Banks' Incentives and the Quality of Internal Risk Models

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Motivation

- Basel I: assets were bucketed into broad risk categories and each category was assigned a fixed risk weight
  - Harmonization was praised, but risk weights' simplicity was questioned
- Basel II: banks can use their models to determine capital levels.
  - Risk-weight of the loan is a function of the bank's estimate of the borrower's probability of default (PD), the loss given default (LGD), and the exposure at default (EAD).
- Praise to IRB approach for building on banks' information ignores the wisdom of Goodhart and Lucas – assumes banks will produce accurate risk estimates without regard for the policy-induced outcome.

Motivation (cont.)

- Why is this a problem?
  - Undermines role of regulatory capital ratios
  - Misleads market participants and weakens market discipline
  - Creates competitive inequities

- Governor Daniel Tarullo, May 8, 2014

"The combined complexity and opacity of risk weights generated by each banking organization for purposes of its regulatory capital requirement create manifold risks of gaming, mistake, and monitoring difficulty."

Objective and preview of results

- Investigate the risk estimates banks report to supervisors within credit syndicates:
  - There are systematic biases
  - Banks with less capital report lower risk estimates
  - Magnitudes are large – bias can reduce RWA by up to 20%
  - Relationship is stronger for larger, riskier, more opaque credits
- Estimate banks' pricing models using their risk estimates
  - Low capital banks set interest rates that are less consistent with the risk estimates that they produce
- Evidence consistent with an effort by low-capital banks to improve capital ratios

Related literature

Literature on the inconsistencies of internal risk models.

- RMA et al. (2000) and Firestone and Rezende (2013) document heterogeneity by banks participating in syndicated loans.
  - These studies rely on cross-sectional differences; we rely on a data panel, and our focus is in understanding the source of inconsistencies.
- Begley et al. (2014): Value-at-Risk violations in trading books correlated with bank capital. Behn et al. (2014): PDs for loans originated under the internal models are lower when compared to safer loans originated under the standardized approach.
  - The former study relies on comparisons across different portfolios of assets and the latter emphasizes within bank differences; we compare a common portfolio of assets across banks.
  - Both papers focus on ex post measures of bias while we rely on an ex ante measure.

Related literature (cont.)

Literature on the role incentives play in the production of risk estimates (e.g. Rajan et al. (2010, 2015)).

- Prior work has documented the role incentives played in distorting estimated risks in the mortgage securitization market; our paper documents evidence of this behavior in the context of banking regulation.

Data

- Our main data source is the SNC program.
- The program collects annual data on loans of $20 million or more that are shared by two or more supervised institutions.
- Agents report detailed data on the syndicate.
- Beginning in 2009, banks adopting the AIRB were required to report data quarterly, and provide their risk metrics for credits
- The AIRB approach allows banks to estimate probability of default (PD), loss given default (LGD) and exposure at default (EAD) using internal models.
- These risk components are used to calculate the risk-weighted value of the asset.

Data (cont.)

- Basel II adoption is mandatory for large, internationally active banking organizations and optional for others.
- Banks must enter a “parallel-run” period during which they remain subject to general-risk based capital rules until the regulator approves their transition to the AIRB.
- Our sample includes banks that have already been approved to use AIRB as well as those undergoing a parallel run.

Sample

- Sample consists of 14,870 credit facilities, from 7,569 unique borrowers, over the fourteen quarters from 2010Q2 to 2013Q3.
- Fifteen banks report PDs.
  - Nine banks report in the initial quarter. The final bank enters the sample in the first quarter of 2013.
- The average number of credits per bank exceeds 1,000 and the median is 561.

Are there biases in reported risk metrics?

$$\Delta PD_{i,j,t} = PD_{i,j,t} - PD_{j,t}^{Median}$$

$$\Delta PD_{i,j,t} = \gamma_{\mathbf{i}} + \tau_{\mathbf{t}} + \epsilon_{i,j,t}.$$

Are there biases in reported risk metrics (cont.)?

Panel A Δ:	(1) PD	(2) LGD_{Bef}	(3) $PD * LGD_{Bef}$	(4) $PD * LGD_{Aft}$	(5) $RW\%$
Bank FE:					
1	0.13***	2.23***	0.091***	0.092***	9.15***
2	0.47***	1.35***	0.14***	0.14***	15.4***
3	-0.22***	-5.57***	-0.11***	-0.11***	-18.6***
4	0.0070	-1.43**	0.010	0.0095	-0.60
5	0.059***	7.61***	0.068***	0.068***	9.42***
6	0.011	-4.04***	-0.034***	-0.035***	-5.28***
7	-0.034	-3.25***	-0.027**	-0.029***	-10.8***
8	0.24***	-6.91***	0.031**	0.019	-7.16***
9	0.29***	-3.15***	0.011	0.0076	-3.27***
10	0.37***	-4.23***	0.12***	0.11***	3.21**
11	0.36***	0.23	0.14***	0.16***	3.85***
12	0.15***	-1.22***	0.062***	0.061***	2.15***
13	0.42***	-6.90***	0.12***	0.11***	0.68
14	-0.32***	-0.26	-0.081***	-0.091***	-9.34***
15	0.083***	2.81***	0.038***	0.037***	7.33***
F-Stat	62.3	170	67.5	73.9	168
Observations	151,881	146,147	146,109	145,710	146,625
R-squared	0.050	0.280	0.058	0.059	0.204

Incentives and biases in risk metrics: Methodology

- We focus on the role of bank's capital
- We consider the following model

$$\Delta PD_{i,j,t} = \beta_0 Tier1_{j,t} + \beta_1' \text{BankControls}_{j,t} + \beta_2 Agent_{i,j,t} + \tau_t + \varepsilon_{i,j,t}$$

- We also consider a model in which Tier I is replaced with Tier I Gap
  - Defined as the residuals from a regression of Tier 1 capital on log assets, ROE, leverage, date fixed effects, and a foreign bank dummy. The residuals are estimated quarterly for every bank in our sample

Incentives and biases in risk metrics (cont.)

Panel A Δ:	(1) PD	(3) $PD * LGD_{Bef}$	(4) $PD * LGD_{Aft}$	(5) $RW\%$
Tier 1	0.075***	0.025***	0.027***	1.47**
	(0.017)	(0.0038)	(0.0040)	(0.58)
log(Assets)	0.034	0.025	0.025	2.24
	(0.039)	(0.017)	(0.017)	(2.83)
ROE	1.76**	1.09***	1.14***	151***
	(0.69)	(0.31)	(0.28)	(34.3)
Foreign	-0.031	-0.026	-0.026	-3.34
	(0.11)	(0.037)	(0.036)	(3.64)
Agent	-0.082**	-0.023**	-0.019*	-1.47**
	(0.033)	(0.010)	(0.011)	(0.71)
Observations	151,888	146,114	145,715	145,709
R-squared	0.021	0.024	0.026	0.099
Panel B Δ:	(1) PD	(3) $PD * LGD_{Bef}$	(4) $PD * LGD_{Aft}$	(5) $RW\%$
Tier 1 Gap	0.063***	0.018***	0.019***	0.44
	(0.016)	(0.0061)	(0.0066)	(0.62)
Agent	-0.13***	-0.034*	-0.030*	-2.07
	(0.036)	(0.019)	(0.018)	(2.92)
Observations	151,888	146,114	145,715	145,709
R-squared	0.013	0.007	0.008	0.003

Which credits are more biased?

- Interact capital constrain measure with credit characteristics

$$\Delta PD_{i,j,t} = \beta_0 Tier1Gap_{j,t} + \beta_X X_{i,t} + \beta_{0,X}(Tier1Gap_{j,t} * X_{i,t}) + \beta_2 Agent_{i,j,t} + \tau_t + \varepsilon_{i,j,t}.$$

- Impact of regulatory capital higher for:
  - Risky credits
  - Drawn credits
  - Large credits
  - Private firms

Magnitudes

- To understand the importance of these magnitudes for the loan portfolio as a whole, we aggregate the measured deviations in PD and its dependents to the bank-quarter level, weighting by the utilized value of the loan.

Weighted Average PD Deviations Relative to Capital

Panel A Δ:	(1) PD	(2) $PD * LGD_{Bef}$	(3) $PD * LGD_{Aft}$	(4) $RW\%$
Tier 1	0.075***	0.016***	0.018***	1.27***
	(0.022)	(0.0037)	(0.0044)	(0.24)
ROE	0.58	0.41*	0.52**	72.9***
	(0.77)	(0.23)	(0.21)	(25.5)
log(Assets)	0.073*	0.027	0.030*	1.34
	(0.041)	(0.016)	(0.017)	(2.43)
Foreign	-0.11	-0.065	-0.072*	-6.07
	(0.13)	(0.041)	(0.039)	(3.75)
Year FE	+	+	+	+
Observations	174	174	174	174
R-Squared	0.340	0.235	0.289	0.325

Panel B Δ:	(1) PD	(2) $PD * LGD_{Bef}$	(3) $PD * LGD_{Aft}$	(4) $RW\%$
Tier 1 Gap	0.075***	0.016***	0.018***	1.10***
	(0.021)	(0.0048)	(0.0059)	(0.34)
Year FE	+	+	+	+
Observations	174	174	174	174
R-Squared	0.336	0.167	0.192	0.086

Robustness tests

- Robust to excluding any single bank
- Robust to parallel run banks only or approved banks only
- Robust to foreign vs US banks only
- Robust to inclusion of bank fixed effects
- Robust to controls of bank risk
- Robust to average (rather than median) as benchmark
- Results hold when we do the analysis at the credit level with credit fixed effects

Identification

1. *Reverse causality*: But, lower PDs lead to lower RWA and a higher Tier 1 ratio.
2. *Learning*: If banks suffer a loss and learn their portfolio is riskier, they should increase PDs, which will lower Tier 1 ratio.
3. *Competency*: Low PDs and Tier 1 ratio are signs of poor skill. But, incompetency predicts inaccurate PDs, not biased PDs.
4. *Selectivity*: Low capital banks concentrate investments in credits they believe can earn the highest return relative to their view of PD. There is some support for selection, but does not appear to be the whole story.
5. *Risk attitude*: If Tier 1 ratio captures a bank's attitude toward risk, then low PDs and Tier 1 ratio is consistent with a greater tolerance for risk, but results hold within banks and when we control for portfolio risk

Evidence from loan spreads

$$log(Spread_{i,t}) = \alpha + \beta_{logPD} log(PD_{i,t}) + \beta_{LC} \mathbf{LoanControls}_{i,t} + \tau_t + \varepsilon_{i,t}$$

- If the PD's bias is proportional to their level, then the coefficient on PD will be higher for banks with downward biased PDs
  - Banks charge more per unit of risk because the spread is high relative to the PD.
- If PDs are biased they should have lower explanatory power on loan prices.
  - The explanatory power of PD-based loan pricing models will be lower for banks with lower capital.
- We find support for both assertions.

Final remarks

- Banks with lower capital report lower PDs relative to the median reporting bank in the syndicate.
- This finding, together with our loan spread analysis, suggest a regulatory arbitrage motive.
- Regardless of the motive, banks' production of systematically disparate risk estimates presents a challenge to an equitable regulatory regime.
  - Particularly important when low capital banks are the ones reporting lower risk estimates.
- Given the increasing reliance on bank-generated information, we highlight the need for mechanisms that incentivize the production of unbiased, accurate risk metrics.