Uncertainty, Investment, and Financial Heterogeneity

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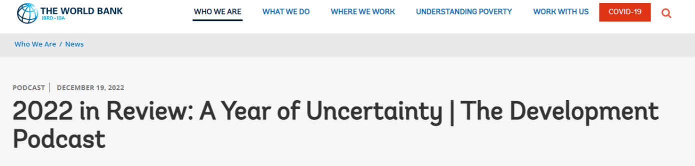
Outline

Motivation: Uncertainty Shocks

Uncertainty accounts for a significant amount of economic fluctuations:



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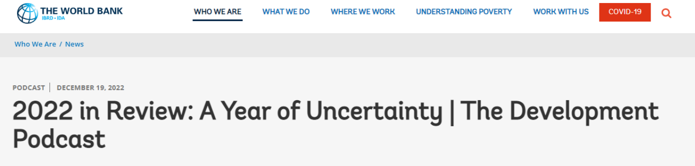

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- Decreases in aggregate consumption, investment, and overall economic activity.

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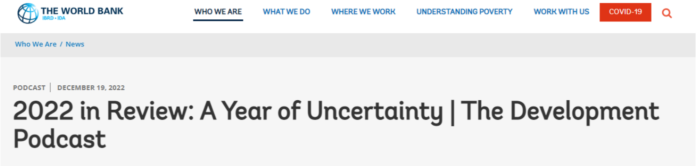

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- A worsening of financial conditions that amplifies the impact of uncertainty.

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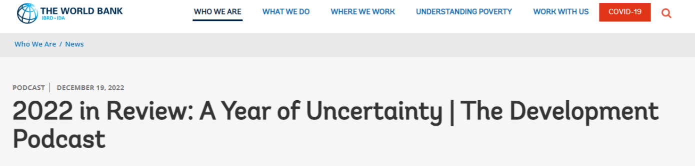

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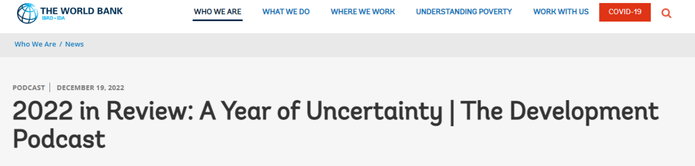

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- A worsening of financial conditions that amplifies the impact of uncertainty.

Financial Uncertainty Multiplier: Alfaro et. al. (2019)

- Focus on the **SIZE** of the financial constraint, but not the **TYPE** of the financial constraint.

Motivation: Financial Heterogeneity

Asset Based Debts:

- Chapter 7 bankruptcy.
- The defaulting firm ceases to operate.
- Debt owners have claims on the liquidized value of the collaterals on default.

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Research Question

How do different types of financial constraints affect the firm-level investment response to uncertainty shocks?

Preview

Empirical Evidence:

- Combined the empirical methodology in Alfaro et al (2019) with Lian and Ma (2020).

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Model Explanation:

- Extended the traditional financial accelerator model with risk shock from Christiano et. al. (2014) into asset based financial accelerator and earning based financial accelerator.

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Model Explanation:

- Extended the traditional financial accelerator model with risk shock from Christiano et. al. (2014) into asset based financial accelerator and earning based financial accelerator.
- The heterogeneity financial accelerator model reveals the possible mechanism.
- When uncertainties increase, the financial accelerator based on earnings can penalize defaulting firms by increasing the proportion of earnings holdings.
- This is a more effective method of punishing a firm than increasing the credit spread.

Literature

Uncertainty Shocks:

- Bloom (2009), Istrefi and Piloiu (2014), Jurado et al. (2015), Ludvigson et al. (2015), Baker et al. (2016), Basu and Bundick (2017), Bloom et al. (2018), Carriero et al. (2018), Altig et. al. (2019), Husted et al. (2019), Berger et al. (2020), Arellano et. al.(2018), Villaverde and Quintana (2020), Alfaro et. al. (2019)

Financial Constraint in DSGE Models:

- Borrowing Capacity Framework: Hart and Moore (1994), Shleifer and Vishny (1992), Kiyotaki and Moore (1997), Kocherlakota (2000), Cordoba and Ripoll (2004), Iacoviello (2005), Bianchi and Mendoza (2010), Jermann and Quadrini (2012), Guerrieri and Iacoviello (2015), Jensen et. al. (2020), Aruoba et. al. (2021)
- Financial Accelerator Framework: Townsend (1979), Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), Bernanke et. al. (1999), Gilchrist and Zakrajsek (2012), Christiano et. al. (2014), Carlstrom et. al. (2016)

Heterogeneity in Types of Financial Constraint:

- Buera et al. (2011), Saunders and Steffen (2011), Greenwald (2018), Lian and Ma (2020) , Ewens and Farre-Mensa (2021), , Drechsel (2022), and Caglio et. al. (2022), Zhao (2022)

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Outline

Identification of Earning-Based Loans and Asset-Based Loans

Capital IQ Capital Structure Dataset:

- Debt capital structure data based on the firm's 10-K filings for the listed firms.
- Highlighted Attributes:
  - security type, secured level, interest rate, maturity date, interest type, interest rate, benchmark, secured flag, convertible type, issued currency, benchmark spread, etc...
- Can be linked to Compustat-CRSP dataset.

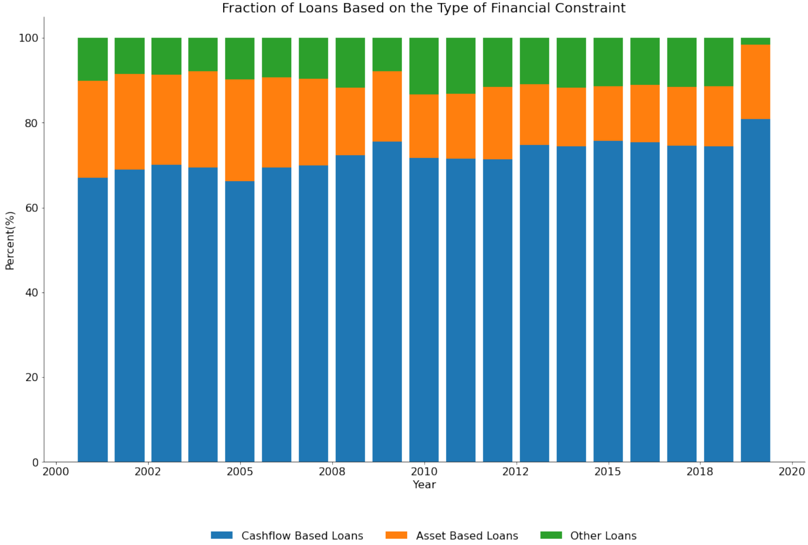
Identification follows Lian and Ma (2020). Detail

- Asset Based Debt: commercial mortgages, asset-based loans, capitalized leases, and secured debt.
- Earning Based Debt: corporate bonds, cashflow based loans, second lien and third lien debts.

Final Data:

- Covers from the year 2001 to 2019, and the number of firms: 5,383

Cashflow Based Loans vs Asset Based Loans on Aggregate Level



The Idiosyncratic Uncertainty Shocks and IV Identification

Uncertainty Shocks:

- Realized: changes in standard error of the realized stock returns in the past year.
- Implied: changes in implied volatility calculated from the option data.

Use IV to identify the exogenous shocks

- The identification strategy follows Alfaro et. al. (2019).
- IV: industrial level exposure to 9 aggregate factors
  - Oil, 7 exchange rates, and policy uncertainty index
- Intuition:
  - The fluctuation of the aggregate factors will influence the firm's uncertainties
  - The firm level variables hardly have significant influence on the aggregate factors.

The firm-year level IV data are provided by the authors, and can be linked to Compustat-CRSP dataset.

IV Construction Data Description

Key Econometric Model

$$\begin{aligned} InvRate_{i,t} = \beta_0 + \beta_1 VolShock_{i,t-1} + \beta_2 EBDRatio_{i,t-2} \times VolShock_{i,t-1} \\ + \beta_3 EBDRatio_{i,t-1} + \gamma X_{i,t-1} + \epsilon_{i,t} \end{aligned} \quad (1)$$

- $InvRate_{i,t}$ (Investment Rate): I/K
- $VolShock_{i,t-1}$ (Firm Level Volatility Shock): Instrumented realized or implied volatility shock
- $EBDRatio_{i,t-2}$ (Earning Based Debt Ratio): Cashflow Based Debt / Total Debt
- Following the construction in Alfaro et. al. (2019), take one year lag of the financial indicators to break the simultaneity of uncertainty and the financial constraint.
- $X_{i,t-1}$ (Controls):
  - Firm level controls: Tobin's Q, tangibility, leverage, return of asset, log of firm size, realized stock return, investment rate, employment growth, intangible asset growth, debt growth, cost of good sold growth, sales growth, cash growth, profit growth, payout growth.
  - First moment aggregate controls
  - Firm fixed effect and time fixed effect, clustering the standard error at the 2-digit SIC code

First Replication

Interaction with Firm Level Cashflow Based Loan Ratio

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.007*	0.025***		
	(0.004)	(0.007)		
Implied Shock × Cashflow Based Loan Ratio			0.011	0.072***
			(0.008)	(0.024)
Realized Shock	-0.016***	-0.070***		
	(0.004)	(0.014)		
Implied Shock			-0.039***	-0.163***
			(0.010)	(0.054)
Cashflow Based Loan Ratio	0.008**	0.008**	0.010**	0.010**
	(0.003)	(0.003)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.158	0.216	0.196

- Baseline: the average of the investment rate is 0.22.
- The above result corresponds to 1 percent increase in the standard error.

Control for the Size of the Financial Constraint

Alfaro et. al. (2019) showed that the financial constraint has an amplification effect for the firm's response to the uncertainty shocks.

- Will the **SIZE** of the financial constraint dampen the effect of the **TYPE** of the financial constraint?

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- No!

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- No!

$$\begin{aligned} InvRate_{i,t} = & \beta_0 + \beta_1 VolShock_{i,t-1} + \beta_2 FC_{i,t-2} \times VolShock_{i,t-1} + \beta_3 FC_{i,t-2} + \\ & \beta_4 CFBRatio_{i,t-2} \times VolShock_{i,t-1} + \beta_5 CFBRatio_{i,t-2} + \gamma X_{i,t-1} + \epsilon_{i,t+h} \end{aligned} \tag{2}$$

- Measurement of the financial constraint size:
  - Log of firm size and the firm's leverage ratio Control Size Control Leverage
  - Indexes constructed in Hadlock and Pierce (2010), and Whited and Wu (2006). Definition
- Following the construction in Alfaro et. al. (2019), take one year lag of the financial indicators to break the simultaneity of uncertainty and the financial constraint.

Conditional on Financial Constraint Size: HP Index

Table: Financial Constraint: Hadlock and Pierce (2010)

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Earnings-Based Debt Ratio	0.003	0.013*		
	(0.004)	(0.008)		
Realized Shock × HP Index	-0.005*	-0.018***		
	(0.003)	(0.006)		
Implied Shock × Earnings-Based Debt Ratio			0.005	0.059***
			(0.008)	(0.022)
Implied Shock × HP Index			-0.009*	-0.030**
			(0.005)	(0.013)
Realized Shock	-0.033***	-0.131***		
	(0.011)	(0.024)		
Implied Shock			-0.068***	-0.275***
			(0.020)	(0.093)
HP Index	0.069***	0.069***	0.070***	0.061***
	(0.011)	(0.011)	(0.017)	(0.019)
Earnings-Based Debt Ratio	0.008**	0.008**	0.011**	0.011**
	(0.004)	(0.004)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.180	0.160	0.219	0.196

Conditional on Financial Constraint Size: WW Index

Table: Financial Constraint: Whited and Wu (2006)

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock $\times$ Cashflow Based Loan Ratio	0.006	0.015*		
	(0.004)	(0.008)		
Realized Shock $\times$ WW Index	-0.024	-0.094**		
	(0.019)	(0.046)		
Implied Shock $\times$ Cashflow Based Loan Ratio			0.006	0.055***
			(0.008)	(0.020)
Implied Shock $\times$ WW Index			-0.104***	-0.294
			(0.036)	(0.219)
Realized Shock	-0.021***	-0.085***		
	(0.006)	(0.023)		
Implied Shock			-0.067***	-0.242**
			(0.015)	(0.111)
WW Index	0.192***	0.185***	0.185***	0.184***
	(0.029)	(0.029)	(0.041)	(0.039)
Cashflow Based Loan Ratio	0.008**	0.007**	0.010**	0.009**
	(0.003)	(0.004)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.178	0.163	0.219	0.197

Robustness Check

Definition change of the financial constraint:

- Asset based loan ratio Detail
- Dummy of high cashflow based loan ratio: 1 if higher than the yearly median. Detail

Taking contemporaneous indicators of the financial constraints. Detail

Control for Uncertainty Shock $\times$ Aggregate Factors:

- Credit Spread: Moody BAA-AAA bond credit spread Detail
- Aggregate Financial Constraint Type: Aggregate CFBRatio Detail
- Aggregate Uncertainty: VIX Index Detail

Further Discussion

Impact of Other Firm-Level Variables:

- When uncertainty increases, firms tend to hold more cash, but earning-based financial constrained firms hold even more cash. Cash
- The firm profit, stock returns, sales, cost of goods, intangible capital growth, employment growth, the payoff to the equity holders and the amount of debt borrowed are not significantly affected by the type of financial constraint. Profit Return Sales COGS Intangible Employment Payout Debt

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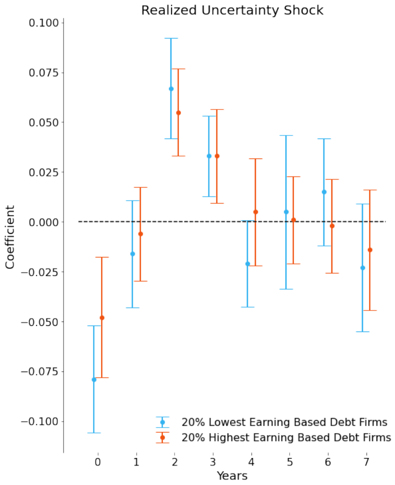
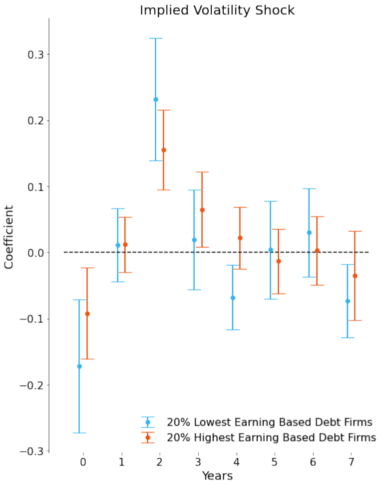
Dynamic Effect:

- Compare the firms with the highest 20 percent cash flow-based debt ratio to those with the lowest 20 percent cash flow-based debt ratio.

$$\begin{aligned} InvRate_{i,t+h} &= \beta_0 + \beta_1 1(High\ EBDRatio)_{i,t-2} \times VolShock_{i,t-1} \\ &+ \beta_2 1(Medium\ EBDRatio)_{i,t-2} \times VolShock_{i,t-1} + \beta_3 1(Low\ EBDRatio)_{i,t-2} \times VolShock_{i,t-1} \\ &+ \beta_4 1(High\ EBDRatio)_{i,t-2} + \beta_5 1(Medium\ EBDRatio)_{i,t-2} + \gamma X_{i,t-1} + \epsilon_{i,t} \end{aligned} \quad (3)$$

Dynamic Effect





Summary

Conclusion of Empirical Analysis:

- Firms with a higher proportion of earning-based debt tend to be less responsive to investment in response to uncertainty shocks.
- The effect of the type of financial constraint is significant, even when controlling for the size of the financial constraint.

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- Firms with a higher proportion of earning-based debt tend to be less responsive to investment in response to uncertainty shocks.
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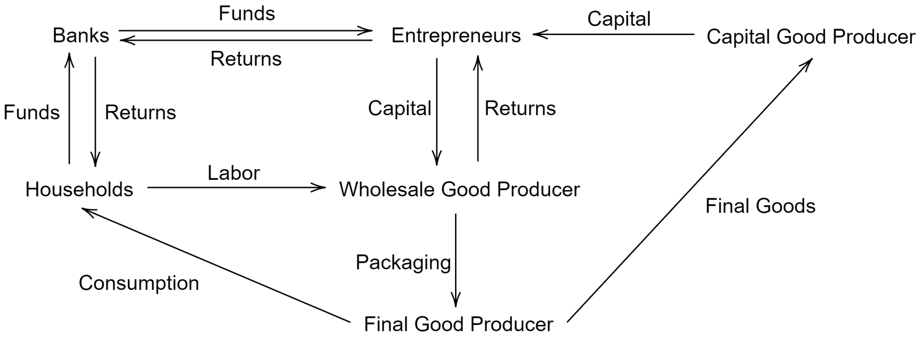
What is the primary cause of the better performance of the earning based financial constraint?

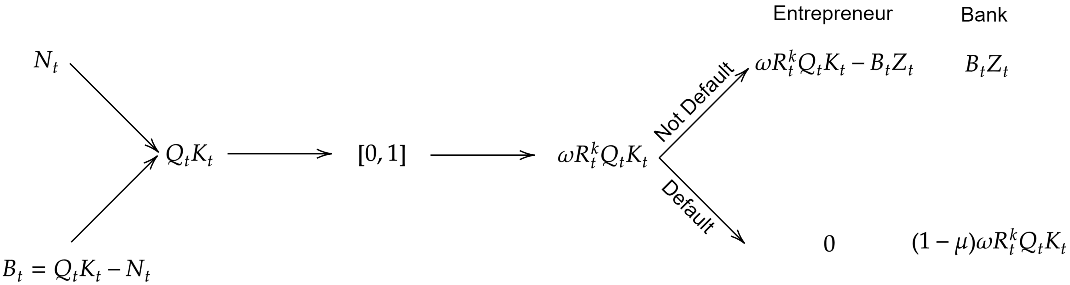
Outline

Model Structure



NK Model

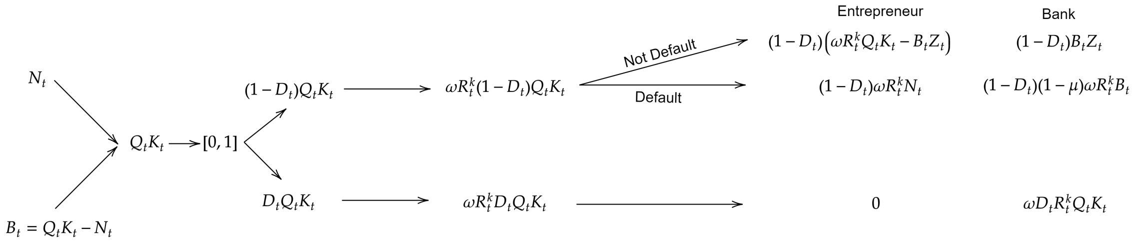
Vanilla (Asset Based) Financial Accelerator



$$r_{t+1}^k - r_t = \nu l_t + \psi \hat{\sigma}_t$$

Bernanke et. al. (1999): $\nu > 0$, Christiano et. al. (2014): $\psi > 0$. Math

Altered (Earning Based) Financial Accelerator



$$r_{t+1}^k - r_t = \tilde{\nu} l_t + \tilde{\psi} \hat{\sigma}_t + \tilde{\varphi} d_t$$

d_t denotes the fraction of earnings hold by the banks because of the firm's default history. Math

Transition of the Fraction of Bank Holdings

Proposition 1

Since the entrepreneur will only obtain payoffs from the projects owned by himself, he would prefer a lower portion of projects owned by the banks, i.e. D_t to be as small as possible.

Proposition 2

When $L_t > 1$, the return of the bank is increasing in D_t. Proof

Ad-hoc Transition of the Bank Holdings:

$$D_{t+1} = (1-\psi)D_t + (1-D_t)\Phi(\bar{\omega}_{t+1}, \sigma_t)$$

- ψ: forgiven rate, controls the size of the financial constraint.
- $(1-D_t)\Phi(\bar{\omega}_{t+1}, \sigma_t)$: fraction of newly defaulted projects.

Footnote

Asset Based vs Earning Based Financial Accelerator

Asset Based Financial Accelerator

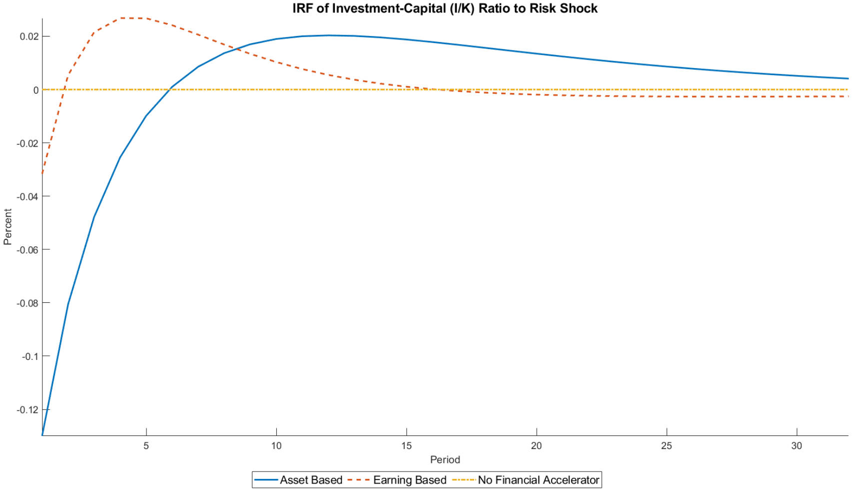
- Upon default, bankers will receive the returns on all of the fixed capital.
- Bankers will receive fixed return if the entrepreneur didn't default.
- Current default has no impact on the future firm structure.

Earning Based Financial Accelerator

- Upon default, bankers will only receive returns on the portion of funds contributed.
- Bankers will receive a flexible return due to the ownership of the restructured firm.
- Current defaults will affect the future structure of the firm.

Compare two separate models while targeting the same steady-state level of the credit spread.

Asset Based vs Earning Based Financial Accelerator



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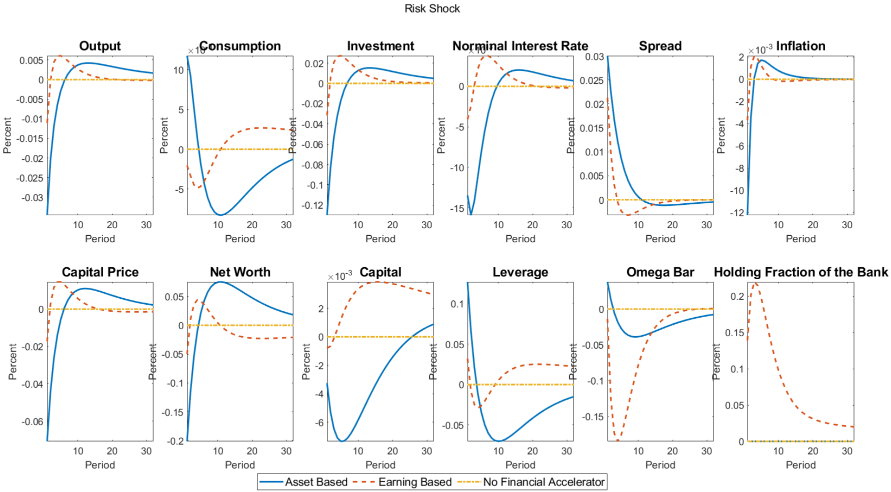


Why Are Earning Based Financial Accelerator Less Impacted?

Mechanism:

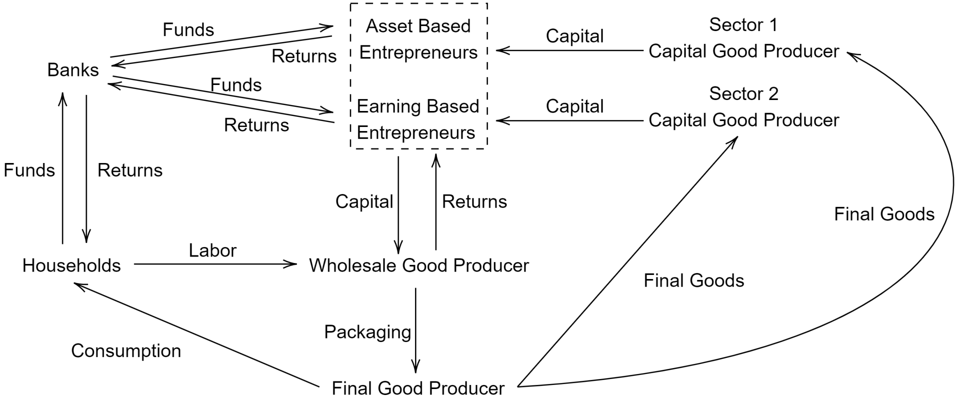
- When the uncertainty level increases, the restructuring procedure allow the banks to have access to more earnings of the entrepreneurs.
- However, this will make the entrepreneurs less likely to default, decreasing the effect on credit spread and aggregate economies.
- The investment hence responses less for the earning based financial accelerator.

Further Decomposition

The IRF of net worth shocks aligns with the results in Lian and Ma (2020). IRF to Net Asset

Outline

Financial Heterogeneity Model



J fraction of total capital comes from the asset based entrepreneurs. Detail

Calibration Strategy

Calibrate the steady state:

- Calibrate the steady state standard error σ of the capital effectiveness shock such that the credit spread of the asset based sector is targeted at 2 percentage points.
- Calibrate ψ to target the same credit spread for the earning based sector at steady state to eliminate the effect of the different size of the financial constraint.

Match the Empirical Result:

- Calibrate φ and ρ_s to target the dynamic effect in the empirical analysis using the realized volatility shocks.
- Choose the shock to be 1 percent increase in the standard error to match the empirical analysis.
- Calculate the IRF of the two sectors' investment rate quarterly in the model, adjust to annual frequency, and choose the parameters $\gamma = \{\varphi, \rho_s\}$ to minimize the following:

$$min_{\gamma}[\hat{\Phi} - \Phi(\gamma)]' V[\hat{\Phi} - \Phi(\gamma)]$$

where V is a diagonal matrix with variances of the empirical IRFs on its diagonals.

Parameter Calibration

Variable	Name	Value	Target
β	Utility Discounting Factor	0.9900	4 Percent Annual Interest Rate
δ	Quarterly Depreciation Rate	0.0250	10 Percent Annual Depreciation Rate
α	Labor Share	0.3500	35 Percent Labor Share in the US
Ω	Entrepreneur Labor Share	0.9846	64 Percent of Entrepreneur Labor Share
η	Elasticity of Substitution Between Goods	11.000	10 Percent Steady State Markup
γ	Entrepreneur Survival Rate	0.9728	2.72 Percent Quarterly Natual Net Worth Shrinking Rate
θ	Price Stickiness	0.7500	25 Percent of Price Changing
σ	Steady State ω Standard Error	0.1713	2 Percent Credit Spread
ξ	Labor Preference Parameter	3.3122	25 Percent of Labor Input
$\bar{G}/\bar{Y}$	Steady State G/Y ratio	0.2000	20 Percent of Government Expenditure to GDP Ratio
μ	State Verification Cost	0.1000	Common Value
ρ	Taylor Rule Persistence	0.9000	Common Value
ζ	Taylor Rule Inflation Reaction	0.1100	Common Value
J	Asset Based Capital Fraction	0.3000	60-80 Percent Earning Based Debt
ψ	Stickiness in Negotiated Structure	0.0239	Same Steady State Credit Spread for the Two Sectors
ρ_s	Risk Shock Persistence	0.7417	Empirical IRFs
φ	Fixed Capital Producer Technology	0.5447	Empirical IRFs

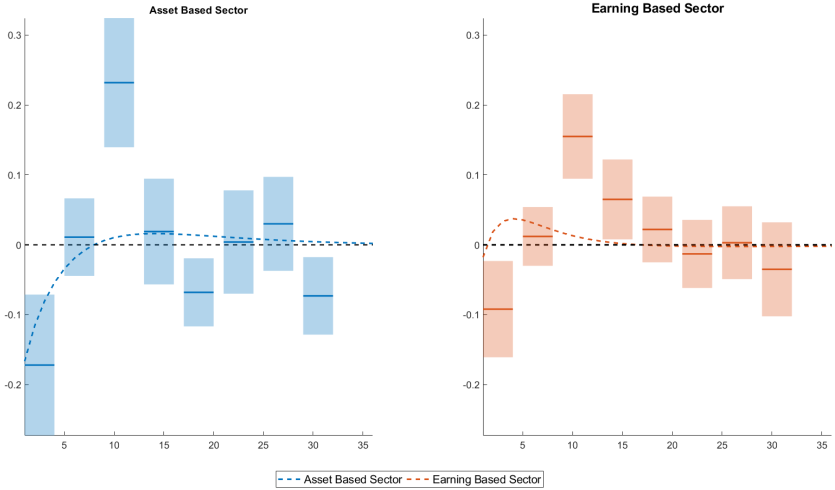
Steady State

Level	Variable	Name	Asset Based Steady State	Earning Based Steady State
Sector Level	$\bar{R}^k - \bar{R}$	Credit Spread	0.0050	0.0050
	$\bar{\omega}$	Default Cutoff	0.6516	0.6773
	$\bar{D}$	Fraction of Buffer Fund	-	0.3743

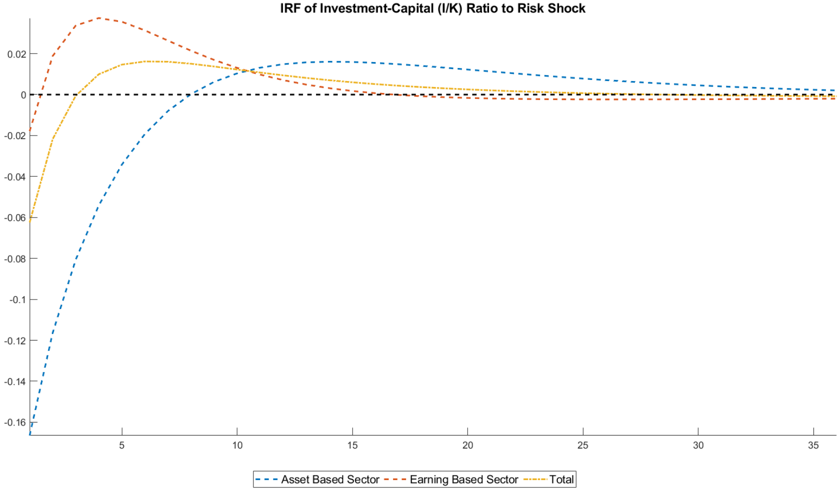
Level	Variable	Name	Aggregate Steady State
Aggregate Level	$\bar{C}/\bar{Y}$	C-Y Ratio	0.5270
	$\bar{I}/\bar{Y}$	I-Y Ratio	0.1984
	$\bar{K}/\bar{Y}$	K-Y Ratio	7.9345
	$\bar{W}^e/\bar{Y}$	Entrepreneur Wage to Y Ratio	0.0091
	$\bar{W}/\bar{Y}$	W-Y Ratio	2.3273
	$\bar{K}/\bar{N}$	Leverage	2.8909
	$\bar{X}$	Markup	1.1000
	$\bar{H}$	Working Hours of a Day	0.2500
	$\bar{R}$	Riskfree Interest rate	1.0101
	$\bar{R}^k$	Capital Return	1.0151

The steady state targets follow the standard targets for the US economy provided by Eric Sims.

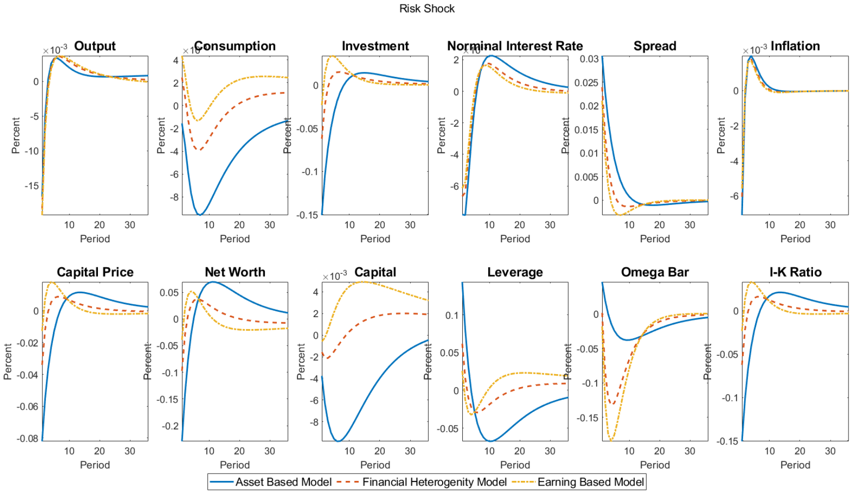
Model vs Data



IRF of the Two Sectors to Risk Shocks



Implication: Model Comparasion



Outline

Conclusion

Main Takeaway:

- Firms with earning-based financial constraints perform better than those with asset-based financial constraints during economic uncertainty shocks.
- This result holds with or without controlling for the size of the financial constraints.
- The financial constraint based on earnings provides an incentive for firms to avoid default, leading to a negative feedback loop that mitigates the effects of uncertainty shocks.

Policy Implication:

- Earning-based financial constraints are generally preferred over asset-based constraints.
- As the proportion of earning-based loans increases, the economy should become more stable in the face of uncertainty.

Next Step:

- More implications...

Outline

Cashflow Based Loan and Asset Based Loan Identification

- Step 1: count the debt as asset based
  - if the debt description contains certain words about the asset based loans.
  - if the debt is a secured resolver.
  - if the debt type is mortgage loan or mortgage note.
  - if the debt structure is commercial lease.
- Step 2: count the debt as other debt if the debt is not counted as the asset based loan in step 1, and the debt description contains certain words about the other loan type.
- Step 3: count the debt as cashflow based if the debt is not counted as the asset based in step 1 or other loans in step 2, and
  - if the debt description contains certain words about the earning based loans.
  - if the debt is convertible.
  - if the debt type is debenture, note payable, cooperate bond, or term loan.
  - if the debt is not first lien or not secured debt.
- Step 4: count all the other secured debts as asset based loans.
- Step 5: count all the other debts as other type loans.

Back

Instrument Variable

Procedure to get the firm level exposure to the aggregate factors:

- step 1: using the firm-year level data, run the following regression:

$$r_{i,t}^{adj} = \alpha_j + \sum_c \beta_j^c r_t^c + \epsilon_{i,t}$$

  regress the daily risk-adjusted stock return of firm i on the changes of the price of the factors for each industry j.

- step 2: construct the instrument variable using:

$$z_{i,t-1}^c = |\beta_{j,t-3}^c| \Delta \sigma_{t-1}^c$$

  for each factor c construct a corresponding instrument, where σ_{t-1}^c denote the variation of factor c.

Back

Data Description

Variable	Observation	Mean	Standard Error	Min	25 Percentile	Median	75 Percentile	Max
Investment Rate	37122	0.22	0.14	-0.24	0.11	0.19	0.31	0.50
Asset Based Loan Ratio	37122	0.27	0.37	0.00	0.00	0.04	0.49	1.00
Cashflow Based Loan Ratio	37122	0.68	0.39	0.00	0.36	0.89	1.00	1.00
Realized Uncertainty Shock	37122	-0.03	0.33	-0.85	-0.26	-0.05	0.17	1.01
Implied Uncertainty Shock	23621	-0.03	0.20	-0.52	-0.16	-0.04	0.07	0.65
Realized Return	37122	0.15	0.61	-0.88	-0.19	0.07	0.35	3.82
Employment Growth	37122	0.03	0.21	-1.00	-0.04	0.02	0.10	1.00
Intangible Asset Growth	37122	0.05	0.37	-1.00	-0.04	0.00	0.08	1.00
Dividend Payout Growth	37122	0.03	0.32	-1.00	0.00	0.00	0.05	1.00
Debt Growth	37122	0.05	0.46	-1.00	-0.15	0.00	0.22	1.00
Cost of Goods Growth	37122	0.06	0.26	-1.00	-0.03	0.06	0.16	1.00
Sales Growth	37122	0.06	0.25	-1.00	-0.03	0.06	0.16	1.00
Cash Holding Growth	37122	0.04	0.55	-1.00	-0.30	0.05	0.40	1.00
Profit Growth	37122	0.06	0.40	-1.00	-0.05	0.03	0.20	1.00
Tangibility	37122	0.57	0.46	0.00	0.21	0.45	0.84	3.76
Leverage	37122	0.57	0.26	0.04	0.40	0.55	0.70	2.31
ROA	37122	0.04	0.19	-1.97	0.02	0.07	0.12	0.59
Log Employment Size	37122	6.44	2.15	-1.91	5.03	6.57	7.90	11.89
Tobin's Q	37122	0.81	2.02	-5.12	-0.61	0.91	2.22	5.75

Back

First Stage Regression

First stage regression shows strong correlation between the uncertainty shocks and the instrument variables:

- Realized Uncertainty Shock
  F Stat: 78.42, P Value: 0.00
- Implied Uncertainty Shock
  F Stat: 42.81, P Value: 0.00

Covered Date: 2001 - 2019 Back

Table: First Stage Regression

VARIABLES	(1) Realized First Stage	(2) Implied First Stage
Oil	1.582***	0.808***
	(0.306)	(0.212)
CAD	-0.302	-0.391*
	(0.357)	(0.230)
EURO	0.752***	0.431***
	(0.252)	(0.106)
JPY	0.539**	0.348***
	(0.234)	(0.122)
AUD	1.874***	0.360**
	(0.283)	(0.140)
SEK	1.353***	0.438**
	(0.325)	(0.187)
CHF	0.404*	0.148
	(0.221)	(0.099)
GBP	-0.005	0.502***
	(0.288)	(0.124)
EPU	77.864	26.084
	(50.454)	(23.727)
Observations	34,704	22,236
R-squared	0.093	0.114

Replication of Alfaro et. al. (2019)

Covered Date: 2001 - 2019

Table: Baseline Regression

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Uncertainty Shock	-0.009***	-0.051***		
	(0.003)	(0.017)		
Implied Uncertainty Shock			-0.031***	-0.109**
			(0.007)	(0.043)
Observations	34,704	34,704	22,236	22,236
R-squared	0.176	0.161	0.213	0.197

In Alfaro et. al. (2022), realized shock coefficient: -0.041, implied shock coefficient -0.058, covered date: 1993 - 2019 Back

Robust Check: Control Firm Size

Table: Robustness Check: Financial Constraint with Firm Size

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.004	0.014		
	(0.004)	(0.011)		
Realized Shock × Firm Size	0.002	0.005		
	(0.002)	(0.004)		
Realized Shock	-0.015***	-0.064***		
	(0.004)	(0.011)		
Implied Shock × Cashflow Based Loan Ratio			0.005	0.056***
			(0.008)	(0.018)
Implied Shock × Firm Size			0.005	0.010
			(0.003)	(0.010)
Implied Shock			-0.043***	-0.158***
			(0.011)	(0.046)
Firm Size	-0.015***	-0.014***	-0.016***	-0.014***
	(0.003)	(0.003)	(0.004)	(0.004)
Cashflow Based Loan Ratio	0.007**	0.007**	0.009**	0.010**
	(0.003)	(0.004)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.160	0.217	0.200

Back

Robust Check: Control Firm Leverage

Table: Robust Check: Firm Leverage

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.008*	0.025***		
	(0.004)	(0.007)		
Realized Shock × Firm Leverage	-0.002	0.001		
	(0.008)	(0.018)		
Realized Shock	-0.015**	-0.071***		
	(0.006)	(0.011)		
Implied Shock × Cashflow Based Loan Ratio			0.009	0.070***
			(0.009)	(0.025)
Implied Shock × Firm Leverage			0.009	0.021
			(0.014)	(0.026)
Implied Shock			-0.044***	-0.175***
			(0.009)	(0.047)
Firm Leverage	-0.041***	-0.036***	-0.036***	-0.028**
	(0.005)	(0.006)	(0.008)	(0.012)
Cashflow Based Loan Ratio	0.008**	0.008**	0.010**	0.010**
	(0.003)	(0.003)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.158	0.216	0.196

Back

Definition of the Financial Constraint Size Index

- WW index:

$$
\begin{aligned}
WWIndex_{i,t} = & -0.091(oibdp_t)/at_{t-1} - 0.062 \times 1(payout_t > 0) \\
& + 0.021(dltt_t/at_{t-1}) - 0.044log(at_{t-1}) \\
& + 0.102 * \Delta(IndSALE_t) - 0.035\Delta(sales_t)
\end{aligned}
$$

  $oibdp_t$: Operating income before depreciation and amortization, at_{t-1}: Total asset, $payout_t$: Payout to the equity holders, $dltt_t$: Long term total debt, $IndSALE_t$: Industrial average sale level, $sales_t$: Firm sale

- HP index:

$$
HPIndex_{i,t} = -0.737log(at_t)^2 + 0.043log(at_t)^2 - 0.040age_t
$$

  age_t: Firm age since IPO.

Back

Robust Check: Asset Based Loan Ratio

Table: Robustness Check: Regression with Asset Based Loan Ratio

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Asset Based Loan Ratio	-0.009**	-0.027***		
	(0.004)	(0.008)		
Implied Shock × Asset Based Loan Ratio			-0.006	-0.073***
			(0.008)	(0.027)
Realized Shock	-0.009***	-0.046***		
	(0.003)	(0.013)		
Implied Shock			-0.030***	-0.093**
			(0.006)	(0.037)
Asset Based Loan Ratio	-0.008**	-0.008**	-0.011**	-0.012**
	(0.004)	(0.004)	(0.005)	(0.005)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.158	0.216	0.197

Back

Robust Check: Dummy for Cashflow Based Loan Ratio

Table: Robustness Check: Regression with Dummy for High Earning Based Loan Ratio

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × High Cashflow Based Loan Ratio	0.005	0.008*		
	(0.003)	(0.004)		
Implied Shock × High Cashflow Based Loan Ratio			0.009	0.034***
			(0.006)	(0.011)
Realized Shock	-0.012***	-0.056***		
	(0.004)	(0.018)		
Implied Shock			-0.036***	-0.128***
			(0.008)	(0.048)
High Cashflow Based Loan Ratio	0.006***	0.005**	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
Observations	34,704	34,704	22,236	22,236
R-squared	0.176	0.161	0.214	0.196

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Contemporaneous Indicators: HP Index

Table: Robustness Check: Contemporaneous Indicators: HP Index

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Earnings-Based Debt Ratio	0.009**	0.012*		
	(0.005)	(0.007)		
Realized Shock × HP Index	-0.002	-0.014*		
	(0.003)	(0.008)		
Implied Shock × Earnings-Based Debt Ratio			0.014*	0.073***
			(0.008)	(0.019)
Implied Shock × HP Index			-0.009	-0.020
			(0.007)	(0.016)
Realized Shock	-0.022*	-0.111***		
	(0.013)	(0.039)		
Implied Shock			-0.078***	-0.232**
			(0.029)	(0.101)
HP Index	0.032*	0.033*	0.028*	0.027*
	(0.018)	(0.018)	(0.016)	(0.016)
Earnings-Based Debt Ratio	0.007**	0.007**	0.008**	0.009***
	(0.004)	(0.004)	(0.003)	(0.003)
Observations	34,704	34,704	22,236	22,236
R-squared	0.177	0.161	0.214	0.199

Back

Contemporaneous Indicators: WW Index

Table: Robustness Check: Contemporaneous Indicators: WW Index

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.010**	0.009		
	(0.004)	(0.008)		
Realized Shock × WW Index	-0.008	-0.119		
	(0.021)	(0.076)		
Implied Shock × Cashflow Based Loan Ratio			0.015*	0.062***
			(0.009)	(0.017)
Implied Shock × WW Index			-0.083	-0.363
			(0.063)	(0.264)
Realized Shock	-0.018**	-0.087***		
	(0.008)	(0.032)		
Implied Shock			-0.067***	-0.263**
			(0.021)	(0.126)
WW Index	0.267***	0.268***	0.275***	0.275***
	(0.035)	(0.035)	(0.054)	(0.052)
Cashflow Based Loan Ratio	0.008**	0.007*	0.008**	0.008**
	(0.004)	(0.004)	(0.003)	(0.004)
Observations	34,704	34,704	22,236	22,236
R-squared	0.180	0.164	0.218	0.198

Back

Robust Check: Interacted with Credit Spread

Table: Robustness Check: Interacted with Credit Spread

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.008**	0.024***		
	(0.004)	(0.006)		
Realized Shock × Credit Spread	-0.029***	-0.090***		
	(0.010)	(0.027)		
Realized Shock	0.015	0.052*		
	(0.010)	(0.028)		
Implied Shock × Cashflow Based Loan Ratio			0.011	0.070***
			(0.008)	(0.024)
Implied Shock × Credit Spread			-0.033**	-0.121***
			(0.013)	(0.034)
Implied Shock			-0.005	0.019
			(0.017)	(0.055)
Credit Spread	-0.001	0.006	0.005	0.011
	(0.005)	(0.006)	(0.007)	(0.007)
Cashflow Based Loan Ratio	0.008**	0.008**	0.010**	0.011***
	(0.003)	(0.003)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.177	0.169	0.217	0.209

Back

Robust Check: Interacted with Credit Spread and HP Index

Table: Robustness Check: Interacted with Credit Spread and HP Index

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.003	0.013*		
	(0.004)	(0.008)		
Realized Shock × Credit Spread	-0.028***	-0.094***		
	(0.010)	(0.026)		
Realized Shock × HP Index	-0.006**	-0.018***		
	(0.003)	(0.006)		
Realized Shock	-0.004	-0.004		
	(0.013)	(0.032)		
Implied Shock × Cashflow Based Loan Ratio			0.006	0.058**
			(0.008)	(0.023)
Implied Shock × Credit Spread			-0.032**	-0.128***
			(0.013)	(0.034)
Implied Shock × HP Index			-0.009*	-0.025**
			(0.005)	(0.012)
Implied Shock			-0.035	-0.063
			(0.022)	(0.085)
Cashflow Based Loan Ratio	0.008**	0.008**	0.011**	0.012***
	(0.004)	(0.004)	(0.004)	(0.004)
HP Index	0.068***	0.065***	0.069***	0.062***
	(0.011)	(0.011)	(0.017)	(0.019)
Credit Spread	-0.001	0.006	0.005	0.011
	(0.005)	(0.006)	(0.007)	(0.007)
Observations	29,119	29,119	19,450	19,450
R-squared	0.181	0.171	0.220	0.211

Back

Robust Check: Interacted with Credit Spread and WW Index

Table: Robustness Check: Interacted with Credit Spread and WW Index

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.006	0.013		
	(0.004)	(0.008)		
Realized Shock × Credit Spread	-0.029***	-0.093***		
	(0.010)	(0.023)		
Realized Shock × WW Index	-0.028	-0.117**		
	(0.019)	(0.050)		
Realized Shock	0.009	0.033		
	(0.010)	(0.024)		
Implied Shock × Cashflow Based Loan Ratio			0.006	0.054***
			(0.008)	(0.020)
Implied Shock × Credit Spread			-0.034**	-0.107***
			(0.013)	(0.032)
Implied Shock × WW Index			-0.113***	-0.274
			(0.036)	(0.210)
Implied Shock			-0.034*	-0.074
			(0.019)	(0.116)
Cashflow Based Loan Ratio	0.008**	0.008**	0.010**	0.010**
	(0.003)	(0.003)	(0.004)	(0.004)
WW Index	0.190***	0.181***	0.184***	0.179***
	(0.029)	(0.029)	(0.041)	(0.039)
Credit Spread	-0.001	0.006	0.005	0.012
	(0.005)	(0.006)	(0.006)	(0.007)
Observations	29,119	29,119	19,450	19,450
R-squared	0.179	0.170	0.220	0.211

Back

Robust Check: Interacted with Aggregate CFBRatio

Table: Robustness Check: Interacted with Aggregate CFBRatio

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.007*	0.021***		
	(0.004)	(0.007)		
Realized Shock × Aggregate CFB Ratio	-0.017	0.949		
	(0.087)	(0.626)		
Realized Shock	-0.004	-0.751		
	(0.063)	(0.465)		
Implied Shock × Cashflow Based Loan Ratio			0.011	0.070***
			(0.008)	(0.023)
Implied Shock × Aggregate CFB Ratio			-0.337	2.620
			(0.218)	(2.048)
Implied Shock			0.205	-2.068
			(0.162)	(1.524)
Aggregate CFB Ratio	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Cashflow Based Loan Ratio	0.008**	0.008**	0.010**	0.010**
	(0.003)	(0.004)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.156	0.217	0.181

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Robust Check: Interacted with VIX Index

Table: Robustness Check: Interacted with VIX Index

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.008**	0.030***		
	(0.004)	(0.008)		
Realized Shock × VIX	-0.000	0.001		
	(0.000)	(0.001)		
Realized Shock	-0.005	-0.134***		
	(0.005)	(0.035)		
Implied Shock × Cashflow Based Loan Ratio			0.011	0.074***
			(0.008)	(0.026)
Implied Shock × VIX			0.000	-0.001
			(0.001)	(0.002)
Implied Shock			-0.040**	-0.178***
			(0.016)	(0.057)
VIX	-0.000	0.002**	-0.000	0.002
	(0.000)	(0.001)	(0.000)	(0.001)
Cashflow Based Loan Ratio	0.007**	0.008**	0.010**	0.010**
	(0.003)	(0.004)	(0.004)	(0.004)
Observations	29,119	29,119	19,450	19,450
R-squared	0.176	0.115	0.217	0.181

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Regression Result of the Profit

Table: Regression with EBIT

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.005	0.054		
	(0.019)	(0.048)		
Implied Shock × Cashflow Based Loan Ratio			-0.023	0.157
			(0.058)	(0.150)
Realized Shock	-0.003	-0.257*		
	(0.016)	(0.145)		
Implied Shock			0.069	-0.548
			(0.056)	(0.447)
Cashflow Based Loan Ratio	-0.017	-0.018	-0.010	-0.013
	(0.013)	(0.013)	(0.016)	(0.017)
Observations	29,119	29,119	19,450	19,450
R-squared	0.092	0.066	0.111	0.072

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Regression Result of the Cash Holding

Table: Regression with Cash Holdings

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.095***	0.132***		
	(0.031)	(0.039)		
Implied Shock × Cashflow Based Loan Ratio			0.204***	0.270**
			(0.056)	(0.107)
Realized Shock	-0.018	-0.012		
	(0.023)	(0.058)		
Implied Shock			0.008	-0.028
			(0.048)	(0.176)
Cashflow Based Loan Ratio	-0.065***	-0.063***	-0.070***	-0.068***
	(0.014)	(0.014)	(0.017)	(0.018)
Observations	29,119	29,119	19,450	19,450
R-squared	0.091	0.091	0.092	0.092

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Regression Result of the Stock Returns

Table: Regression with Stock Return

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.032	0.049		
	(0.038)	(0.089)		
Implied Shock × Cashflow Based Loan Ratio			0.069	-0.058
			(0.076)	(0.176)
Realized Shock	0.116***	0.335***		
	(0.024)	(0.110)		
Implied Shock			0.272***	1.441***
			(0.082)	(0.308)
Cashflow Based Loan Ratio	-0.026	-0.022	-0.024	-0.010
	(0.018)	(0.018)	(0.024)	(0.024)
Observations	29,119	29,119	19,450	19,450
R-squared	0.103	0.088	0.105	-0.011

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Regression Result of the Sales Growth

Table: Regression with Sale Growth

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.019	0.028		
	(0.013)	(0.039)		
Implied Shock × Cashflow Based Loan Ratio			0.015	0.066
			(0.026)	(0.121)
Realized Shock	-0.045***	-0.237**		
	(0.013)	(0.107)		
Implied Shock			-0.070**	-0.595*
			(0.035)	(0.304)
Cashflow Based Loan Ratio	0.018***	0.016**	0.018**	0.011
	(0.006)	(0.007)	(0.009)	(0.009)
Observations	29,119	29,119	19,450	19,450
R-squared	0.127	0.068	0.149	0.027

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Regression Result of the Cost of Goods

Table: Regression with Cost of Goods

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.017	0.036		
	(0.018)	(0.036)		
Implied Shock × Cashflow Based Loan Ratio			0.015	0.071
			(0.031)	(0.081)
Realized Shock	-0.033***	-0.162***		
	(0.009)	(0.048)		
Implied Shock			-0.076**	-0.498***
			(0.029)	(0.165)
Cashflow Based Loan Ratio	0.023***	0.022***	0.021**	0.017
	(0.008)	(0.008)	(0.010)	(0.011)
Observations	29,119	29,119	19,450	19,450
R-squared	0.128	0.108	0.135	0.072

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Regression Result of the Intangible Capital Growth

Table: Regression with Intangible Capital Growth

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	-0.002	0.004		
	(0.014)	(0.027)		
Implied Shock × Cashflow Based Loan Ratio			-0.015	0.047
			(0.039)	(0.065)
Realized Shock	-0.004	0.026		
	(0.013)	(0.035)		
Implied Shock			-0.019	0.096
			(0.035)	(0.089)
Cashflow Based Loan Ratio	-0.011	-0.011	-0.006	-0.001
	(0.010)	(0.010)	(0.012)	(0.013)
Observations	29,119	29,119	19,450	19,450
R-squared	0.046	0.045	0.056	0.051

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Regression Result of the Employment Growth

Table: Regression with Employment Growth

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.018*	0.021		
	(0.009)	(0.017)		
Implied Shock × Cashflow Based Loan Ratio			0.012	0.069
			(0.017)	(0.051)
Realized Shock	-0.024***	-0.056***		
	(0.007)	(0.019)		
Implied Shock			-0.023	-0.152
			(0.014)	(0.094)
Cashflow Based Loan Ratio	0.008	0.008	0.012	0.012
	(0.007)	(0.007)	(0.008)	(0.009)
Observations	29,119	29,119	19,450	19,450
R-squared	0.130	0.128	0.139	0.133

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Regression Result of the Payout

Table: Regression with Payout

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	-0.010	-0.021		
	(0.020)	(0.038)		
Implied Shock × Cashflow Based Loan Ratio			-0.124**	-0.091
			(0.057)	(0.094)
Realized Shock	-0.021	-0.023		
	(0.016)	(0.041)		
Implied Shock			-0.009	-0.105
			(0.045)	(0.105)
Cashflow Based Loan Ratio	0.022***	0.022**	0.013	0.013
	(0.008)	(0.008)	(0.012)	(0.012)
Observations	29,119	29,119	19,450	19,450
R-squared	0.017	0.017	0.027	0.026

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Regression Result of the Maximum Debt

Table: Regression with Debt Capacity

VARIABLES	(1) Realized OLS	(2) Realized IV	(3) Implied OLS	(4) Implied IV
Realized Shock × Cashflow Based Loan Ratio	0.023	0.048		
	(0.024)	(0.049)		
Implied Shock × Cashflow Based Loan Ratio			0.119	0.221*
			(0.080)	(0.127)
Realized Shock	-0.043**	-0.131***		
	(0.021)	(0.049)		
Implied Shock			-0.122	-0.451***
			(0.076)	(0.137)
Cashflow Based Loan Ratio	-0.061***	-0.061***	-0.064***	-0.065***
	(0.015)	(0.015)	(0.019)	(0.020)
Observations	29,119	29,119	19,450	19,450
R-squared	0.066	0.063	0.070	0.060

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Standard New Keynesian Blocks

Standard Representative Household: $U = \sum_t \beta^t E_t[log(C_t) + \xi log(1 - H_t)]$

- Euler's Equation: $c_t = -r_t + E_t c_{t+1}$
- Consumption and Labor Tradeoff: $\frac{H}{1-H} h_t = w_t - c_t$

Raw Capital Producer:

- Return of Fixed Capital: $E_t r^k_{t+1} = (1-\epsilon) E_t rr_{t+1} + \epsilon E_t q_{t+1} - q_t$
- Raw Capital Producer FOC: $q_t = \varphi(i_t - k_t)$
- Law of Motion of Aggregate Fixed Capital: $k_{t+1} = (1-\delta)k_t + \delta i_t$

New Keynesian Block:

- Wholesale Good Producer FOC: $rr_t = y_t - k_t - x_t,\ w_t = y_t - h_t - x_t,\ w^e_t = y_t - x_t$
- Aggregate Production Function: $y_t = a_t + \alpha k_t + (1-\alpha)\Omega h_t$
- NKPC: $\pi_t = -\kappa x_t + \beta E_t \pi_{t+1}$, where $\kappa = \frac{(1-\theta)(1-\theta\beta)}{\theta}$.

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Entrepreneurs Net Worth Transition Equation

Each period, $1-\gamma$ fraction of entrepreneurs die and consume their net worth, hence the entrepreneur's consumption is

$$C_t^e = (1-\gamma)\,V_t$$

After the left will form the new net worth by:

$$N_t = \gamma\,V_t + W_t^e$$

Definition of V_t:

- In ABC setup: $R_t^k Q_{t-1} K_t - R_{t-1}(Q_{t-1}K_t - N_{t-1}) - \mu \int_0^{\bar{\omega}_t} \omega_t \phi(\omega_t) R_t^k Q_{t-1} K_t d\omega_t$
- In EBC setup: $R_t^k Q_{t-1} K_t - R_{t-1}(Q_{t-1}K_t - N_{t-1}) - \mu(1-D_t) \int_0^{\bar{\omega}_t} \omega_t \phi(\omega_t) R_t^k (Q_{t-1} K_t - N_t) d\omega_t$

With $\mu << 1$, The entrepreneurs net worth transition equation is almost the same after log-linearization.

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Market Clearing Condition and Auxiliary Equations

Entrepreneurs net worth transition equation:

$$n_t = \frac{\gamma RK}{N}(r_t^k - r_{t-1}) + \gamma R(r_{t-1} + n_{t-1}) + (R^k - R)\frac{\gamma K}{N}(q_{t-1} + k_t + r_t^k) + \frac{W^e}{N} w_t^e$$

Market clearing condition:

$$y_t = \frac{C}{Y}c_t + \frac{I}{Y}i_t + \frac{G}{Y}g_t + \frac{C^e}{Y}c_t^e$$

Auxiliary Equations:

- With $\gamma \approx 1$ and $W_t^e \approx 0$, we have $V_t \approx N_t$, hence $C_t^e = (1-\gamma)V_t \approx (1-\gamma)N_t$, after log-linearization we have: $c_t^e = n_t$
- Definition of the Leverage Ratio: $l_t = q_t + k_{t+1} - n_t$
- Risk shock: $\hat{\sigma}_t = \rho_\sigma \hat{\sigma}_{t-1} + e_{\sigma,t}$

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Asset Based Financial Constraint: Entrepreneurs

Definition of the cutoff $\bar{\omega}_{t+1}$:

$$\underbrace{Z_{t+1}(Q_t K_{t+1} - N_t)}_{\text{Cost of the External Funds}} \quad = \quad \underbrace{\bar{\omega}_{t+1} R^k_{t+1} Q_t K_{t+1}}_{\text{Returns on the Fixed Capital}}$$

Payoff to the Entrepreneurs:

$$\int_{\bar{\omega}_{t+1}}^{+\infty} \underbrace{[\omega_{t+1} R^k_{t+1} Q_t K_{t+1} - Z_{t+1}(Q_t K_{t+1} - N_t)]}_{\text{Case Not Default}} d\Phi(\omega_{t+1}) \quad + \quad \underbrace{0}_{\text{Case Default}}$$

$$= \quad \int_{\bar{\omega}_{t+1}}^{+\infty} (\omega_{t+1} - \bar{\omega}_{t+1}) d\Phi(\omega_{t+1}) R^k_{t+1} Q_t K_{t+1} \quad = \quad f(\bar{\omega}_{t+1}) R^k_{t+1} L_t N_t$$

With the assumption that ω follows log-normal distribution with an expectation of 1, function f have a closed form of ω and σ.

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Asset Based Financial Constraint: Banks

Payoff to the bank:

$$\underbrace{\int_0^{\bar{\omega}_{t+1}} \omega_{t+1}(1-\mu)R^k_{t+1}Q_tK_{t+1}\,d\Phi(\omega_{t+1})}_{\text{Case Default}} + \underbrace{\int_{\bar{\omega}_{t+1}}^{+\infty} Z_{t+1}(Q_tK_{t+1}-N_t)\,d\Phi(\omega_{t+1})}_{\text{Case Not Default}}$$

$$= [\int_0^{\bar{\omega}_{t+1}} \omega_{t+1}(1-\mu)\,d\Phi(\omega_{t+1}) + \int_{\bar{\omega}_{t+1}}^{+\infty} \bar{\omega}_{t+1}\,d\Phi(\omega_{t+1})]R^k_{t+1}Q_tK_{t+1} = g(\bar{\omega}_{t+1})R^k_{t+1}L_tN_t$$

- With the assumption that ω follows log-normal distribution with an expectation of 1, function g have a closed form of ω and σ.
- Return of the bank = Payoff of the bank / External Funds
- The return of the bank should be able to cover the cost of the fund, which is the risk-free interest rate R_t.
- With free entry condition, The return has to be exactly R_t.

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Formal Contracting Problem: ABFC

$$max_{\bar{\omega}_{t+1},L_t} E_t[f(\bar{\omega}_{t+1},\sigma_t)R^k_{t+1}L_t]$$
$$s.t.\ E_t[\frac{g(\bar{\omega}_{t+1},\sigma_t)R^k_{t+1}L_t}{L_t-1}]=R_t$$

- Solving the problem by taking FOCs.
- Combine the FOC and log-linearize to obtain one equation:

$$r^k_{t+1}-r_t=\nu l_t+\psi\hat{\sigma}_t$$

- Bernanke et. al. (1999): $\nu > 0$, Christiano et. al. (2014): $\psi > 0$
- When the leverage becomes higher, the spread become higher.
- When the cost of getting loans increases, the capital demand by the entrepreneurs decreases.
- When the risk increases, the spread increases, and the same explanation applies.

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Earning Based Financial Constraint: Cutoff

Proposition 1

Since the entrepreneur will only obtain payoffs from the projects owned by himself, he would prefer a lower portion of projects owned by the banks, i.e. D_t to be as small as possible.

Definition of the cutoff $\bar{\omega}_{t+1}$:

$$\underbrace{\bar{\omega}_{t+1} R^k_{t+1}(1-D_t)N_t}_{\text{Return Under Default}} = \underbrace{\bar{\omega}_{t+1} R^k_{t+1}(1-D_t)Q_t K_{t+1}}_{\text{Revenue Not Default}} - \underbrace{Z_{t+1}(1-D_t)(Q_t K_{t+1} - N_t)}_{\text{Cost Not Default}}$$

Re-write as:

$$Z_{t+1} = \bar{\omega}_{t+1} R^k_{t+1}$$

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Earning Based Financial Constraint: Entrepreneurs

Return of the Entrepreneurs:

$$\int_0^{\bar{\omega}_{t+1}} \underbrace{(1-D_t)N_t\omega_{t+1}R^k_{t+1}}_{\text{Payoff When Default}} d\Phi(\omega_{t+1}) \quad + \quad \int_{\bar{\omega}_{t+1}}^{+\infty} \underbrace{(1-D_t)\left[\begin{matrix}\omega_{t+1}R^k_{t+1}Q_tK_{t+1} \\ -Z_{t+1}(Q_tK_{t+1}-N_t)\end{matrix}\right]}_{\text{Payoff When Not Default}} d\Phi(\omega_{t+1})$$

Use the definition of the cutoff to eliminate Z_t and calculate the returns by dividing N_t, we have

$$\begin{aligned} &= R^k_{t+1}(1-D_t)[\underbrace{\int_0^{\bar{\omega}_{t+1}} \omega_{t+1}\,d\Phi(\omega_{t+1}) + \int_{\bar{\omega}_{t+1}}^{\infty} \bar{\omega}_{t+1}\,d\Phi(\omega_{t+1})}_{h(\bar{\omega}_{t+1})} + \underbrace{\int_{\bar{\omega}_{t+1}}^{+\infty} (\omega_{t+1}-\bar{\omega}_{t+1})\,d\Phi(\omega_{t+1})L_t]}_{f(\bar{\omega}_{t+1})L_t]} \\ &= R^k_{t+1}(1-D_t)[\quad h(\bar{\omega}_{t+1}) \quad + \quad f(\bar{\omega}_{t+1})L_t] \end{aligned}$$

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Earning Based Financial Constraint: Bank

Payoff to the bank:

$$\underbrace{D_t R^k_{t+1} Q_t K_{t+1}}_{\text{Payoff from Bank Owned Projects}} + \underbrace{(1-D_t) B_t \int_0^{\bar{\omega}_{t+1}} \omega_{t+1} \, d\Phi(\omega_{t+1})(1-\mu) R^k_{t+1}}_{\text{Payoff from Mutual Projects When Default}}$$

$$+ \underbrace{(1-D_t) B_t \int_{\bar{\omega}_{t+1}}^{+\infty} Z_t \, d\Phi(\omega_{t+1})}_{\text{Payoff from Mutual Projects When Not Default}}$$

Use the definition of the cutoff to eliminate Z_t and calculate the returns by dividing B_t, we have

$$\begin{aligned}
&= R^k_{t+1} D_t \tfrac{L_t}{L_t - 1} + (1-D_t) \underbrace{\left[\int_0^{\bar{\omega}_{t+1}} \omega_{t+1} \, d\Phi(\omega_{t+1})(1-\mu) + \int_{\bar{\omega}_{t+1}}^{+\infty} \bar{\omega}_{t+1} \, d\Phi(\omega_{t+1})\right]} R^k_{t+1} \\
&= R^k_{t+1} D_t \tfrac{L_t}{L_t - 1} + (1-D_t) g(\bar{\omega}_{t+1}, \sigma) R^k_{t+1}
\end{aligned}$$

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Formal Contracting Problem: EBFC

$$max_{\bar{\omega}_{t+1}, L_t}(1 - D_t)R^k_{t+1}h(\bar{\omega}_{t+1}, \sigma) + (1 - D_t)R^k_{t+1}f(\bar{\omega}_{t+1}, \sigma)L_t$$

$$s.t.\ (1 - D_t)g(\bar{\omega}_{t+1}, \sigma)R^k_{t+1} = R_t - R^k_{t+1}D_t\frac{L_t}{L_t - 1}$$

- Solving the problem by taking FOCs.
- Combine the FOC and log-linearize to obtain one equation:

$$r^k_{t+1} - r_t = \tilde{\nu}l_t + \tilde{\psi}\hat{\sigma}_t + \tilde{\varphi}d_t$$

- From one of the three FOCs solve for $\bar{\omega}_{t+1}$, and denoted the log-linearized $\bar{\omega}_{t+1}$ as $\hat{\omega}_{t+1}$:

$$\hat{\omega}_{t+1} = o(l_t, \sigma_t, d_t, r^k_{t+1} - r_t)$$

- Now the spread is not only determined by the leverage ratio and the uncertainty shocks, but also the fraction of earnings owned by banks.

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Law of Motion of D_t

Theoretically the fraction D_t should be determined by the bank:

$$max_{D_t}\ (1-D_t)g(\bar{\omega}_{t+1},\sigma)R^k_{t+1} + R^k_{t+1}D_t\frac{L_t}{L_t-1}$$

Proposition 2

When $L_t > 1$, the return of the bank is increasing in D_t. Proof

- The bank will always have incentive to directly own the projects.
- Losing projects to banks is less profitable for the entrepreneurs for any fixed contract.
- Set $D_t = 1$ will kill the financial frictions in the model.
- Alternative ad-hoc law of motion of D_t:

$$D_{t+1} = (1-\psi)D_t + (1-D_t)\Phi(\bar{\omega}_{t+1},\sigma_t)$$

where ψ denote the forgetting rate.

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Optimal Fraction of Bank Holdings

Optimal Fraction of Bank Holdings:

- The optimal fraction of earnings hold by the bank is determined through Nash Bargaining to determine the optimal D_t.

$$max_{D_t^N}(1-D_t^N)^{1-\upsilon}[(1-D_t^N)g(\bar{\omega}_{t+1},\sigma)R_{t+1}^k + R_{t+1}^k D_t^N \frac{L_t}{L_t-1}]^{\upsilon}$$

- Optimal bank holding D_t^N requires that: $R_t = \upsilon_0 \frac{L_t}{L_t-1} R_t^k$, no effect of risk shock!

$$r_{t+1}^k - r_t = \tilde{\nu} l_t + \tilde{\psi}\hat{\sigma}_t + \tilde{\varphi} d_t$$

- In response to risk shocks, the most effective form of punishment is to increase the shares given to the bank.
- The financial constraint based on earnings is closer to the optimal transition of D_t, which is another way to interpret the first channel why earning based financial accelerator response less to the risk shock.

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Proof of the Proposition

Proposition 2

When $L_t > 1$, the return of the bank is increasing in D_t. Back

Proof: The FOC gives us $\frac{L_t}{L_t - 1} - g(.)$. By the definition of function g, when $L > 1$, we have:

$$\int_0^{\bar{\omega}_{t+1}} \omega_{t+1} \, d\Phi(\omega_{t+1})(1-\mu) + \int_{\bar{\omega}_{t+1}}^{+\infty} \bar{\omega}_{t+1} \, d\Phi(\omega_{t+1}) \leq$$

$$\int_0^{\bar{\omega}_{t+1}} \omega_{t+1} \, d\Phi(\omega_{t+1}) + \int_{\bar{\omega}_{t+1}}^{+\infty} \omega_{t+1} \, d\Phi(\omega_{t+1}) \leq \int_{-\infty}^{+\infty} \omega_{t+1} \, d\Phi(\omega_{t+1}) = 1 \leq \frac{L_t}{L_t - 1}$$

Mechanism

Channel 1:

- When the uncertainty level increases, the restructuring procedure allow the banks to have access to more earnings of the entrepreneurs.
- However, this will make the entrepreneurs less likely to default, decreasing the effect on credit spread and aggregate economies.
- The investment hence responses less for the earning based financial accelerator.

Channel 2:

- With banks holding a fraction of the risky earnings, some of the idiosyncratic risks are transferred to the bank.
- However, since the banks invest in a lot of entrepreneurs, the idiosyncratic risk will be canceled out.

Set $d_t = 0$ will shutdown the first channel, and separate the effect of the two channels.

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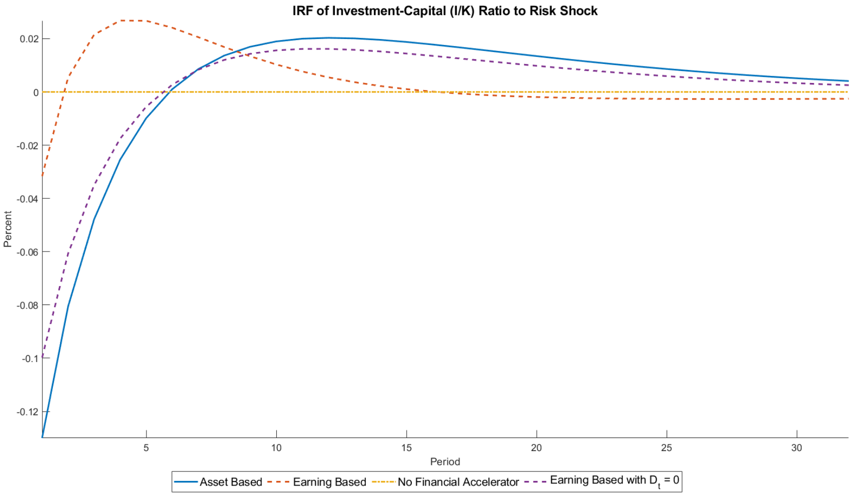
Asset Based vs Earning Based Financial Accelerator



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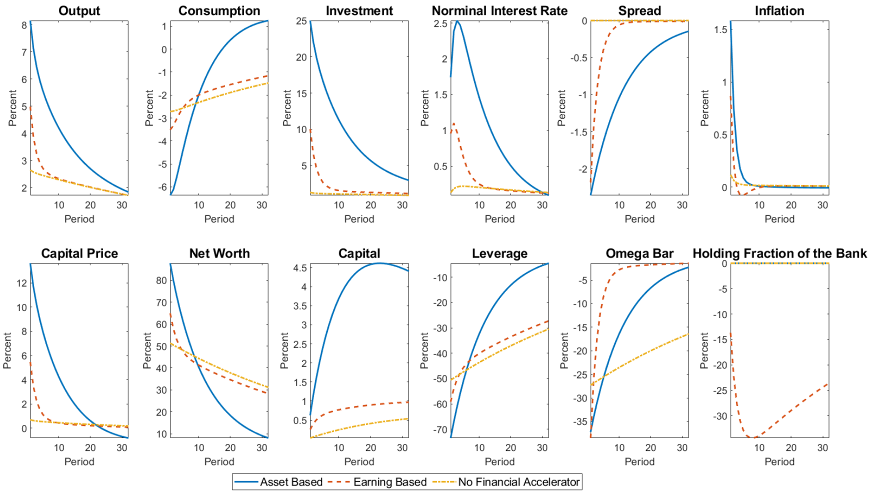
Net Worth Shock



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Financial Heterogeneity Model

Return to capital:

$$r_t^{kA} = (1-\epsilon) rr_t + \epsilon q_t^A - q_{t-1}^A$$
$$r_t^{kE} = (1-\epsilon) rr_t + \epsilon q_t^E - q_{t-1}^E$$

Price of capital:

$$q_t^A = \varphi(i_t^A - k_{t-1}^A)$$
$$q_t^E = \varphi(i_t^E - k_{t-1}^E)$$

Capital accumulation:

$$k_t^A = \delta i_t^A + (1-\delta) k_{t-1}^A$$
$$k_t^E = \delta i_t^E + (1-\delta) k_{t-1}^E$$

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Financial Heterogeneity Model

Evolution of net worth:

$$n_t^A = \gamma R \frac{K^A}{N^A}(r_t^{kA} - r_{t-1}) + \gamma R(r_{t-1} + n_{t-1}^A) + (R^k - R)\gamma \frac{K^A}{N^A}(q_{t-1}^A + k_t^A + r_t^{kA}) + \frac{W^{eA}}{N^A} w_t^e$$
$$n_t^E = \gamma R \frac{K^E}{N^E}(r_t^{kE} - r_{t-1}) + \gamma R(r_{t-1} + n_{t-1}^E) + (R^k - R)\gamma \frac{K^E}{N^E}(q_{t-1}^E + k_t^E + r_t^{kE}) + \frac{W^{eE}}{N^E} w_t^e$$

The leverage ratio is targeted to be the same for the two sectors at the steady state.

Formal contracting problem: the FOCs of the asset based and earning based financial accelerator.

Sum of capital:

$$k_t = J k_t^A + (1 - J) k_t^E$$

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