Uncertainty, Investment, and Financial Heterogeneity

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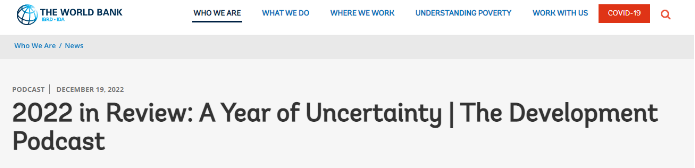
Outline

Uncertainty accounts for a significant amount of economic fluctuations:



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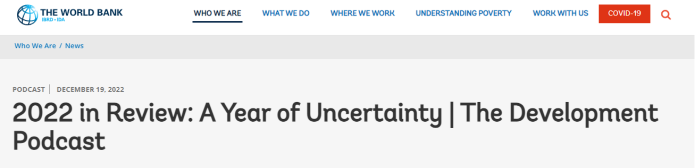

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- Decreases in aggregate consumption, investment, and overall economic activity.

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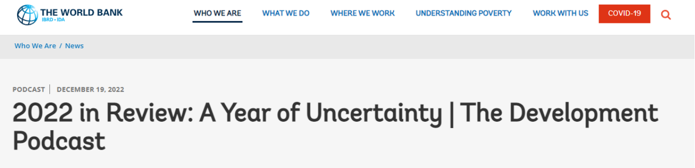

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- A worsening of financial conditions that amplifies the impact of uncertainty.

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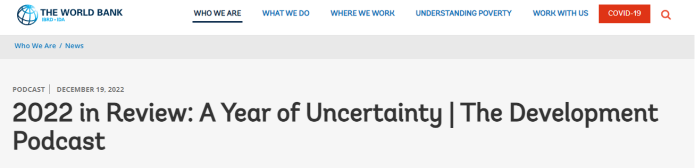

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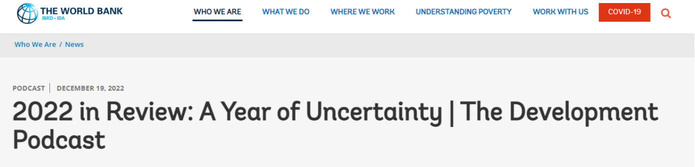

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Financial Uncertainty Multiplier: Alfaro et. al. (2019)

- 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: defaulting firm ceases to operate.
- Debt owners have claims on the liquidized value of the collaterals on default.

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Earning Based Debts:

- Chapter 11 bankruptcy: defaulting firm keeps running and goes through a restructuring procedure.
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Research Question

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

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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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- The first one to introduce the earning based financial accelerator.
- When uncertainties increase, the financial accelerator based on earnings can penalize defaulting firms by increasing the proportion of earnings holdings.
- This will reduce the effect on credit spread, and hence reduce the effect on investment.
- Consistent result that can coincide with the model under the borrowing capacity framework.

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: 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: 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), Caglio et. al. (2022), and 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.

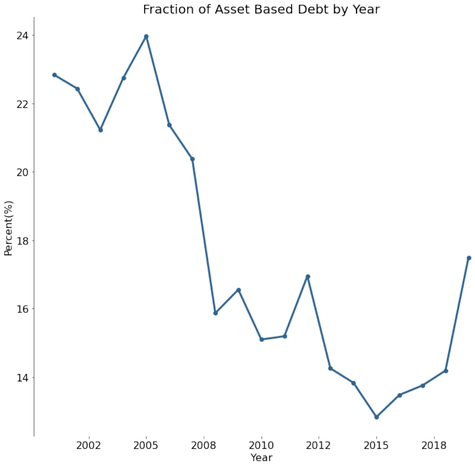
Identification follows Lian and Ma (2020). Detail

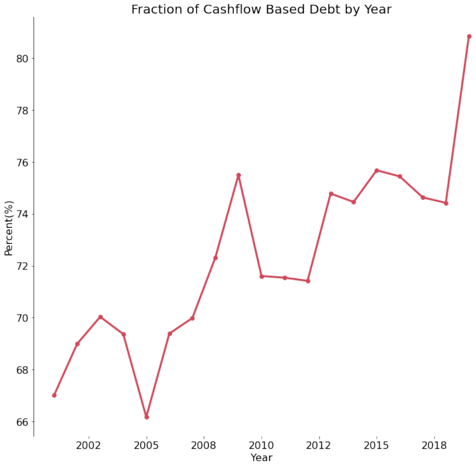
- Asset Based Debt: commercial mortgages, asset-based loans, capitalized leases, and secured debt.
- Earning Based Debt: corporate bonds, cashflow based loans, second lien and third lien debts.

Final Data:

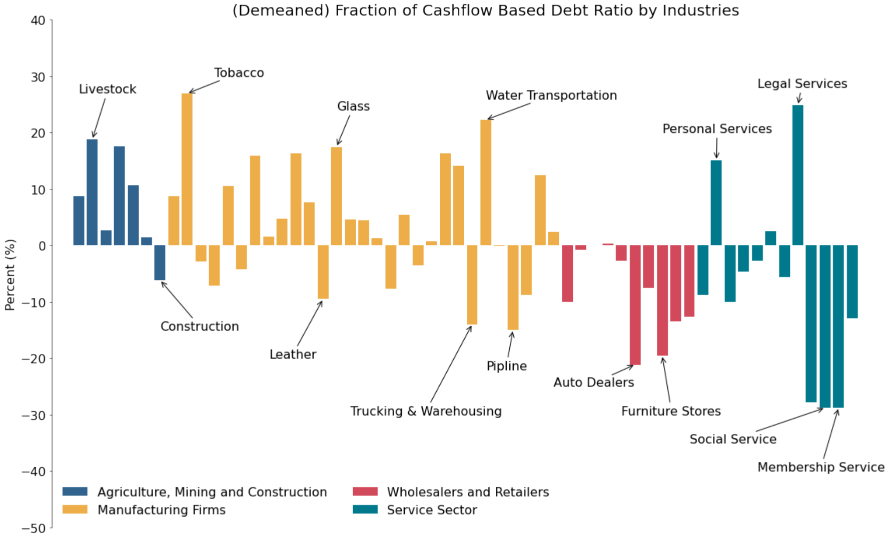
- Covers from the year 2001 to 2019, and the number of firms: 5,383

Cashflow Based Loans vs Asset Based Loans on Aggregate Level





Debt Fraction by Industry



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

The annual firm-level IV data are provided by the authors.

The quarterly firm-level IV data was calculated using a similar procedure, serving as a reliable validation measure.

Instrument Variable: Construction

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.

Instrument Variable: Assumptions

The Relevance Assumption:

- Aggregate uncertainties will influence the firm-level uncertainties.

The Exclusion Restriction:

- The separation between the first and second moment effects allows us to look only into the second moment effect.
- Suppose the price of one aggregate factor f increases.
- Consider three industries.
- First moment effects: positive $(+)$, negative (-) and zero (0).
- Second moment effects: positive $(+)$, positive $(+)$ and zero (0).

Data Description

Table: Data Description

	Count	Mean	Standard Error	Min	25 Percentile	Median	75 Percentile	Max
Investment Rate	34334	0.220	0.139	-0.238	0.112	0.186	0.305	0.500
Cashflow Based Debt Ratio	34334	0.678	0.392	0.000	0.339	0.908	0.998	1.000
Δ Cashflow Based Debt Ratio	28754	0.107	0.214	0.000	0.000	0.013	0.097	1.000
Realized Shock	34334	-0.031	0.332	-0.846	-0.259	-0.048	0.169	1.011
Implied Shock	22065	-0.029	0.197	-0.522	-0.156	-0.042	0.072	0.647
Realized Return	34334	0.151	0.617	-0.878	-0.200	0.071	0.349	3.818
Leverage	34334	0.561	0.257	0.039	0.390	0.545	0.693	2.335
Return of Asset	34334	0.040	0.195	-1.997	0.016	0.072	0.126	0.607
Firm Size	34334	0.850	2.001	-5.116	-0.562	0.951	2.230	5.733
Tobin Q	34334	1.584	0.786	0.434	1.061	1.355	1.857	6.100

Key Econometric Model

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

- $InvRate_{i,t}$ (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
- $X_{i,t-1}$ (Controls):
  - Firm level controls: Tobin's Q, tangibility, leverage, return of asset, log of firm size, realized stock return, lag investment rate, short term debt ratio, 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

Sanity Check

Interaction with Firm Level Cashflow Based Loan Ratio

Table: Baseline Regression: Effect of the Firm Debt Category

	(1) OLS	(2) IV	(3) OLS	(4) IV
Realized Shock # Cashflow Based Debt Ratio	0.007	0.028***		
	(0.004)	(0.007)		
Implied Shock # Cashflow Based Debt Ratio			0.010298	0.067***
			(0.008)	(0.024)
Realized Shock	-0.016***	-0.069***		
	(0.006)	(0.017)		
Implied Shock			-0.039***	-0.155***
			(0.008)	(0.052)
Cashflow Based Debt Ratio	0.006**	0.006**	0.011***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)
R-Squared	0.178	0.162	0.221	0.203
Observation	26760	26760	18087	18087

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

- Measurement of the financial constraint size:
  - Log of firm size and the firm's leverage ratio
  - Indexes constructed in Hadlock and Pierce (2010), and Whited and Wu (2006). Definition
  - Invest grade from the S&P Rating.
- 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: Realized Shocks

Table: Controlling the Financial Constraint Size: Realized Shocks

	(1) HP Index	(2) WW Index	(3) 1(Invest Grade)	(4) Firm Size	(5) Firm Leverage
Realized Shock # Cashflow Based Debt Ratio	0.014	0.019**	0.026***	0.016*	0.027***
	(0.009)	(0.007)	(0.008)	(0.009)	(0.008)
Realized Shock # Financial Constraint Size Measurment	-0.027**	-0.087*	0.011**	0.005	0.007
	(0.013)	(0.052)	(0.004)	(0.004)	(0.014)
Realized Shock	-0.152***	-0.084***	-0.068***	-0.063***	-0.073***
	(0.044)	(0.026)	(0.017)	(0.012)	(0.016)
Financial Constraint Size Measurment	0.071***	0.179***	-0.001	-0.014***	-0.033***
	(0.010)	(0.038)	(0.002)	(0.003)	(0.005)
Cashflow Based Debt Ratio	0.006**	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
R-Squared	0.165	0.166	0.164	0.164	0.162
Observation	26760	26760	26760	26760	26760

Conditional on Financial Constraint Size: Implied Shocks

Table: Controlling the Financial Constraint Size: Implied Shocks

	(1) HP Index	(2) WW Index	(3) 1(Invest Grade)	(4) Firm Size	(5) Firm Leverage
Implied Shock # Cashflow Based Debt Ratio	0.050**	0.051**	0.064***	0.050**	0.064**
	(0.023)	(0.022)	(0.024)	(0.019)	(0.025)
Implied Shock # Financial Constraint Size Measurement	-0.070**	-0.275	0.007	0.011	0.031
	(0.027)	(0.188)	(0.008)	(0.009)	(0.020)
Implied Shock	-0.396***	-0.230**	-0.142***	-0.150***	-0.172***
	(0.132)	(0.102)	(0.052)	(0.043)	(0.047)
Financial Constraint Size Measurement	0.068***	0.201***	-0.001	-0.014***	-0.027**
	(0.021)	(0.042)	(0.002)	(0.004)	(0.012)
Cashflow Based Debt Ratio	0.011***	0.010***	0.011***	0.010***	0.011***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
R-Squared	0.202	0.203	0.208	0.207	0.203
Observation	18087	18087	18087	18087	18087

Further Discussion

Robustness Check:

- Definition change of the financial constraint: Detail
  - Dummy of high cashflow based loan ratio: 1 if higher than the yearly median.
- Control for Uncertainty Shock $\times$ Aggregate Factors: Detail
  - Credit Spread: Moody BAA-AAA bond credit spread
  - Aggregate Financial Constraint Type: Aggregate CFBRatio
  - Aggregate Uncertainty: VIX Index
- Control for industrial level fixed effect. Detail

Other Firm-Level Variables:

- Growth: employment, intangible asset, debt, cost of goods, sales, cash, profit, payout, stock returns.
- Cost of funding: Net Paid Interest / Total Debt

Table: Impact on Other Firm-Level Variables

Panel A: Realized Uncertainty Shock									
	(1) Employment Growth	(2) Intangible Asset Growth	(3) Debt Growth	(4) Cost of Good Growth	(5) Sales Growth	(6) Cash Growth	(7) Profit Growth	(8) Payout Growth	(9) Stock Return
Realized Shock # Cashflow Based Debt Ratio	0.027	0.001	0.047	0.036	0.039	0.129***	0.070	-0.018	0.052
	(0.018)	(0.028)	(0.052)	(0.029)	(0.034)	(0.039)	(0.051)	(0.039)	(0.095)
Realized Shock	-0.058***	0.034	-0.120**	-0.162***	-0.252**	-0.026	-0.267*	-0.017	0.321***
	(0.017)	(0.040)	(0.054)	(0.036)	(0.099)	(0.065)	(0.142)	(0.039)	(0.108)
Cashflow Based Debt Ratio	0.003	-0.015	-0.079***	0.017**	0.017**	-0.074***	-0.016	0.017**	-0.020
	(0.007)	(0.009)	(0.014)	(0.007)	(0.008)	(0.015)	(0.012)	(0.007)	(0.020)
R-Squared	0.082	0.044	0.072	0.132	0.124	0.095	0.074	0.016	0.096
Observation	25594	25594	25594	25594	25594	25594	25594	25594	25594

Panel B: Implied Uncertainty Shock									
	(1) Employment Growth	(2) Intangible Asset Growth	(3) Debt Growth	(4) Cost of Good Growth	(5) Sales Growth	(6) Cash Growth	(7) Profit Growth	(8) Payout Growth	(9) Stock Return
Implied Shock # Cashflow Based Debt Ratio	0.097**	0.097	0.181	0.096	0.103	0.254**	0.189	-0.087	-0.049
	(0.047)	(0.075)	(0.122)	(0.079)	(0.113)	(0.125)	(0.158)	(0.092)	(0.165)
Implied Shock	-0.183**	0.031	-0.384***	-0.516***	-0.651**	-0.047	-0.597	-0.072	1.426***
	(0.079)	(0.099)	(0.144)	(0.137)	(0.282)	(0.179)	(0.427)	(0.095)	(0.294)
Cashflow Based Debt Ratio	0.005	-0.006	-0.086***	0.013	0.015	-0.092***	-0.011	0.008	-0.004
	(0.009)	(0.013)	(0.019)	(0.010)	(0.010)	(0.020)	(0.016)	(0.012)	(0.021)
R-Squared	0.088	0.049	0.070	0.100	0.071	0.098	0.075	0.025	0.005
Observation	17119	17119	17119	17119	17119	17119	17119	17119	17119

Cost of Funding

Table: Evidence on the Cost of Funding

	(1)	(2)	(3)	(4)
	Realized Shock		Implied Shock	
	HP Index	WW Index	HP Index	WW Index
Uncertainty Shock # Cashflow Based Debt Ratio	-0.056*	-0.041	-0.166**	-0.135*
	(0.030)	(0.028)	(0.082)	(0.078)
Uncertainty Shock # Financial Constriant Size	-0.012	0.119	-0.024	0.560*
	(0.021)	(0.098)	(0.048)	(0.281)
Uncertainty Shock	-0.011	0.050	0.019	0.271**
	(0.071)	(0.037)	(0.172)	(0.128)
Financial Constriant Size	-0.016	-0.022	0.071	-0.065
	(0.033)	(0.098)	(0.058)	(0.091)
Cashflow Based Debt Ratio	-0.012	-0.011	-0.024**	-0.022*
	(0.009)	(0.009)	(0.011)	(0.011)
R-Squared	0.016	0.016	0.032	0.031
Observation	26760	26760	18087	18087

Dynamic Effect

$$\begin{aligned} InvRate_{i,t+h} = \beta_{0,h} + \beta_{1,h}1(High\ EBDRatio)_{i,t-2} \times VolShock_{i,t-1} \\ + \beta_{2,h}1(Low\ EBDRatio)_{i,t-2} \times VolShock_{i,t-1} \\ + \beta_{3,h}1(High\ EBDRatio)_{i,t-2} + \gamma_h X_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{3}$$

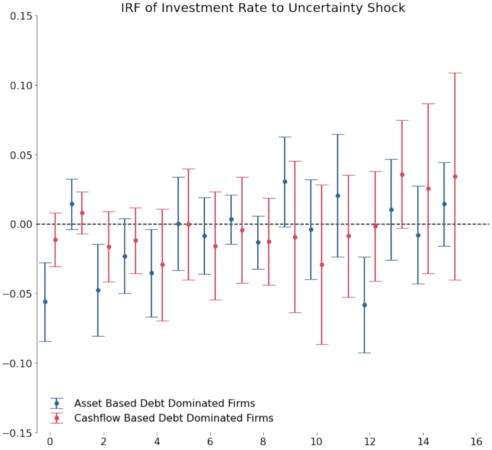
Quarterly Dynamic Effect on Risk Shock:

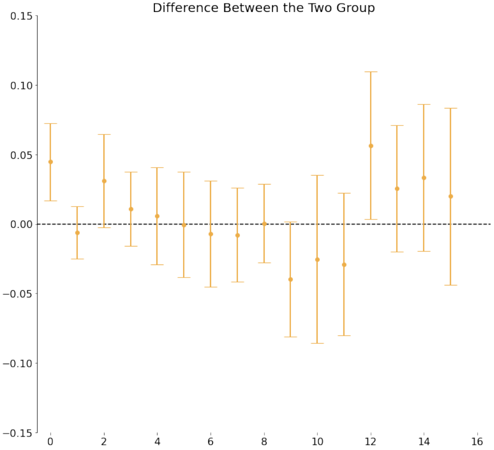
- Compare the firms with the highest 50 percent cash flow-based debt ratio to those with the lowest 50 percent cash flow-based debt ratio.
- Use quarterly data to get more precise result.
- Only consider realized uncertainty shocks.
- Another regression to obtain the difference between $\beta_{1,h}$ and $\beta_{2,h}$.
- Control for firm fixed effect and time fixed effect.

Dynamic Effect on Monetary Policy Shock: Swanson (2020)

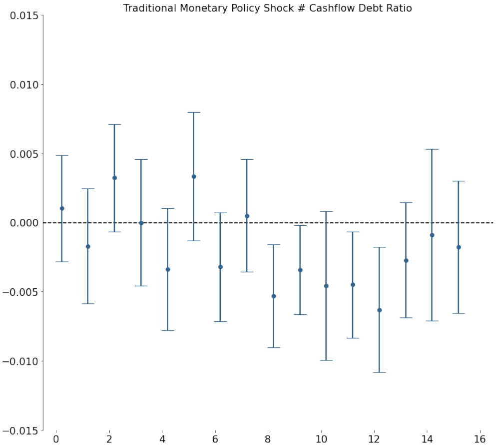
- The result coincide with Caglio et. al. (2022)

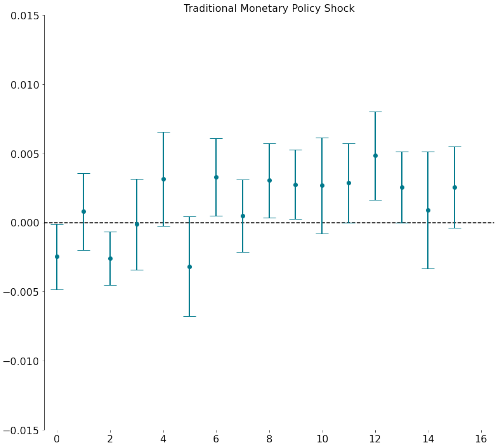
Risk Shock Dynamic Effect





Implication: Traditional Monetary Policy Shock





Other MP Shocks

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.

Summary

Conclusion of Empirical Analysis:

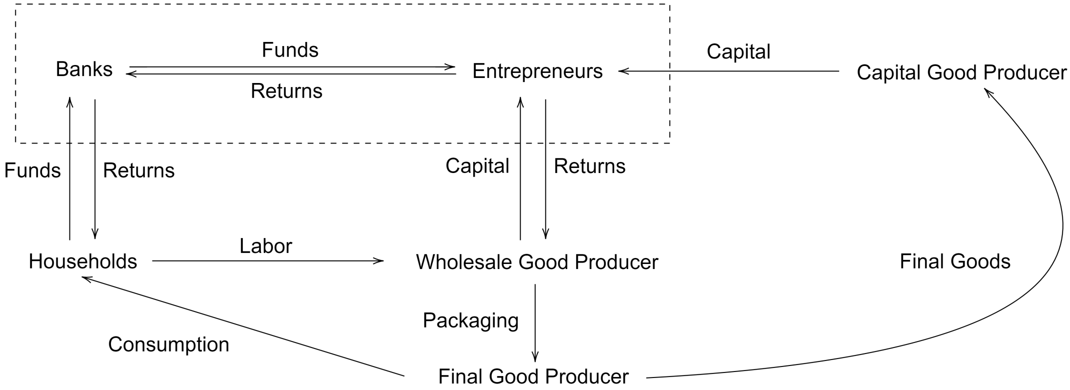
- Firms with a higher proportion of earning-based debt tend to be less responsive to investment in response to uncertainty shocks.
- The effect of the type of financial constraint is significant, even when controlling for the size of the financial constraint.

Key Question:

- What is the primary cause of the better performance of the earning based financial constraint facing uncertainty shocks?

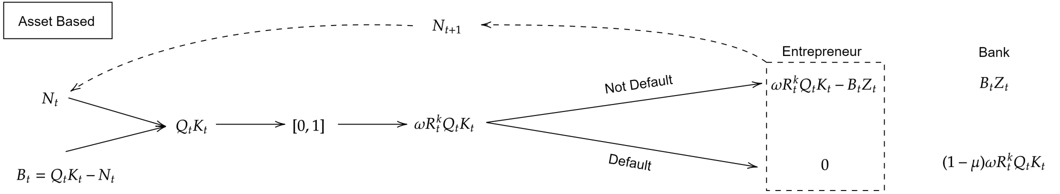
Outline

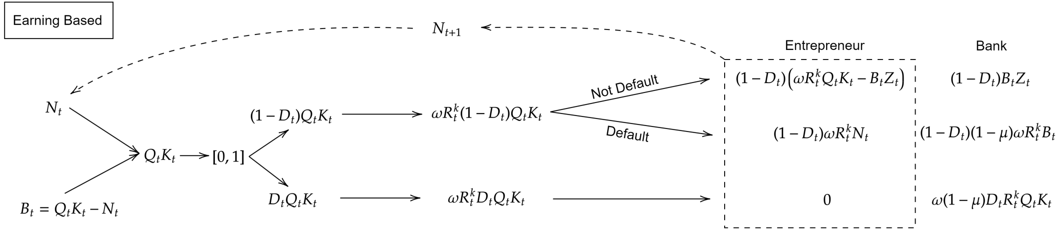
Model Structure



NK Model

Asset Based vs Earning Based Financial Accelerator





Formal Contracting Problem: Asset Based

$$\begin{aligned} max \text{ Expected Return to the Entrepreneurs} \\ s.t. \text{ Expected Return to the Bank} = R_t \end{aligned}$$

Solving the formal contracting problem will result in:

- $r^k_{t+1} - r_t = \nu l_t + \psi \hat{\sigma}_t$
- Bernanke et. al. (1999): $\nu > 0$, Christiano et. al. (2014): $\psi > 0$
- Financial accelerator: leverage $\uparrow$, credit spread $\uparrow$, capital demand $\downarrow$
- Uncertainty accelerator: risk $\uparrow$, credit spread $\uparrow$, capital demand $\downarrow$

Transition equation of N_t:

- $N_t = \gamma \left[R^k_t Q_{t-1} K_t - R_{t-1}(Q_{t-1}K_t - N_{t-1}) - \mu \int_0^{\bar{\omega}_t} \omega_t \phi(\omega_t) R^k_t Q_{t-1} K_t d\omega_t \right]$

Math

Formal Contracting Problem: Earning Based

Solving the formal contracting problem given the earnings hold by the bank:

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

Transition of the fraction of the earnings hold by the bank:

- $D_{t+1} = (1-\psi) D_t + (1 - D_t) \Phi(\bar{\omega}_{t+1}, \sigma_t)$
- 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.
- Probability to default $\uparrow$, fraction of earnings hold by the bank (as a punishment) $\uparrow$

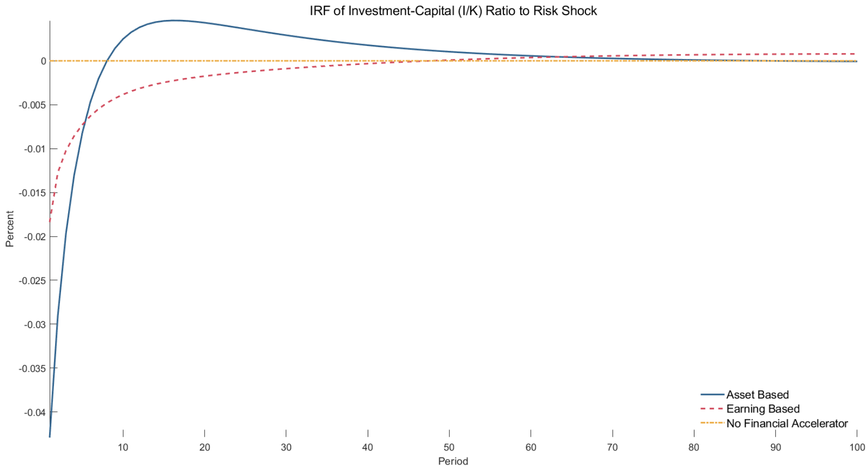
Transition equation of N_t:

- $N_t = \gamma \left[(1 - \mu D_t) R^k_t Q_{t-1} K_t - R_{t-1}(Q_{t-1} K_t - N_{t-1}) - \mu \int_0^{\bar{\omega}_t} \omega_t \phi(\omega_t) R^k_t Q_{t-1} K_t d\omega_t \right]$

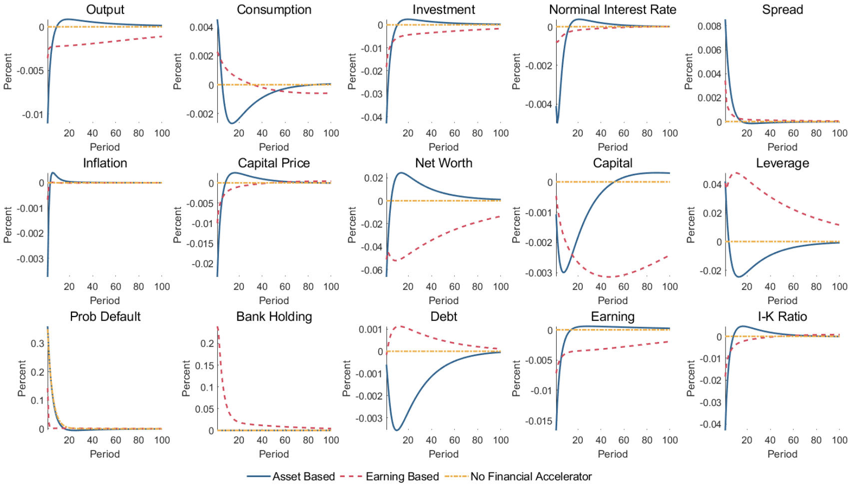
Compare two separate models while targeting the same steady-state level of defaulting probabilities.

Math

Asset Based vs Earning Based Financial Accelerator



Asset Based vs Earning Based Financial Accelerator



Why Are Earning Based Financial Accelerator Less Impacted?

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

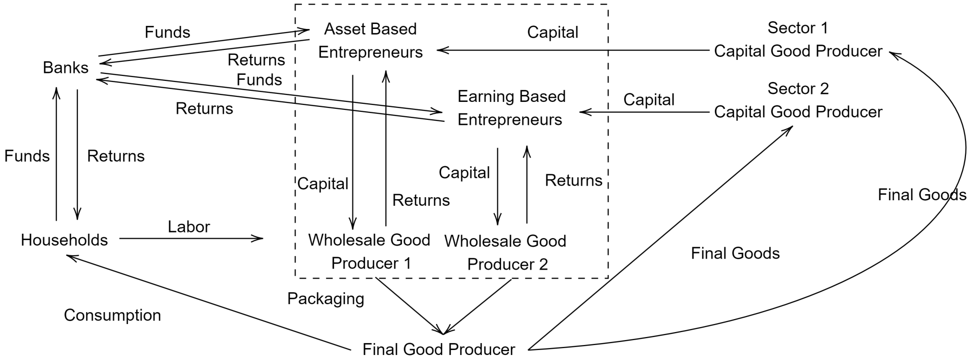
- Upon default, bankers will only receive returns on the portion of contributed funds.
- Bankers will receive a flexible return due to the ownership of the restructured firm.
- Current defaults will affect the future structure of the firm.

Mechanism:

- When uncertainty 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

Outline

Financial Heterogeneity Model



J_A 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 probability to default 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

Table: Parameter Calibration

Variable	Name	Value	Target
β	Utility Discounting Factor	0.990	4 Percent Annual Interest Rate
δ	Quarterly Depreciation Rate	0.025	10 Percent Annual Depreciation Rate
α	Labor Share	0.350	35 Percent Labor Share in the US
Ω	Entrepreneur Labor Share	0.985	64 Percent of Entrepreneur Labor Share
η	Elasticity of Substitution Between Goods	11.000	10 Percent Steady State Markup
γ	Entrepreneur Survival Rate	0.973	2.72 Percent Quarterly Natual Net Worth Shrinking Rate
φ	Fixed Capital Producer Technology	0.545	Calibrated From the Data
θ	Price Stickiness	0.750	25 Percent of Price Changing
σ	Steady State ω Standard Error	0.312	2 Percent Credit Spread
ρ	Taylor Rule Persistence	0.900	Common Value
ζ	Taylor Rule Inflation Reaction	1.100	Common Value
ξ	Labor Preference Parameter	5.455	25 Percent of Working Hours of a Day
μ	State Verification Cost	0.015	Common Value
$\bar{G}/\bar{Y}$	Steady State G/Y ratio	0.200	20 Percent Goverment Expenditure to GDP Ratio
J_A	Fraction of the Asset Based Financial Accelerator	0.300	Average of 30% from the data
J_E	Fraction of the Earning Based Financial Accelerator	0.700	Average of 70% from the data

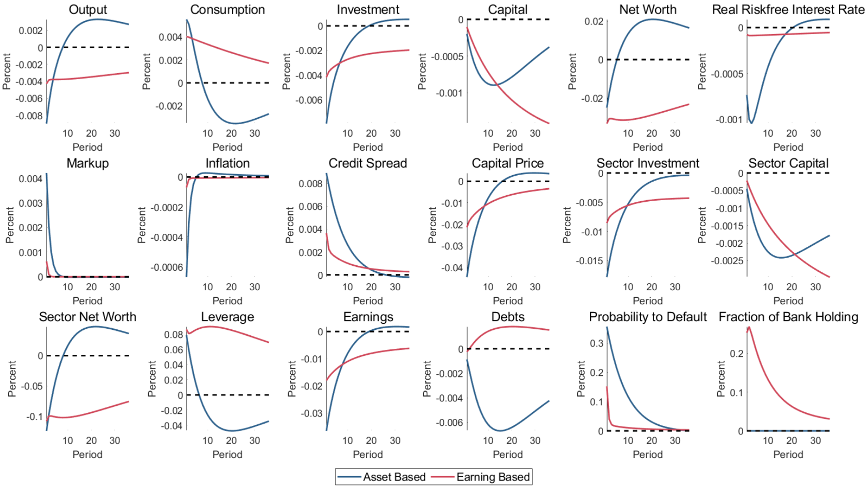
Steady State

Table: Steady State

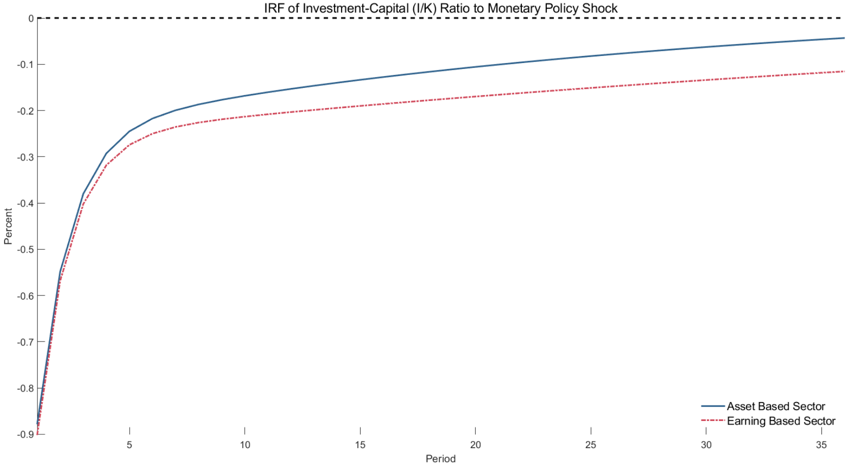
Aggregate Variables			Sector Variables			
Variable	Name	Steady State	Variable	Name	Steady State	
			$\bar{R}^k$	Capital Return	1.015	1.021
$\bar{X}$	Markup	1.100	$\bar{R}^k - \bar{R}$	Credit Spread	0.005	0.011
$\bar{H}$	Working Hours of a Day	0.250	$\bar{I}/\bar{Y}$	I-Y Ratio	0.198	0.172
$\bar{R}$	Riskfree Interest rate	1.010	$\bar{K}/\bar{Y}$	K-Y Ratio	7.935	6.871
$\bar{C}/\bar{Y}$	C-Y Ratio	0.320	$\bar{W}^e/\bar{N}$	Entrepreneur Wage to N	0.003	0.007
$\bar{I}/\bar{Y}$	I-Y Ratio	0.370	$\bar{K}/\bar{N}$	Leverage	2.891	5.300
$\bar{W}/\bar{Y}$	W-Y Ratio	2.327	$\bar{\omega}$	Default Cutoff	0.663	0.663
			$\bar{D}$	Fraction of Buffer Fund	-	0.600

Model vs Data

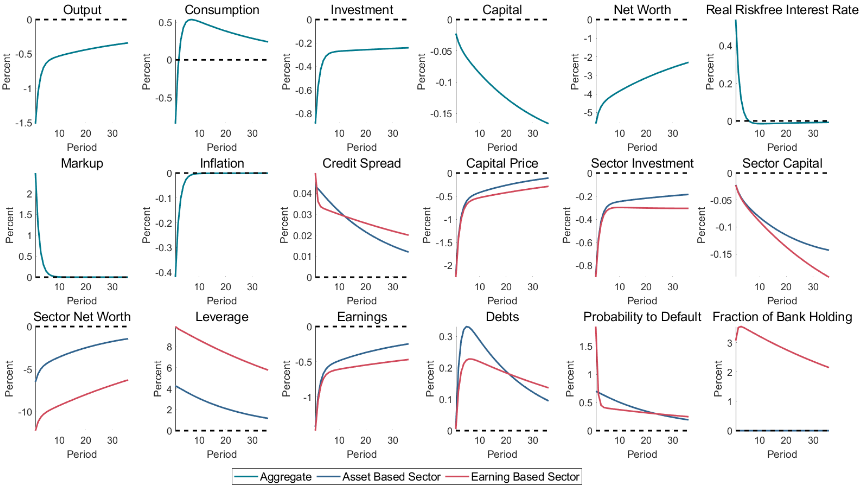
Model vs Data



Implication: Monetary Policy Shocks



Implication: Monetary Policy Shocks Detail



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.

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

First Stage Regression and Sanity Check

Table: First Stage Regression and Sanity Check

Panel A: First Stage		
	(1) Realized Shock	(2) Implied Shock
F-Statistics	94.682	58.696
P Value of F-Stats	0.000	0.000
R-Squared	0.099	0.117
Observation	32094	20795

Panel B: Sanity Check				
	(3) Realized OLS	(4) Realized IV	(5) Implied OLS	(6) Implied IV
Uncertainty Shock	-0.010***	-0.048***	-0.030***	-0.102**
	(0.003)	(0.016)	(0.006)	(0.039)
Hansen's J: P-Value		0.612		0.785
R-Squared	0.177	0.163	0.215	0.200
	32094	32094	20795	20795

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Definition of the Financial Constraint Size Index

- WW index:

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

$oibdp_t$: 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.

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Robust Check: Dummy for Cashflow Based Loan Ratio

Table: Dummy Variable Regression

	(1) OLS	(2) IV	(3) OLS	(4) IV
Realized Shock # 1(Cashflow Based Debt Ratio)	0.006*	0.013***		
	(0.003)	(0.005)		
Implied Shock # 1(Cashflow Based Debt Ratio)			0.002	0.021*
			(0.006)	(0.011)
Realized Shock	-0.014***	-0.058***		
	(0.004)	(0.015)		
Implied Shock			-0.032***	-0.115***
			(0.006)	(0.038)
1(Cashflow Based Debt Ratio)	0.003**	0.003**	0.005***	0.005***
	(0.001)	(0.001)	(0.002)	(0.002)
R-Squared	0.178	0.163	0.220	0.204
Observation	26760	26760	18087	18087

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Robust Check: Interacted with Aggregate Factors

Table: Regression Interacted with Aggregate Factors

	(1)	(2)	(3)	(4)	(5)	(6)
	Realized Uncertainty Shocks			Implied Uncertainty Shocks		
	Average Credit Spread	Aggregate Uncertainty	Aggregate Cashflow Loan Ratio	Average Credit Spread	Aggregate Uncertainty	Aggregate Cashflow Loan Ratio
Uncertainty Shock # Cashflow Based Debt Ratio	0.030***	0.030***	0.027***	0.071***	0.073***	0.069***
	(0.008)	(0.008)	(0.007)	(0.023)	(0.026)	(0.022)
Uncertainty Shock # Aggregate Factor	0.036***	0.001	0.955	0.020	0.000	-0.381
	(0.013)	(0.001)	(0.639)	(0.019)	(0.001)	(1.464)
Uncertainty Shock	-0.128***	-0.106***	-0.770	-0.187***	-0.176***	0.141
	(0.027)	(0.030)	(0.465)	(0.048)	(0.050)	(1.067)
Cashflow Based Debt Ratio	0.005	0.006	0.006	0.010**	0.010**	0.011***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
R-Squared	0.149	0.145	0.148	0.205	0.199	0.215
Observation	25594	25594	25594	17119	17119	17119

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Robust Check: Industrial Fixed Effect

Table: Industrial Fixed Effect

	(1) OLS	(2) IV	(3) OLS	(4) IV
Realized Shock # Cashflow Based Debt Ratio	0.010*	0.029***		
	(0.005)	(0.008)		
Implied Shock # Cashflow Based Debt Ratio			0.010	0.066***
			(0.007)	(0.023)
Realized Shock	-0.020***	-0.076***		
	(0.006)	(0.020)		
Implied Shock			-0.038***	-0.153***
			(0.007)	(0.051)
Cashflow Based Debt Ratio	0.001	0.001	0.005**	0.006***
	(0.001)	(0.001)	(0.002)	(0.002)
R-Squared	0.456	0.446	0.504	0.495
Observation	27295	27295	18434	18434

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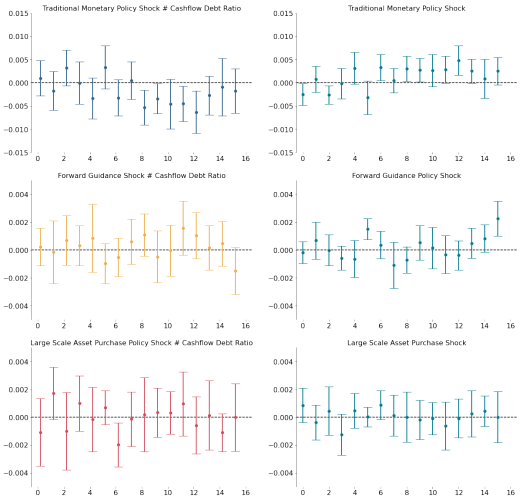
Implication: Monetary Policy Shock



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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 $\kappa = \frac{(1-\theta)(1-\theta\beta)}{\theta}$.

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:

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

By approximation:

$$V_t \approx N_t$$

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

Market Clearing Condition and Auxiliary Equations

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 $\bar{\omega}_{t+1}$:

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

Payoff to the Entrepreneurs:

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

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

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

Asset Based Financial Constraint: Banks

Payoff to the bank:

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

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

- 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.

Back

Earning Based Financial Constraint: Entrepreneurs

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:

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

Return of the Entrepreneurs:

$$\int_0^{\bar{\omega}_{t+1}} \underbrace{(1-D_t)N_t \omega_{t+1} R^k_{t+1}}_{\text{Payoff When Default}} d\Phi(\omega_{t+1}) + \int_{\bar{\omega}_{t+1}}^{+\infty} \underbrace{(1-D_t)\begin{bmatrix} \omega_{t+1} R^k_{t+1} Q_t K_{t+1} \\ -Z_{t+1}(Q_t K_{t+1} - N_t) \end{bmatrix}}_{\text{Payoff When Not Default}} d\Phi(\omega_{t+1})$$

Earning Based Financial Constraint: Banks

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

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

Payoff to the bank:

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

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

Earning Based Financial Constraint: Bank

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

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

Solve the following formal contracting problem:

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

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

Combine the FOC and log-linearize to obtain one equation:

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

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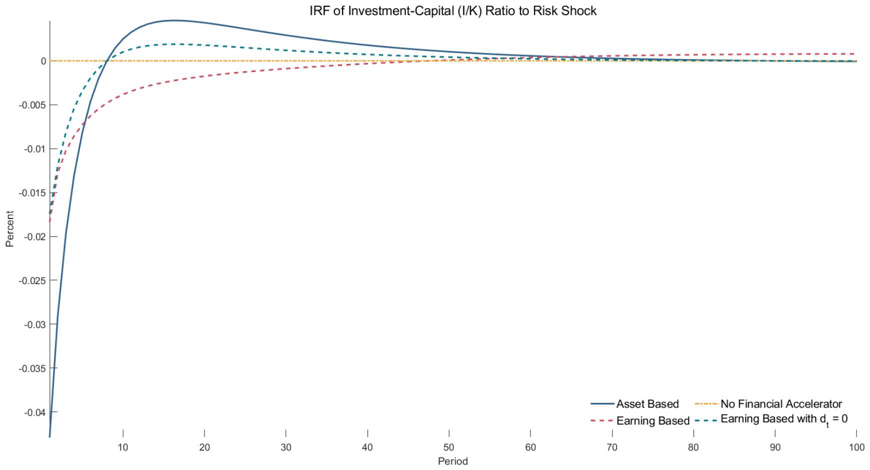
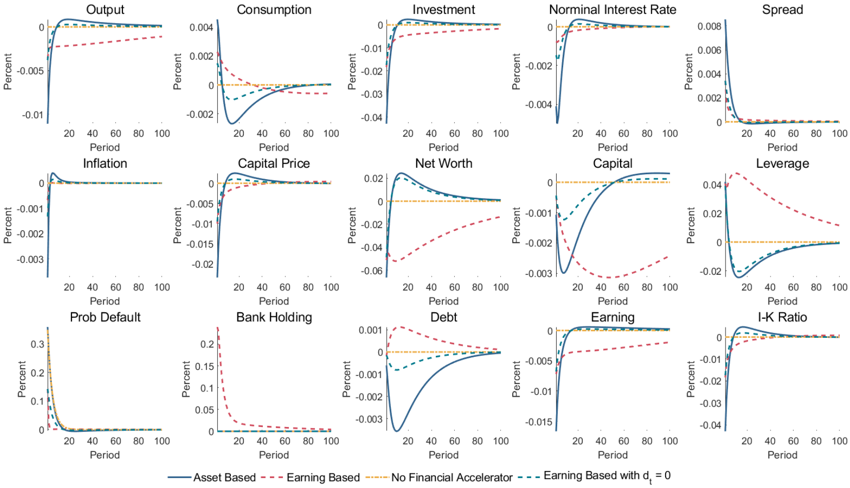
Holding D_t Constant



Holding D_t Constant



Back

Financial Heterogeneity Model

Return to capital:

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

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:

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

Financial Heterogeneity Model

Capital Partition:

$$y_t = Jy_t^A + (1-J)y_t^E$$

Labor Partition:

$$h_t = Jh_t^A + (1-J)h_t^E$$

Inflation Partition:

$$\pi_t = J\pi_t^A + (1-J)\pi_t^E$$

FOC of the Packaging Technology:

$$\pi_t^A - \pi_t^E = -(y_t^A - y_t^E - (y_{t-1}^A - y_{t-1}^E));$$

Financial Heterogeneity Model

Production Technology:

$$y_t^A = a_t + a_t^A + \alpha k_{t-1}^A + (1-\alpha)\Omega h_t^A$$
$$y_t^E = a_t + a_t^E + \alpha k_{t-1}^E + (1-\alpha)\Omega h_t^E$$

Wholesale Labor FOC:

$$w_t = y_t^A - h_t^A - x_t^A$$
$$w_t = y_t^E - h_t^E - x_t^E$$

Return to capital:

$$rr_t^A = y_t^A - k_t^A - x_t^A$$
$$rr_t^E = y_t^E - k_t^E - x_t^E$$

Markup Partition:

$$x_t = Jx_t^A + (1-J)x_t^E$$

Financial Heterogeneity Model

Evolution of net worth:

$$
\begin{aligned}
n_t^A =& \gamma R \frac{K^A}{N^A}(r_t^{kA} - r_{t-1}) + \gamma R(r_{t-1} + n_{t-1}^A) + (R^k - R)\gamma \frac{K^A}{N^A}(q_{t-1}^A + k_t^A + r_t^{kA}) + \frac{W^{eA}}{N^A} w_t^e \\
n_t^E =& \gamma R \frac{K^E}{N^E}(r_t^{kE} - r_{t-1}) + \gamma R(r_{t-1} + n_{t-1}^E) + (R^k - R)\gamma \frac{K^E}{N^E}(q_{t-1}^E + k_t^E + r_t^{kE}) \\
& - \mu D R k^E L^E (d_{t-1}^E + r_t^{kE} + q_{t-1}^E + k_{-1}^E) + \frac{W^{eE}}{N^E} w_t^e
\end{aligned}
$$

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. Back