The Cost of Capital and Misallocation in the United States

Miguel Faria-e-Castro
FRB St. Louis

Julian Kozlowski
FRB St. Louis

Jeremy Majerovitz
University of Notre Dame

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The Cost of Capital and Misallocation in the United States

Goal: Measure how dispersion in the cost of capital affects the allocation of capital

Methodological contribution:

- Adapt a standard macrofinance model to enable measurement using micro data
- Derive a sufficient statistic for misallocation using credit registry data

Empirical Results (US):

- Low levels of misallocation in normal times ($\approx 0.5\%$ of GDP)
- 🔥 Losses from misallocation increased to 1.1% of GDP in 2020-2021 🔥
- Driven by an increase in moral hazard and zombie lending 🧟

Related Literature

- **Measuring Misallocation:**
  - Seminal work by Restuccia and Rogerson (2008), Hsieh and Klenow (2009)
  - Contribution: Use cost of capital heterogeneity as a proxy for dispersion on the marginal product of capital
- **Heterogeneity in Cost of Capital:**
  - Developing countries: Banerjee and Duflo (2005), Cavalcanti, Kaboski, Martins, and Santos (2021)
  - US: Gilchrist, Sim, and Zakrajek (2013), Gormsen and Huber (2023, 2024), Faria-e-Castro, Jordan-Wood, and Kozlowski (2024)
  - Contribution:
    - Estimate firm-level cost of capital using credit registry data, correcting for default and LGD.
    - Derive and estimate sufficient statistic for misallocation

Outline

1. Macrofinance model
2. Welfare & sufficient statistic for misallocation
3. Mapping to credit registry data
4. Empirical results in the US

1. Macrofinance Model

Macrofinance Model

Borrowers 🏭

- Produce output $f(k, z)$
- Invest in capital k
- Borrow long-term debt b
- Limited liability: default

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- Price loans competitively
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Matching 🤝

- Borrower matched with lender
- Match efficiency: ρ
- Heterogeneity in ρ
- Wedge accounting: $\rho = \bar{\rho} + \omega$

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Key question: How do heterogeneity in ρ and financial frictions distort the allocation of capital?

Firm's Problem

Value of Repayment:

$$V(k,b,z) = \max_{k',b'} \pi(k,b,z,k',b') + \beta\mathbb{E}\overbrace{\left[\max\left\{V\left(k',b',z'\right),0\right\}\middle| z\right]}^{\text{Limited liability}}$$

Profits:

$$\pi(k,b,z,k',b') = f(k,z) + (1-\delta)k - k' - \theta b + Q(k',b',z)(b' - (1-\theta)b)$$

Price of Debt:

$$Q(k',b',z) = \frac{\mathbb{E}\left[\mathcal{P}(k',b',z')(\theta + (1-\theta)Q(k'',b'',z')) + (1-\mathcal{P}(k',b',z'))\phi k'/b' \middle| k',b',z\right]}{\underbrace{1+\rho}_{\text{borrower-lender efficiency}}}$$

The Firm's Cost of Capital

Define the implicit interest rate paid by the firm as

$$1 + r_t^{firm} = \frac{\mathbb{E}_t \left[\mathcal{P}_{t+1}(\theta + (1-\theta)Q_{t+1})\right]}{Q_t}$$

Lemma 1 (Firm's Cost of Capital)

The firm's cost of capital is:

$$1 + r^{firm} = \frac{1+\rho}{1+\Lambda} \qquad \Lambda \equiv \frac{\mathbb{E}_t \left[(1-\mathcal{P}_{t+1})\,\phi k'/b'\right]}{\mathbb{E}_t \left[\mathcal{P}_{t+1}\left(\theta + (1-\theta)\,Q_{t+1}\right)\right]}$$

▷ *Proof*

Λ is the financial frictions' wedge due limited liability and partial recovery ϕ

- $\phi = 0$: no recovery after default, then $r^{firm} = \rho$
- If $\phi > 0$, then $\Lambda > 0$ and $r^{firm} < \rho$: borrower only takes into account repayment states

Marginal Revenue Product of Capital

$$\underbrace{(1 + r_t^{firm})\mathcal{M}_t}_{\text{Cost of capital}} = \underbrace{\mathbb{E}_t[\mathcal{P}_{t+1}(f_k(k_{t+1}, z_{t+1}) + 1 - \delta)]}_{\text{Expected marginal revenue product of capital}} \tag{1}$$

where $\mathcal{M}$ reflects the price feedback multiplier

$$\mathcal{M} \equiv \frac{1 - \gamma \times \frac{b'}{k'} \times \frac{\partial \log Q}{\partial \log k'}}{1 + \gamma \times \frac{\partial \log Q}{\partial \log b'}} \qquad \gamma \equiv \frac{b' - (1-\theta)b}{b'}$$

Wedge accounting: ω is a wedge in the Euler equation

$$\left(1 + \frac{1 + \bar{\rho} + \omega}{1 + \Lambda}\right)\mathcal{M} = \mathbb{E}\left[MRPK\right]$$

Key empirical insight:

- Measure r_t^{firm} by measuring ρ and Λ
- Intuition: heterogeneity in r_t^{firm} $\rightarrow$ heterogeneity in MRPK

2. Welfare & Sufficient Statistic for Misallocation

Aggregate Economy and Welfare

Decentralized Equilibrium:

$$Y^{DE} + (1-\delta)K^{DE} = \int_0^1 \mathbb{E}_t \left[\mathcal{P}^{DE}_{i,t+1}\left(f(k^{DE}_{i,t+1}, z_{i,t+1}) + (1-\delta)k^{DE}_{i,t+1}\right) + (1-\mathcal{P}^{DE}_{i,t+1}) \cdot \phi k^{DE}_{i,t+1}\right] di$$

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Planner's Problem:

- Takes as given $\mathcal{P}^{DE}$ and aggregate capital K^{DE} (lower bound on full misallocation)
- Redistributes capital to maximize expected output

$$Y^{*} + (1-\delta)K^{DE} = \max_{\{k^*_{i,t+1}\}_i} \int_0^1 \mathbb{E}_t \left[\mathcal{P}^{DE}_{i,t+1}\left(f(k^{*}_{i,t+1}, z_{i,t+1}) + (1-\delta)k^{*}_{i,t+1}\right) + (1-\mathcal{P}^{DE}_{i,t+1})\cdot\phi k^{*}_{i,t+1}\right] di$$

$$s.t. \quad \int_0^1 k^*_{i,t+1} di = K^{DE}_{t+1} \equiv \int_0^1 k^{DE}_{i,t+1} di$$

Private vs Social Optimality

Private optimality:

$$(1 + r_{i,t}^{firm})\mathcal{M}_{i,t} = \mathbb{E}_t[\mathcal{P}_{i,t+1}^{DE}(f_k(k_{i,t+1}^{DE}, z_{i,t+1}) + 1 - \delta)]$$

Planner's optimality:

- Define the social marginal product of capital at firm i, $r_{i,t}^{social}$

$$1 + r_{i,t}^{social} \equiv \mathbb{E}\left[\mathcal{P}_{i,t+1}^{DE}\left(f_k\left(k_{i,t+1}^{*}, z_{i,t+1}\right) + 1 - \delta\right) + \left(1 - \mathcal{P}_{i,t+1}^{DE}\right)\phi\right]$$

- Takes into account recovery in the case of default

- Optimality: The planner wants to **equalize** $r_{i,t}^{social}$ across firms

Misallocation

Proposition 1 (Misallocation)

Misallocation can be measured with $\mathbb{E}\left[r^{social}\right]$ *and* $Var\left(r^{social}\right)$ *as*

$$\log\left(Y^*/Y^{DE}\right) \approx \frac{1}{2} \cdot \mathcal{E} \cdot \log\left(1 + \frac{Var\left(r^{social}\right)}{\left(\mathbb{E}\left[r^{social}\right] + \delta\right)^2}\right)$$

▷ *Proof*

- This is an extension of Hughes and Majerovitz (2024) to a *dynamic economy with default*
- We can calibrate $\mathcal{E} = \frac{1}{2}$ and $\delta = 0.06$ ▷ Calibration
- Misallocation can be measured with credit registry data: We now show how to measure $r_{i,t}^{social}$

3. Mapping to Credit Registry Data

Data: FR Y-14Q (Schedule H.1)

- Quarterly loan-level panel on universe of loan facilities $> \$1$M
- Covers top 30/40 BHCs, 2014:Q4-2024Q4
- Detailed information on features of credit facilities
- Variables of interest: origination date, size, maturity, interest rate/spread, probability of default, loss given default, fixed vs. floating, type of loan
- Focus on term loans issued to non-government, non-financial US companies

Asset Pricing of Term Loans

The break-even condition for a lender with discount rate ρ is

$$1 = \sum_{t=1}^{T} \left[\frac{P^t \mathbb{E}_0 [r_t] + P^{t-1}(1-P)(1-LGD)}{(1+\rho)^t} \right] + \frac{P^T}{(1+\rho)^T} \tag{2}$$

- Maturity T
- Interest rate $\mathbb{E}_0 r_t$ (fixed rate or fixed coupon over floating benchmark rate) ▷ Forward rates
- Repayment probability P (constant over time)
- Loss given default LGD (constant over time)
- $\Rightarrow$ Solve for lender's discount rate: ρ

Lender's Discount Rate

Fixed contractual rate:

Lemma 2 (Lender's Discount Rate)

For a fixed contractual rate loan:

$$1 + \rho = P\,(1 + r) + (1 - P)\,(1 - LGD)$$

▷ *Proof*

Note: ρ independent of maturity T for fixed rate loans.

Floating contractual rate: Numerical solution of (2).

Firm's Cost of Capital

Lemma 3 (Firm's Cost of Capital)

We can solve for Λ *as*

$$\Lambda = \frac{(1-P)(1-LGD)}{1+\rho-(1-P)(1-LGD)}$$

$$1+r^{firm} = (1+\rho) - \underbrace{(1-P)(1-LGD)}_{\text{Adjusted Default Probability}}$$

▷ *Proof*

- Adjusted Default Probability $(1-P)(1-LGD)$: a default event that does not result in a loss
- With probability $(1-P)(1-LGD)$ the borrower defaults, but the lender receives payment
- Larger ADP → larger wedge between borrower and lender
- For fixed interest rate loans: $1+r^{firm} = (1+r)\,P$

Social Cost of Capital

Lemma 4 (Social Cost of Capital)

The social cost of capital is:

$$
\begin{aligned}
1 + r^{social} &= (1 + r^{firm})\mathcal{M} + (1 - P)(1 - LGD)lev \\
&= \underbrace{(1+\rho)\,\mathcal{M}}_{\rho \text{ heterogeneity}} + \underbrace{(lev - \mathcal{M}) \cdot \underbrace{(1 - P) \cdot (1 - LGD)}_{\text{Adjusted default probability}}}_{\text{Agency Friction}}
\end{aligned}
$$

- Social cost of capital = lender's discount rate + agency friction

Sufficient Statistic for Misallocation

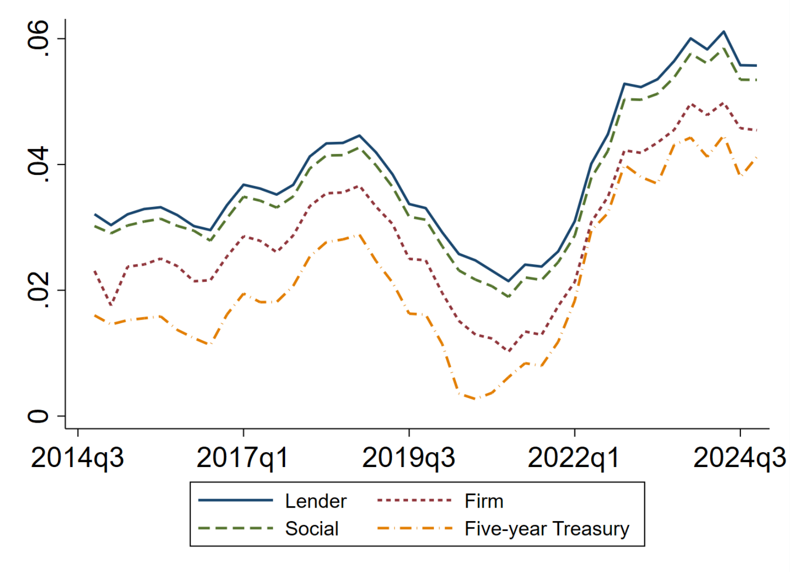
$$\log\left(Y^*/Y^{DE}\right) \approx \frac{1}{2} \cdot \mathcal{E} \cdot \log\left(1 + \frac{\text{Var}\left(r^{social}\right)}{\left(\mathbb{E}\left[r^{social}\right] + \delta\right)^2}\right)$$

$$1 + r_i^{social} = (1 + \rho_i)\,\mathcal{M}_i + (lev_i - \mathcal{M}_i) \cdot (1 - P_i) \cdot (1 - LGD_i)$$

- Calibrate $\mathcal{M} = 1$. We also estimated $\mathcal{M}$ and obtained similar results ▷ Estimate $\mathcal{M}$
- Can measure misallocation directly with credit registry data!
- Dispersion in r^{social} comes from:
  1. Dispersion in lender's discount rate, ρ
  2. Dispersion in agency friction
  3. Covariance between ρ and agency friction

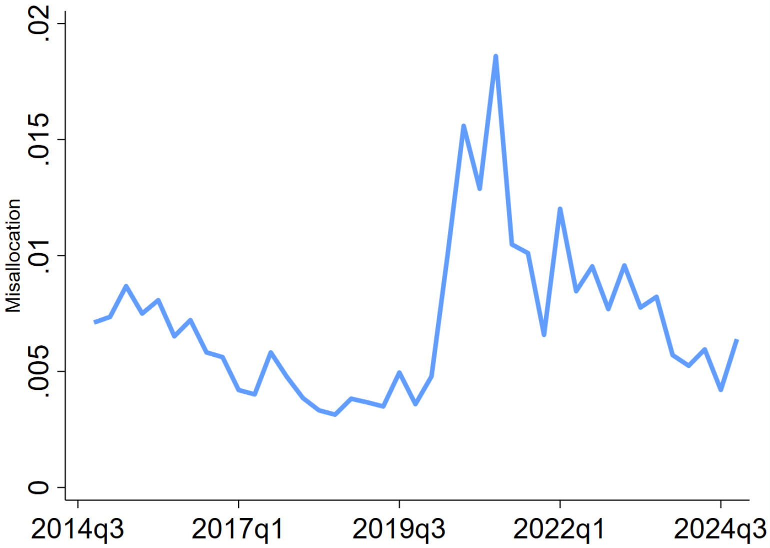
4. Empirical Results

Average Discount Rate, Firm and Social Cost of Capital



- Rates follow the UST
- Social return exceeds firm cost: agency friction
- $\rho \approx r^{social} > r^{firm}$

Misallocation



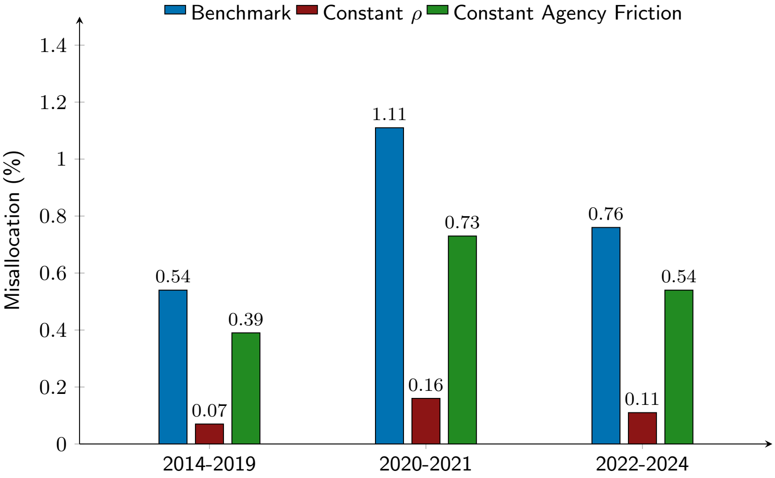
- About 0.5% before 2020
- Increase to 1.1% during 2020-2021
- Back to 0.8% in 2022-2024

The 2020–2021 Increase in Misallocation

1. Predominantly explained by ρ heterogeneity, rather than agency frictions
2. Sharp rise in the coefficient of variation of ρ
3. Dispersion in ρ is traced to changes in the distribution of contractual rates (not P or LGD)
4. The shift in contractual rates is driven by underpricing of very risky loans

$\Rightarrow$ Leads to moral hazard and zombie lending 🧟

Sources of Misallocation: Heterogeneous ρ vs. Agency Friction



- Mostly driven by heterogeneity in ρ
- Interaction between ρ and agency friction $(0.54 > 0.07 + 0.39)$
- The 2020-2021 spike is driven by an increase in the dispersion of ρ

$\Rightarrow$ 1. Predominantly explained by ρ heterogeneity

▷ Decomposition

2020-2021: Dispersion in ρ

- The heterogeneity in ρ is the most important driver of increase in misallocation during 2020-2021
- As rates decreased in 2020-2021, the mean ρ decreased too
- The standard deviation of ρ increased during this period

$\Rightarrow$ 2. Sharp rise in the coefficient of variation of ρ

2020-2021: Contractual Rates

- We can approximate $\rho \approx r - (1 - P)LGD$
- The coefficient of variation depends on: (i) r, (ii) $(1 - P)LGD$ and (iii) the covariance

$$\frac{\mathbb{V}[\rho]^{0.5}}{\mathbb{E}[\rho]} \approx \frac{\left(\mathbb{V}[r] + \mathbb{V}[(1-P)LGD] - 2\,\mathbb{COV}[r, (1-P)LGD]\right)^{0.5}}{\mathbb{E}[r] - \mathbb{E}[(1-P)LGD]}$$

$\Rightarrow$ 3.Dispersion in ρ is traced to changes in the distribution of contractual rates (not P or LGD)

2020-2021: Underpricing of Risky Loans

- Key observation: underpricing of very risky loans—offered with unusually favorable contractual rates
- These loans had low implied ρ, increasing overall dispersion

Our hypothesis:

- Broad fiscal and monetary interventions (e.g., PPP, MSLP, PMCCF, SMCCF) supported distressed firms
- Lenders inferred implicit government guarantees for risky loans
- This created a moral hazard and zombie lending: Lenders took on more risk, expecting government bailouts in case of default

Implication:

- Risk was mispriced, leading to credit misallocation
- Absent guarantees, risk would have been priced more accurately, improving allocative efficiency.

Cross-Country Comparison 🌐

	Aleem 1990 Pakistan	Khwaja & Mian 2005 Pakistan	Cavalcanti et al. 2024 Brazil	Beraldi 2025 Mexico	This paper 2025 United States
Years of Data	1980–1981	1996–2002	2006–2016	2003–2022	2014–2024
Average contractual rate, %	78.7	14.1	83.0	16.8	3.9
St deviation of contractual rate, %	38.1	2.9	93.3	5.2	1.5
Default probability, %	2.7	16.9	4.0	8.9	1.4
Recovery rate (World Bank), %	42.8	42.8	18.2	63.9	81.0
Implied Misallocation, %	4.9	2.2	21.5	1.7	0.6

- Developing countries show higher mean and standard deviation of contractual rates
- U.S. shows lower mean and standard deviation of contractual rate, with high recovery
- Brazil: most extreme misallocation: 21.5%.
- Misallocation in the U.S. is small but non-trivial: 0.6%.

▷ Assumptions

Conclusions

- Develop a macrofinance model with heterogeneous costs of capital and limited liability
- Derive a new sufficient statistic for measuring capital misallocation from credit registry data
- Map to U.S. credit registry data, estimating firm-level cost of capital and social returns
- 2020-2021 interventions lead to increased moral hazard and zombie lending 🧟 → increased misallocation

Appendices

Firm Interest Rate

$$\mathbb{E}_t\left[\frac{\mathcal{P}_{t+1}\left(\theta+(1-\theta)\,Q_{t+1}\right)}{Q_t}\right]=(1+\rho)\,\frac{\mathbb{E}_t\left[\mathcal{P}_{t+1}\left(\theta+(1-\theta)\,Q_{t+1}\right)\right]}{\mathbb{E}_t\left[\mathcal{P}_{t+1}\left(\theta+(1-\theta)\,Q_{t+1}\right)\right]+\mathbb{E}_t\left[\left(1-\mathcal{P}_{t+1}\right)\phi k'/b'\right]}$$

$$=(1+\rho)\left(1+\frac{\mathbb{E}_t\left[\left(1-\mathcal{P}_{t+1}\right)\phi k'/b'\right]}{\mathbb{E}_t\left[\mathcal{P}_{t+1}\left(\theta+(1-\theta)\,Q_{t+1}\right)\right]}\right)^{-1}$$

$$=(1+\rho)\,(1+\Lambda)^{-1}$$

where

$$\Lambda\equiv\frac{\mathbb{E}_t\left[\left(1-\mathcal{P}_{t+1}\right)\phi k'/b'\right]}{\mathbb{E}_t\left[\mathcal{P}_{t+1}\left(\theta+(1-\theta)\,Q_{t+1}\right)\right]}$$

▷ Back

Lender's Discount Rate: Fixed rate

$$1 = \sum_{t=1}^{T} \left(\frac{P}{1+\rho} \right)^t \left[r + \frac{(1-P)}{P} (1 - LGD) \right] + \left(\frac{P}{1+\rho} \right)^T$$

Let $x = \frac{P}{1+\rho}$ so

$$1 = \left(r + \frac{(1-P)}{P} (1 - LGD) \right) \frac{x}{1-x} \left(1 - x^T \right) + x^T$$

Guess that $1 + \rho = (1 + r) P + (1 - P) (1 - LGD)$

$$\frac{1-x}{x} = \frac{1}{x} - 1 = \frac{(1+r) P + (1-P) (1-LGD)}{P} - 1 = r + \frac{1-P}{P} (1 - LGD)$$

And, therefore

$$1 = 1 \left(1 - x^T \right) + x^T$$

which validates the guess.

▷ Back

Firm's Cost of Capital: Model:

$$Q_t = \frac{\mathbb{E}_t \left[\mathcal{P}_{t+1} \left(\theta + (1-\theta)\, Q_{t+1}\right) + \left(1 - \mathcal{P}_{t+1}\right) \phi k_{t+1} / b_{t+1}\right]}{1+\rho}$$

Note that

$$Q_t = Q_t^P + Q_t^D$$

$$Q_t^P = \frac{\mathbb{E}_t \left[\mathcal{P}_{t+1} \left(\theta + (1-\theta)\, Q_{t+1}\right)\right]}{1+\rho}$$

$$Q_t^D = \frac{\mathbb{E}_t \left[\left(1 - \mathcal{P}_{t+1}\right) \phi k_{t+1} / b_{t+1}\right]}{1+\rho}$$

That is, we strip the bond into the payment in repay $\left(Q_t^P\right)$ and the payment in default $\left(Q_t^D\right)$.

We are interested in

$$\Lambda = \frac{\mathbb{E}_t \left[\left(1 - \mathcal{P}_{t+1}\right) \phi k_{t+1} / b_{t+1}\right]}{\mathbb{E}_t \left[\mathcal{P}_{t+1} \left(\theta + (1-\theta)\, Q_{t+1}\right)\right]}$$

$$\Lambda = \frac{Q_t^D}{Q_t^P}$$

Firm's Cost of Capital: Measurement:

The firm defaults with probability $(1-P)$ and the lender recovers $(1-LGD)$. Hence

$$Q_t^{D,data} = \frac{(1-P)(1-LGD)}{1+\rho}$$

For the payment portion notice that at issuance we have the following condition

$$1 = \sum_{s=1}^{T}\left[\frac{P^s \mathbb{E}_t[r_{t+s}] + P^{s-1}(1-P)(1-LGD)}{(1+\rho)^s}\right] + \frac{P^T}{(1+\rho)^T}$$

$$1 = \frac{(1-P)(1-LGD)}{1+\rho} + P\frac{\mathbb{E}_t[r_{t+1}]}{1+\rho} + \left(\sum_{s=2}^{T}\left[\frac{P^s \mathbb{E}_t[r_{t+s}] + P^{s-1}(1-P)(1-LGD)}{(1+\rho)^s}\right] + \frac{P^T}{(1+\rho)^T}\right)$$

So, we can define $Q_t^{P,data}$ as $1 = Q_t^{P,data} + Q_t^{D,data}$ so $Q_t^{P,data} = 1 - Q_t^{D,data}$. Finally

$$\Lambda^{data} = \frac{Q_t^{D,data}}{Q_t^{P,data}} = \frac{(1-P)(1-LGD)}{1+\rho-(1-P)(1-LGD)}$$

▷ Back

Forward Interest Rate Expectations

To estimate ρ for floating rate loans, we need estimates of $\mathbb{E}_0\left[r_t\right]$

- Floating rate loans charge reference rate + spread
- We use smoothed daily yield curve estimates from the Fed Board, based on methodology in Gürkaynak, Sack, and Wright (2006)
- We assume expectations hypothesis: long rates reflect expected short rates
- Back out $\mathbb{E}\left[r_t\right]$ for each loan, using treasury forward rate plus loan's spread
- *Note: Most loans actually use LIBOR/SOFR as the reference rate, not treasuries. For now we treat the rates as the same; they are very similar during our sample period.*

▷ Back

Proof of Misallocation

- Formally, planner's problem is now the same as solving $Y = \max_{\{k_i\}_i} \int_0^1 f_i(k_i) di$, where $f_i(k_i)$ is now expected output

- Apply Hughes and Majerovitz (2024), noting $\frac{dY}{dk} = r^{social} + \delta$

$$\log\left(Y^*/Y^{DE}\right) \approx \frac{1}{2} \cdot \mathcal{E} \cdot \log\left(1 + \frac{\text{Var}\left(r^{social}\right)}{\left(\mathbb{E}\left[r^{social}\right] + \delta\right)^2}\right)$$

- $\mathcal{E}$ is (negative) elasticity of output w.r.t. cost of capital $(r^{social} + \delta)$

- $\mathcal{E} = \frac{1}{2}$ corresponds to $f(k, z) = z \cdot k^{1/3}$

▷ Back

Calibration of $\mathcal{E}$

- $\mathcal{E}_i$ is the elasticity of expected output with respect to the cost of capital

- In a Cobb-Douglas setting, with $f(k, z) = z \cdot k^{\alpha}$ and no default, the elasticity simplifies to $\mathcal{E} = \frac{\alpha}{1-\alpha}$

- We calibrate $\mathcal{E} = \frac{1}{2}$, consistent with $\alpha = \frac{1}{3}$.

▷ Back

Sources of Misallocation: Heterogeneous Cost of Capital and Agency Problem

Counterfactual I: What if all lenders have the same $\bar{\rho}$?

$$1 + r^{cf,I}_{social} = \overline{(1+\rho)\mathcal{M}} + (lev - \mathcal{M}) \cdot PD \cdot (1 - LGD)$$

Heterogeneity in r^{cf}_{social} → Misallocation due to agency frictions

Counterfactual II: what if we equalize the agency friction?

$$1 + r^{cf,II}_{social} = (1+\rho)\,\mathcal{M} + \overline{(lev - \mathcal{M}) \cdot PD \cdot (1 - LGD)}$$

Heterogeneity in r^{cf}_{social} → Misallocation due to heterogeneous cost of capital

▷ Back

Summary Statistics

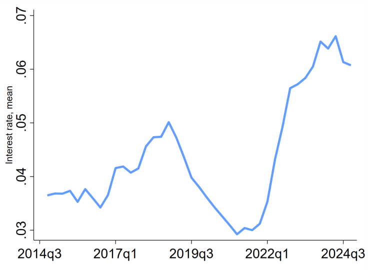
Summary Statistics

Table: Summary Statistics

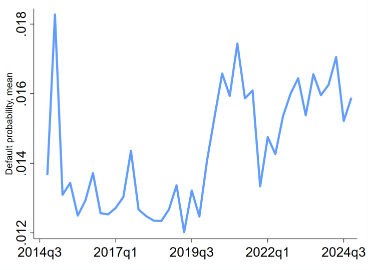
	mean	sd	p10	p50	p90
Interest rate	4.17	1.69	2.21	3.93	6.59
Maturity (yrs)	6.85	4.64	3.00	5.00	10.25
ρ (%)	3.75	1.69	2.05	3.69	5.88
r^{firm} (%)	2.82	2.75	0.87	3.04	5.26
r^{social} (%)	3.54	1.88	1.77	3.53	5.71
Prob. Default (%)	1.42	2.37	0.19	0.82	2.85
LGD (%)	34.50	13.20	16.00	36.00	50.00
Loan amount (M)	10.77	68.81	1.11	2.55	22.64
Sales (M)	1,254.73	5,923.53	2.17	58.80	1,556.58
Assets (M)	1,770.83	8,956.78	1.06	35.52	1,792.00
Leverage (%)	72.03	24.57	42.57	71.17	100.00
Return on assets (%)	22.61	29.05	4.68	15.56	44.04
N Loans	62687				
N Firms	38587				
N Fixed Rate	31540				
N Variable Rate	31147				

Raw Data: Contractual Rate, Default, LGD

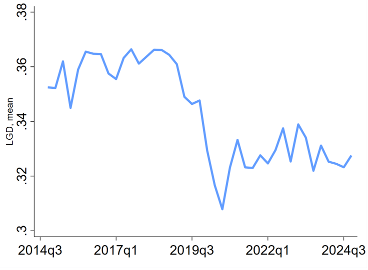
Contractual rate (fixed only)



Default Probability



LGD



- 2020-2021: Increase in default probability
- Modest decline in losses given default (better recovery)

Variance decomposition

Variance decomposition

- Decompose total variance in: time, firm, bank, and error

- Keep firms with 5 or more securities

Variance Decomposition

	Time	Bank	Firm	Loan
Interest rate	71.88	1.63	13.45	13.04
ρ	61.94	3.08	14.02	20.96
r^{firm}	33.23	4.25	20.12	42.4
r^{social}	53.84	3.87	16.21	26.08
N Firms	1681			
N Securities	14738			

Table: Variance decomposition of interest rates and cost of capital (ρ, r^{firm}, and r^{social})

Data Cleaning and Sample Construction

Sample period: We use FR Y-14Q Schedule H.1 data from 2014Q4 onward, due to improvements in reporting consistency and data quality.

Borrower Filters:

- Drop loans without a Tax ID
- Keep only Commercial & Industrial loans to nonfinancial U.S. addresses
- Drop borrowers with NAICS codes:
  - 52 (Finance and Insurance), 92 (Public Administration)
  - 5312 (Real Estate Agents), 551111 (Bank Holding Companies)

Data Cleaning and Sample Construction

Loan Filters:

- Drop loans with:
  - Negative committed exposure
  - Utilized exposure exceeding committed exposure
  - Origination after or maturity before report date
- Keep only "vanilla" term loans (Facility type $= 7$)
- Drop loans with:
  - Mixed-rate structures
  - Maturity outside 110 years
  - Implausible interest rates or spreads (outside 1st99th percentile, or $> 50\%$)
  - Missing or invalid PD/LGD values (outside $[0, 1]$)
  - PD $= 1$ (flagged as in default)

Estimating $\mathcal{M}$

$$\mathcal{M}_t = \frac{1 - \gamma \times \frac{Qb'}{k'} \times \frac{\partial \log Q}{\partial \log k'}}{1 + \gamma \times \times \frac{\partial \log Q}{\partial \log b'}}$$

Given estimates for the function Q, γ, and firm leverage Qb'/k' we can compute $\mathcal{M}$

Compute Q

- Compute Q for every loan origination
- Loans are modeled as perpetuities that decay at a geometric rate θ, we can write Q as the present value of all future payments, discounted at the contractual interest rate r:

$$Q = \frac{\theta + (1-\theta)Q}{1+r} = \frac{\theta}{r+\theta}$$

r is directly observed in the data, and we can apply the common approximation that $\theta = 1/T$

Estimating $\mathcal{M}$: Q elasticities

- We approximate (the log of) Q as a polynomial of investment, borrowing, productivity and ρ
- Investment: tangible assets
- Borrowing: total debt owed by the firm at loan origination
- Productivity: sales over tangible assets (a measure of TFPR following Hsieh Klenow 2009)
- We estimate:

$$\begin{aligned}\log Q_i = \alpha &+ \beta_k \log k_i + \beta_b \log b_i + \beta_z \log z_i + \beta_\rho \rho_i \\ &+ \beta_{k,k} (\log k_i)^2 + \beta_{k,b} \log k_i \times \log b_i + \beta_{k,z} \log k_i \times \log z_i + \beta_{k,\rho} \log k_i \times \rho_i \\ &+ \beta_{b,b} (\log b_i)^2 \beta_{b,z} \log b_i \times \log z_i + \beta_{b,\rho} \log b_i \times \rho_i \\ &+ \beta_{z,z} (\log z_i)^2 \beta_{z,\rho} \log z_i \times \rho_i + \beta_{\rho,\rho} (\rho_i)^2 \epsilon_i\end{aligned}$$

- Compute the partial derivatives of $\log Q$ with respect to investment and borrowing.

Estimating $\mathcal{M}$: Results

- The distribution is extremely concentrated around 1.
- The mean is equal to 0.996 and the median to 0.997, with a standard deviation of 0.006.
- The two measures of misallocation are extremely similar
- Taken together, these results suggest that our assumption that $\mathcal{M} = 1$ is a good one.

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Approximating Misallocation

Assumptions:

- Recovery rates from the World Banks Doing Business
- We use the lender's cost of capital, ρ, in place of the social cost of capital, r_{social} (don't have leverage)
- Use the fixed rate formula for ρ and assume that the probability of default and the losses given default do not vary across firms
- This allows us to compute a cost of misallocation.
- The cost of misallocation for the US is similar to the actual cost

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