United They Fail:
Bank Risk After the Dodd-Frank Act

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Bank risk taking in run-up to GFC and response:

- Global Financial Crisis: Banks took too much risk that went undetected
- Prompted a series of reforms / regulations to curb bank risk taking:
  - Complex models of risk measurement
  - Capital requirements
  - Liquidity requirements
- This paper: How has bank risk evolved over time and what factors contribute to bank risk-exposure post-GFC?
- Our focus: Similarity or commonality in bank exposure to risk factors and 'hidden risk'.

Theoretical work on bank similarity and homogeneity motivates our study:

- Goldstein, Kopytov, Shen and Xiang (2020): Homogeneity $\rightarrow$ fire-sale externality.
- Morris and Shin (1999): Homogeneity $\rightarrow$ excessive volatility and destabilizing effects.
- Intermediary Asset Pricing: Common shocks to banks $\rightarrow$ asset pricing implications.
- Several theoretical models: Goldstein, Kopytov, Shen and Xiang (2020); Kopytov (2019); Cai, Eidam, Saunders, and Steffen (2018); Brownlees and Engle (2017); Acharya, Pedersen, Philippon, and Richardson (2017)

More recently, concern about bank similarity has increased:

- "... One implication of releasing all details of the models is that firms could conceivably use them to make modifications to their businesses that change the results of the stress test without changing the risks they face. In the presence of such behavior, the stress test could give a misleading picture of the actual vulnerabilities faced by firms..."

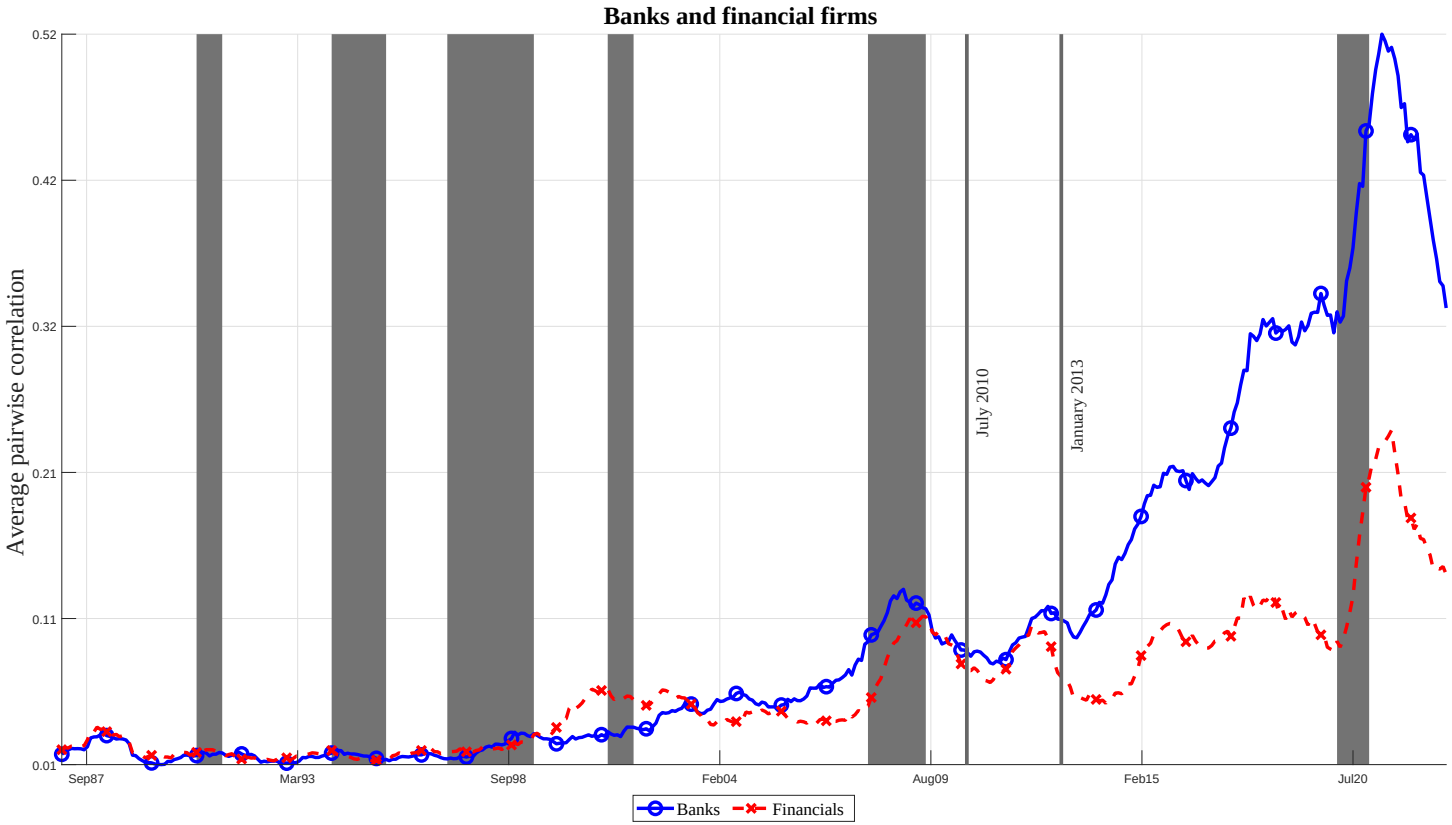
  ...(Federal Register, 2017)

- "...all the banks doing the same thing – can minimize risk for each individual bank, but maximize the probability of the entire system collapsing..."

  ...Haldane & May (Nature, 2011)

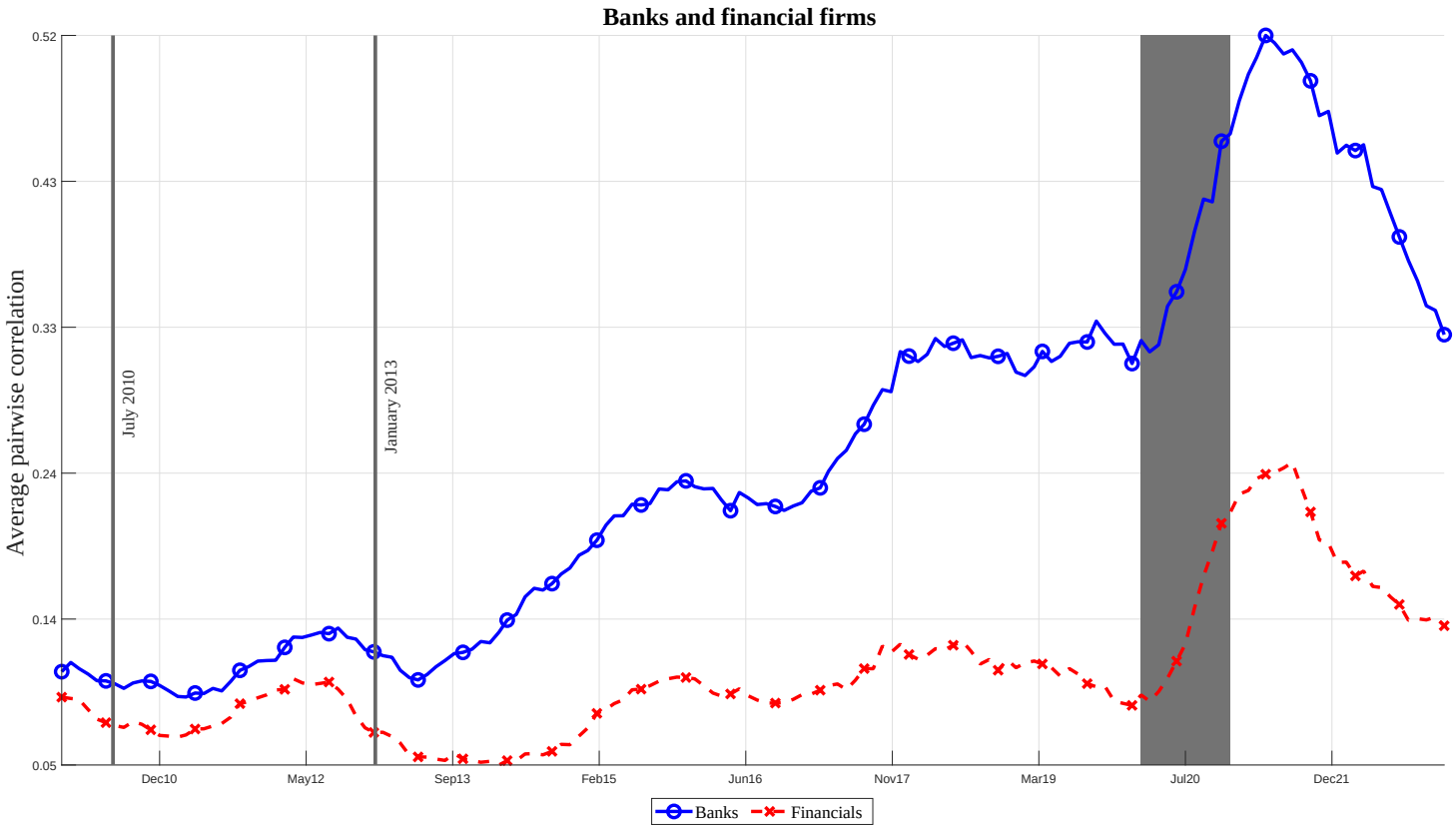
- Has bank similarity increased? If yes, why?

Equity return correlation: Banks vs. other financial firms:

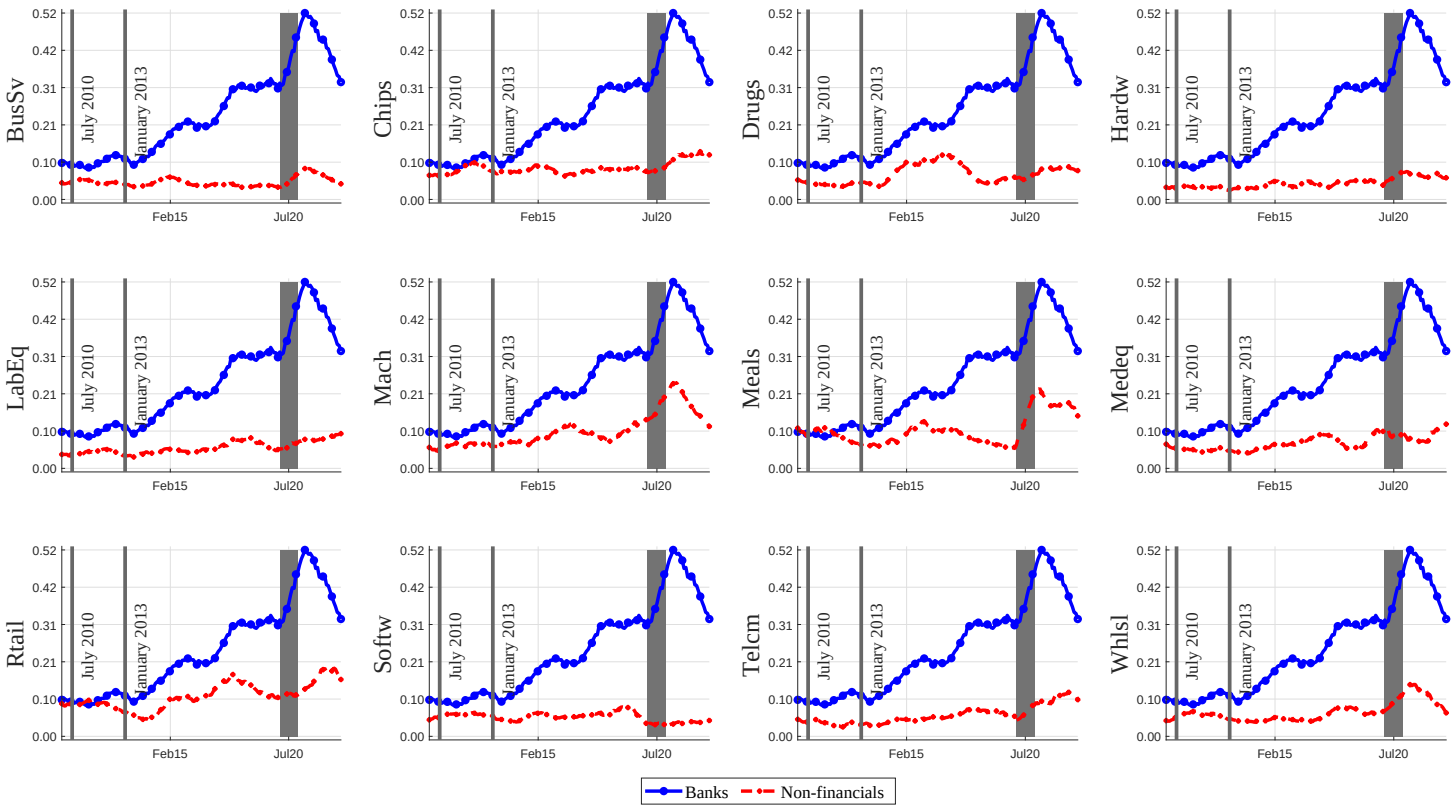


This figure plots the average pairwise correlation (12-month moving average) of daily idiosyncratic equity returns for banks (blue solid line) and financial firms (red dashed line). Banks defined as All BHCs in CRSP-FRB link; other financial firms are defined as Fama-French "Insurace" and "Fin Trading" firms.

Not driven by crisis, but post-crisis evolution:



No other industry shows a similar pattern:



First PCA explains a higher percentage of return variation for banks:

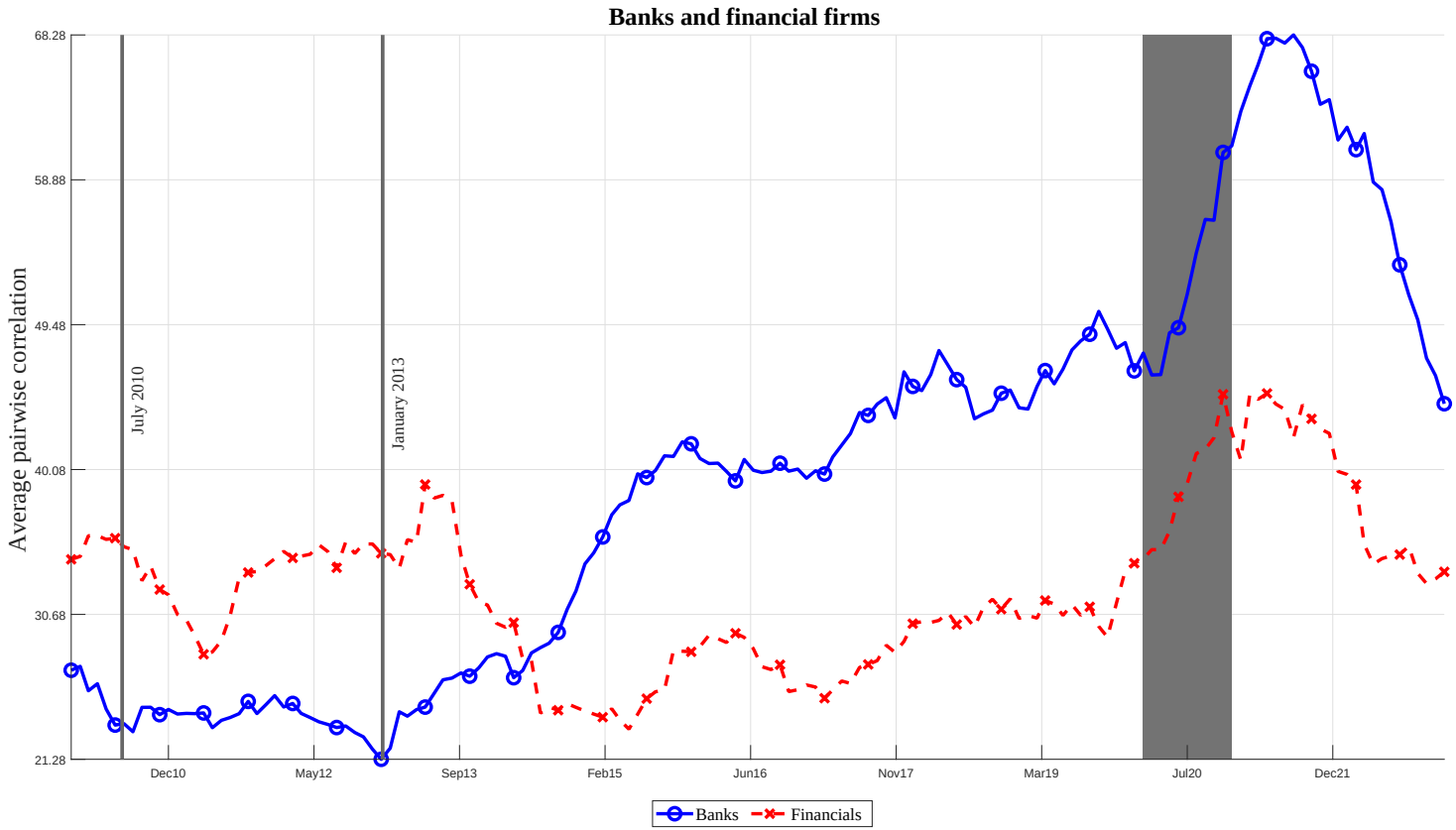


Figure: Principal component for banks and financial firms.

Story so far: New empirical fact and competing explanations:

- Significant increase in commonality of bank stock returns
- Not a crisis phenomenon
- Unique to banks
- What explains it: Could be:
  - Changes in how risk is measured after GFC
  - Other regulations
  - Loose monetary policy
  - Unobserved changes (?)

Changes in risk measurement:

- Strong move towards model-based regulation: Annual Stress Tests
- Stress tests itself impact bank behavior and create 2 opposing forces:
  - Regulators wish to assess bank risk and take action before risk materializes
  - The assessment itself creates incentive problem: Banks wishing to ace tests, adjust investment decisions, increase exposure similarity

Roadmap of empirical tests to show this:

- Industry level: Banks versus others
- Within banks: Stress-tested versus non-stress tested
- Stress tested banks over time and by size
- Similarity on factor loadings
- Correlation of stress-tested and non-stress tested banks post 2018
- Change in behavior after failure
- Loading on 'hidden risk factor'
- Actual portfolio decisions

Correlation: Banks vs. other industries: Before & after DFA:

$$\rho_{i,t} = \alpha_i + \beta_{pst} D_{pst} + \beta_{bnk} D_{bnk} + \gamma D_{pst} \times D_{bnk} + \epsilon_{it}$$

In the model above, $\rho_{i,t}$ is the average monthly pairwise correlation at the industry level for banks, financial, or non-financial firms at time t. D_{pst} is an indicator variable that equals one for the years 2013 – 2020 and D_{bnk} is an indicator variable that equals one for banks. The unit of observation is industry-month.

Coefficient	(1)		(2)		(3)		(4)	
β_{pst}	0.0672^{***}	(0.0081)	–	–	0.0382^{***}	(0.0014)	–	–
β_{bnk}	0.0039	(0.0069)	0.0039	(0.0047)	–	–	–	–
γ	0.1680^{***}	(0.0115)	0.1680^{***}	(0.0079)	0.1970^{***}	(0.0053)	0.1960^{***}	(0.0047)
R^2	0.6070		0.8129		0.5043		0.6059	
N	672		672		4,584		4,584	
Year fixed effects	*No*		*Yes*		*No*		*Yes*	
Industry fixed effects	*No*		*No*		*Yes*		*Yes*	

- Correlation among banks increased by 17% post 2013 (coefficient of 0.1680)
- Nearly 3 times compared to value for all firms (0.0672)

Is the effect stronger for stress-tested banks:

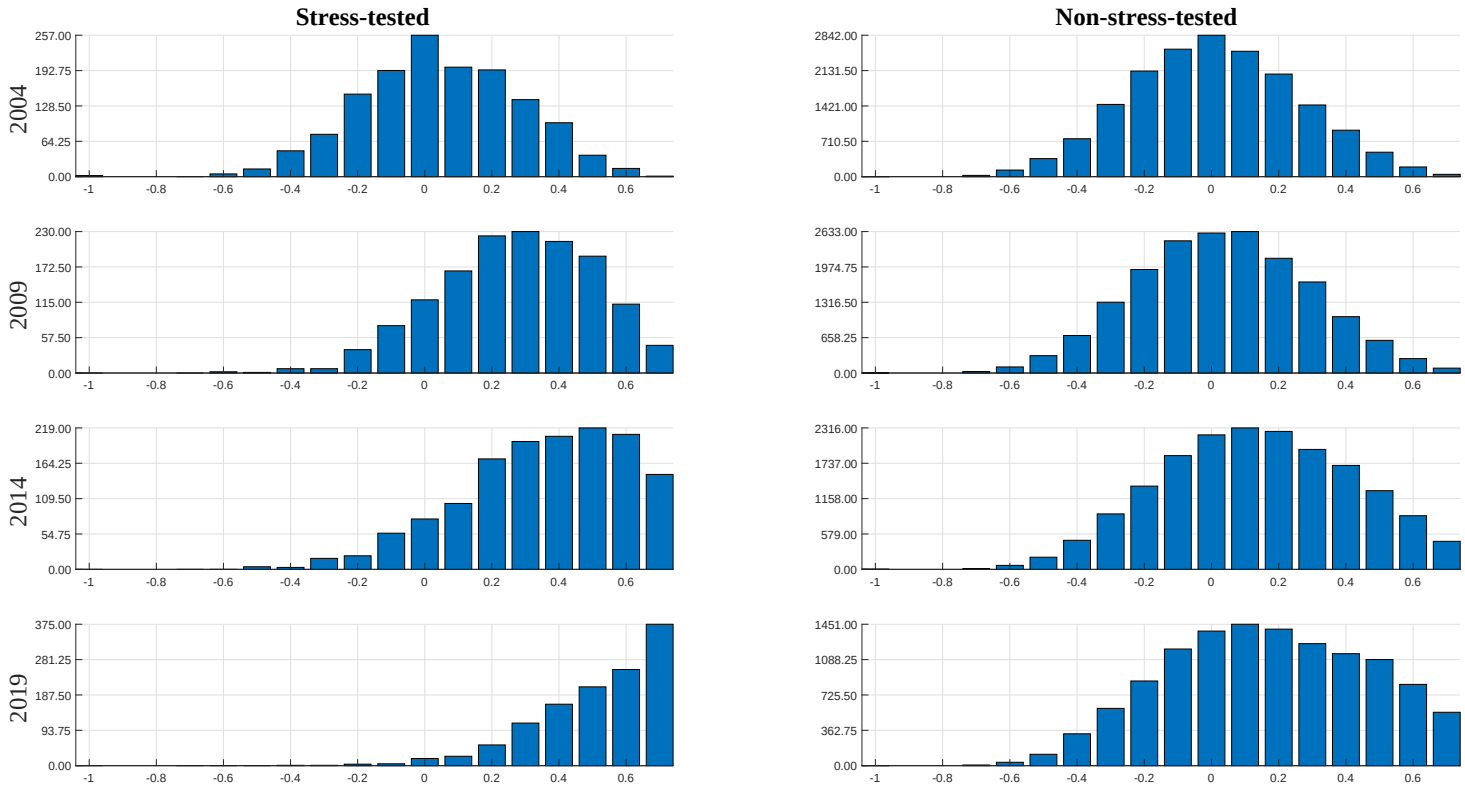


Figure: Distribution of pairwise equity return correlations.

Correlation across stress-tested and non-tested banks:

This Table shows the estimated coefficients for the following bank-month level regression:

$$\overline{\rho^i} = \alpha + \beta_{str} D_{str} + \beta_{pst} D_{pst} + \gamma D_{str} \times D_{pst} + Controls + \epsilon_i$$

Here, $\overline{\rho^i}$ is the average pairwise correlation of bank i with all other banks in the same group.

	(1)		(2)		(3)		(4)	
β_{str}	0.1289***	(0.0075)	–	–	–	–	–	
β_{pst}	0.1936***	(0.0077)	0.1936***	(0.0077)	0.0961***	(0.0068)	–	–
γ	0.1205***	(0.0113)	0.1206***	(0.0113)	0.1007***	(0.0122)	0.0841***	(0.0093)
Assts					0.1123***	(0.0043)	0.0396***	(0.0058)
Levrg					-0.0027*	(0.0011)	-0.0025*	(0.0010)
R^2	0.4072		0.4072		0.5331		0.6360	
N	74,089		74,089		58,310		58,310	
Bank fixed effects	*No*		*Yes*		*Yes*		*Yes*	
Year fixed effects	*No*		*No*		*No*		*Yes*	

$\gamma > 0 \rightarrow$ correlation for ST banks increased post 2013

Regional and large stress-tested banks:

$$\begin{aligned}\overline{\rho^i} &= \alpha_i + \beta_{str10} D_{str10} + \beta_{str50} D_{str50} + \beta_{str250} D_{str250} + \beta_{pst} D_{pst} \\ &+ \gamma_{10} D_{str10} \times D_{pst} + \gamma_{50} D_{str50} \times D_{pst} + \gamma_{250} D_{str250} \times D_{pst} + Controls + \epsilon_i\end{aligned}$$

D_{str10} equals 1 for a bank if it is subject to stress tests and has more than \$10 billion but less than \$50 billion in book value of assets, and zero otherwise. D_{str50} equals 1 for a bank if it is subject to stress tests and has more than \$50 billion but less than \$250 billion in book value of assets, and zero otherwise. Finally, D_{str250} equals 1 for a bank if it is subject to stress tests and has more than \$250 billion in book value of assets, and zero otherwise.

	(1)		(2)		(3)		(4)	
β_{str10}	0.1219***	(0.0092)	–	–	–	–	–	–
β_{str50}	0.1606***	(0.0127)	–	–	–	–	–	–
β_{str250}	0.1215***	(0.0129)	–	–	–	–	–	–
β_{pst}	0.1936***	(0.0077)	0.1936***	(0.0077)	0.0962***	(0.0068)	–	–
γ_{10}	0.1414***	(0.0126)	0.1414***	(0.0126)	0.1264***	(0.0127)	0.1106***	(0.0080)
γ_{50}	0.0848***	(0.0143)	0.0848***	(0.0143)	0.0564***	(0.0167)	0.0409**	(0.0148)
γ_{250}	0.0731***	(0.0127)	0.0732***	(0.0127)	0.0353	(0.0275)	0.0125	(0.0188)
Assts					0.1122***	(0.0043)	0.0394***	(0.0055)
Levrg					-0.0028*	(0.0011)	-0.0025*	(0.0011)
R^2	0.4088		0.4088		0.5357		0.6389	
N	74,089		74,089		58,310		58,310	
Bank fixed effects	*No*		*Yes*		*Yes*		*Yes*	
Year fixed effects	*No*		*No*		*No*		*Yes*	

Similarity driven by loadings on risk factors: Market Factors:

	(BBB)		(VIX)		(Mortgage rate)	
γ	-0.1457***	(0.0203)	-0.0038	(0.0024)	-0.0228**	(0.0116)
Assts	-0.0369*	(0.0203)	-0.0028*	(0.0023)	-0.0218**	(0.0095)
Levrg	0.0006	(0.0009)	0.0003***	(0.0001)	0.0004	(0.0009)
R^2	0.1027		0.4269		0.0840	
N	47,456		47,456		47,456	
Bank fixed effects	*Yes*		*Yes*		*Yes*	
Year fixed effects	*Yes*		*Yes*		*Yes*	

$\gamma < 0 \rightarrow$ banks look similar in their exposure to factor shocks

Similarity driven by loadings on risk factors: Macro Factors:

	(Consumption)		(CPI)		(Case-Shiller)	
γ	-0.0927***	(0.0132)	-0.0972***	(0.0151)	-0.0825***	(0.0154)
Assts	-0.0214*	(0.0126)	-0.0440**	(0.0188)	-0.0627***	(0.0195)
Levrg	-0.0007	(0.0006)	0.0015	(0.0013)	-0.0003	(0.0011)
R^2	0.1002		0.0703		0.1445	
N	47,456		47,456		47,456	
Bank fixed effects	*Yes*		*Yes*		*Yes*	
Year fixed effects	*Yes*		*Yes*		*Yes*	

$\gamma < 0 \rightarrow$ banks look similar in their exposure to factor shocks

Correlation: Stress and non-stress tested: Post-2018:

Notes: This Table shows the estimated coefficients for the following regression:

$$\overline{\rho^i} = \alpha_i + \theta_t + \beta_{str} D_{str} + \beta_{pst} D_{pst} + \gamma D_{str} \times D_{pst} + \beta_{fal} D_{str} \times D_{fal} + Controls + \epsilon_{it}$$

	(1)		(2)		(3)		(4)	(5)
	(1)		(2)		(3)		(4)	
β_{str}	0.2283***	(0.0165)	–	–	–	–	–	
$\beta_{pst}18$	-0.0011	(0.0035)	-0.0012	(0.0035)	-0.0093**	(0.0044)	–	–
γ	0.0332***	(0.0078)	0.0333***	(0.0079)	0.0411***	(0.0080)	0.0421***	(0.0080)
Assts					-0.0300*	(0.0163)	-0.0125	(0.0172)
Levrg					-0.0104***	(0.0032)	-0.0110***	(0.0032)
R^2	0.0037		0.0037		0.0060		0.0070	
N	7,802		7,802		6,127		6,127	
Bank fixed effects	*No*		*Yes*		*Yes*		*Yes*	
Year fixed effects	*No*		*No*		*No*		*Yes*	

$\gamma > 0 \rightarrow$ correlation for ST banks increases post failure

Failure of stress test:

Notes: This Table shows the estimated coefficients for the following regression:

$$\overline{\rho^i} = \alpha_i + \theta_t + \beta_{str} D_{str} + \beta_{pst} D_{pst} + \gamma D_{str} \times D_{pst} + \beta_{fal} D_{str} \times D_{fal} + Controls + \epsilon_{it}$$

	(1)		(2)		(3)		(4)		(5)	
β_{fal}	0.0492**	(0.0158)	0.0469**	(0.0161)	0.0495***	(0.0135)	0.0439**	(0.0158)	0.0462***	(0.0134)
β_{str}	0.1175***	(0.0108)	–	–	–	–	–	–	–	–
γ	0.0896***	(0.0103)	0.0898***	(0.0103)	0.0883***	(0.0099)	0.0903***	(0.0102)	0.0889***	(0.0098)
Assts					0.0384***	(0.0059)			0.0366***	(0.0059)
Levrg							-0.0026*	(0.0012)	-0.0026*	(0.0011)
R^2	0.6278		0.6278		0.6332		0.6303		0.7177	
N	58,310		58,310		58,310		58,310		58,310	
Bank Fixed effects	*No*		*Yes*		*Yes*		*Yes*		*Yes*	
Year Fixed effects	*Yes*		*Yes*		*Yes*		*Yes*		*Yes*	

$\gamma > 0 \rightarrow$ correlation for ST banks increases post failure

Exposure to 'f' that does not enter the stress-test scenario:

Table: Sensitivity to a risk factor orthogonal to U.S. macroeconomic risk.

Notes: This Table shows the estimated coefficients for the following regression:

$$\beta^i = \alpha_i + \beta_{str} D_{str} + \beta_{pst} D_{pst} + \gamma D_{str} \times D_{pst} + Controls + \epsilon_i$$

	(1)		(2)		(3)		(4)		(5)	
β_{str}	-0.0903***	(0.0187)	–	–	–	–	–	–	–	–
γ	0.0629***	(0.0151)	0.0627***	(0.0151)	0.0614***	(0.0148)	0.0619***	(0.0152)	0.0606***	(0.0149)
Assts					-0.0302*	(0.0166)			-0.0300	(0.0166)
Levrg							0.0025***	(0.0007)	0.0025***	(0.0007)
R^2	0.4608		0.4629		0.5656		0.4631		0.4653	
N	47,456		47,456		47,456		47,456		47,456	
Bank fixed effects	*No*		*Yes*		*Yes*		*Yes*		*Yes*	
Year fixed effects	*Yes*		*Yes*		*Yes*		*Yes*		*Yes*	

$\gamma > 0 \rightarrow$ loadings for ST banks increases post 2013
'f' is a mimicking portfolio orthogonal to U.S. macroeconomic risk

More fun stuff in the paper:

- Theoretical framework: Shows how increasing similarity is rational response to model-based regulation
- Banks with limited capital choose investments
- Assets have different exposure to macroeconomic factor f and an uncorrelated shocks
- f enters stress test scenarios, shocks do not
- Banks differ in terms of skill i.e., screening and monitoring technologies
- Banks choose portfolios subject to: (A) Unconstrained (B) Frictions and internal risk management, and (C) Frictions, internal risk management and stress test

Conclusion:

- Main result: Banks have become very similar in their risk exposure.
- Highlights an important cost of stress tests
- Individual safety of a bank, in part, comes at the expense of a higher risk of collective failure (Regional Bank Crisis?).
- Can be costly if there are hidden sources of risk.
- Can be costly if intermediaries sell correlated assets in bad times.