Modeling Your Stress Away

Friederike Niepmann and Viktors Stebunovs

Federal Reserve Board

May 30, 2018

This paper

- EBA stress tests have been subject to criticism
  - Worst banks perform the best, especially in the 2011 test (Acharya et al. (2013))
- Build on work by Phillipon, Pessarossi, and Camara (2017)
  - Analyze the 2011 and 2014 tests
  - Focus on credit risk captured by bank-own loss models
  - Conclude that EBA stress tests are informative and not biased
- Here, apply similar methodology to compare the 2014 and 2016 tests
  - Contribute to the literature on biases in stress tests and interal risk models and information production through stress tests
  - Decompose changes in credit losses from one edition to the other into changes from exposure, scenario, and model changes
  - Explore factors driving exposure, scenario, and model changes

Highlights of findings

- Models are systematically adjusted to lower credit losses in stress tests
  - Banks that would have seen credit losses increase the most due to exposure and scenario changes saw the strongest decreases in credit losses from model changes in 2016
- Model adjustments do not reflect changes in the riskiness of credit portfolios
- Model adjustments were most evident for banks that use the Internal Risk Based approach and that have "more realistic" model performance
- Stress tests that rely on bank-own models appear to have a significant deficiency, with material implications for investors, supervisors, and financial stability

Philippon et al. (2017)'s model

- Back out bank-specific models that map macro factors into credit risk losses
- First step: Estimate the macro factor $F_{jt}^{p} = \hat{\theta}_{\mathbf{j}}^{\mathbf{p}} \mathbf{y_{jt}}$

$$\log \frac{I_{ijt}^{p}}{(1 - I_{ijt}^{p})} = \alpha_i^p + \theta_{\mathbf{j}}^{\mathbf{p}} \mathbf{y_{jt}} + \epsilon_{ijt}^{p}, \tag{1}$$

  where I_{ijt}^{p} is the impairment rate of bank i in forecast year t on portfolio p in country j; y_{jt} is a triple of inflation, GDP growth, and unemployment; $p \in \{retail, corporate\}$

- Second step: Estimate the bank-specific loss model $\{\alpha_i^p, \beta_i^p\}$

$$\log \frac{I_{ijt}^{p}}{(1 - I_{ijt}^{p})} = \alpha_i^p + \beta_i^p \times F_{jt}^{p} + \epsilon_{ijt}^{p}. \tag{2}$$

Model,sample, and outputs

Model

- Checks for alternative specifications and for inclusion of more scenario variables

Sample

- Separate estimation for the 2014 and 2016 tests, covering 50 banks in about 25 countries

Outputs

- Average β_i^p close to 1 by construction but significant variation
- Good fit of both 2014 and 2016 models (R^2s range from 0.6 to 0.7)
- Macroeconomic factors are a key driver of loss rates, bank idiosyncrasies are also relevant
- Good predictive power of both 2014 and 2016 models over the 2013-16 period

Finding: Changes in exposures led to lower losses

- Table shows hypothetical loss rates for different combinations of exposures, scenarios and models

	model/scenario/exposure			
	(1)	(2)	(3)	(4)
	m16/s16/e16	m16/s16/e14	m16/s14/e16	m16/s14/e14
adverse	178,866	188,998	348,230	387,484
baseline	102,165	108,025	156,614	172,433
	m14/s14/e14	m14/s14/e16	m14/s16/e14	m14/s16/e16
adverse	253,764	236,812	246,372	237,138
baseline	124,580	115,593	105,297	100,679
	mb16/sf14/e14		mb14/sf16/e16	
adverse	212,451		240,237	

Finding: Adverse scenario was less severe in 2016

- Adverse scenario was less severe both in absolute an in relative terms.

	model/scenario/exposure			
	(1)	(2)	(3)	(4)
	m16/s16/e16	m16/s16/e14	m16/s14/e16	m16/s14/e14
adverse	178,866	188,998	348,230	387,484
baseline	102,165	108,025	156,614	172,433
	m14/s14/e14	m14/s14/e16	m14/s16/e14	m14/s16/e16
adverse	253,764	236,812	246,372	237,138
baseline	124,580	115,593	105,297	100,679
	mb16/sf14/e14		mb14/sf16/e16	
adverse	212,451		240,237	

Finding: Models were tailored to each stress test edition

- Each model produces the lowest losses given the exposures and scenarios that applied in the corresponding stress test edition.
- If 2014 model would have been used for 2016 adverse scenario and exposures, aggregate credit losses would have been 20 percent higher.

	model/scenario/exposure			
	(1)	(2)	(3)	(4)
	m16/s16/e16	m16/s16/e14	m16/s14/e16	m16/s14/e14
adverse	178,866	188,998	348,230	387,484
baseline	102,165	108,025	156,614	172,433
	m14/s14/e14	m14/s14/e16	m14/s16/e14	m14/s16/e16
adverse	253,764	236,812	246,372	237,138
baseline	124,580	115,593	105,297	100,679
	mb16/sf14/e14		mb14/sf16/e16	
adverse	212,451		240,237	

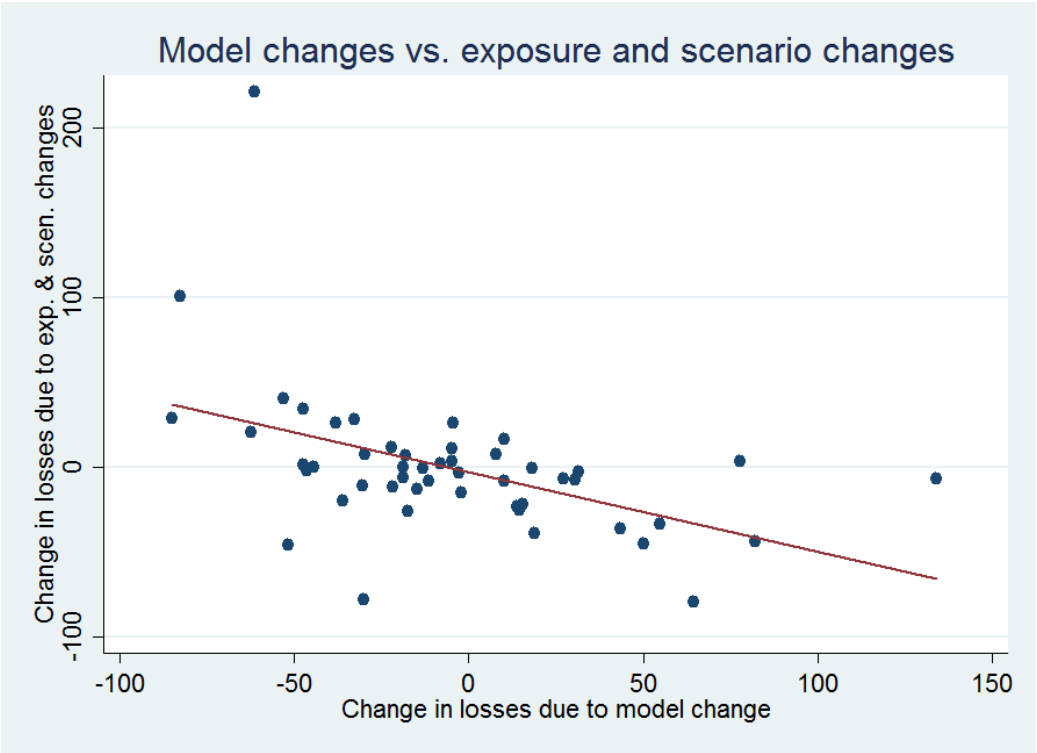
Scenario and exposure changes

- Banks cannot adjust exposures to scenarios because exposures are fixed before scenarios are known
- No sign that scenarios were biased: They did not lower losses for weaker banks nor for banks with higher 2016 losses because of changes in exposures

VARIABLES	(1) ΔS_i^{14}	(2) ΔS_i^{16}	(3) ΔS_i^{14}	(4) ΔS_i^{16}	(5) ΔES_i^{14}	(6) ΔES_i^{16}
ΔE_i^{14}	0.202					
	(0.142)					
ΔE_i^{16}		0.337**				
		(0.135)				
Capital buffer			0.00342*	-0.00266	0.00217	-0.00531
			(0.00184)	(0.00493)	(0.00279)	(0.00609)
Constant	-0.00956	-0.288***	-0.109	-0.256*	-0.144	-0.287
	(0.0282)	(0.0822)	(0.0700)	(0.142)	(0.0978)	(0.175)
Observations	50	50	39	39	39	39
R-squared	0.088	0.041	0.151	0.008	0.018	0.021

Systematic model adjustments

- Plot changes in losses because of exposure and scenarios changes against changes in losses because of model changes
- Banks with a larger increase in losses because of scenario and exposure changes saw losses decrease more due to model changes



No correlation of model changes with changes in risk

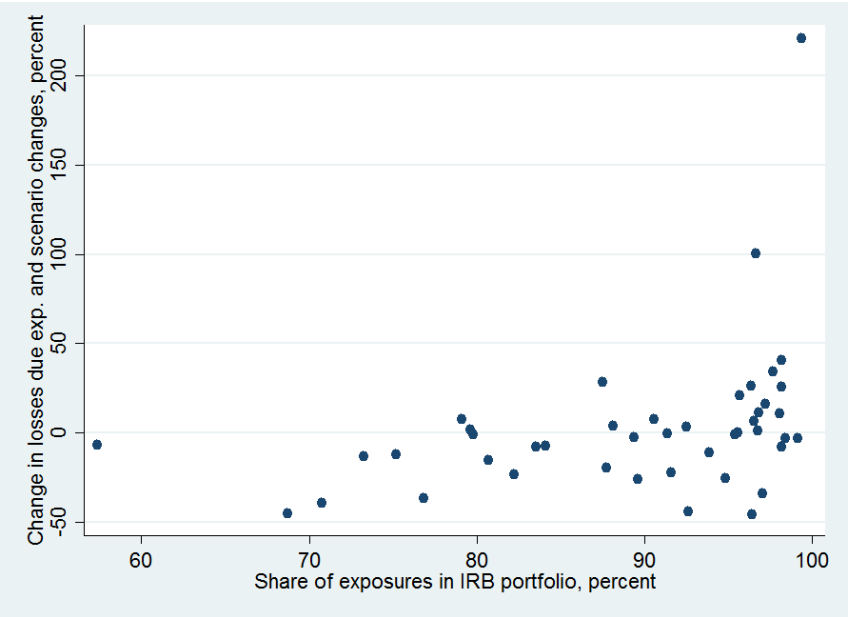
- Correlation between exposure and scenario changes and model changes is highly significant
- No correlation with the change in riskiness of portfolios proxied by the change in the share of non-performing exposures from 2013:Q4 to 2015:Q4
- If 2014 model had been used in 2016, losses would have been higher by 2.8 percent of a bank's CET1 capital on average in adverse scenario

VARIABLES	(1) ΔM_i^{14}	(2) ΔM_i^{16}	(3) ΔM_i^{14}	(4) ΔM_i^{14}	(5) ΔM_i^{14}
ΔES_i^{14}	-0.839***	-0.712**			-0.756***
	(0.229)	(0.274)			(0.201)
ΔNPE_i			-0.0186		
			(0.0351)		
$\Delta adj.\ NPE_i$				-0.167	-2.389
				(4.430)	(3.416)
Constant	0.135	-0.195**	0.163*	0.175*	0.119
	(0.0833)	(0.0741)	(0.0944)	(0.100)	(0.0858)
Observations	50	50	48	48	48
R-squared	0.266	0.241	0.003	0.000	0.254

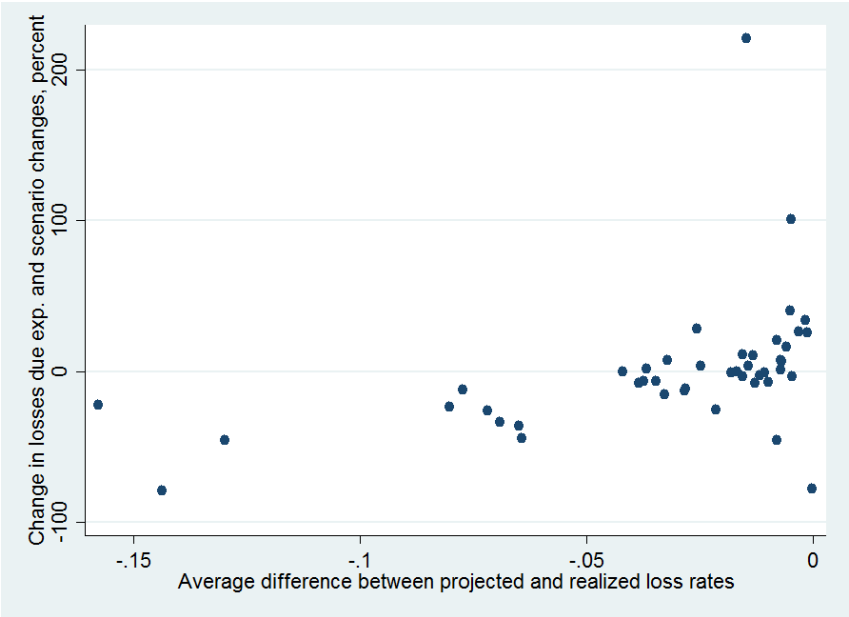
Two factors that might have obscured model changes

- Higher increase in losses from scenario and exposure changes for banks 1) with larger share of exposures subject to IRB approach and 2) with "more realistic" models

Share of IRB exposure



Average forecast error



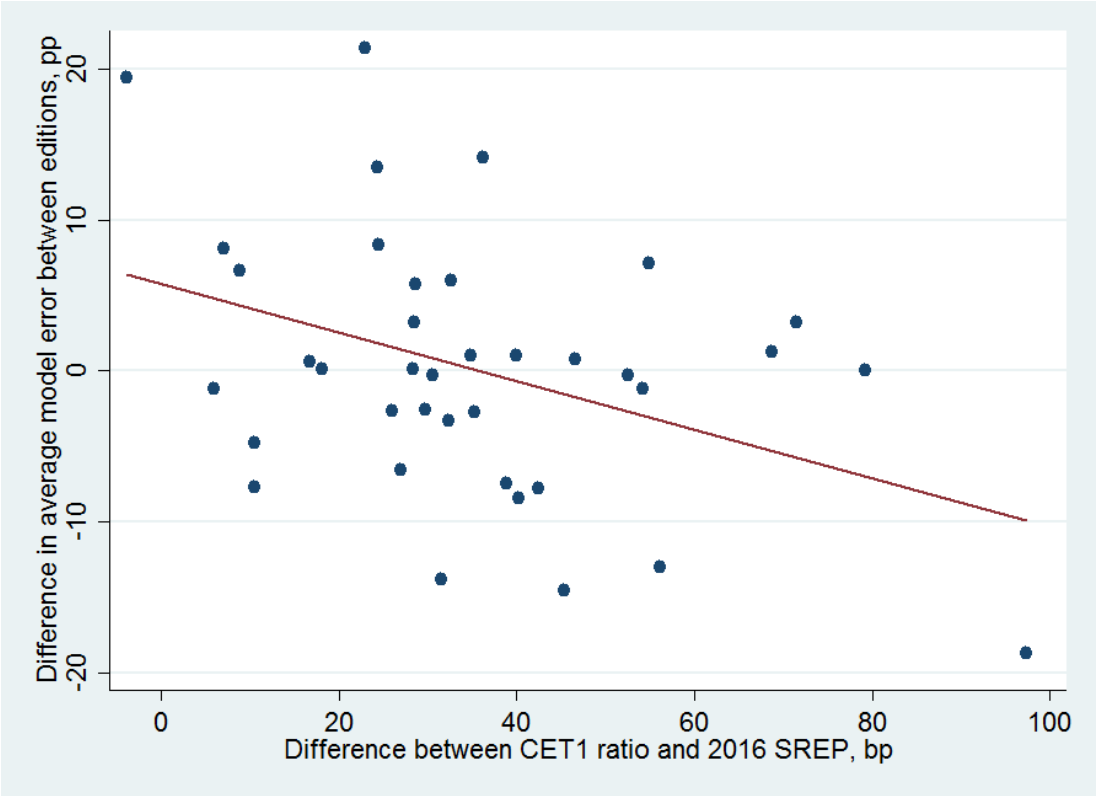
Model changes went in the "right" direction

- Controlling for exposure and scenario changes, banks with larger share of exposures subject to the IRB approach saw larger model adjustments
- Credit losses increased more for banks for which model under-predicted loss rates more: Model changes went in the "right" direction

	(1) ΔES_j^{14}	(2) ΔES_j^{14}	(3) ΔES_j^{14}	(4) ΔM_j^{14}	(5) ΔM_j^{14}	(6) ΔM_j^{14}	(7) ΔM_j^{14}
IRB share	0.0129**		0.00524	-0.0284**			-0.0148
	(0.00507)		(0.00429)	(0.0111)			(0.0103)
MP_i^{14}		5.932**	4.377***		-8.543**		-4.799
		(2.242)	(1.306)		(3.439)		(3.790)
ΔES_j^{14}						-1.160***	-0.729**
						(0.342)	(0.312)
Constant	-1.183**	0.107	-0.353	2.703***	-0.0648	0.158*	1.351
	(0.439)	(0.0944)	(0.377)	(1.000)	(0.126)	(0.0907)	(0.949)
Observations	44	45	42	44	45	42	42
R-squared	0.156	0.249	0.305	0.166	0.215	0.282	0.380

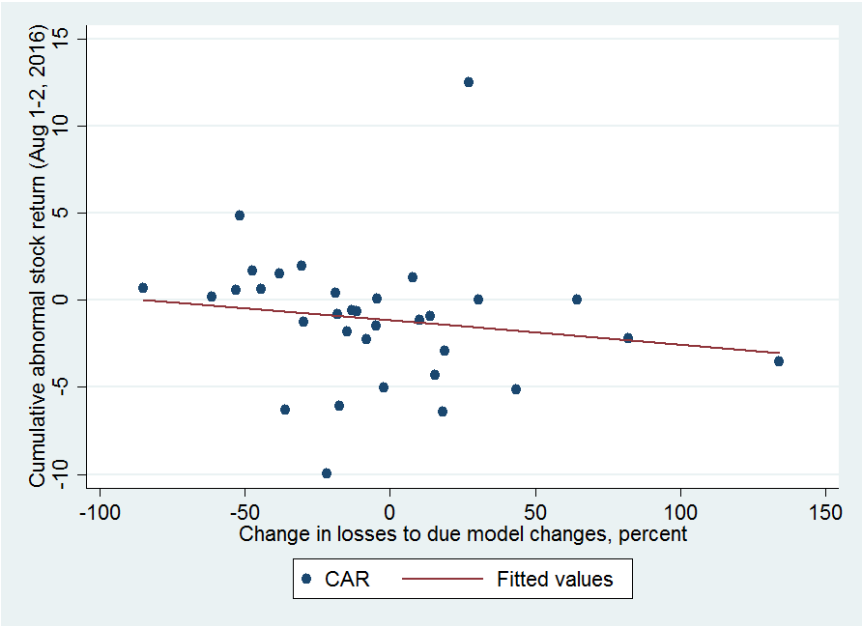
Larger model improvements for weaker banks

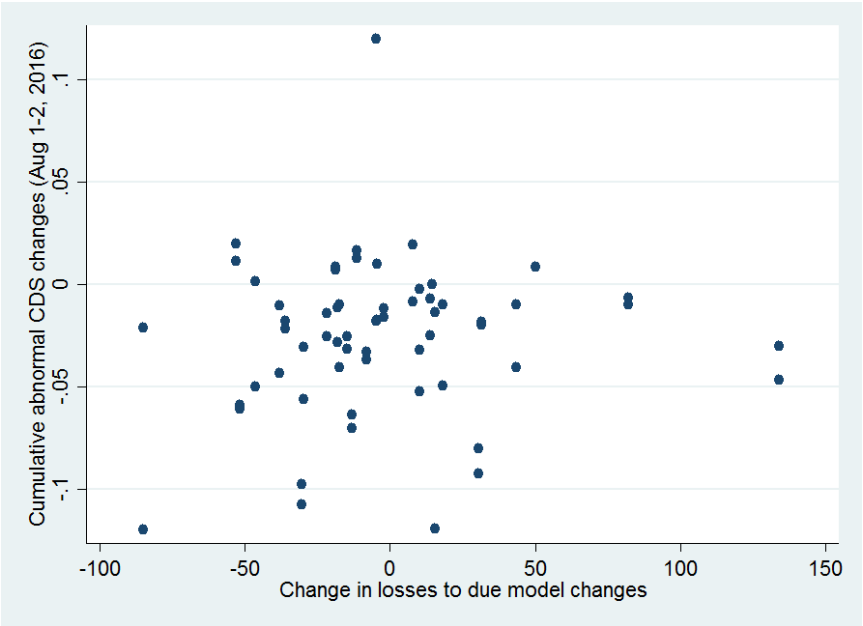
- Evidence that weaker banks saw more pressure to improve models
- Recall: scenario and exposure changes uncorrelated with capital buffers
- Bottom line: Models improved overall, with bigger improvements for weaker banks despite systematic model adjustments



Market response to the 2016 test release

- Abnormal stock price and CDS spread changes on the first two days after the publication of the stress test results (Aug 1-2, 2017)





Response implies the anticipation of lower capital requirements

- Test results were to inform 2017 bank-specific capital requirements
- Response is consistent with lower anticipated requirements due to decrease in losses from model changes
- No indication that changes in losses from model changes were related to changes in risk: Lower credit losses are associated with an increase in CDS spreads, with a stronger increase for weaker banks

	stock price (1)	CDS (2)	CDS (3)
ΔM_i^{16}	-1.408	0.0123	-0.0418*
	(0.950)	(0.0116)	(0.0240)
Capital buffer			0.000615
			(0.000413)
$\Delta M_i^{16} \times$ cap buf			0.00144*
			(0.000745)
Constant	-1.317*	-0.0394***	-0.0223***
	(0.744)	(0.0124)	(0.00541)
Observations	33	61	57
R-squared	0.034	0.025	0.091

Summary

- Evidence that credit loss models were systematically adjusted to reduce losses/smooth losses from 2014 to 2016 stress tests
- Magnitude of the adjustments quantitatively significant
- Difficult to detect because model changes went in the right direction, that is, model performance improved overall in 2016
- Stress tests that rely on bank-own models appear to have a significant deficiency, with material implications for investors, supervisors, and financial stability