



EUROPEAN CENTRAL BANK

EUROSYSTEM

Extreme Financial Distress and the Macroeconomy *

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**ECB workshop on *Monetary Policy and
Financial Stability***

17 & 18 December 2018

*The views expressed here are of the authors, not necessarily those of the European Central Bank

- 1 Motivation
- 2 Model
- 3 Calibration and Model Fit
- 4 Bank Risk Taking
- 5 Shocks to Diversifiable Risk
- 6 How important are island shocks?
- 7 ...Non Linearities?
- 8 ...Bank Leverage?
- 9 Policy Insights

- **Firms and Banks defaults:**

- High Firms default can occur **with** or **without** High Banks default

- **Macro-economic outcomes:**

- substantially worse in periods in which the default rate of **both** Firms and Banks is **High**

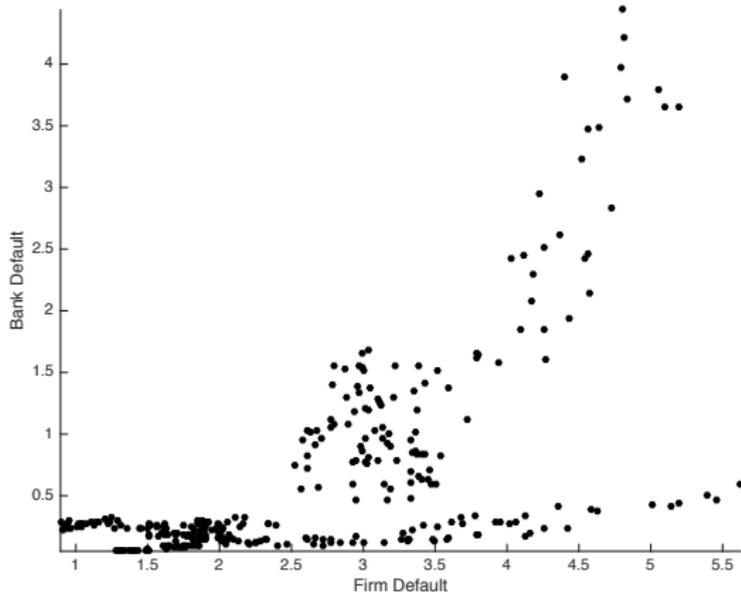
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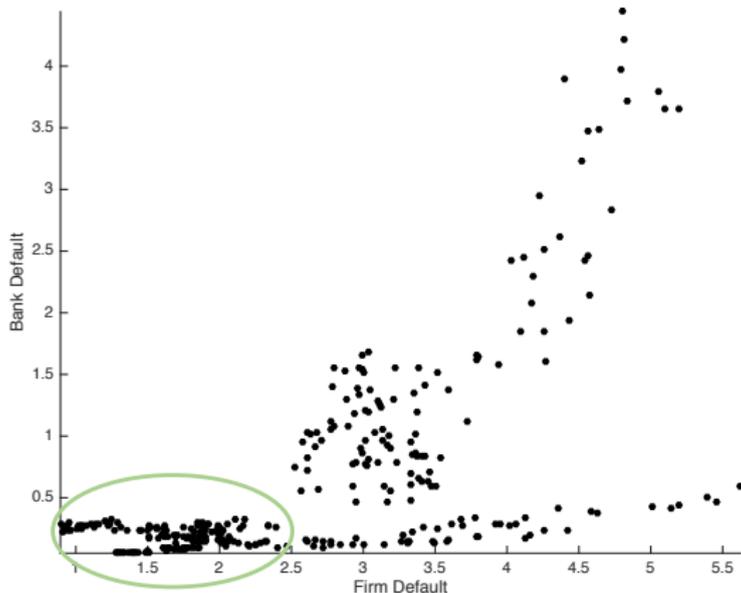
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Key Facts: Firms and Banks Default Rates - EA (1992-2016)



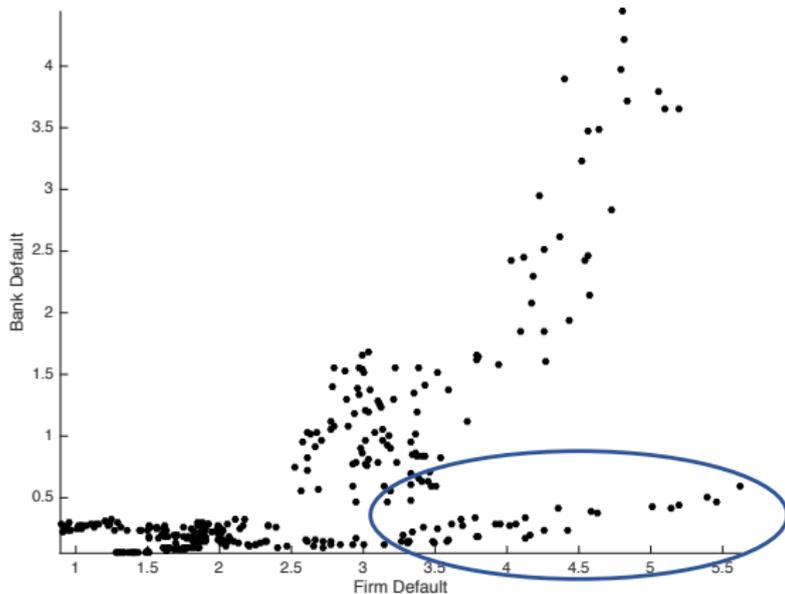
Scatter plot of Moody's expected default frequency within one year: non-financial corporations (Firm default) and banks (Bank default).

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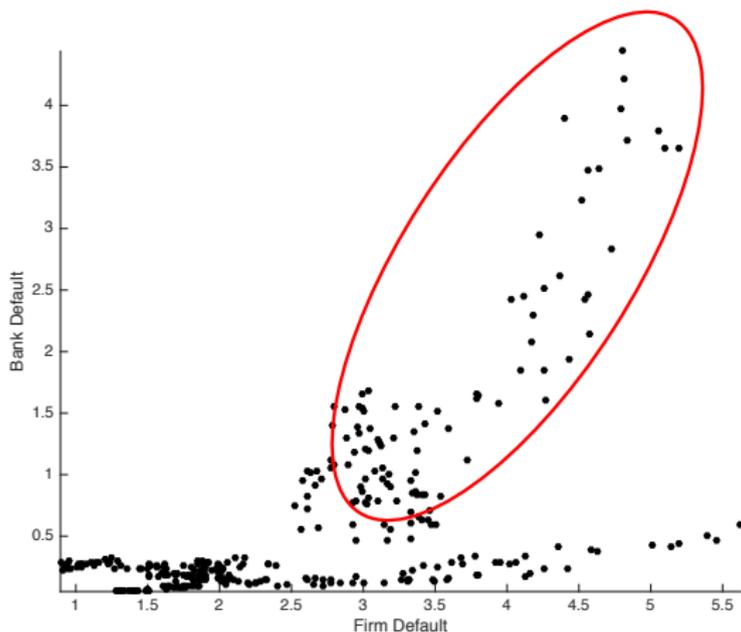
1) Default of both Firms and Banks **Low** (Normal Times)

Key Facts:Firms and Banks Default Rates - EA (1992-2016)



2) Firms default **High** but Banks default **Low**

Key Facts:Firms and Banks Default Rates - EA (1992-2016)



3) Default of both Firms and Banks **High** (*extreme financial distress*)

Table: Average Quarterly GDP growth (demeaned)

	High Firm Def. Low Bank Def	High Firm Def. High Bank Def.
EA	-0.0466	-0.5842

High default obs.: above the 90th percentile of the corresponding variable.
Quarterly GDP growth de-measured. Sample: US(1940-2016); EA (1992-2016)

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Tractable **quantitative macro-banking model** that embeds:

- a **microfounded banking setup**: microfounds bank-firm default
- into an otherwise standard **macro framework**

...to reproduce the following facts:

- ① High Firm default can occur **with** or **without** High Bank default
- ② Bank credit losses **may** or **may not** lead to *infrequent* but *highly disruptive* events of financial crises (High Bank and Firm defaults)

The outcome (regimes of defaults & their macro impact) depends on the underlying nature of borrowers riskiness (*diversifiable vs non-diversifiable*).

Key mechanism → **Bank Risk-taking Channel**

- ① powerful if banks face an increase in **non-diversifiable** borrowers risk
- ② amplified by **high bank leverage** and **non-linearities**

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A growing number of papers studies

- **financial crises and their normative analysis**

Bianchi and Mendoza, 2010, 2018; Jeanne and Korinek, 2010; Benigno et al., 2013; Boissay, Collard, and Smets 2016; Adrian and Duarte, 2017; Gertler, Kiyotaki, Prestipino, 2017; Elenev, Landvoigt, Nieuwerburgh, 2018;...

⇒ Framework of analysis that **micro-founds the link between Bank and Firm defaults** & capture: normal times/recessions vs financial crisis

- the long-run effects of **capital/leverage requirements**

(e.g. Van Den Heuvel, 2008; Christiano and Ikeda, 2014; Martinez-Miera and Suarez, 2014; Begenau, 2016; Corbae and D'Erasmus, 2017; Begenau and Ladvoigt, 2017; Mendicino, Nikolov, Supera, Suarez, 2018)

⇒ Capturing the **different regimes in the correlation of defaults** is KEY when drawing conclusions on the optimal capital requirements!

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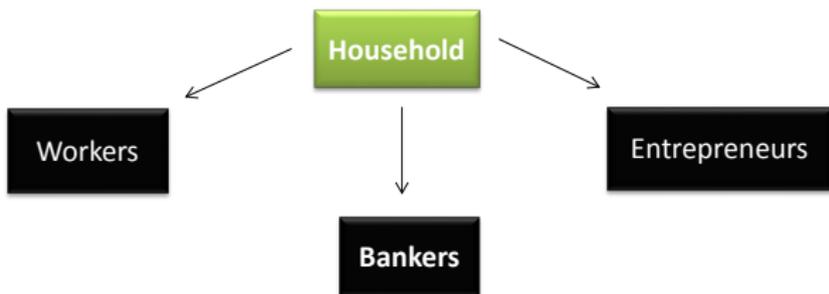
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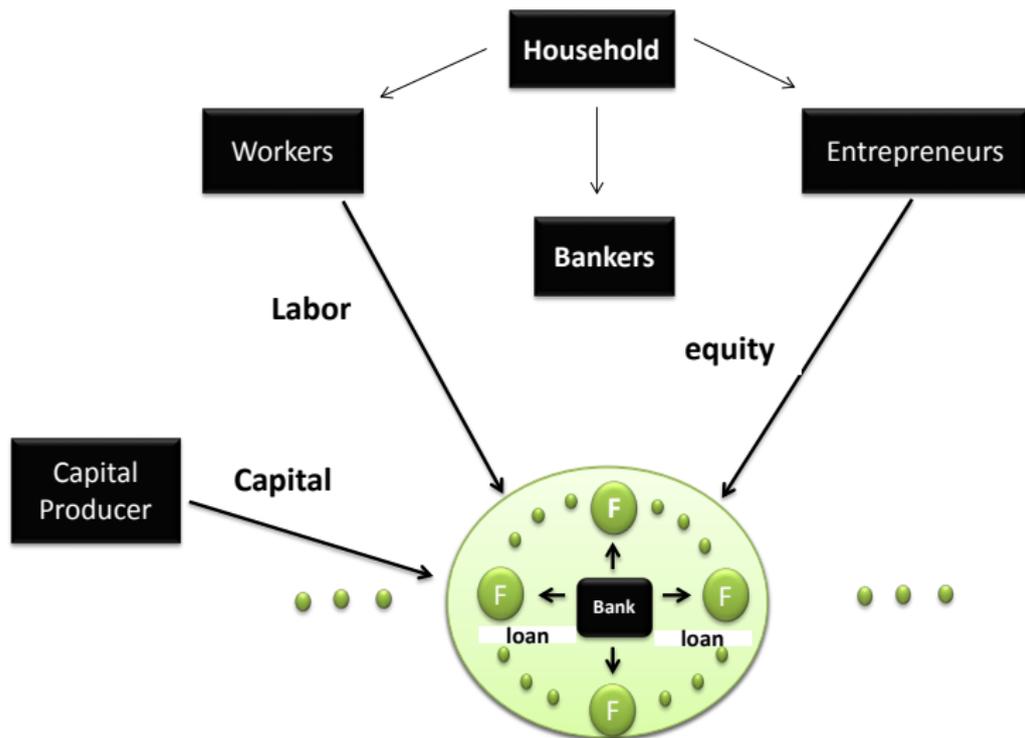
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Representative household: 3 different types of household members

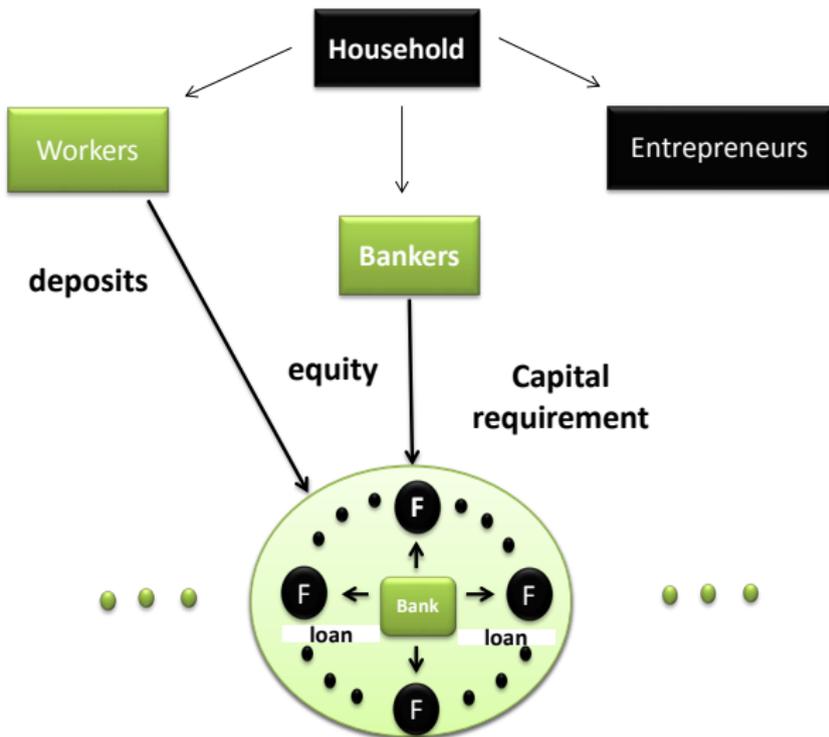


Continuum Island: In each operate one **Bank** and a continuum of **Firms**





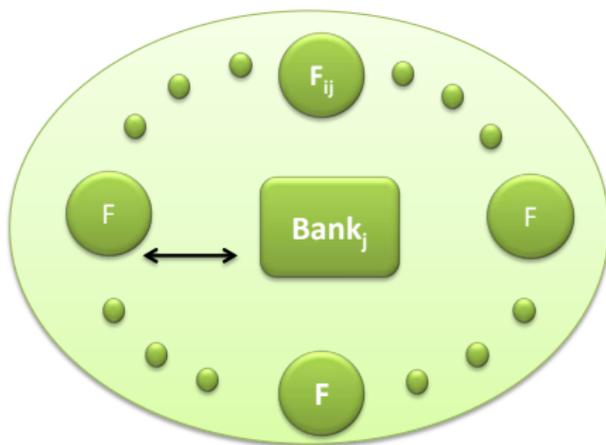
Firm produces the final good y ; pays input of production using **equities** and **loans**



Bank: use **equity** and (partially insured) **deposits** to grant loans to firms in the island

Firm i living on an island j

- borrows from **Bank j**
- and **defaults** if terminal value of assets $\omega_i \omega_j [q_{t+1} (1 - \delta) k_t + y_{t+1}]$ insufficient to repay bank loans $R_{f,t} B_{f,t}$

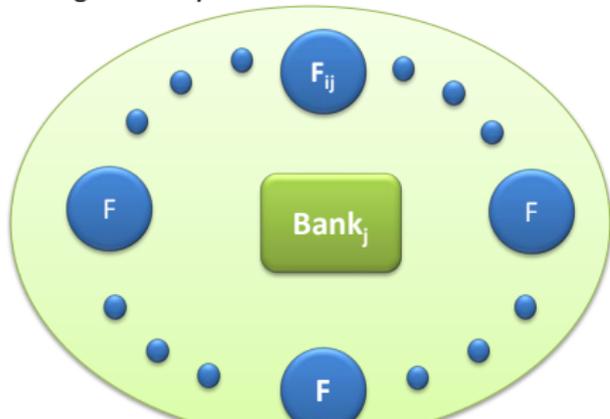


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ω_i : firm-idiosyncratic shock \rightarrow diversifiable at bank/island level

iid log-normally distributed



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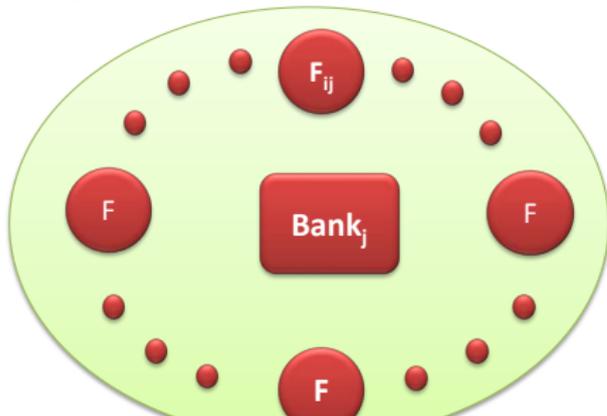
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NOT diversifiable at
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ω_j = bank-idiosyncratic
shock that affects bank
returns in a **non-linear**
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All borrowers (including Banks)

- can **default** on their debt obligations
- operate under **limited liability**

All external financing

- is subject to **CSV frictions**
- takes the form of non-recourse **uncontingent debt**

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Firms:

- Contracting problem between Bank and Firm (participation constraint of the bank)



internalize expected cost of default!

Banks:

- operate under safety net guarantees (insured deposits)
- part of deposits not insured: priced according to the **average** rather than **individual** risk profile of the Bank

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- Third-order approximate solution
- Quarterly data for the Euro area (1992:1-2016:4)
- GMM

Variable	Data	Model	Variable	Data	Model
MEAN GDP gr.	0.3301	0.3313	STD GDP gr.	0.6877	0.6222
MEAN Loans/GDP	2.442	1.7374	STD Loan gr.	1.1965	0.7234
MEAN Loan spr.	1.2443	1.3084	STD Loan spr.	0.6828	0.8217
MEAN Firm def.	2.6469	2.0990	STD Firm def.	1.0989	2.1386
MEAN Bank def.	0.6646	0.5282	STD Bank gr.	0.8438	1.1753
MEAN ROE banks	6.4154	6.2137	STD ROE gr.	4.1273	2.9301
CORR (B & F def.)	0.6421	0.7396	STD Inv. gr.	1.3908	2.0631

Note: Interest rates, equity returns, default rates, and spreads are reported in annualized percentage points. The standard deviation of GDP growth, Capital Investment and Loan growth is in quarterly percentage points.

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Implied Moments: 3 Defaults Regimes

	Frequency	GDP growth	Bank default	Firm default
Low Firm and Low Bank Default				
Data	0.844	0.0923	0.4346	2.3480
Model	0.857	0.0392	0.196	1.4409
High Firm and Low Bank Default				
Data	0.038	-0.0466	0.4033	4.8500
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Data	0.058	-0.5842	3.2294	4.6688
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High level of defaults is above 90th percentile.
based on 1.000.000 simulations.

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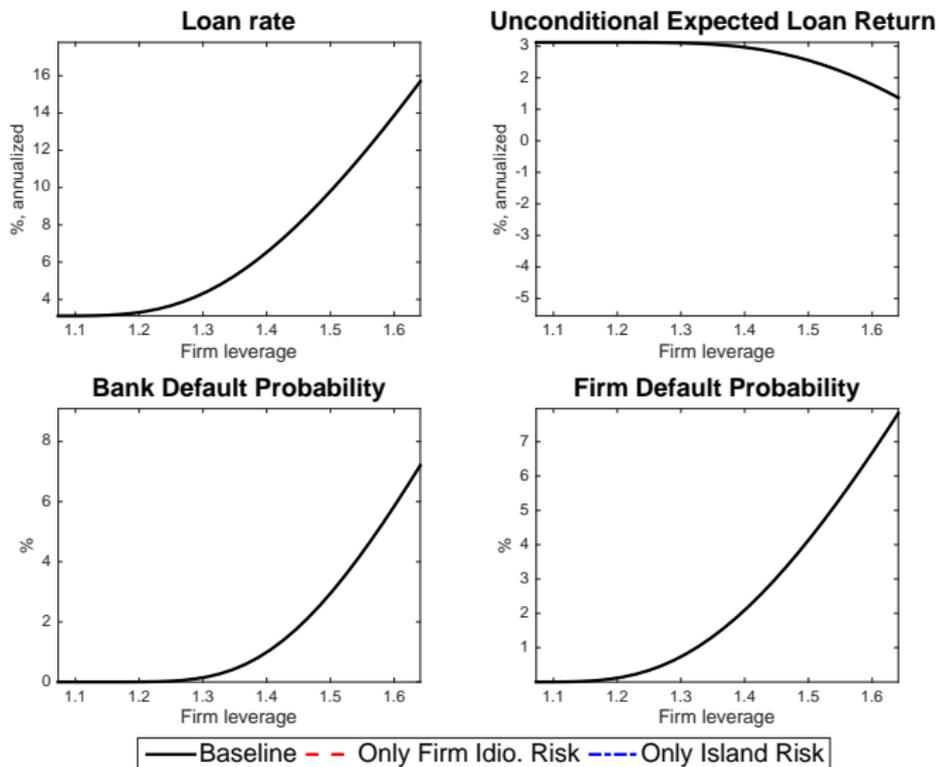
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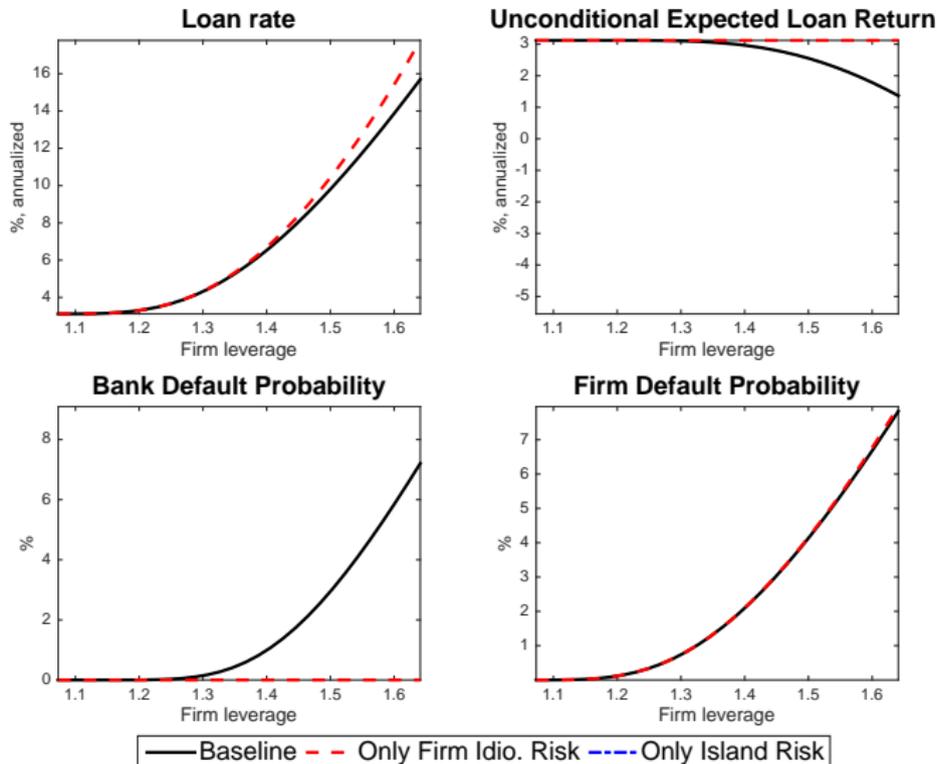
Banks are the center stage of the transmission mechanism of our model

- ① **bank risk taking**
- ② **bank funding cost**
- ③ **bank net worth**

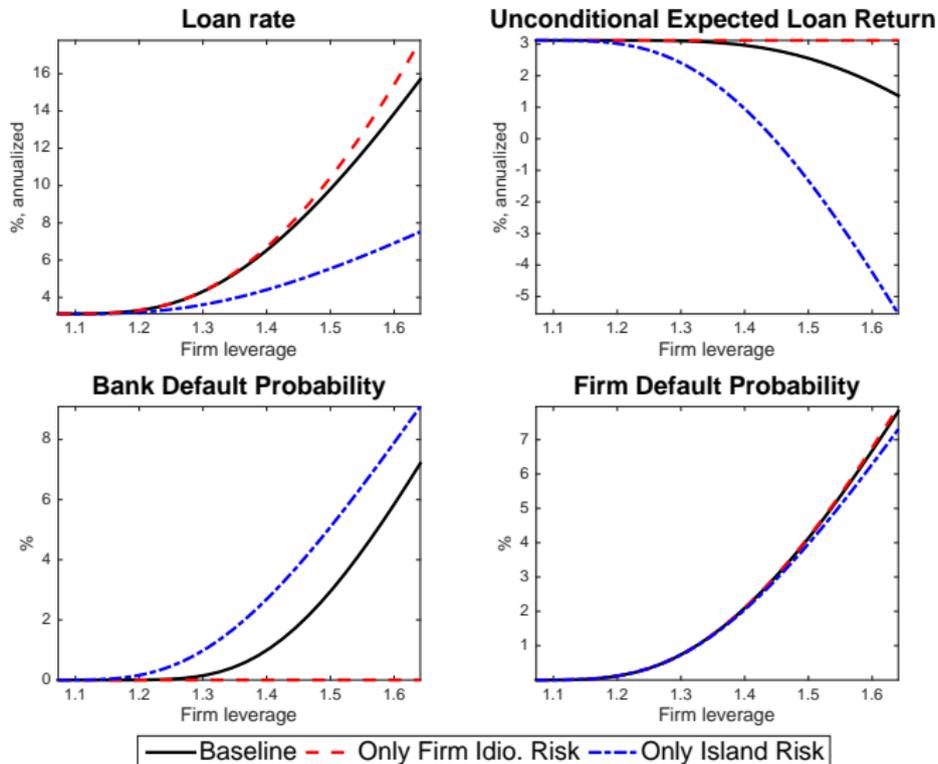
Bank Loan Pricing: diversifiable vs non-diversifiable Risk



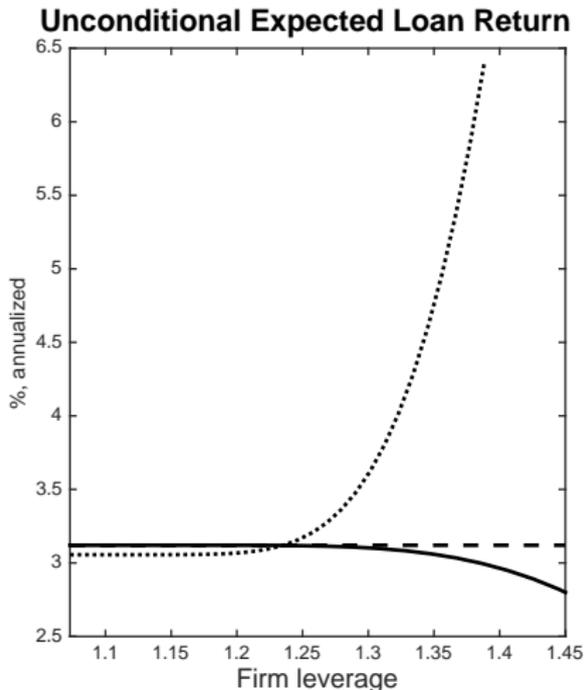
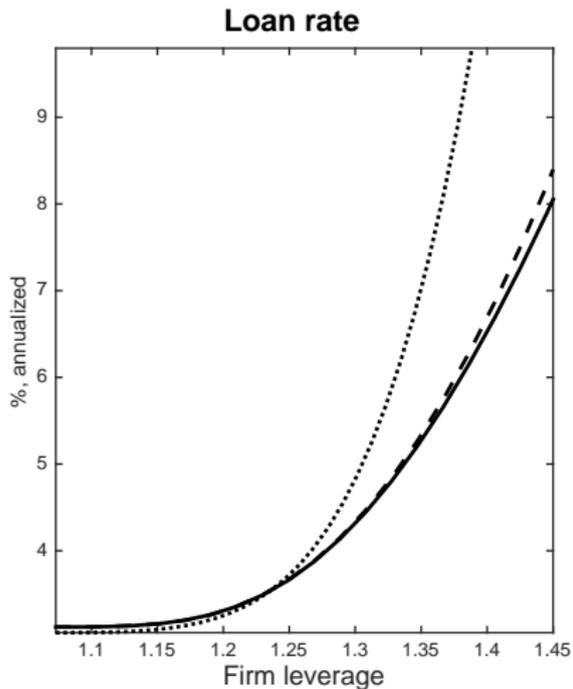
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Bank Loan Pricing: Limited Liability Bank Risk Pricing



— Baseline - - - Full Liability Deposit Pricing at Margin

Banks that face **non-diversifiable borrowers risk**

- ① operate **under limited liability**
- ② in the absence of **risk pricing at the margin**

-> 1+2: are prone to engage in **risk taking!**



High Firm and Bank Default

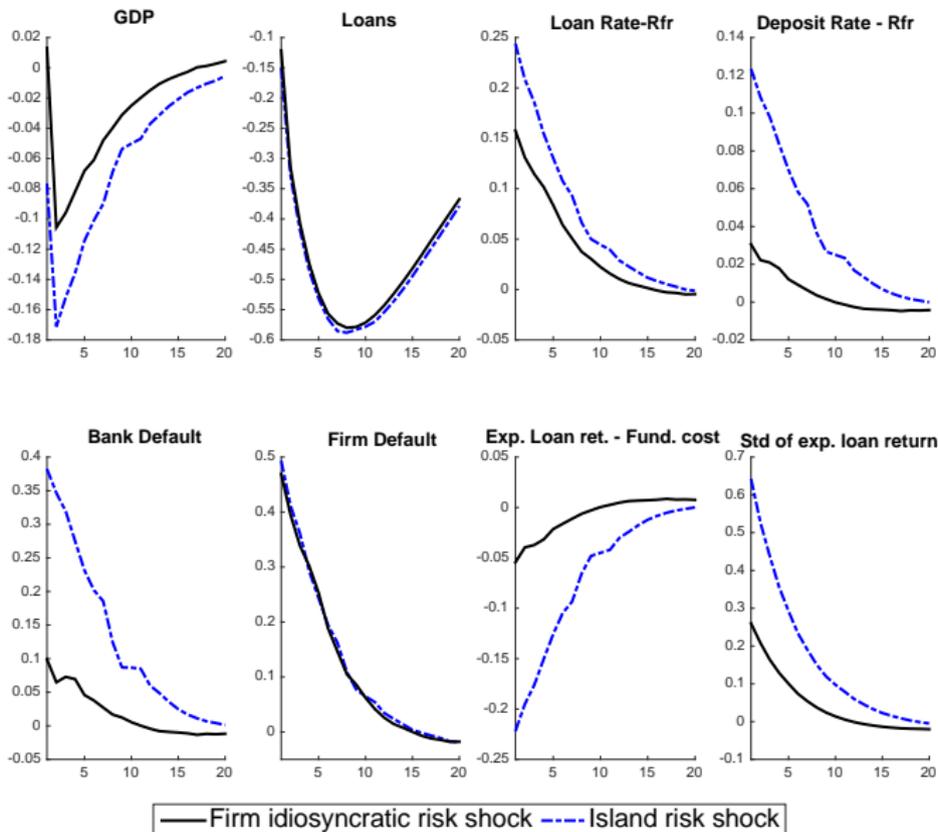
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Conditional on the same effect on aggregate borrowers riskness, a shock to **non-diversifiable risk**

- Increases **bank risk taking** and banks default...
- ...activates the **bank funding cost channel**
- and **depresses economic activity**

by more than a shock to **diversifiable risk!**

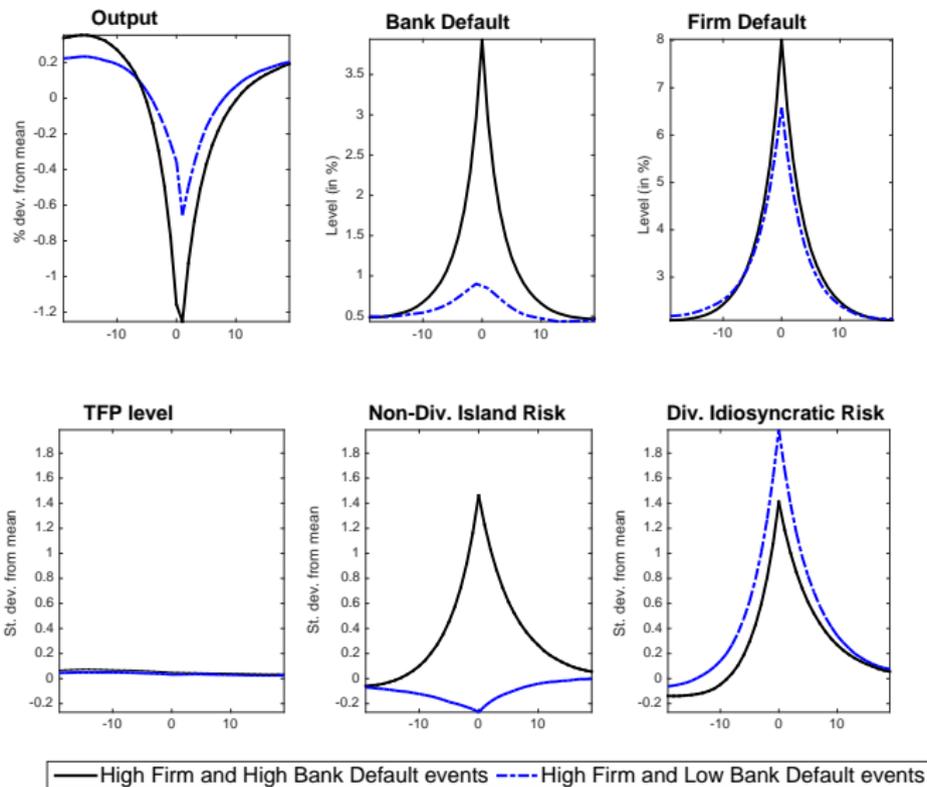
Shocks to diversifiable and undiversifiable risk



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Path to crisis: periods of High Firms and Bank default rates are driven by moderate (1.5 std) increases in non-diversifiable risk

...instead other regimes can be produced without it!



Path to crisis: periods of **High Firms and Bank default rates** are driven by moderate (1.5 std) increases in non-diversifiable risk

- **High bank leverage** amplifies the transmission of non-diversifiable risk
- **Non-linear** behaviour of bank returns and loan pricing (3 order approx)
 - Conditional on High Firms and Banks defaults the amplification of non-diversifiable risk shocks is strongly amplified (more than 3 times larger drop in GDP)
 - First-order approximate solution fails to match periods of high bank defaults (also with much larger undiversifiable shocks)

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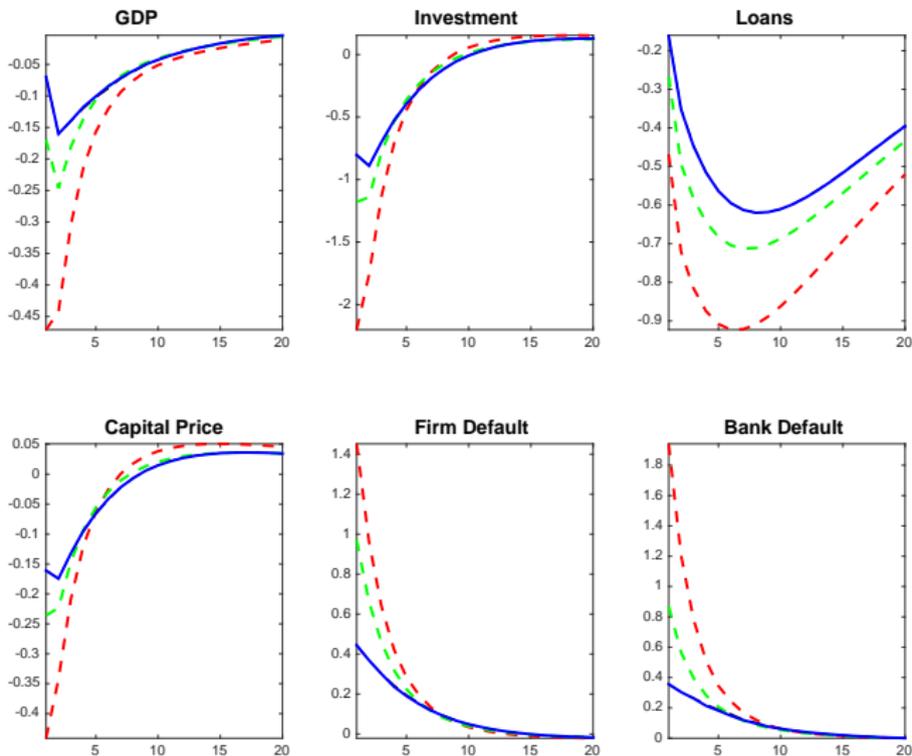
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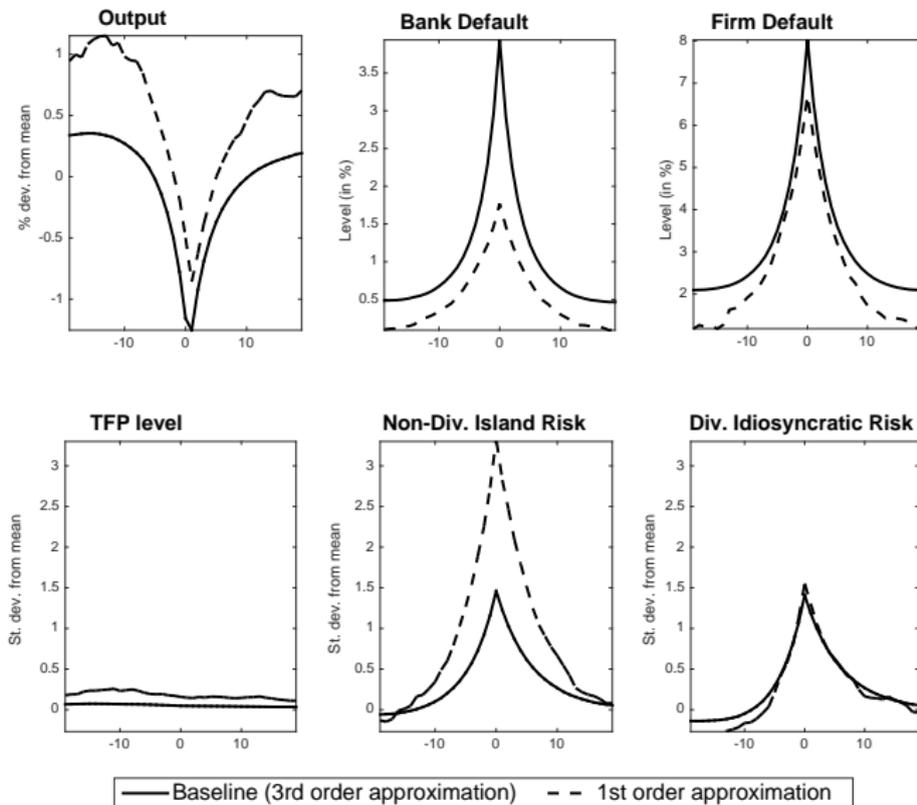
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Conditional IRFs to Island Risk Shock



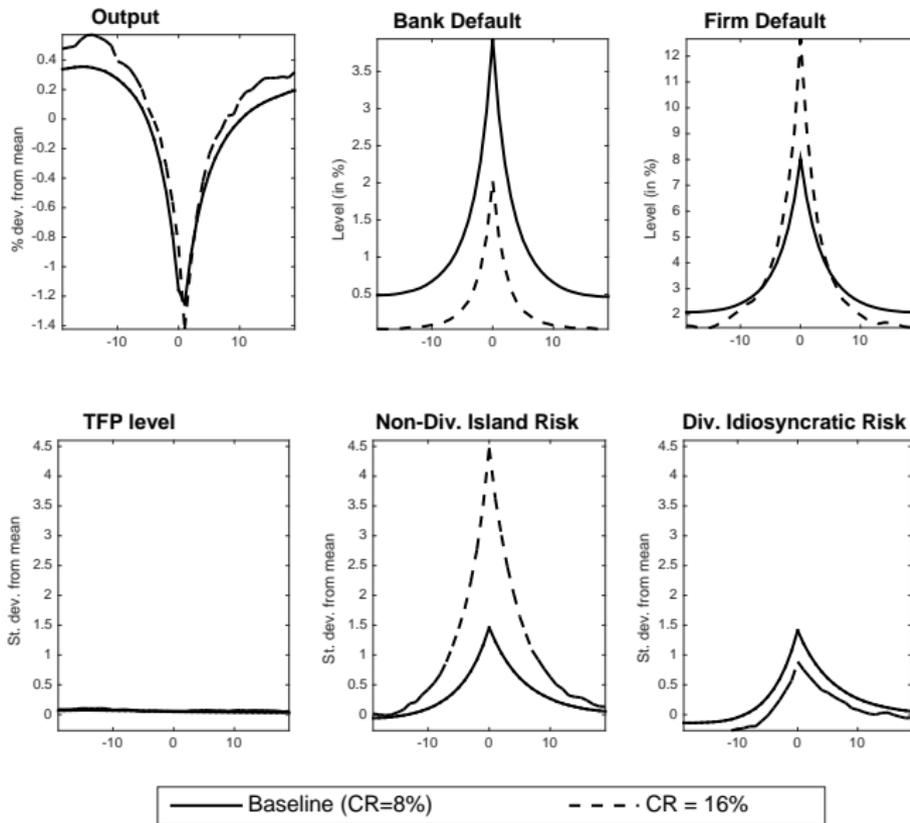
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Path to Crisis: 1st order



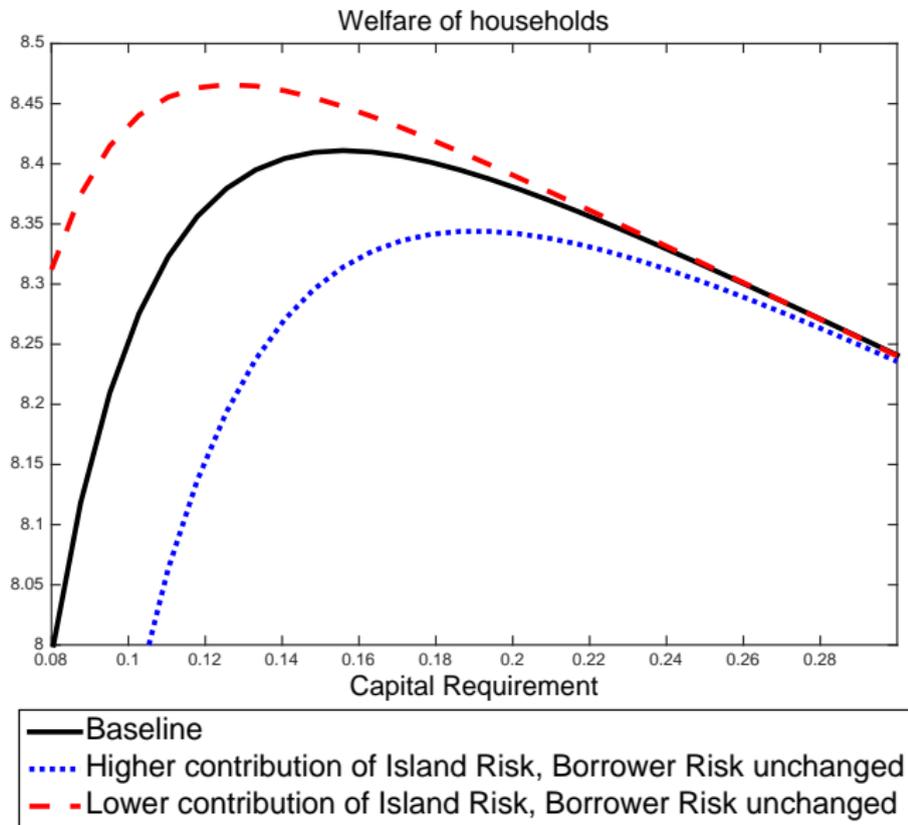
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- 4 Bank Risk Taking
- 5 Shocks to Diversifiable Risk
- 6 How important are island shocks?
- 7 ...Non Linearities?
- 8 ...Bank Leverage?
- 9 Policy Insights**

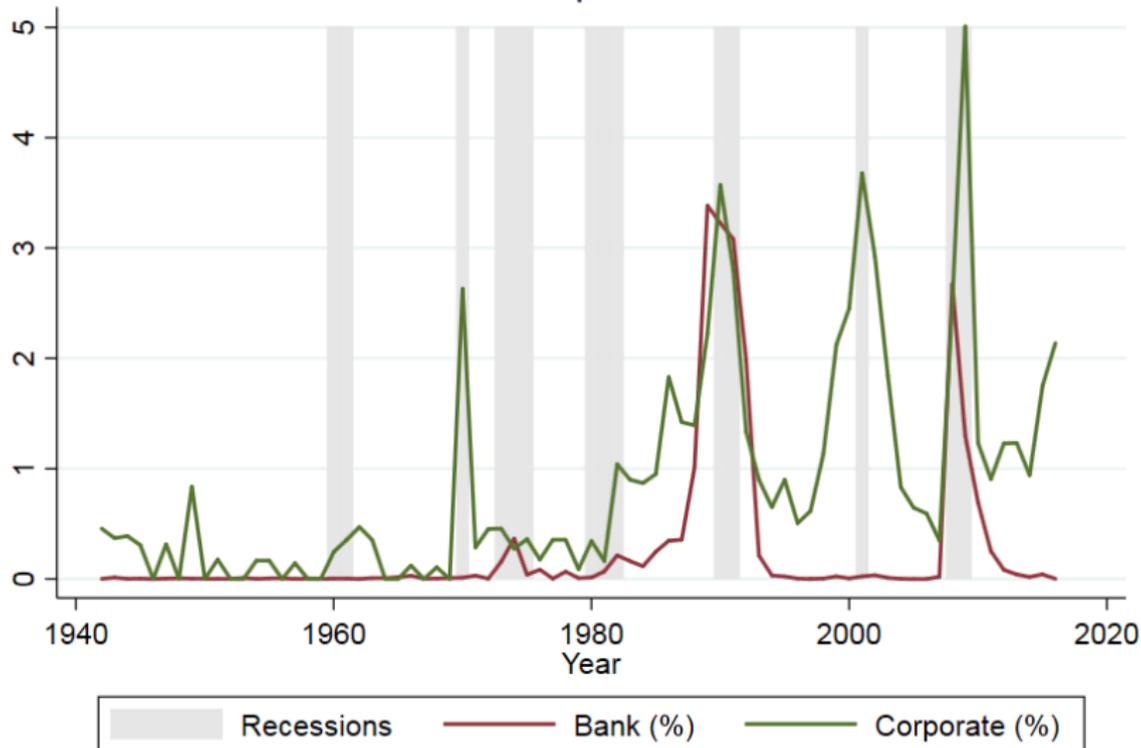
Optimal Capital Requirement: Welfare



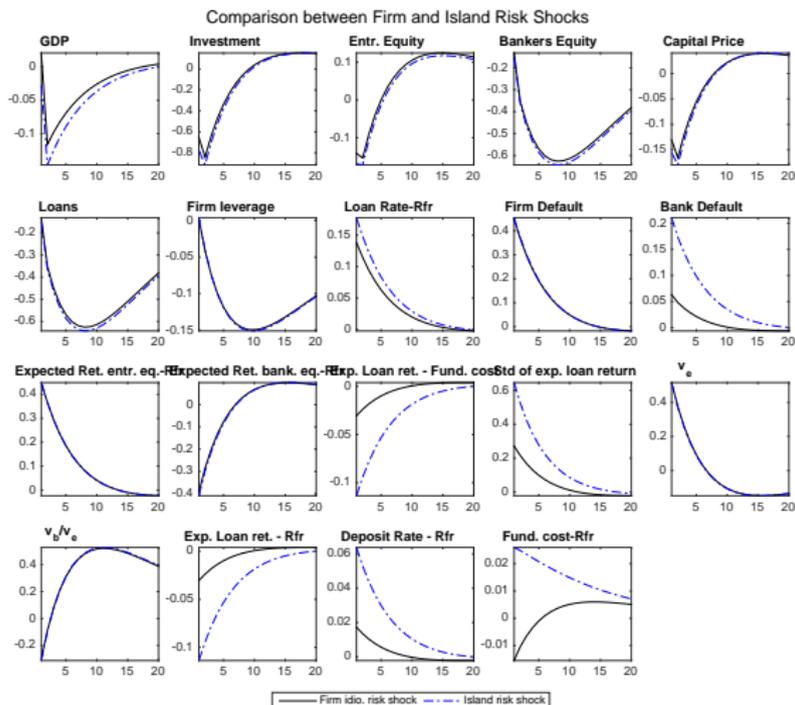
- **Bank risk taking** key amplification channel of borrowers risk
- Shocks to **non-divesifiable risk** play an important role in generating of *extreme financial distress* (high firms and banks defaults + large GDP drops) when **banks are highly leveraged**
- **Non-linearities** are key!
- Getting the **correlation of defaults** right (underlying nature of borrowers risk) it is of first order importance when drawing conclusions on the optimal level of capital requirements!

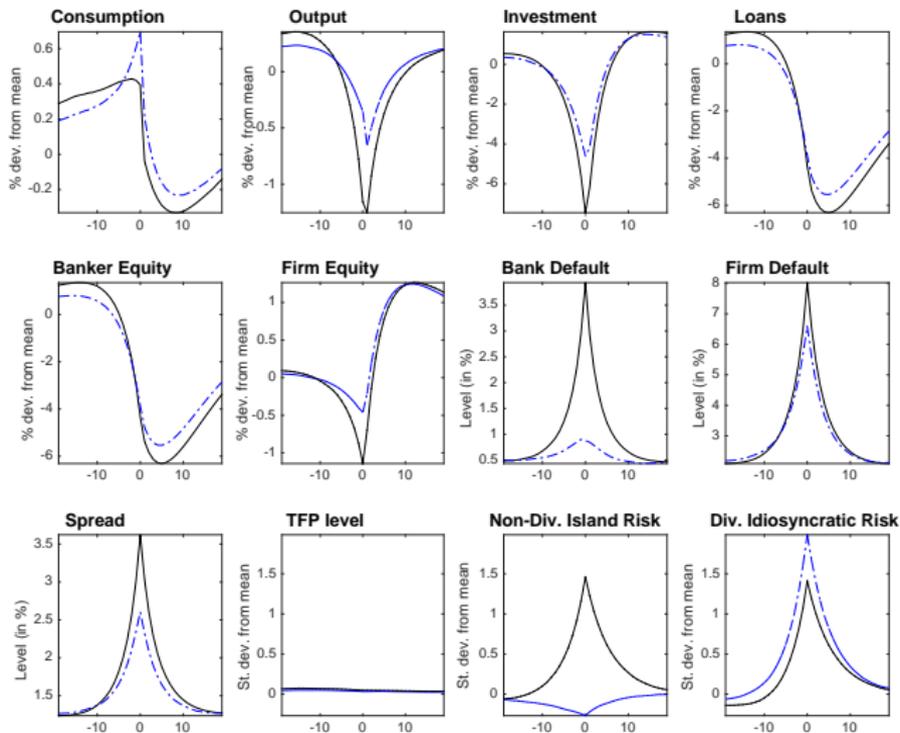
BACKGROUND SLIDES

US Bank and Corporate Failure Rate



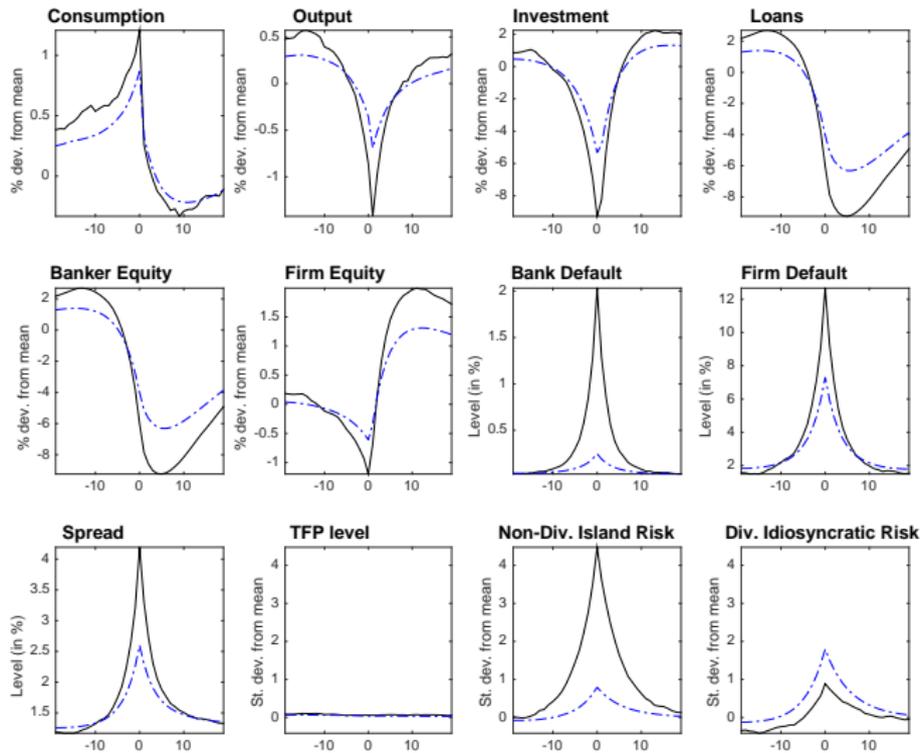
Parameter		Value
Entrepreneurs' endowment	χ_e	0.5514
Bankers' endowment	χ_b	0.5233
Mean std of firm idio. shock	$\bar{\sigma}_{\omega_i}$	0.4425
Mean std of island idio. shock	$\bar{\sigma}_{\omega_j}$	0.3131
Std TFP shock	σ_A	0.0053
Persistence TFP shock	ρ_A	0.9868
Std firm idio. risk shock	σ_i	0.0789
Persistence firm idio. risk shock	ρ_{σ_i}	0.8322
Std island idio. risk shock	σ_j	0.084
Persistence island idio. risk shock	ρ_{σ_j}	0.8401
Mean productivity growth	\bar{z}	1.0965
Capital adjustment cost	ψ_k	4.9902





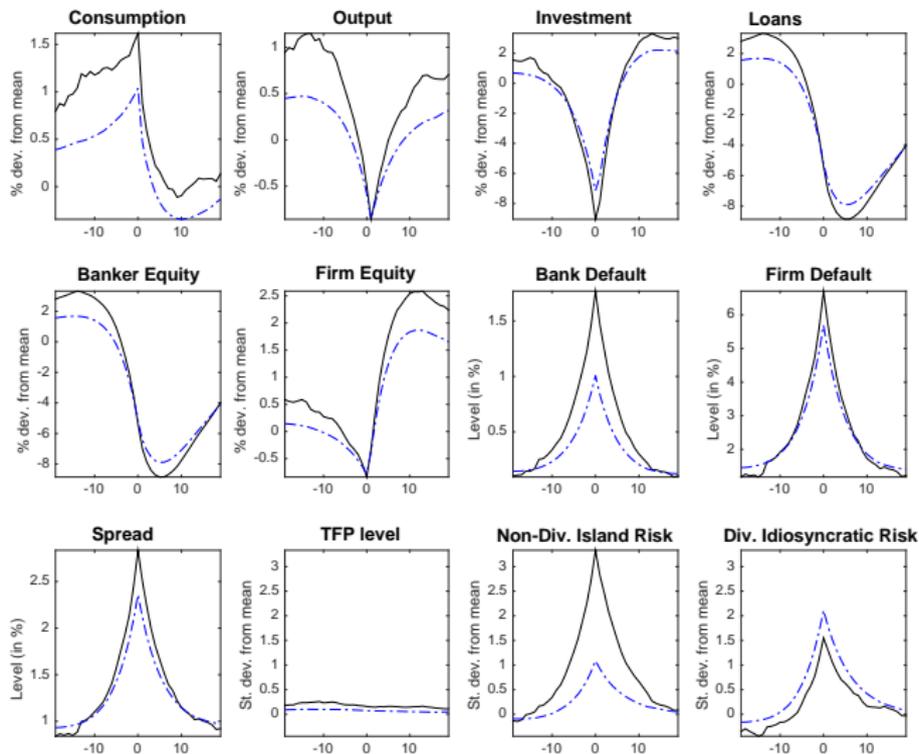
— High Firm and High Bank Default events - - - High Firm and Low Bank Default events

Paths to crises and Bank Leverage



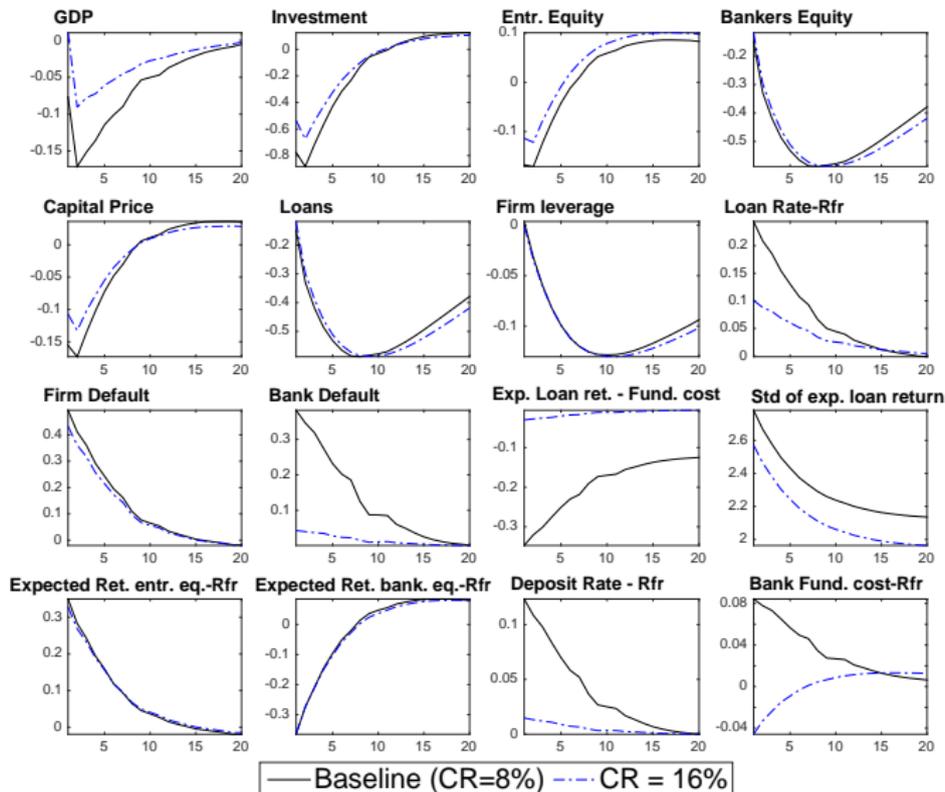
— High Firm and High Bank Default events - - - High Firm and Low Bank Default events

Path to Crisis: 1st order



— High Firm and High Bank Default events - - - High Firm and Low Bank Default events

Island idio. risk shock and Bank Leverage



Conditional Moments: Bank Leverage

	Moment	Baseline Model ($\phi = .08$)	Model ($\phi = .105$)	Model ($\phi = .16$)	Data
Low Firm and Low Bank Default					
Mean	GDP growth	0.0392	0.0273	0.0196	0.0923
Mean	Bank default	0.196	0.0688	0.0067	0.4346
Mean	Firm default	1.4409	1.3849	1.2584	2.3480
High Firm and Low Bank Default					
Mean	GDP growth	-0.0863	-0.103	-0.0805	-0.0466
Mean	Bank default	0.814	0.326	0.0491	0.4033
Mean	Firm default	6.3371	6.2944	6.0243	4.8500
High Firm and High Bank Default					
Mean	GDP growth	-0.4048	-0.2396	-0.1628	-0.5842
Mean	Bank default	3.8718	1.9106	0.4344	3.2294
Mean	Firm default	7.6206	7.4513	7.0123	4.6688

Conditional Moments: Approximation

	Moment	Baseline	1st order app.	Data
Low Firm and Low Bank Default				
Mean	GDP growth	0.0392	0.0213	0.0923
Mean	Bank default	0.196	0.1034	0.4346
Mean	Firm default	1.4409	1.3458	2.3480
High Firm and Low Bank Default				
Mean	GDP growth	-0.0863	-0.102	-0.0466
Mean	Bank default	0.814	0.5548	0.4033
Mean	Firm default	6.3371	4.4265	4.8500
High Firm and High Bank Default				
Mean	GDP growth	-0.4048	-0.1538	-0.5842
Mean	Bank default	3.8718	0.997	3.2294
Mean	Firm default	7.6206	4.8921	4.6688