility and should not be interpreted as reflecting the views of the Federal Reserve System or of any other person associated with the Federal Reserve System.

Motivation

- There are substantial within-industry productivity differences in the US manufacturing sector.
- The plant at the 90th percentile of the productivity distribution, on average, makes more than twice as much output with the same measured inputs as the 10th percentile plant.
- Why are there strikingly large differences in total factor productivity (TFP) across plants/firms within narrowly defined industries? How does the evolution of TFP dispersion react to cyclical fluctuations? What is its interplay with financial conditions?
- The macro finance literature has also come up with an answer: Financial frictions can impede the efficient allocation of capital.
- We build on this macro finance literature by constructing a model of credit rationing in the spirit of Stiglitz and Weiss (1981).

What's in our model?

- We extend a standard RBC model to include a continuum of firms with idiosyncratic levels of total-factor productivity.
- Asymmetric information results in misallocation of capital and reduced productivity.
  - Idiosyncratic productivity above some threshold level is private and unobservable.
- Credit rationing arises because:
  1. Increasing lending incentivizes strategic default by less productive firms.
  2. The potential offer by high-productivity firms to pay a higher lending rate lacks credibility.
- Loan default is an equilibrium outcome that can influence productivity dispersion and aggregate productivity.
- There are 2 sources of TFP:
  1. Exogenous (standard).
  2. Endogenous (due to changes in productivity dispersion).

Related papers

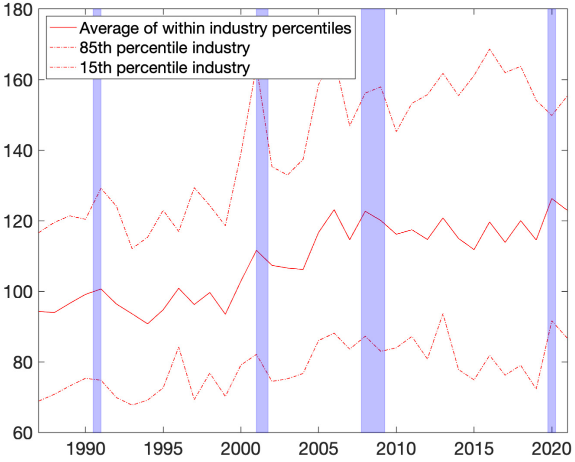
- Classic papers with costly state verification have an *exogenous* TFP dispersion — e.g, Carlstrom and Fuerst (1997), Bernanke et al. (1999), and Christiano et al. (2014).
- Khan and Thomas (2013) develop a model in which financial frictions lead to misallocation of resources across firms — productivity has an *endogenous* component. In their model, there is no equilibrium default. By contrast, we consider a strategic default in a tractable model that others can easily reuse and extend.
- Buera and Moll (2015) and Liu and Wang (2014) offer tractable models in which collateral constraints lead to the misallocation of resources across firms. Our setup includes additional margins, such as default and a distinction between bank and non-bank credit.
- Broader literature on models with heterogeneous firms, financial frictions, and default decisions: Gilchrist et al. (2014), Arellano et al. (2019), and Gomes and Schmid (2021).

A look at the data

- We use a new BLS dataset DiSP that reports summary statistics on TFP dispersion within 86 4-digit NAICS manufacturing industries based on Census microdata files.
- This dataset is described in Cunningham et al. (2023).
- Dataset has annual statistics, from 1987 to 2021.
- For the charts that follow, we merged the DiSP dataset with BEA data to compute average dispersion measures weighted by value added.

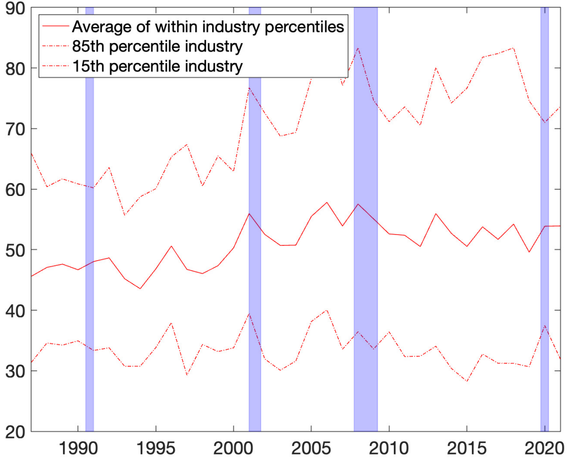
Large within-industry TFP differences

Percentage difference between the 90th and 10th TFP percentiles



Robustness IQR: Large within-industry TFP differences

Percentage difference between the 75th and 25th TFP percentiles



Cyclical properties of productivity dispersion

- Simple empirical framework:

$$\gamma_{i,t} = c_i + \beta x_t + \varepsilon_{i,t},$$

  where $\gamma_{i,t}$ is the within-industry TFP gap for industry i, c_i is industry-specific fixed effects, x_t denotes alternative cyclical indicators, and ε_{it} is an industry-specific error term.
- We include industry weights proportional to the value added shares of the industries.
- Regression evidence:
  - The relationship between aggregate growth of GDP and TFP dispersion is negative.
  - The relationship between delinquency rates and TFP dispersion is negative.
  - The relationship between a short-term real interest rate and TFP dispersion is negative.
- We take these observations to help calibrate and assess our model.

Regression results

Table: Panel regression of within-industry TFP dispersion on (1) GDP growth, (2) delinquency rate on business loans at commercial banks, and (3) Real interest rate — 1987-2021

	Percentage difference between the 90th and 10th percentile of the log of TFP		
	(1)	(2)	(3)
Yearly GDP growth (%)	-2.875*** (-6.397)		
Delinquency rate (%)		-3.744*** (-3.726)	
Real interest rate (%)			-3.730*** (-4.205)
Observations	3010	3010	3010
S.E. type	by: industry	by: industry	by: industry
R^2	0.618	0.626	0.635
R^2 Within	0.033	0.052	0.076

Significance levels: $*$ $p < 0.05$, $**$ $p < 0.01$, $***$ $p < 0.001$. In the table, t-stats are in parentheses. All regressions are weighted using industry shares in value added and include industry fixed effects.

Robustness IQR: Regression results

Table: Robustness of panel regression of within-industry TFP dispersion on (1) GDP growth, (2) delinquency rate on business loans at commercial banks, and (3) real interest rate — 1987-2021

	Percentage difference between the 75th and 25th percentile of the log of TFP		
	(1)	(2)	(3)
Yearly GDP growth (%)	-0.917*** (-4.774)		
Delinquency rate (%)		-1.057* (-2.218)	
Real interest rate (%)			-0.968* (-2.634)
Observations	3010	3010	3010
S.E. type	by: industry	by: industry	by: industry
R^2	0.671	0.672	0.673
R^2 Within	0.015	0.018	0.022

Significance levels: $*$ p $<$ 0.05, $**$ p $<$ 0.01, $***$ p $<$ 0.001. In the table, t-stats are in parentheses. All regressions are weighted using industry shares in value added and include industry fixed effects.

Model description and core mechanisms

- Firms draw idiosyncratic productivity shocks, plus standard aggregate shocks.
- Firm-specific productivity is private information.
- Investors cannot distinguish between high-productivity and low-productivity firms, so they allocate savings equally across firms.
- More productive firms want to borrow more capital, but lenders cannot verify their productivity.
- As a result, lenders do not raise interest rates to market-clearing levels because that would attract risky borrowers likely to default.
- The most productive firms cannot borrow as much as they would like, and some less productive firms still receive resources. This is where the misallocation comes from.
- If the financial friction could be turned off, only the most productive firm would produce and our model would collapse to the standard RBC model.

Households

Infinitely-lived households with GHH preferences over consumption C_t and labor H_t solve the following problem:

$$\max_{\left\{A_{t+\tau},C_{t+\tau},H_{t+\tau},B^H_{t+\tau}\right\}_{\tau=0}^{\infty}} E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \frac{1}{1-\sigma} \left(C_{t+\tau} - \vartheta \frac{H_{t+\tau}^{1+\nu}}{1+\nu} \right)^{1-\sigma} ,$$

subject to

$$C_{t+\tau} + A_{t+\tau} + B^H_{t+\tau} =$$
$$R^A_{t+\tau} A_{t+\tau-1} + W_{t+\tau} H_{t+\tau} + R^B_{t+\tau-1} B^H_{t+\tau-1} + \Pi_t + T_t + \Xi_t.$$

Households finance firms through a mutual fund A_t that earns a return R^A_t. B^H_t is a government bond held by households. Π_t is profits from ownership of goods-producing and capital-producing firms. T_t represents a lump-sum transfer from the government. Ξ_t refers to transfers that the household receives because firms that take the outside option are subject to a haircut on the returns from the outside option.

Firms, overview

	Period t	Period $t+1$
1	Raise equity a_t	Produce, **outside option matures**
2	**Productivity level** $\omega \in [0, 1]$ **is drawn**	Repay loans to other firms
3	**Lend or borrow in inter-firm market**	Pay households
4	**Some borrowing firms take the outside option and default**	
5	Purchase physical capital	

- The outside option consists of purchasing government bonds.
- Firms that borrow decide whether to exercise the outside option or purchase capital goods to produce.
- If firm (ω) walks away with the outside option, it can retain a fraction $\Theta_t(\omega)$ of the funds borrowed from other firms $b_t^i(\omega)$. We assume $\Theta_t(\omega)$ increases in ω.
- Firms that take the outside option are subject to a haircut cost ξ on their investment.

Firms' production technology

- Firms have this production technology

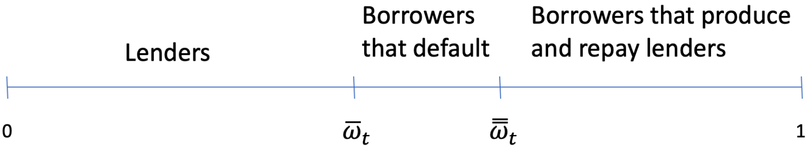
$$y_{t+1}(\omega) = Z_{t+1}\omega k_t(\omega)^{\alpha} h_{t+1}(\omega)^{1-\alpha}.$$

- There are two types of productivity shocks:
  1. An aggregate technology shock Z_{t+1} evolves according to

$$\log Z_{t+1} = \rho_z \log Z_t + \varepsilon^z_{t+1}.$$

  2. A firm-specific productivity shock ω follows the cumulative distribution function $\mu(\omega)$ on the interval $[0, 1]$, satisfying some regularity conditions — $\mu(0) = 0$, $\mu(1) = 1$, and $\mu'(\omega) > 0$.

Sorting firms into groups



- In equilibrium, firms with the lowest level of productivity become lenders — think of them as financial intermediaries.
- A group of firms with intermediate productivity borrows from financial intermediaries and defaults.
- Only firms with sufficiently high productivity produce.
- The cutoff points that determine the mass of these groups of firms will be influenced by economic conditions.
- We show these results in a series of 3 propositions. Our strategy is to posit a solution that satisfies the FOCs of firms and then verify that no firm can or has an incentive to switch to a different segment.

Details on firms' maximization problem

Pinning down lending rate ρ_t

For the cutoff firm $\overline{\omega}_t$ the return from lending matches the returns from borrowing and defaulting:

$$E_t\left[\beta\frac{\lambda_{ct+1}}{\lambda_{ct}}\left(\rho_t\frac{1-\mu(\overline{\overline{\omega}}_t)}{1-\mu(\overline{\omega}_t)}+(1-\theta)\frac{\mu(\overline{\overline{\omega}}_t)-\mu(\overline{\omega}_t)}{1-\mu(\overline{\omega}_t)}\right)a_t\right]=$$
$$E_t\left[\beta\frac{\lambda_{ct+1}}{\lambda_{ct}}\left(R_t^B-\xi\right)\left(a_t+\Theta_t(\overline{\omega}_t)b_t\right)\right],$$

where $1-\theta$ is the average recovery rate on defaulted loans, so

$$\theta=\int_{\overline{\omega}_t}^{\overline{\overline{\omega}}_t}\Theta_t(\omega)\frac{\mu'(\omega)}{\mu(\overline{\overline{\omega}}_t)-\mu(\overline{\omega}_t)}\mathrm{d}\omega.$$

- On the LHS, the return for lending is not firm specific, and conversely, the RHS increases in ω since $\Theta_t(\omega)$ is increasing in ω.
- There is no dependence of b_t on ω because $b_t=b_t(\omega)$ for all ω due to asymmetric information.

Pinning down $\overline{\omega}_t$

- Assume that a screening technology allows lenders to tell whether borrowers can be expected to make more than the outside option.
- We verify that if the firms that have a firm-specific productivity $\omega < \overline{\omega}_t$ will choose to lend, then for a firm with $\omega = \overline{\omega}_t$ the expected return from producing equals the return of the outside option:

$$E_t\left[\beta\frac{\lambda_{ct+1}}{\lambda_{ct}}\left(\frac{1}{Q_t}\alpha\ Z_{t+1}\left(\frac{H_{t+1}}{K_t}\right)^{1-\alpha}\overline{\omega}_t+\frac{(1-\delta)}{Q_t}Q_{t+1}\right)\right]=$$
$$E_t\left[\beta\frac{\lambda_{ct+1}}{\lambda_{ct}}\left(R_t^B-\xi\right)\right].$$

Squaring the claim that firms with $\omega < \overline{\omega}_t$ will lend

Pinning down $\overline{\overline{\omega}}_t$

- The firm with $\omega = \overline{\overline{\omega}}_t$ will be indifferent between diverting funds and producing, thus

$$E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(R_t^B - \xi \right) \left(a_t + \Theta(\overline{\overline{\omega}}_t) b_t \right) \right] =$$
$$E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(R_{t+1}(\overline{\overline{\omega}}_t)(a_t + b_t) - \rho_t b_t \right) \right].$$

- Notice that both the LHS and the RHS increase with ω. But we can ensure that the increase is slower for the LHS by the choice of the slope of the function $\Theta(\omega)$.
- For a convex $\Theta(\omega)$ a sufficient global condition is

$$E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(R_t^B - \xi \right) \Theta_t'(1) b_t \right] < E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(\frac{1}{Q_t} \alpha \; Z_{t+1} \left(\frac{H_{t+1}}{K_t} \right)^{1-\alpha} \right) (a_t + b_t) \right].$$

- We verify this condition computationally.

Capital-producing firms

The aggregate capital stock evolves according to:

$$K_t = I_t^n + (1-\delta)K_{t-1},$$

where K_t is the amount of capital allocated to the goods-producing firms. Investment is subject to quadratic adjustment costs

$$I_t^n = \left[1 - \frac{\phi}{2}\left(\frac{I_t^g}{I_{t-1}^g} - 1\right)^2\right] I_t^g,$$

The capital producing firms are owned by households, and solve the problem

$$\max_{I_{t+i}^g} E_t \sum_{i=0}^{\infty} \beta^i \frac{\lambda_{ct+i}}{\lambda_{ct}} \left\{ Q_{t+i} \left[1 - \frac{\phi}{2}\left(\frac{I_{t+i}^g}{I_{t+i-1}^g} - 1\right)^2\right] I_{t+i}^g - I_{t+i}^g \right\}.$$

The government and lump-sum transfers to households

- The only role of the government in the model is to provide an alternative source of returns for firms that borrow and default.

$$T_t = B_t^G - R_{t-1}^B B_{t-1}^G.$$

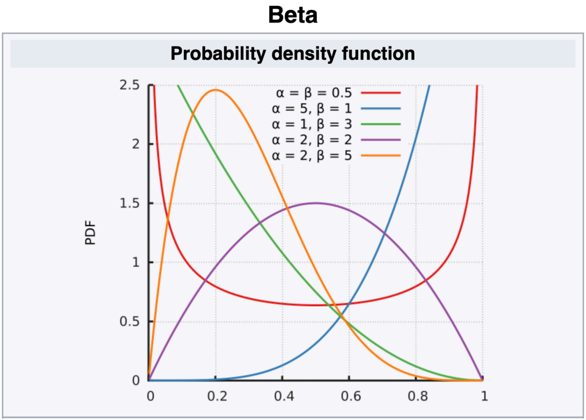
- Only firms can buy government bonds, so $B_t^G = D_t$.
- Since firms that take the outside option are subject to a haircut cost ξ for each unit invested in government bonds in the previous period, the amount of transfers rebated to the household to ensure that there are no deadweight losses in the economy is equal to

$$\Xi_t = \xi D_{t-1}.$$

- Households also receive profits from capital-producing firms, Π_t.

A distribution for ω

- The Beta distribution, $f(\omega, \alpha, \beta) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}\omega^{(\alpha-1)}(1-\omega)^{(\beta-1)}$ allows the flexibility of a large mass of firms on the left side and a large mass on the right side — see the case $\alpha = \beta = 0.5$.



Calibration

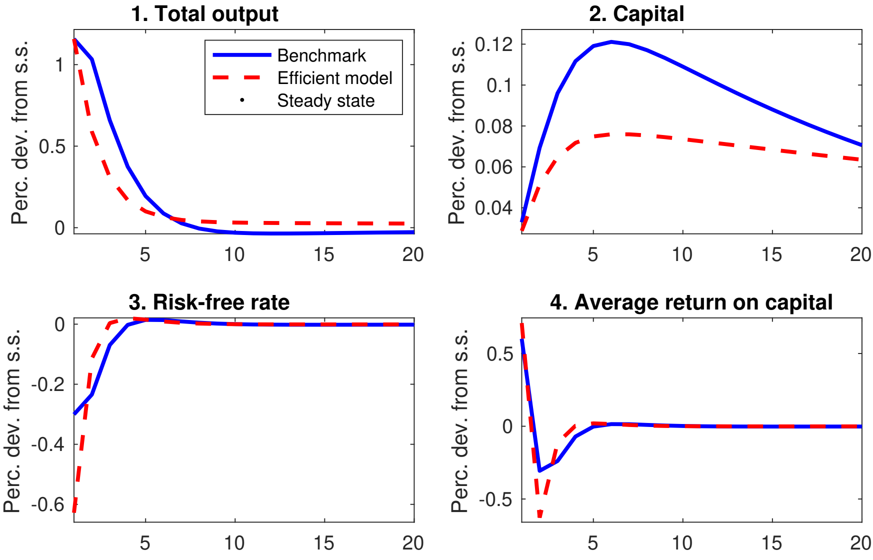
▸ Parameter values, moment matching, and variance decomposition

- US quarterly data from 1987 to 2021.
- It corresponds to the availability of data on productivity dispersion.
- We choose η_1 and η_2 (the parameters of Beta distribution), θ (the average recovery rate on defaulted loans), ξ (haircut on government bonds for taking the outside option) to jointly match the following steady-state targets:
  1. The average 90-10 productivity dispersion – set at 2.08.
  2. The average share of bank credit in total credit – set at 47%.
  3. The average delinquency rate on business loans – set at 2.61%.
  4. The average spread between the loan rate and interbank lending rate – set at 2.71%.
- The investment adjustment cost, and shock processes are estimated using a SMM procedure to hit the variances, correlations, and autocorrelations of 1) real output, 2) real consumption, 3) relative investment price, and 4) delinquency rate.
- Other parameters receive conventional values from the literature.

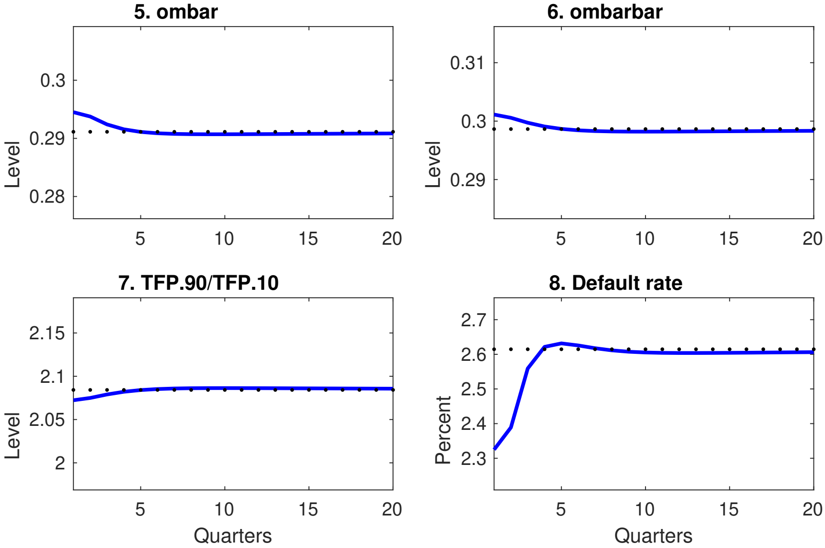
Shock processes

- We consider 2 shocks that drive the business cycle:
  1. TFP shock:
  $$\log Z_t = \rho_z \log Z_{t-1} + \varepsilon_t^z$$
  2. Financial shock: a shock that tightens financial conditions:
  $$FS_t = \rho_f FS_{t-1} + \varepsilon_t^f$$
- Our financial shock is specified as an exogenous term appended to the consumption Euler equation:
$$U'(C_t) = \beta E_t \left\{ \lambda_{ct+1} \left(R_t^b + \varepsilon_t^f \right) \right\}, \quad (1)$$
$$\lambda_{ct} = \beta E_t \left\{ \lambda_{ct+1} R_t^b \right\}. \quad (2)$$
- This financial shock is inspired by risk premium shock in Smets and Wouters (2007).
- Fisher (2015) gives a structural interpretation of it as a shock to the demand for safe and liquid assets.

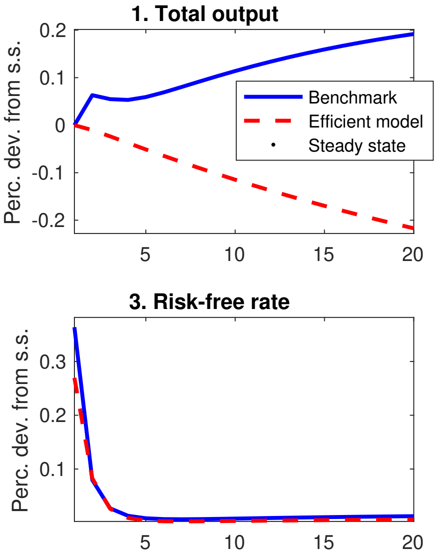
Expansionary productivity shocks curb credit rationing



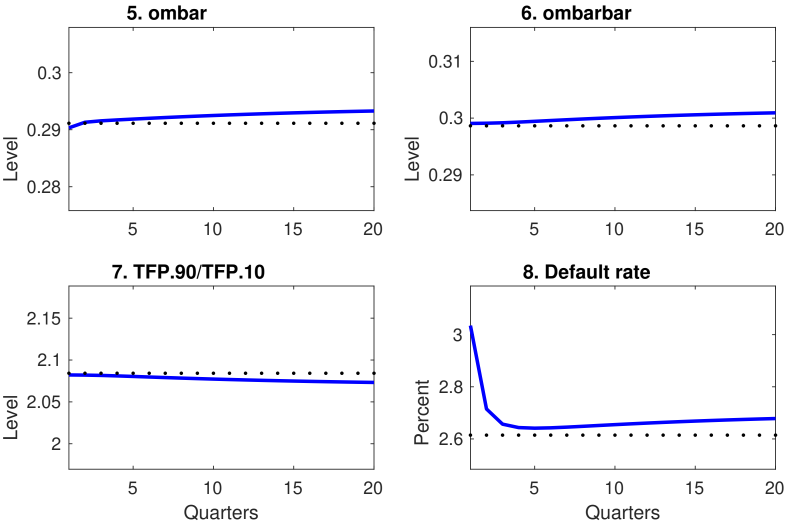
Expansionary productivity shocks reduce TFP dispersion



A shock that tightens financial conditions



A shock that tightens financial conditions reduces TFP dispersion



How does our model speak about the stylized facts?

- To test if our model is in line with the described stylized facts, we
  1. Draw 1,000 data samples with 500 quarters in each sample.
  2. Collect simulated data.
  3. For each of the 1,000 samples, we estimate regressions analogous to the ones shown before using the observed data.
- We test the hypothesis that the estimated model and observed data produce statistically indistinguishable slope coefficients at the 5% significance level.

Model simulated and observed data: regression results

(a)

	90-10 TFP dispersion	
	Model	Data
Default rate	-10.315***	-3.744***
	(3.084)	(1.005)
95% Confidence Interval	[−15.761; −3.578]	[−5.713; −1.775]

(b)

	90-10 TFP dispersion	
	Model	Data
Real interest rate	-0.999	-4.315***
	(1.359)	(1.096)
95% Confidence Interval	[−4.507; 0.771]	[−6.463; −2.167]

(c)

	90-10 TFP dispersion	
	Model	Data
GDP growth	-0.684***	-2.875***
	(0.101)	(0.449)
95% Confidence Interval	[−0.926; −0.504]	[−3.756; −1.994]

(d)

	90-10 TFP dispersion (cyclical)	
	Model	Data
Real GDP (cyclical)	-1.046***	-0.601*
	(0.091)	(0.345)
95% Confidence Interval	[1.256; −0.880]	[−1.277; 0.075]

Conclusion

- The paper combines firm heterogeneity, private productivity information, and strategic default in a tractable macro framework.
- It adds an endogenous TFP channel: aggregate productivity moves partly because shocks change which firms produce.
- It shows that financial frictions generate time-varying within-industry productivity dispersion.
- Quantitatively, it links the model to U.S. data by matching both the level of productivity dispersion and important cyclical correlations with GDP growth, default rates, and financial conditions.
- The tractability of our framework allows us to embed it in the many variants of an RBC model.
- We view our modeling contribution as providing a building block that others can easily reuse or extend.

Firms that produce ($\omega \geq \overline{\overline{\omega}}_t$) Back

Producing firms maximize expected discounted profits

$$\max_{k_t(\omega), b_t^{tot}(\omega)} E_t \left\{ \max_{h_{t+1}(\omega)} \beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \pi_{t+1}(\omega) \right\},$$

where

$$\begin{aligned} \pi_{t+1}(\omega) = \quad & z_{t+1} \omega k_t(\omega)^{\alpha} h_{t+1}(\omega)^{1-\alpha} + (1-\delta) Q_{t+1} k_t(\omega) \\ & - R_{t+1}(\omega) b_t^{tot}(\omega) - W_{t+1} h_{t+1}(\omega), \end{aligned}$$

and subject to

$$b_t^{tot}(\omega) = a_t(\omega) + b_t(\omega),$$

and to

$$b_t^{tot}(\omega) = Q_t k_t(\omega).$$

Returns for producing firms ▸ Back

- Upon observing ω, the producing firm determines the demand for inter-firm loans by solving the following problem:

$$\max_{b_t(\omega)|\omega} E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(R_{t+1}(\omega) \left(a_t(\omega) + b_t(\omega) \right) - R^A_{t+1}(\omega) a_t(\omega) - \rho_t b_t(\omega) \right) \right]$$

- Producing firms, given constant returns to scale technology, would choose not to borrow in the inter-firm market if the average returns to production were lower than the cost of inter-firm funding.
- So, the inter-firm lending rate is such that $\rho_t \leq E_t R_{t+1}$.
- As a corollary, firms that borrow could increase returns by borrowing even more — in other words, credit is rationed.
- The returns paid to households by firms in this segment are derived from the zero-profit condition:

$$R^A_{t+1}(\omega) = \frac{R_{t+1}(\omega) \left(a_t(\omega) + b_t(\omega) \right) - \rho_t b_t(\omega)}{a_t(\omega)}.$$

Firms that borrow and default ($\overline{\omega}_t \leq \omega < \overline{\overline{\omega}}_t$) Back

The problem of the firm that diverts the borrowed funds by choosing the outside option can be described as follows:

$$\max_{b_t(\omega)|\omega} E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \Big(\left(R_t^B - \xi \right) \left(a_t(\omega) + \Theta_t(\omega) b_t(\omega) \right) - R_{t+1}^A(\omega) a_t(\omega) \Big) \right]$$

We can show that the returns to households from firms in this group will be:

$$R_{t+1}^A(\omega) = \frac{\left(R_t^B - \xi \right) \left(a_t(\omega) + \Theta_t(\omega) b_t(\omega) \right)}{a_t(\omega)}.$$

Lending firms ($\omega < \overline{\omega}_t$) Back

The problem of firms that lend in the inter-firm market is

$$\max_{l_t(\omega)|\omega} E_t\left[\beta\frac{\lambda_{ct+1}}{\lambda_{ct}}\left(\rho_t\frac{1-\mu(\overline{\overline{\omega}}_t)}{1-\mu(\overline{\omega}_t)}l_t(\omega)+\frac{\mu(\overline{\overline{\omega}}_t)-\mu(\overline{\omega}_t)}{1-\mu(\overline{\omega}_t)}(1-\theta)l_t(\omega)\right.\right.$$
$$\left.\left.-R^A_{t+1}(\omega)a_t(\omega)\right)\right],$$

subject to the constraint that $l_t(\omega) \leq a_t(\omega)$.
Returns

$$R^A_{t+1}(\omega) = \rho_t\frac{1-\mu(\overline{\overline{\omega}}_t)}{1-\mu(\overline{\omega}_t)}+\frac{\mu(\overline{\overline{\omega}}_t)-\mu(\overline{\omega}_t)}{1-\mu(\overline{\omega}_t)}(1-\theta),$$

where θ is the average recovery rate on defaulted loans.

Squaring the claim that firms with $\omega < \overline{\omega}_t$ will lend

Back

- For ω_t to be a cutoff point between firms that lend and firms that borrow and default, we still need to check that firm with $\omega < \overline{\omega}_t$ make higher expected profits from lending than from producing, i.e.,

$$E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(\rho_t \frac{1-\mu(\overline{\overline{\omega}}_t)}{1-\mu(\overline{\omega}_t)} + (1-\theta) \frac{\mu(\overline{\overline{\omega}}_t)-\mu(\overline{\omega}_t)}{1-\mu(\overline{\omega}_t)} \right) a_t \right] >$$
$$E_t \left[\beta \frac{\lambda_{ct+1}}{\lambda_{ct}} \left(R_{t+1}(\omega) a_t \right) \right],$$

for all firms with $\omega < \overline{\omega}_t$.

- We've done the work on this one, but the proof is not pretty. Let's move on for the sake of this presentation.

Parameters

Back

	Value	Description	
Conventional			
β	0.9925	Discount rate	
α	0.3	Capital share in production	
σ	1.1	Inverse intertemporal elasticity of substitution	
δ	0.01	Depreciation rate	
ν	2	Inverse Frisch elasticity of labor supply	
Calibrated (first-order moments matching steady-state conditions)			*Targets/Explanation*
η_1	1.71053	First parameter of Beta distribution	jointly to match the average 1) 90-10 within-industry productivity dispersion, 2) spread between the loan rate and interbank lending rate, 3) share of bank credit, and 4) default rate on business loans
η_2	3.36804	Second parameter of Beta distribution	
ξ	0.00688	Haircut on the returns from the outside option	
θ	0.00031	Average fraction of funds that can be diverted	
Estimated (Simulated methods of moments)			*Targets/Explanation*
ϕ	0.20227	Investment adjustment costs	estimated to hit the variances, correlations, and autocorrelations of 1) real output, 2) real consumption, 3) relative investment price, and 4) delinquency rate
ρ_z	0.49914	Persistence of technology shock	
ρ_f	0.98767	Persistence of financial shock	
ε^z	0.00888	1 s.d. of technology shock	
ε^f	0.03450	1 s.d of financial shock	
Specific			*Explanation*
ψ	2	Parameter in the function $\Theta_t(\omega) = \omega^{\psi} F_t$	Ensures that the slope condition is verified
ϑ	0.83340	Disutility of labor	Supports aggregate labor = 1 in the steady state

Matching Moments and Variance Decomposition

Back

	Data	Model	Model 5th perc.	Model 95th perc.
Var(GDP)	1.70	2.28	1.54	2.92
Corr(GDP,Consumption)	0.91	0.59	0.41	0.73
Corr(GDP,Investment price)	0.31	0.67	0.60	0.74
Corr(GDP,Default rate)	-0.58	-0.60	-0.70	-0.51
Var(Consumption)	2.10	1.90	1.24	2.49
Corr(Consumption,Investment price)	0.22	0.30	0.16	0.44
Corr(Consumption,Default rate)	-0.42	-0.19	-0.32	-0.05
Var(Investment price)	0.56	0.62	0.47	0.75
Corr(Investment price,Default rate)	-0.48	-0.96	-0.97	-0.94
Var(Default rate)	0.34	0.27	0.21	0.34
Autocorr(GDP)	0.64	0.64	0.53	0.71
Autocorr(Consumption)	0.57	0.72	0.59	0.78
Autocorr(Investment price)	0.90	0.27	0.13	0.39
Autocorr(Default rate)	0.95	0.25	0.11	0.37

	Output	Investment	Consumption	Default Rate	Real Rate	90-10 TFP dispersion
TFP	99.76	49.05	34.50	42.79	51.67	93.79
Financial shock	0.24	50.95	65.50	57.21	48.33	6.21