EUROPEAN CENTRAL BANK

EUROSYSTEM

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Bank Risk Taking and Twin Defaults*

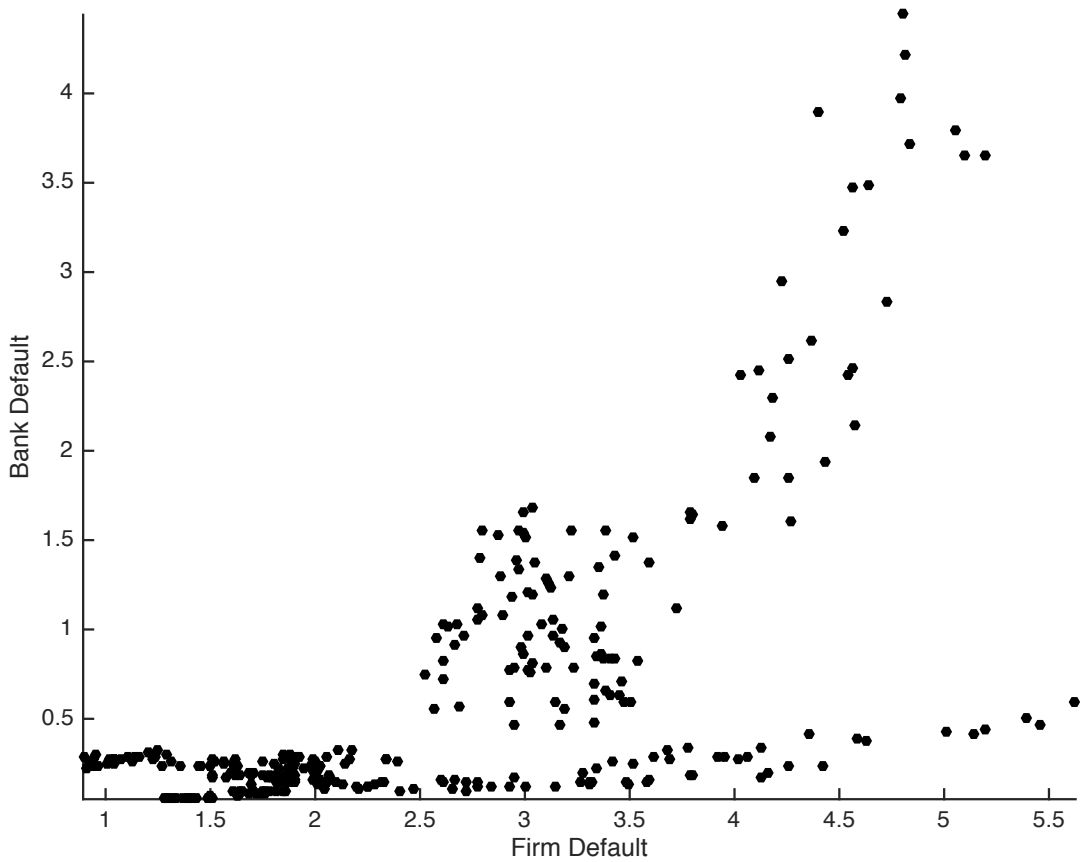
*The views expressed here are of the authors, not necessarily those of the European Central Bank

Focus of the Project

Motivated by the recent financial crisis focus on understanding:

- how **banks credit losses** translate into *rare* but *severe* waves of **bank failures** (twin defaults)
- the implications of *firm and bank defaults* for **macroeconomic outcomes**
- the role of **bank capital regulation** in the presence of a trade-off between impact in *normal times* and *crisis times* (twin defaults)

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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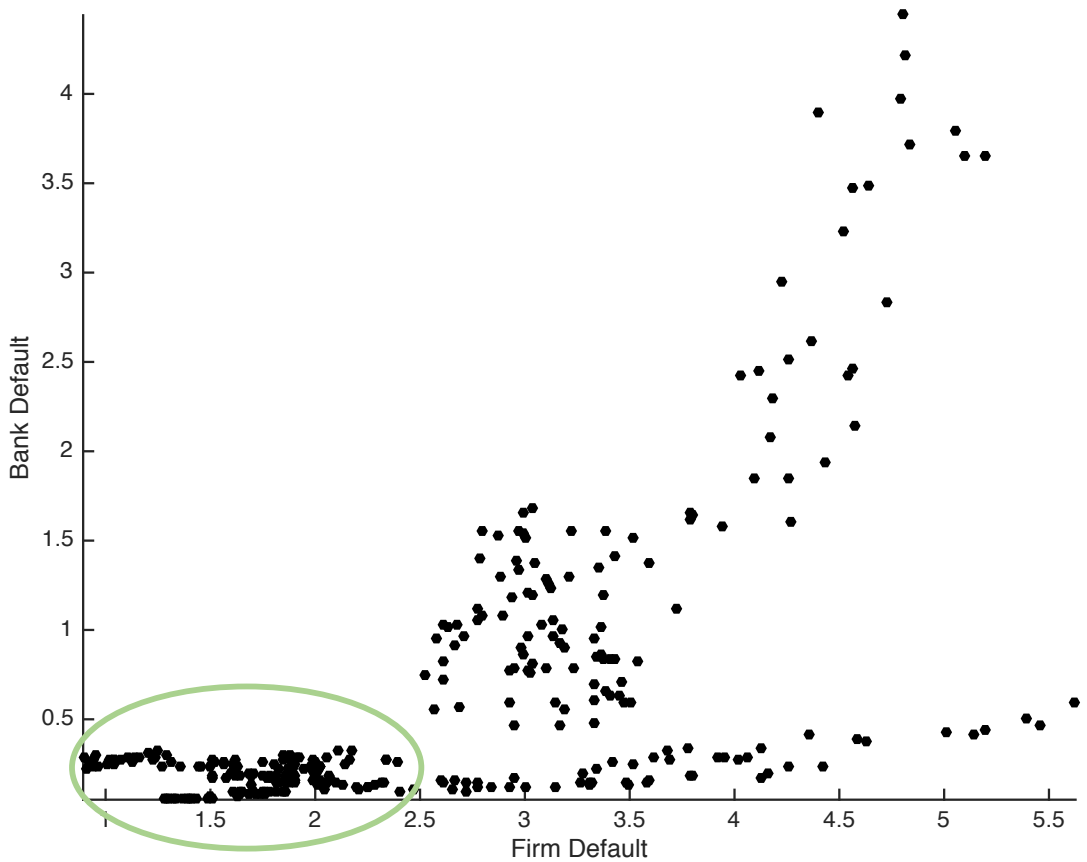

1) Default of both Firms and Banks **Low** (Low Default)

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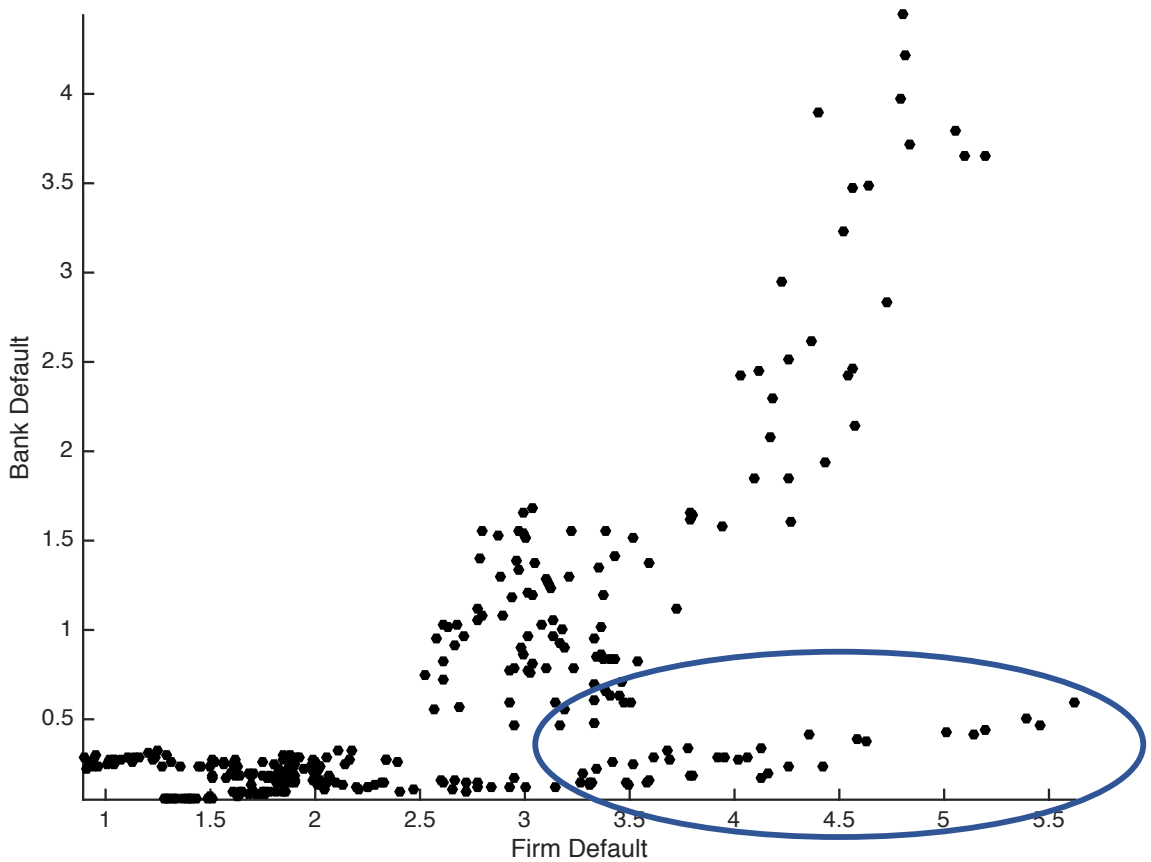

2) Firms default **High** but Banks default **Low** (Firm Default)

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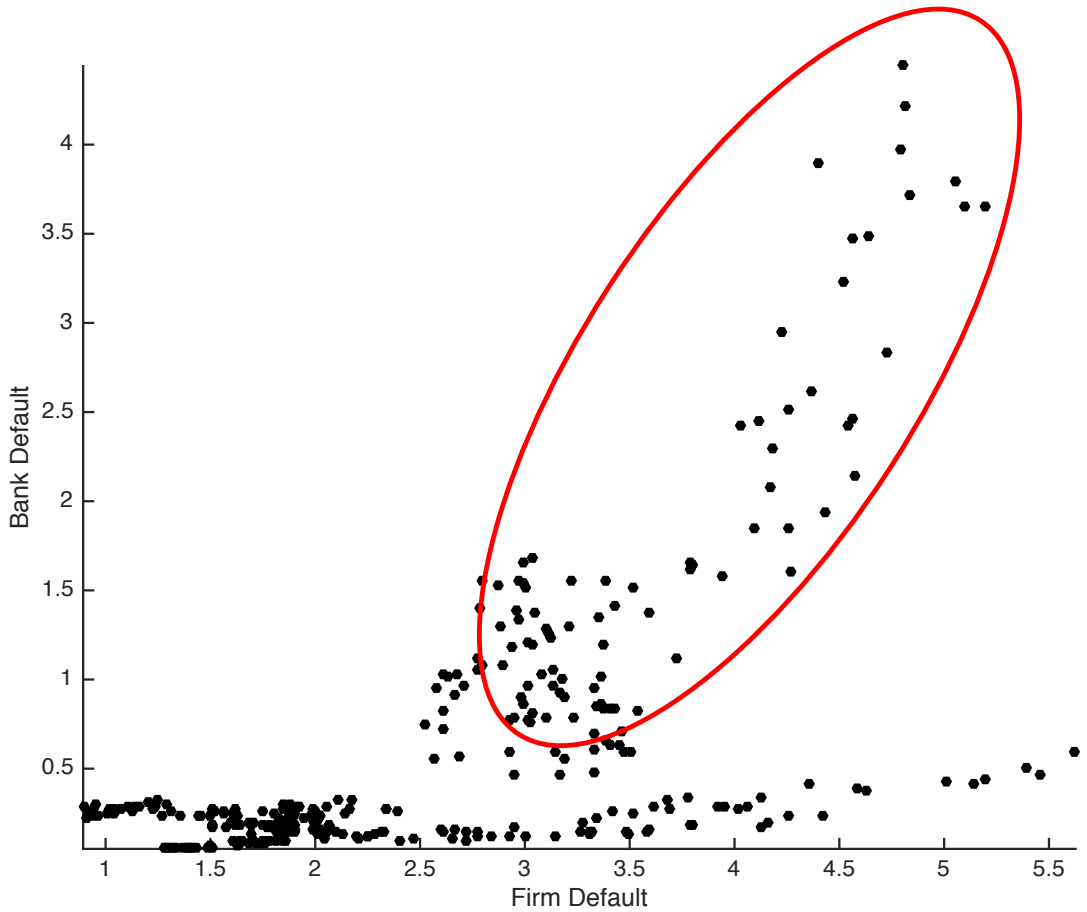


3) Default of both Firms and Banks **High** (**Twin Defaults**)

Higher sensitivity of bank default to firm default in upper Q

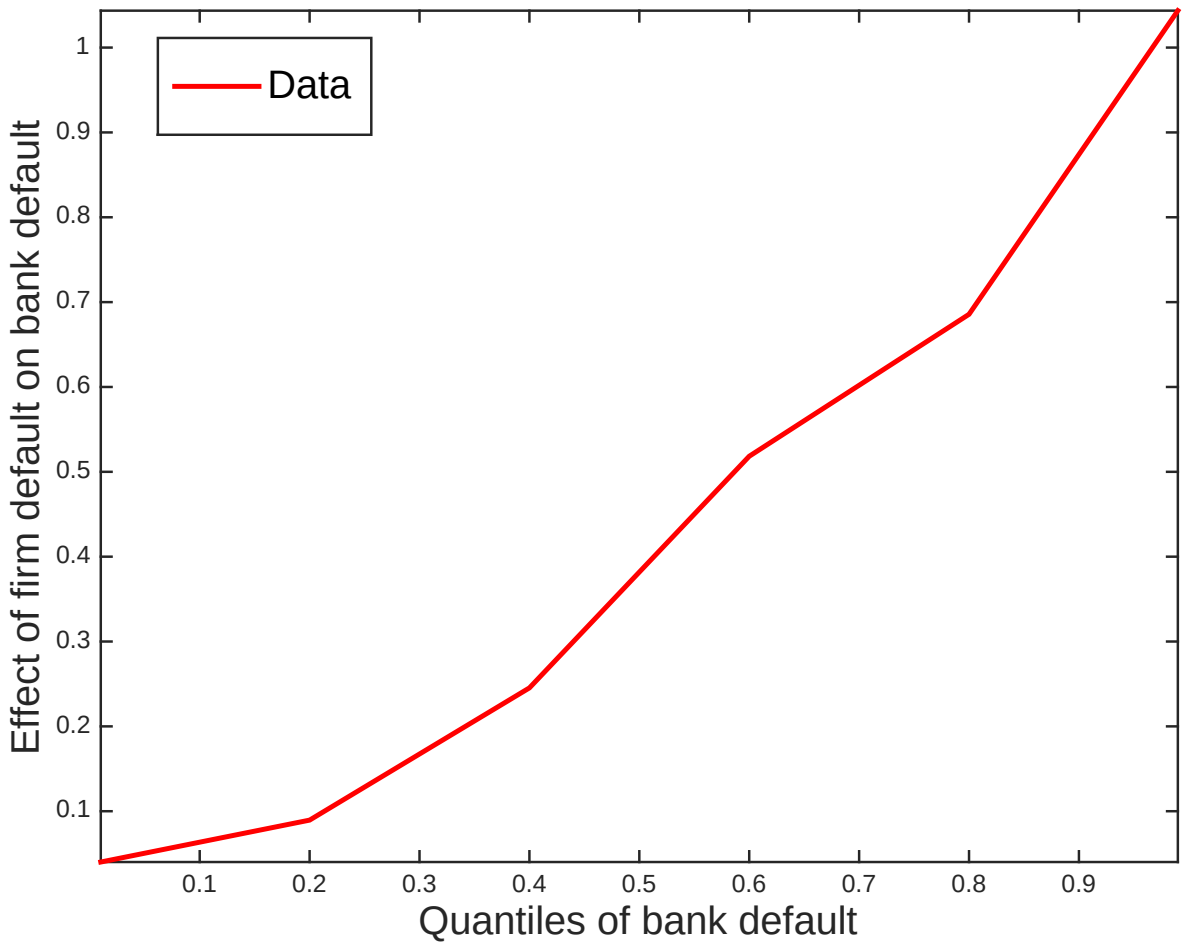
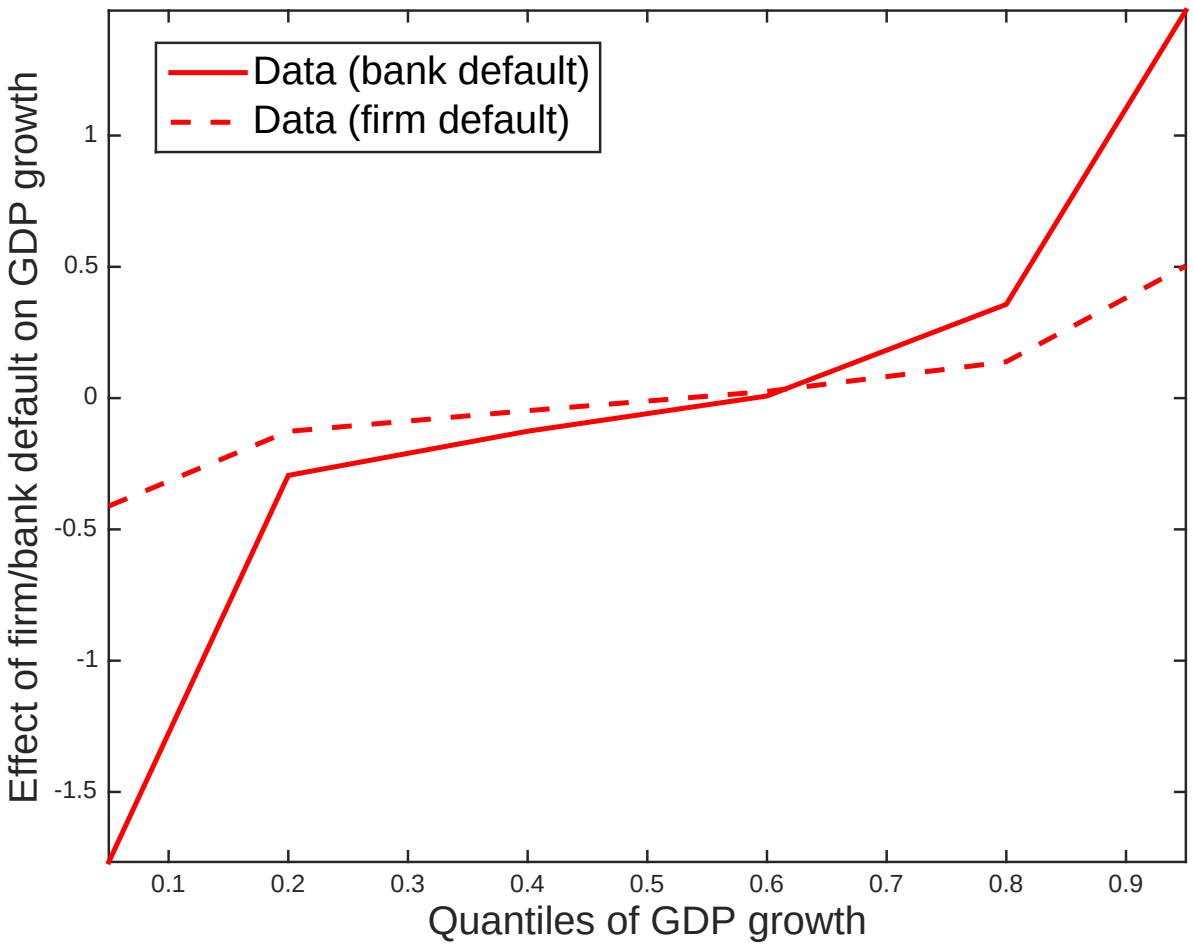


Table: Average Quarterly GDP growth (demeaned)

	High Firm Def.	**Twin** Defaults
EA	-0.0466	-0.5842
DE	-0.2550	-0.6690
FR	-0.0718	-0.6605
IT	-0.0242	-0.5471
NL	-0.5043	-2.1904
BE	-0.3645	-0.4051
US	-0.0781	-0.9790

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

Higher sensitivity of next period GDP growth to bank default in lower Q



- We embed a **structural model of bank default risk** into a quantitative macro framework:
  - captures borrower risk that is *non-diversifiable* at individual bank level $\Rightarrow$ bank default risk
  - takes into account highly non-linear nature of implied bank asset returns.
- We solve it using **third-order approximations**
- We calibrate it to match unconditional moments of EA data
  - reproduces the **non-linear patterns of correlation** of firm and bank defaults (including rare crisis episodes **twin defaults**)
  - and associated **macroeconomics outcomes**
- We provide results for **optimal** bank capital requirements

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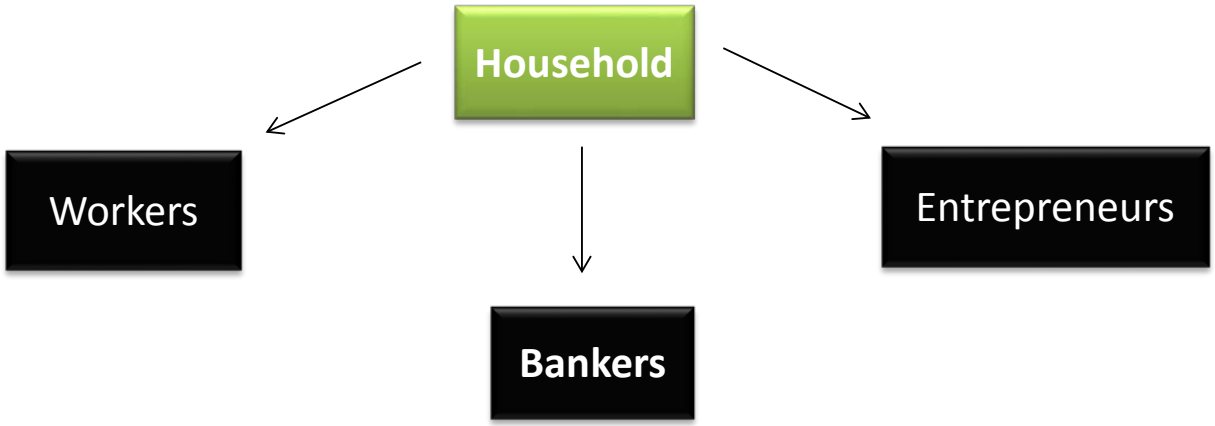
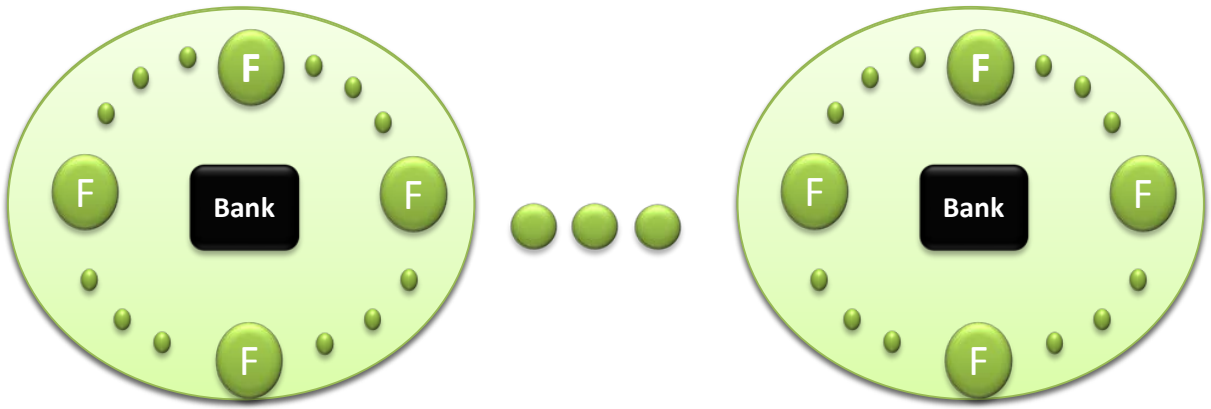
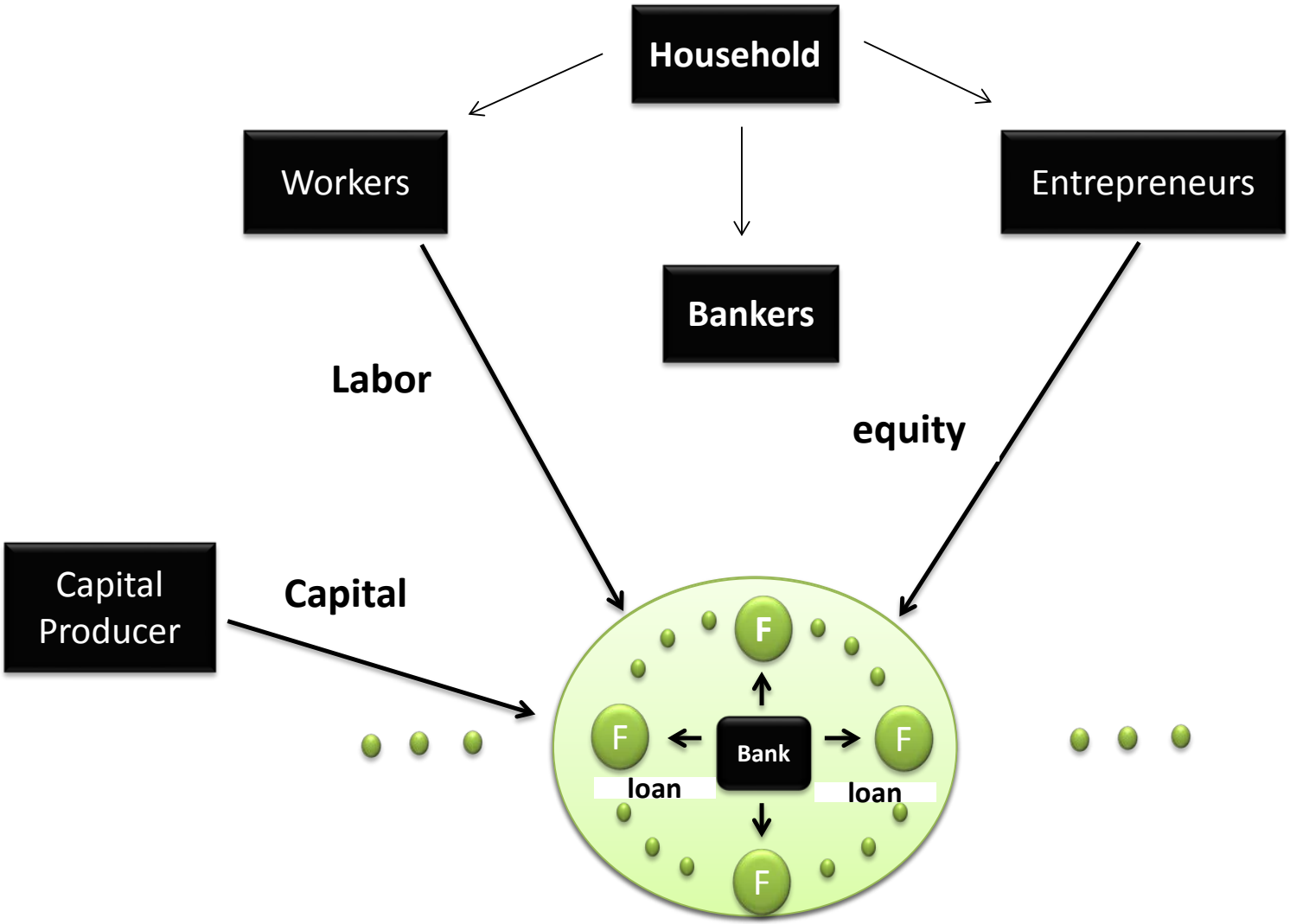
Representative household: 3 different types of household members



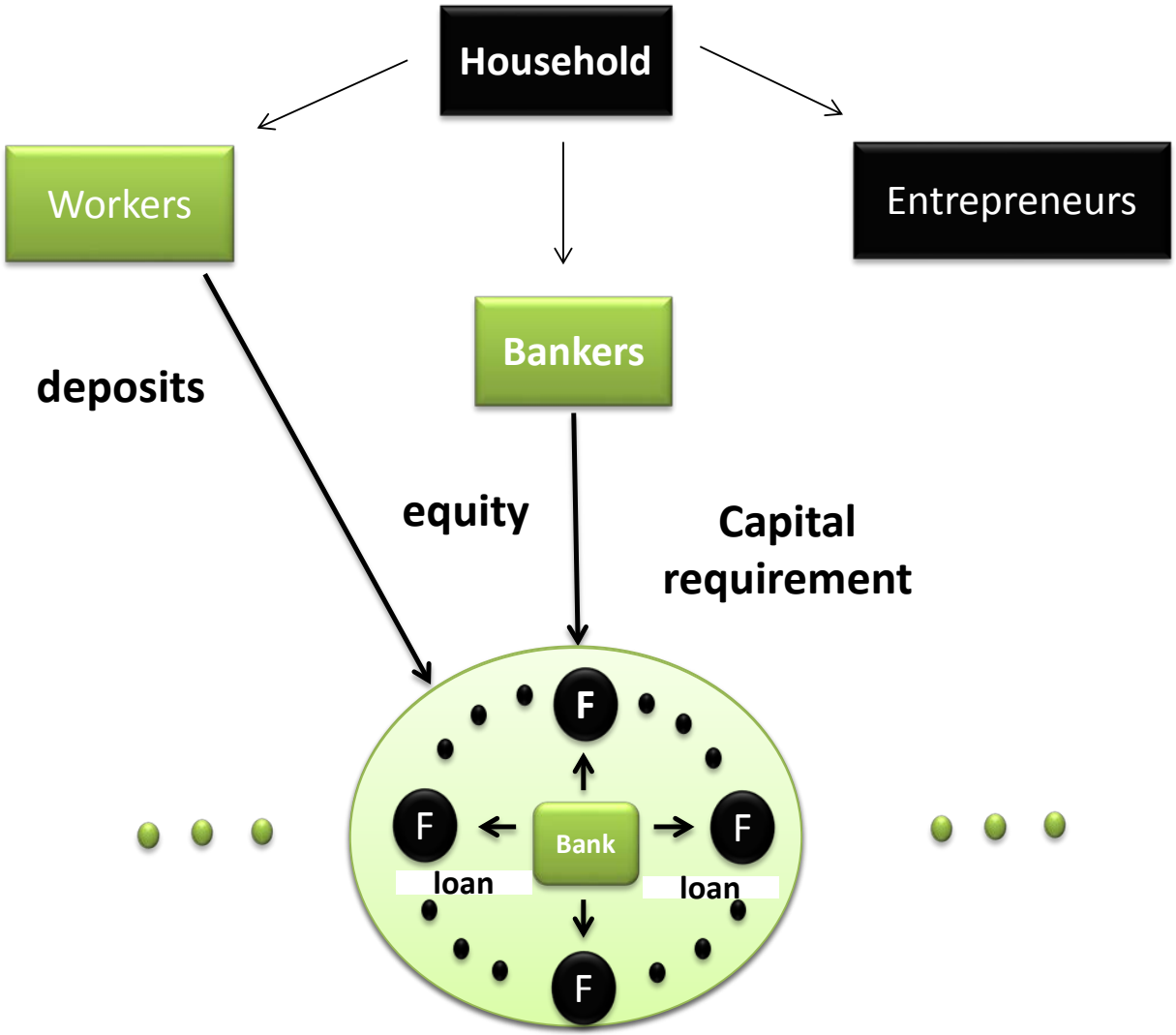
Continuum of Islands: each with one **bank** and a continuum of **firms**



banks and **firms** live 1 period



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



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

Firm i living on an **island j** borrows from **Bank j**

- **defaults** if terminal value of assets $\omega_i \omega_j \left[q_{t+1} \left(1 - \delta \right) k_t + y_{t+1} \right]$

insufficient to repay bank loans $R_{f,t} B_{f,t}$

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- **Bank asset returns** are a highly **non-linear** function of ω_j

- **Banks defaults** when a large fraction of their borrowers default and have not enough equity buffers to cover the losses

Banks and Firms: Key Differences

Firms:

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

  $\Downarrow$

  firms internalize expected cost of default!

Banks:

- operate under safety net guarantees (insured deposits)
- individual risk profile of the Bank not priced by depositors

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Targeted: Unconditional Moments

- **Solution**: Third-order approximate solution with pruning (Andreasen, Fernandez-Villaverde and Rubio-Ramirez, 2017)
- **Estimation**: SMM
- **Data**: Quarterly data for the Euro area (1992:1-2016:4)

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: Defaults Correlation Patters

	Frequency	GDP growth	Bank default	Firm default
Low Default				
Data	0.844	0.0923	0.4346	2.3480
Model	0.857	0.0392	0.196	1.4409
Firm Default				
Data	0.038	-0.0466	0.4033	4.8500
Model	0.042	-0.0863	0.814	6.3371
Twin Defaults				
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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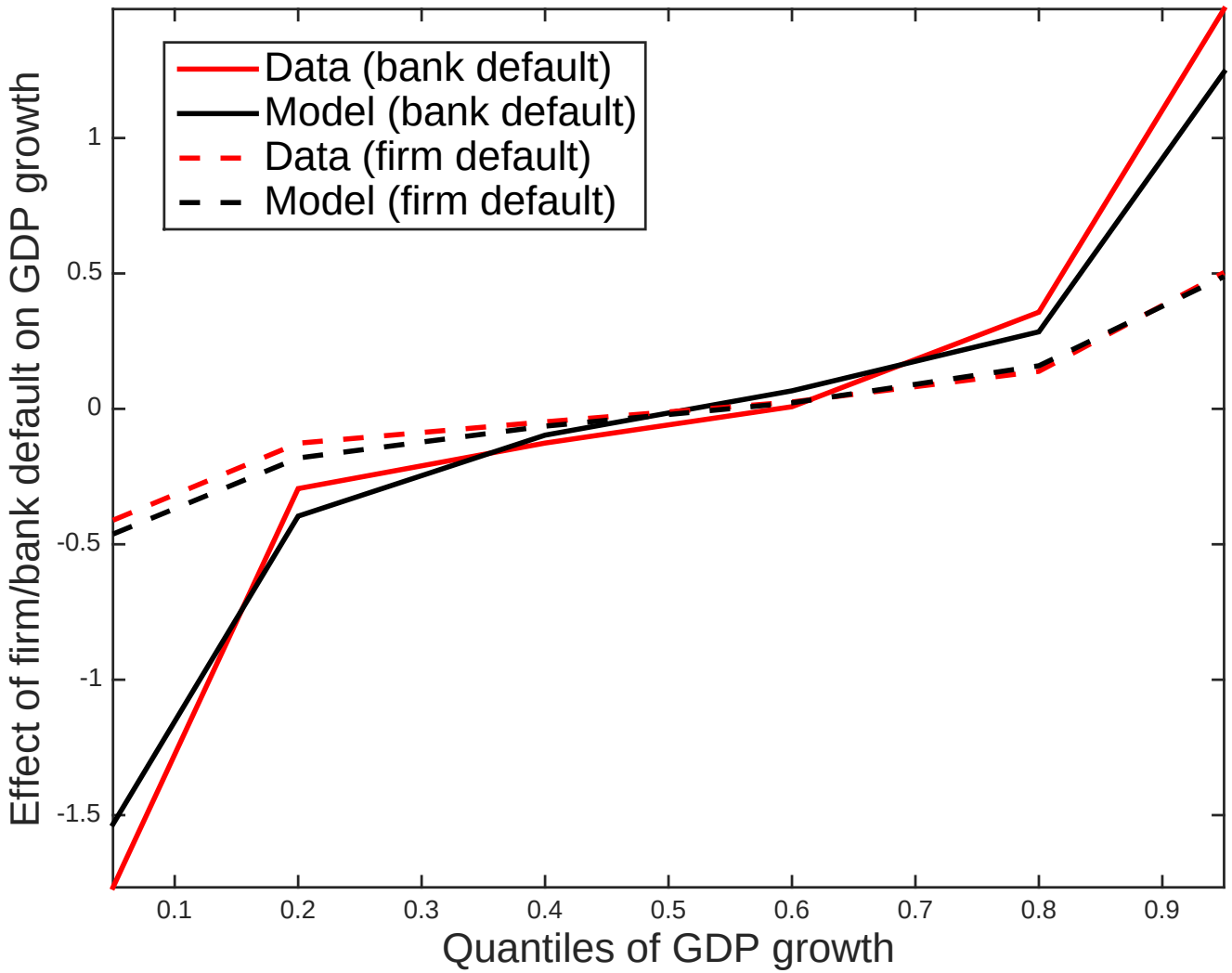
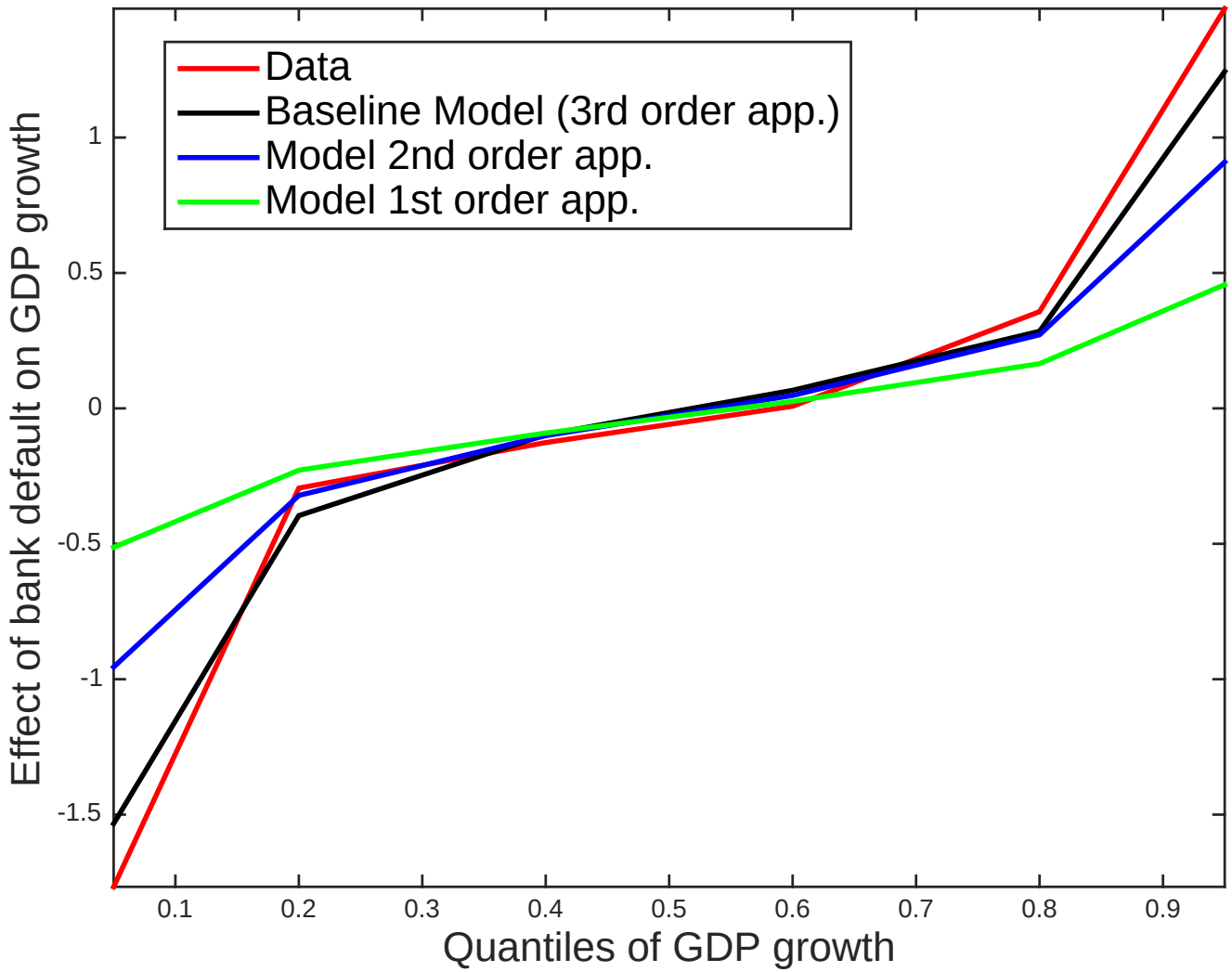
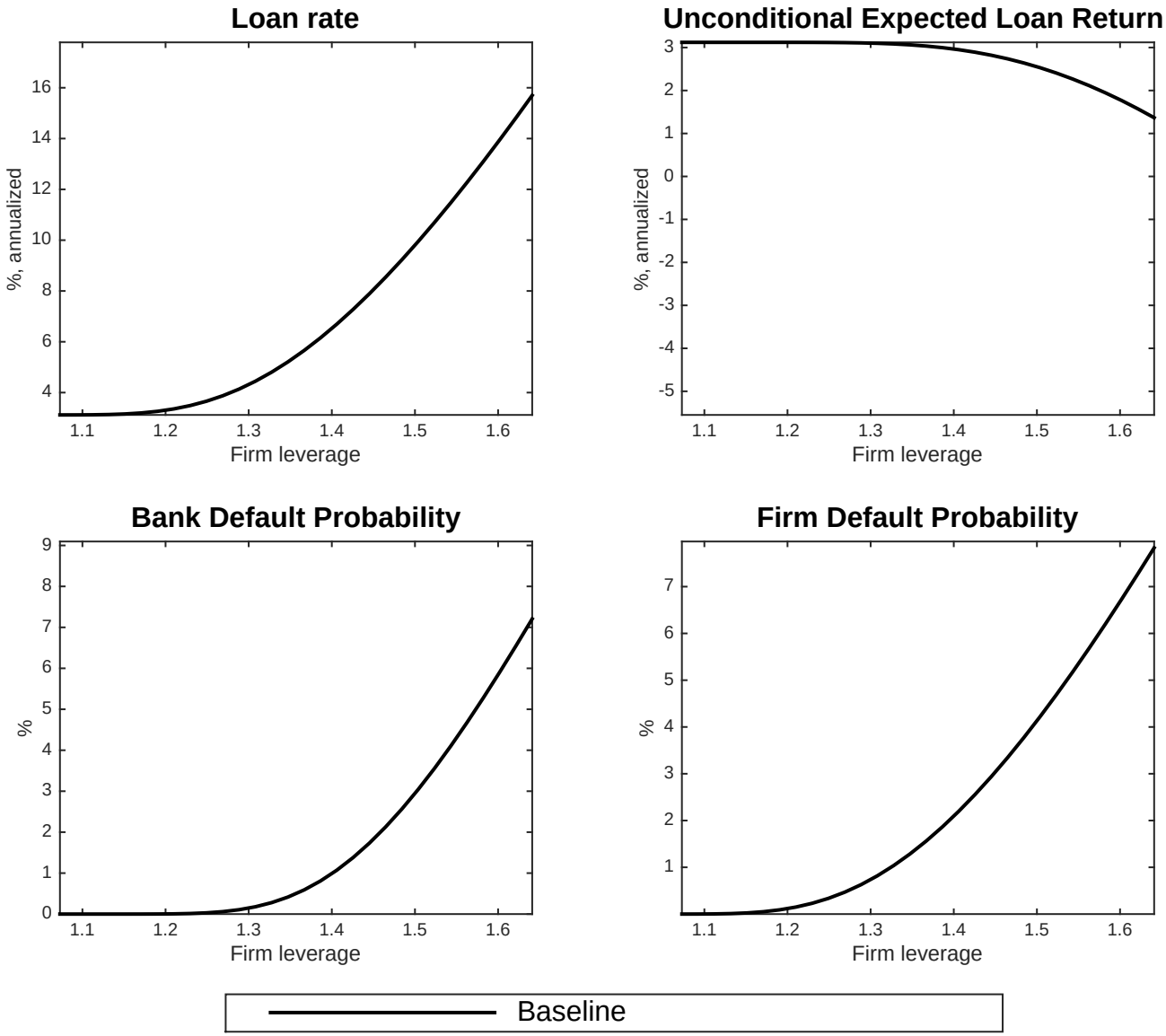
Quantile Regression Coefficients (baseline)



Quantile Regression Coefficients (Approx. order)



Bank Loan Pricing: diversifiable vs non-diversifiable Risk



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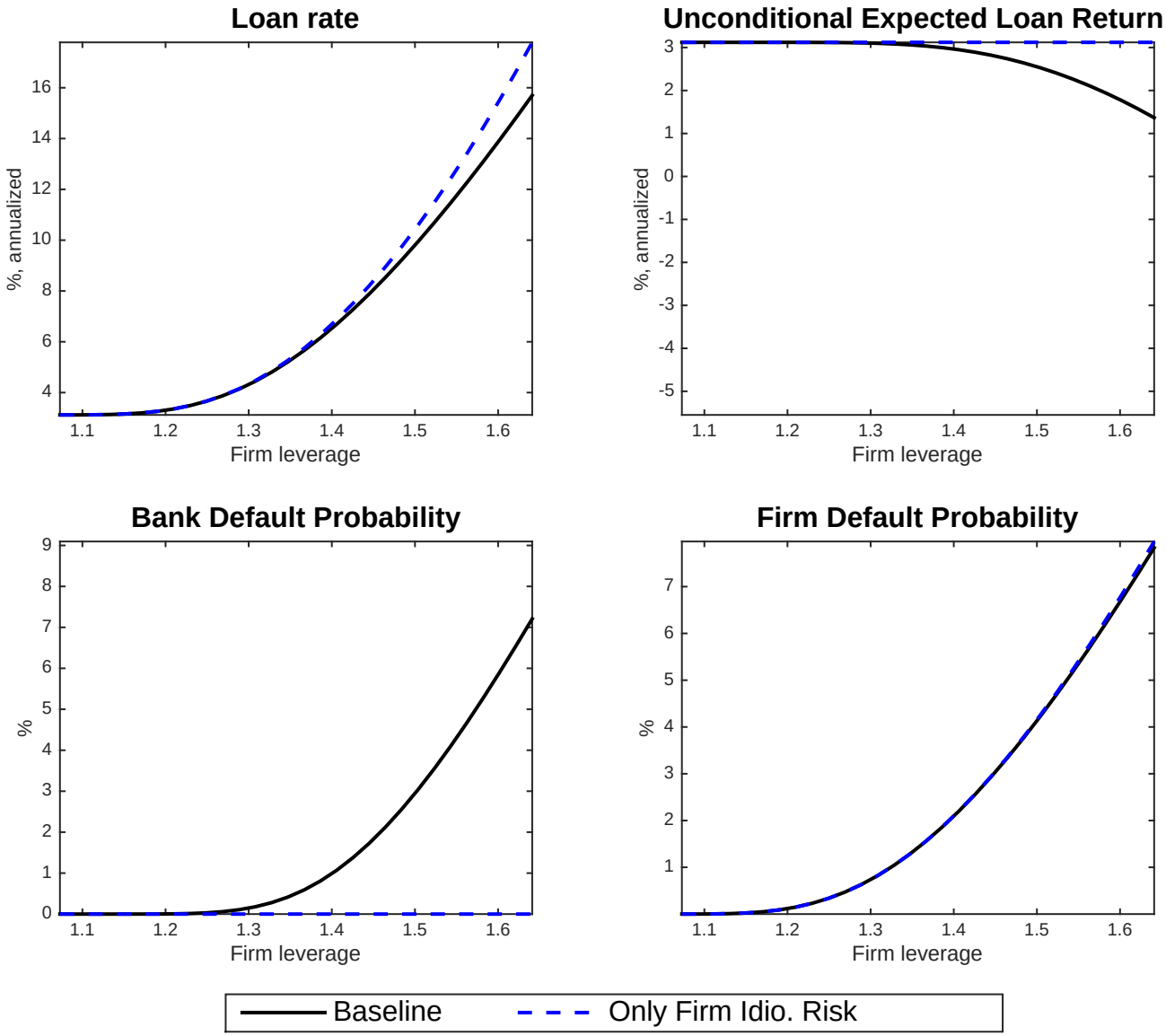

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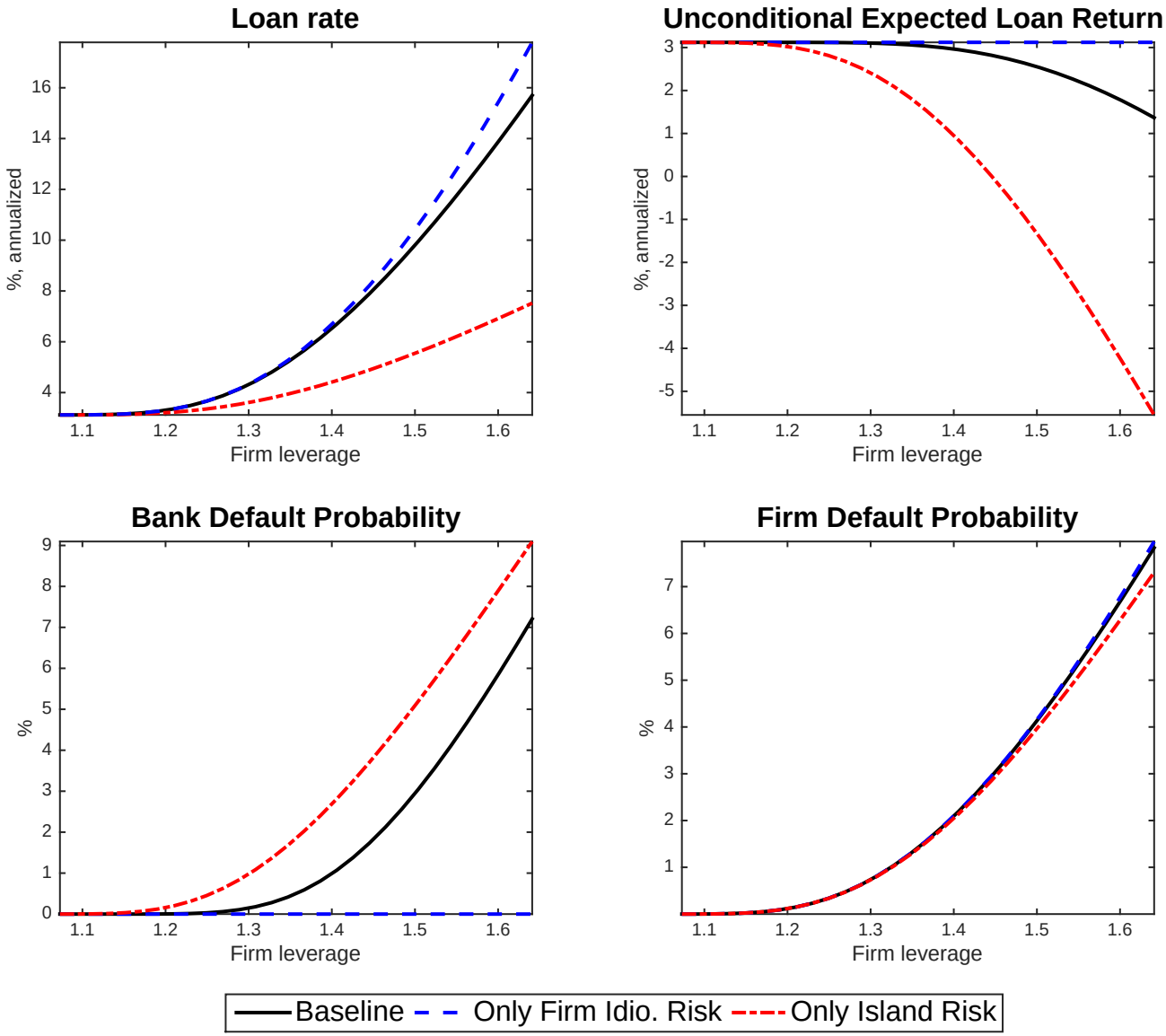


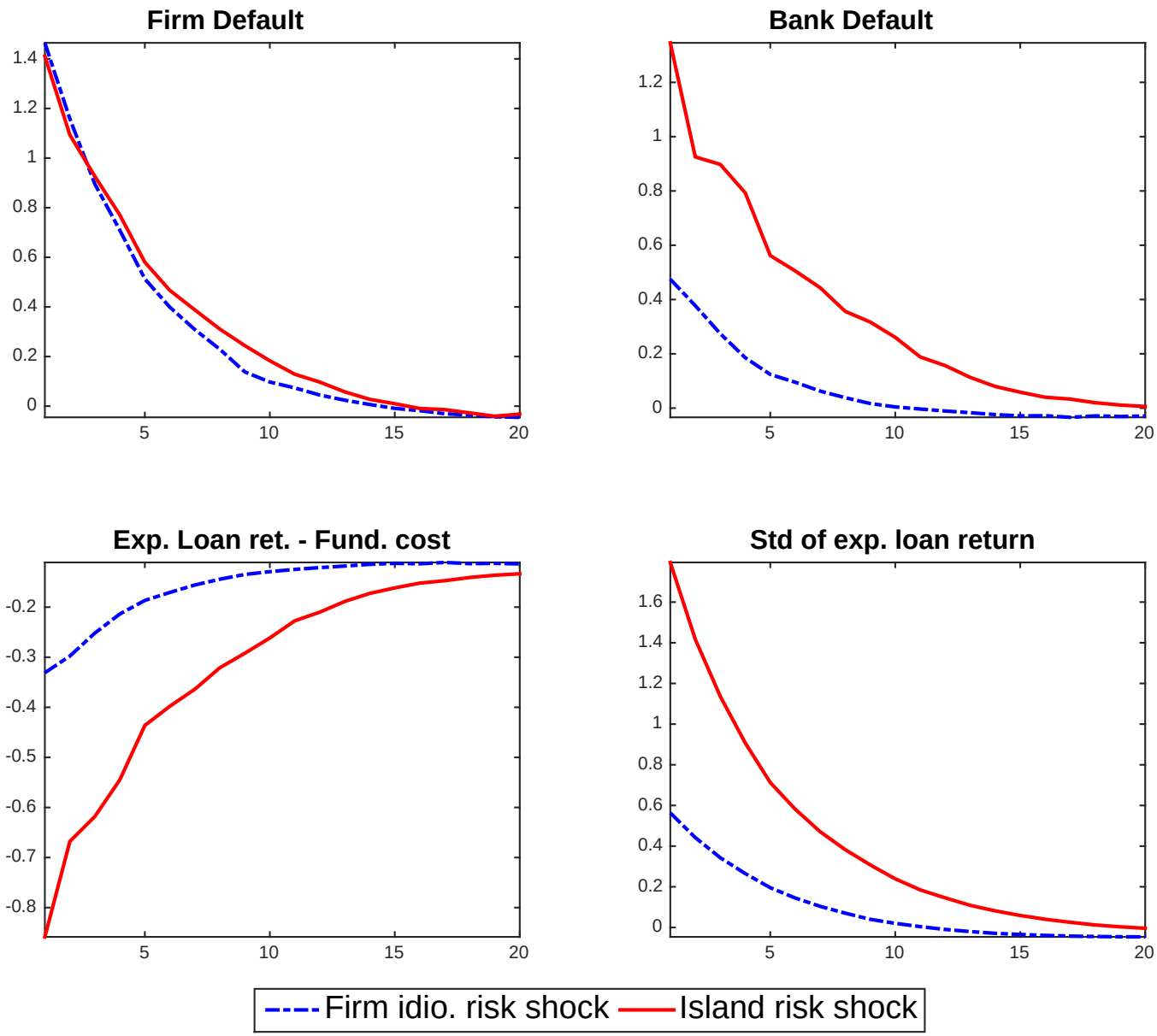
Diversifiable and Non-diversifiable Risk Shocks

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

- Increases **bank risk taking** and banks default...
- and **depresses economic activity**

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

Diversifiable and Non-diversifiable Risk Shocks



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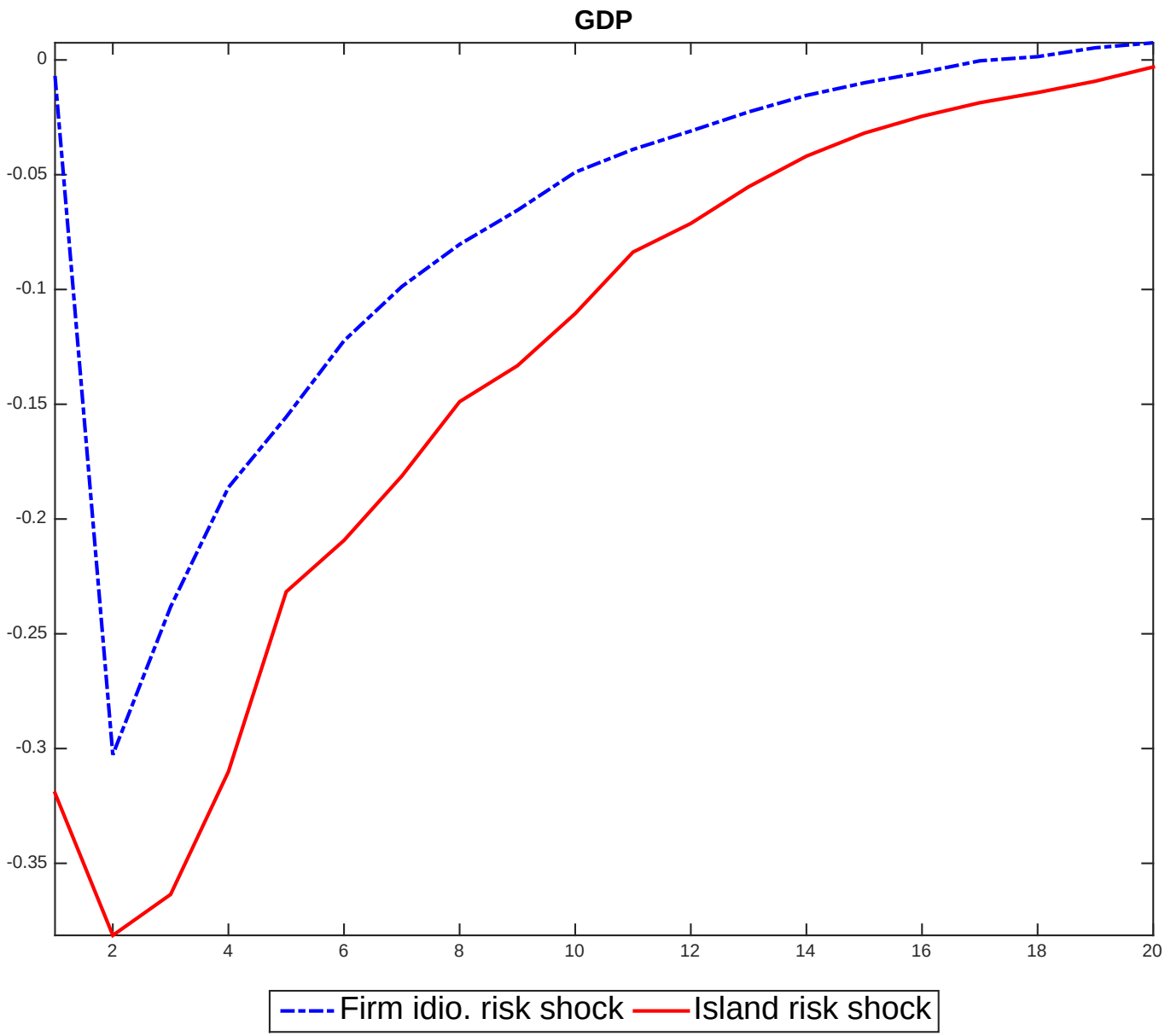
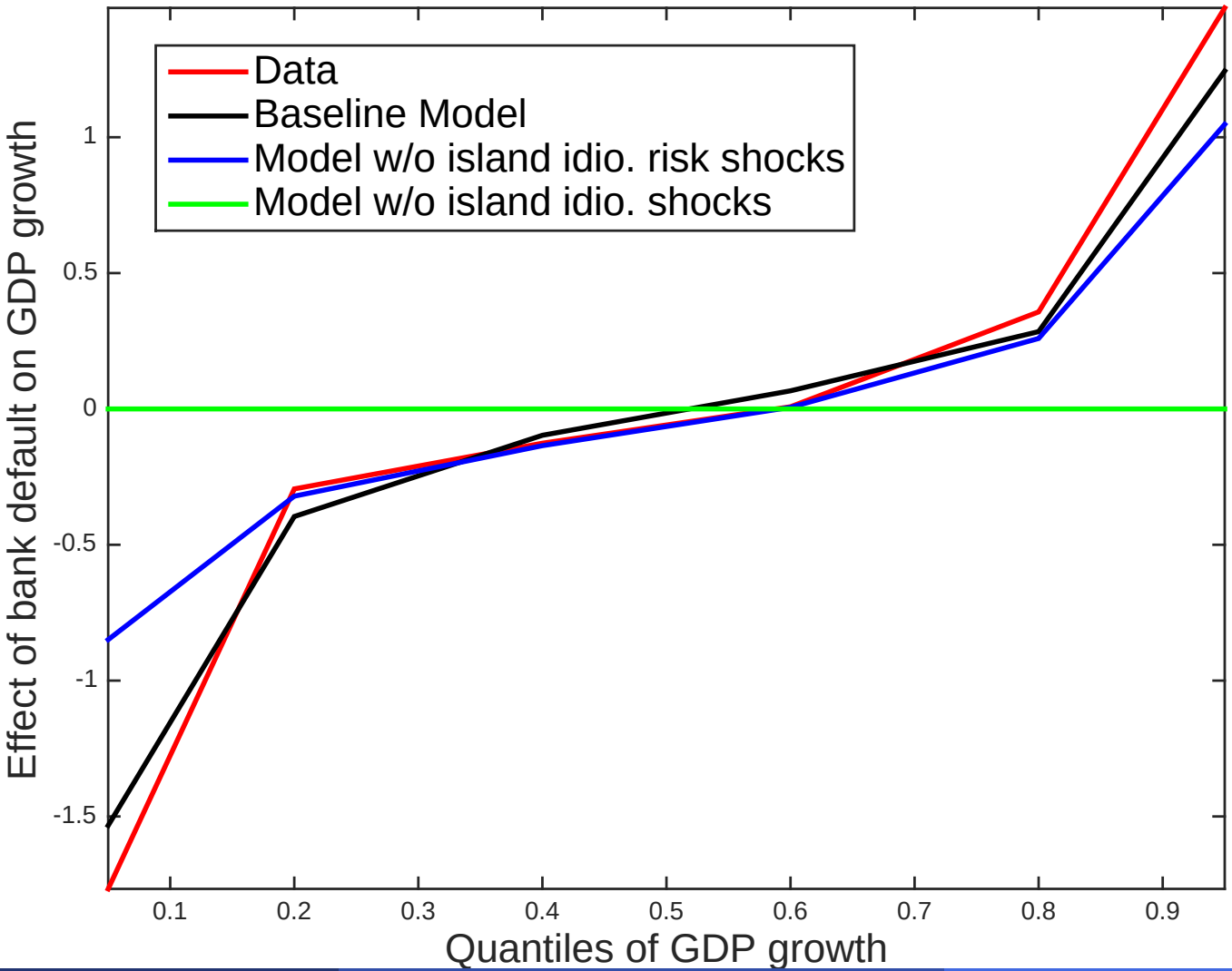
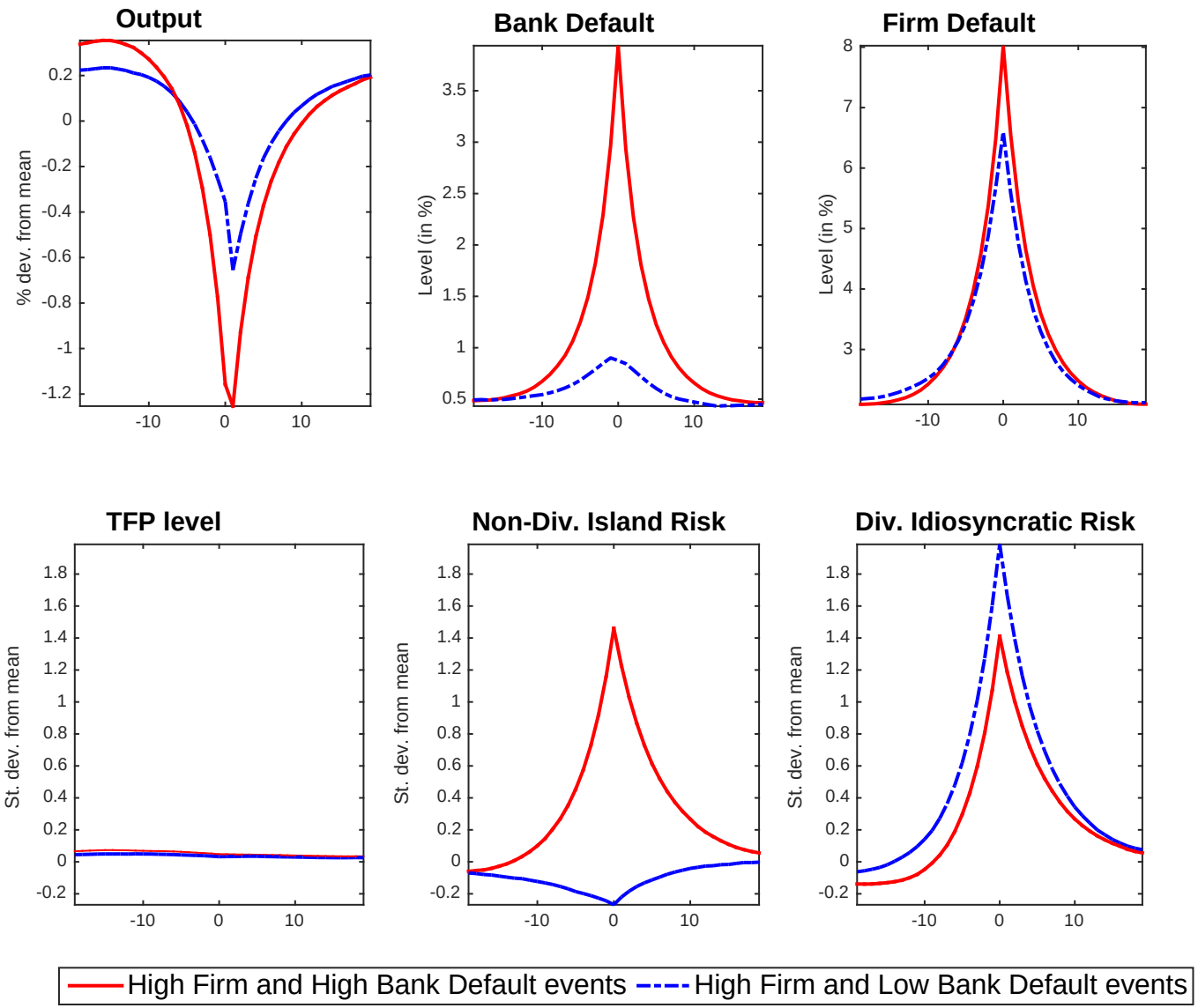


Quantile Regression Coefficients (Diversifiable and Non-diversifiable Risk Shocks)



Path to Crisis: 3-order



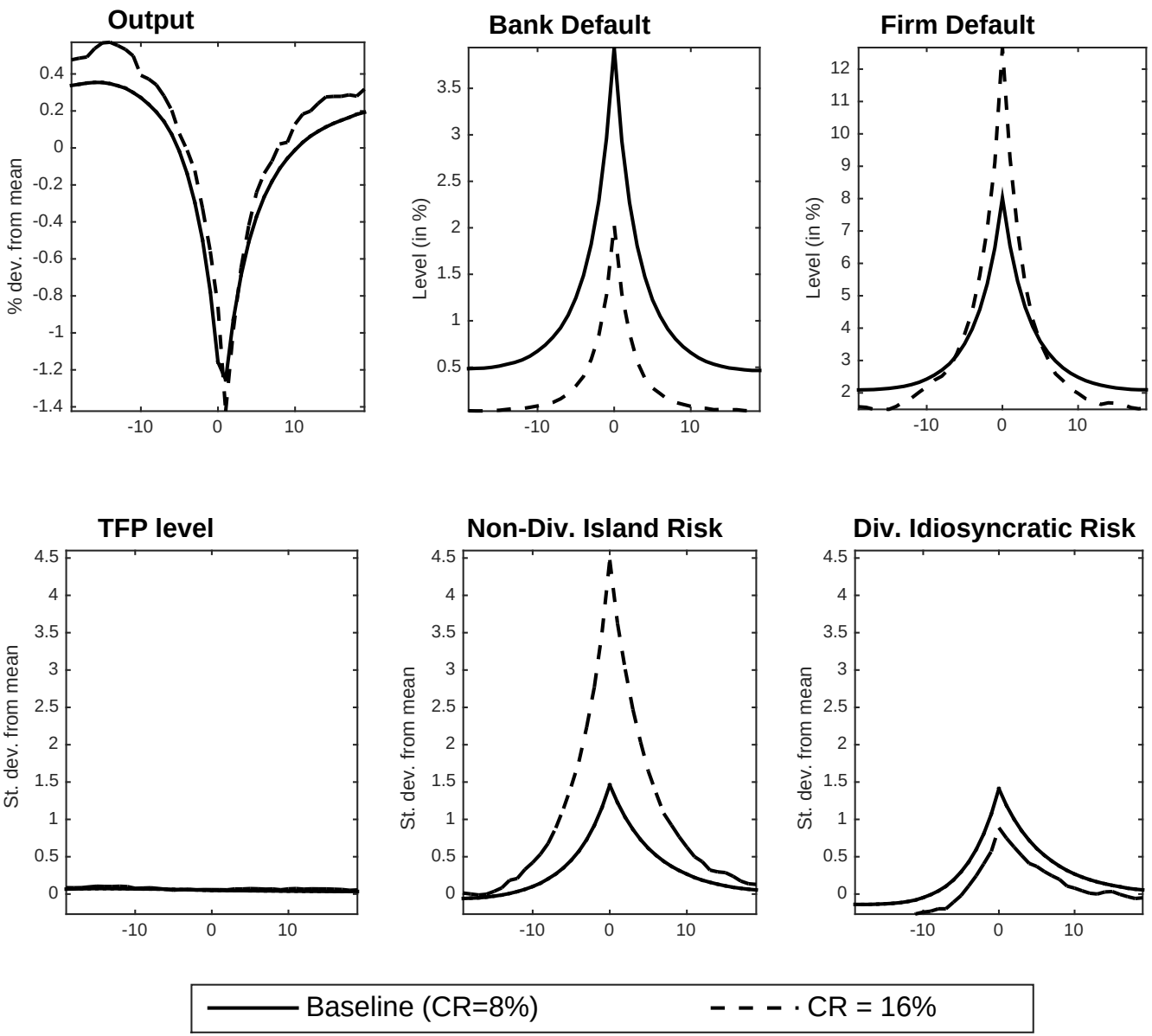
Shock to Non-diversifiable Risk

Path to crisis: periods of **Twin defaults** are driven by moderate (1.5 std) increases in non-diversifiable risk

- **High bank leverage**
- **Non-linear** behaviour of bank returns and loan pricing

...amplify the transmission of non-diversifiable risk!

Paths to crises and Bank Leverage



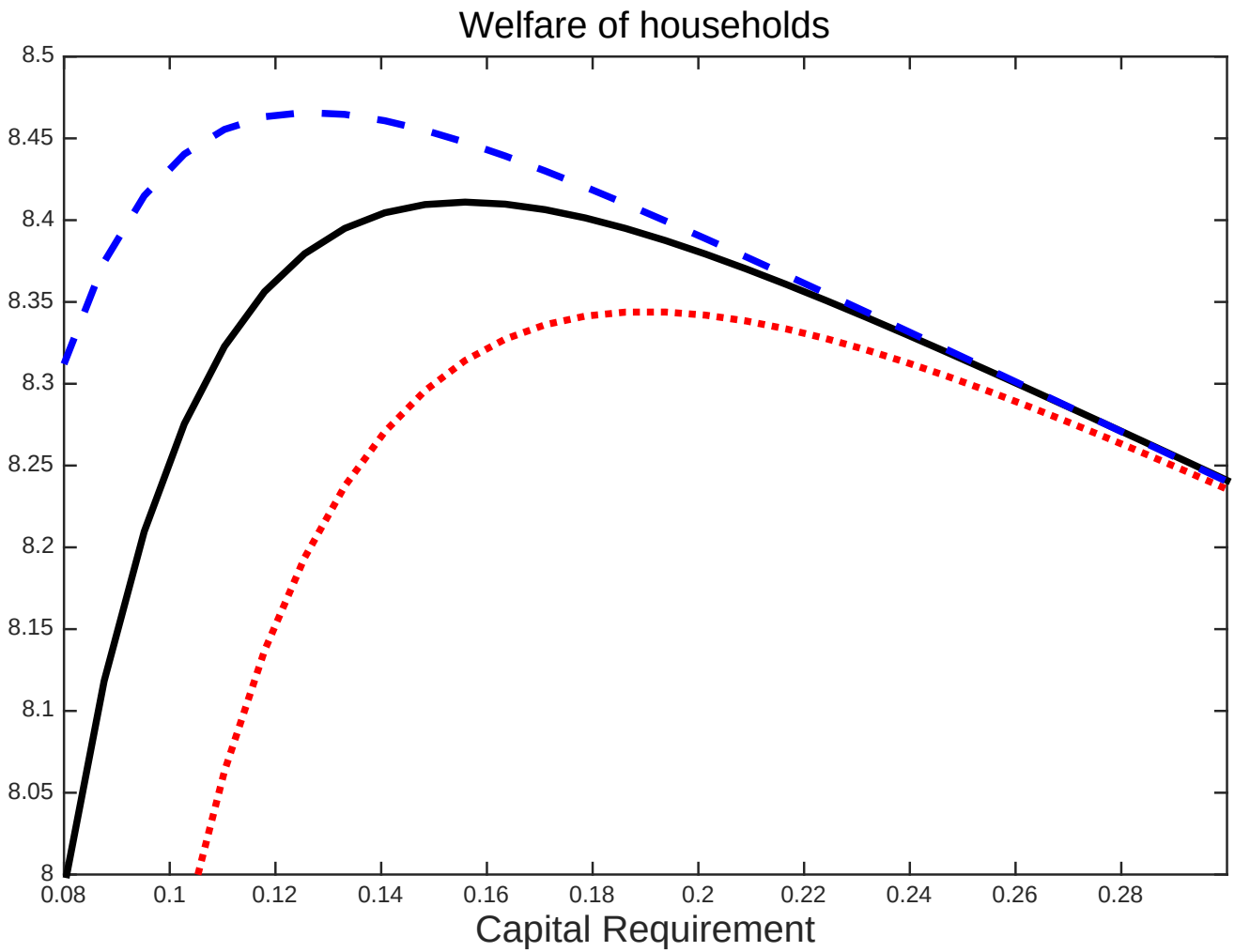
Capital Requirements Trade-off

Higher bank capital requirements

- reduces the probability of **twin defaults**
- BUT...reduces the supply of credit in **normal times**!

—> What is the optimal (maximizes Welfare) capital requirement level ?

Optimal Capital Requirement: Welfare



Conclusions

Propose a framework that reproduces the **correlation patterns** of firm and bank defaults including the rare crisis episodes (**twin defaults**) and associated **macroeconomic outcomes**

- Shocks to **non-divesifiable risk** play an important role in generating *Twin Defaults*
- **Non-linearities** are key!
- **Bank risk-taking incentives** amplify the effect of borrower non-diversifiable risk on bank failures and macroeconomic performance
- Amplification is stronger at **high bank leverage** so can be mitigated by bank capital regulation

Getting the underlying nature of **borrowers risk** and thus the occurrence of **twin defaults** right it is of first order importance when drawing conclusions on the optimal level of capital requirements!

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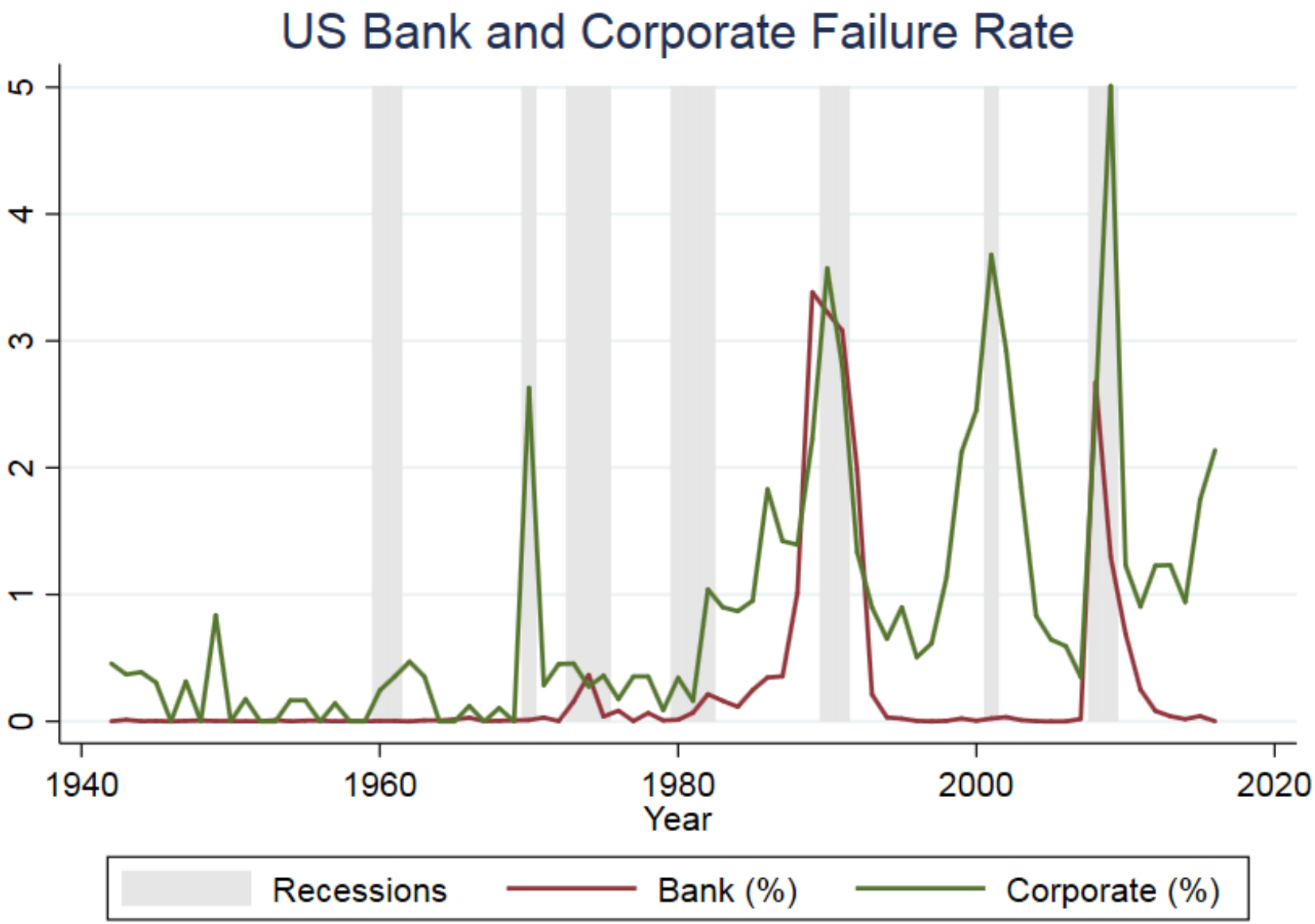
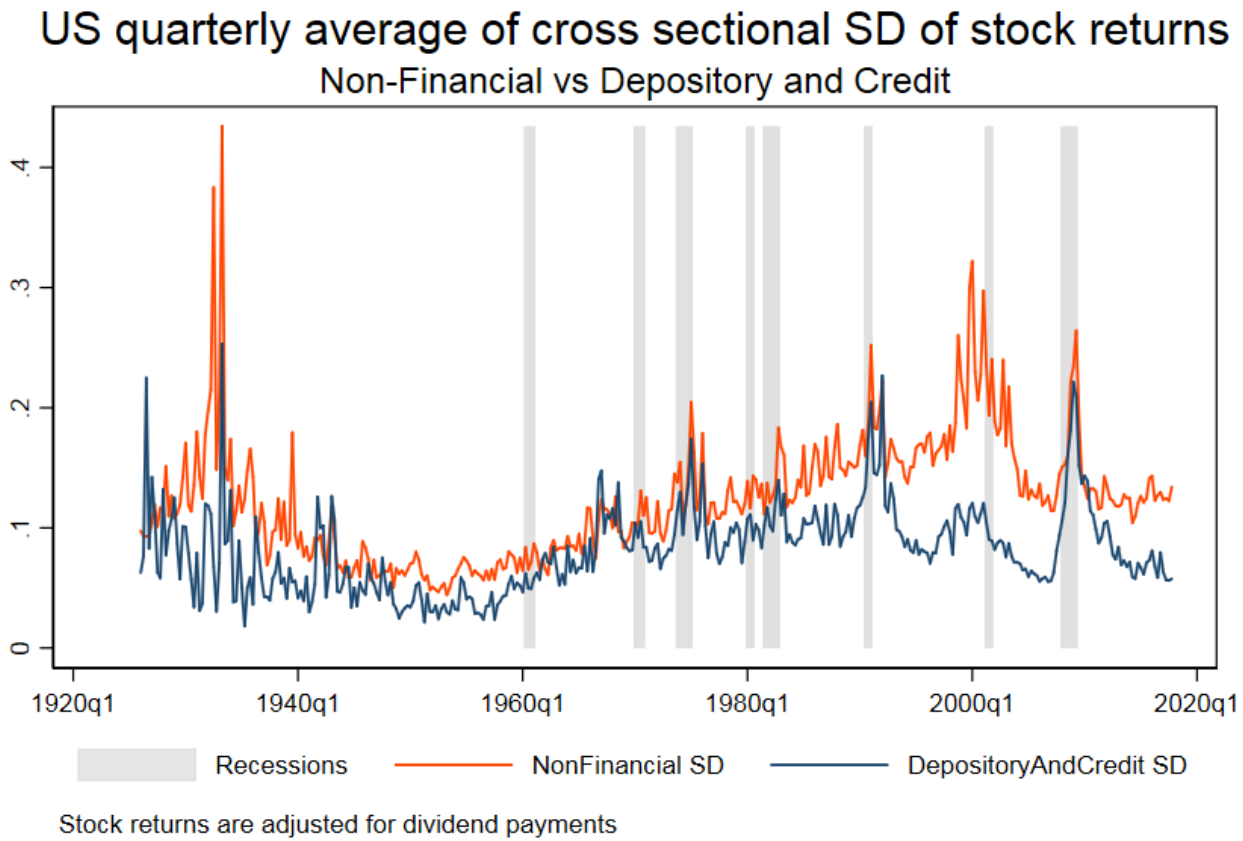
BACKGROUND SLIDES


US Bank and Corporate Failure Rate
0
1
2
3
4
5
1940
1960
1980
2000
2020
Year
Recessions
Bank (%)
Corporate (%)


US quarterly average of cross sectional SD of stock returns
Non-Financial vs Depository and Credit
0
.1
.2
.3
.4
1920q1
1940q1
1960q1
1980q1
2000q1
2020q1
Recessions
NonFinancial SD
DepositoryAndCredit SD
Stock returns are adjusted for dividend payments

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

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

Paths to crises and Bank Leverage