Financial Innovation and Risk: Evidence from Operational Losses at U.S. Banking Organizations

discussion by

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FEDERAL RESERVE BANK of CLEVELAND

Background

Operational risk = the risk of loss resulting from inadequate or failed *internal processes*, *people* and *systems*, or from *external events*. (BIS, 2001)

Event types (Basel definitions)

ET1: Internal Fraud – unauthorized activity, theft & fraud involving at least 1 internal party

ET2: External Fraud – theft & fraud by a 3rd party, systems security

ET3: Employment Practices and Workplace Safety – discrimination, general liability, compensation

ET4: Clients, Products, and Business Practices – improper business & mkt practices, model errors

ET5: Damage to Physical Assets – natural and man-made disasters, vandalism

ET6: Business Disruption and Systems Failures – hardware & software failures, telecommunications

ET7: Execution, Delivery, and Process Management – data entry error, missed deadline, delivery failure

Operational risk ≈ all financial risks – (credit risk + market risk)

Motivation

Impact of financial innovation

Positive:

- Improves ability of banks to meet customer needs
- Enhances product value (Chen *et al* 2019)
- Improves data security
- Contributes to bank growth (Beck *et al* 2016)
- Improves economic efficiency (Miller 1986, 1992, Merton 1992, Tufano 2003)

Negative:

- New cybersecurity risks
- Increases regulatory, compliance, and legal risks
- Discrimination by AI-backed systems
- More complex data maintenance
- Transaction execution errors
- Technology interconnectedness may cause system-wide failures

focus of this paper

Paper summary and contributions

Main result

More innovative financial organizations have more operational risk.

Financial innovation and operational risk event types:

ET1: Internal Fraud – unauthorized activity, theft & fraud involving at least 1 internal party

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Data

Operational risk data 2000-2018

FR Y-14Q supervisory data on operational risk:

- 29 largest U.S. BHCs
- BHCs with consolidated assets $100 bln+
- Complete history of operational losses
- Loss amount, frequency, occurrence & settlement dates, event types
- 434,714 loss events

Top operational risk types by loss amount in the sample:

1. Clients, Products & Business Practices (**76%**)
   (operational losses due to poor services to clients, or flawed products)
2. Execution, Delivery & Process Management (**14%**)
   (operational losses due to data entry errors, delivery failures, missed deadlines)

Data

Financial innovation data 2000-2018

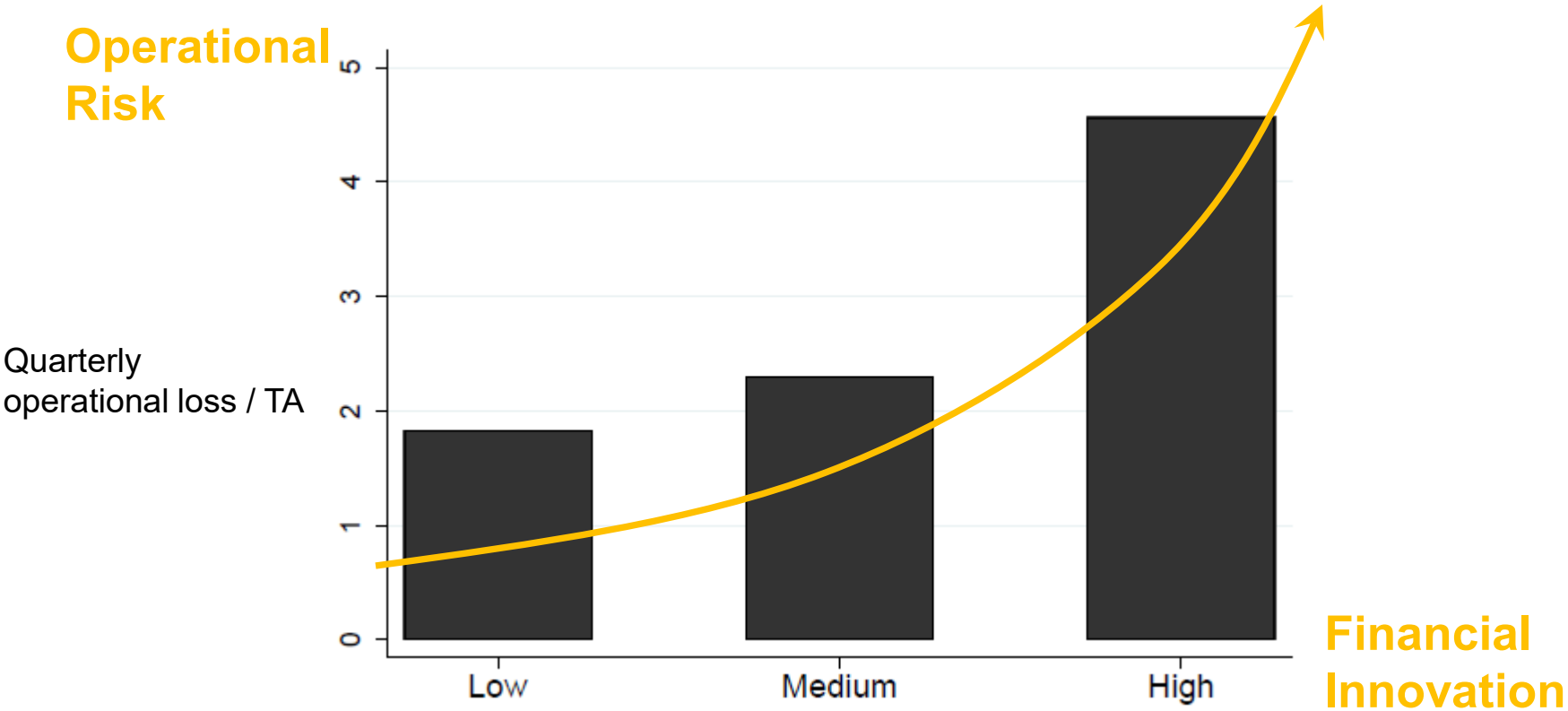
Financial patents data (used in Lerner *et al* 2023 JPE):

- Original data: 24,000+ U.S. financial patents
- Original data: 3,944 patents (16.3%) in financial services firms
- This sample: 2,142 patents in BHCs
- Info on patent types, dates, organization name

Top 3 patent types in the sample:

1. Payments (**45%**)
2. Security (**17%**)
3. Commercial and retail banking (**15%**)

Financial innovation and operational risk: Preliminary evidence



Terciles by quarterly number of patent applications

Econometric model

$$Operational\ Loss_{i,t} = \beta_t + \beta_1 Ln(N\ Patents)_{i,t-1} + \beta_2 Controls_{i,t-1} + \varepsilon_{i,t}$$

1. Total $ loss / TA
2. LN(total $ loss)
3. LN(total # losses)
4. LN(ave $ loss)

Quarter FE

LN(# patents)

NII / II
Deposits / TA
Loans / TA
ROE
Loan charge-off rate
Leverage
Maturity gap

Clustered by BHC + *t*

t = quarter
Sample period 2000-2018
1,374 quarterly obs

Key result

	(1)	(2)	(3)	(4)
	LtA	Ln(Loss)	N Evts	Ln(Avg Sev)
Ln(N Patents)	1.985***	0.323**	0.268***	0.089
	(0.001)	(0.012)	(0.000)	(0.145)
Ln(TA)	0.610*	1.345***	1.115***	0.228***
	(0.054)	(0.000)	(0.000)	(0.001)
	(0.916)	(0.418)	(0.000)	(0.017)
ROE	4.018	3.674***	3.352***	-0.394
	(0.436)	(0.003)	(0.002)	(0.578)
Leverage	-8.269	-1.603*	-2.067***	0.390
	(0.326)	(0.086)	(0.000)	(0.446)
Maturity Gap	-0.099	-0.039	-0.040	-0.046
	(0.795)	(0.762)	(0.197)	(0.310)
Loan Losses	-1.369**	0.156	0.598***	-0.384***
	(0.017)	(0.396)	(0.000)	(0.001)
Observations	1,374	1,374	1,374	1,374
Adjusted R^2	0.146	0.712		0.282

More innovative banking organizations experience more operational losses.

One SD increase in LN(#patents) is associated with a $142,920 increase in quarterly operational losses per $1 bln of TA.

Instrumental variable approach

Treatment of endogeneity:

- BHCs with high operational losses may use innovation to reduce future operational risk (reverse causality)

Instrumental variable:

- NSF data on proportion of high science, engineering, and technology business establishments, in neighboring states (by BHC headquarters)
- Rationale: Innovation emerges from regional mixing of ideas (Glaeser *et al* 2002, Agrawal *et al* 2008, Jaffe *et al* 1993, Kerr 2010)
- This IV should capture exogenous variation in BHC innovation

1st stage: Positive *** coefficient of IV
2nd stage: Positive *** coefficient of $\widehat{LN(\#patents)}$

Additional results

1. By patent type. (+)*** for patents related to payments, security, commercial & retail banking, currency, insurance.

2. Quantile regression: 90^{th}, 95^{th}, 99^{th} percentiles of tail operational losses. More innovative BHCs have more frequent tail events.

3. Interact LN(#patents) with risk management measure. (–)***

4. Financial crisis (2007-2009). Coefficient of LN(#patents)xGFC is (+)***

5. Weaker effect for lagged LN(#patents), lagged 2 and 3 years

6. Questionable impact of innovation on BHC value:
   - (+)*** effect of innovation on asset & deposit share, but
   - no impact on MTB and Tobin's *q*

6 comments and recommendations

Comments and recommendations

Comment #1. Explaining the channel.

Why does financial innovation increase operational risk? Do banks take on more risks strategically to achieve better performance to reward shareholders?

Section 5.3. (BHC Value and Innovation) findings:

- BHC's asset share and deposit share ratio in banking industry increase with higher #financial patents.
- No statistically significant effect on market-to-book ratio and Tobin's *q*.

Authors conclude:
"Financial innovation is not reliably related to BHC valuation metrics."

Recommendations:

1. Emphasize these results. Is operational risk endogenous? Or due to fin. innovation?
2. Increase num lags in #patents. Positive impact on BHC performance may be delayed.
3. Include other metrics of performance (market-based and balance sheet-based): SD(equity vol), ROA, ROE, Z-score, asset growth rate, etc. (e.g., Cornett *et al* 2002 JF, Laeven and Levine 2009 JFE)

Comments and recommendations

Comment #2. Number of patents as measure of financial innovation.

Good data is limited…

Recommendations:

- Is R&D spending data available for the firms in this sample?
- # banks' partnerships with FinTech firms (Rysman and Schuh 2016; Klus *et al* 2018)
- New products/services (count and revenue share)
- # directors and executives with IT expertise (see MIS literature, e.g., Choi *et al* 2021 MISQ)
- Does Lerner et al (2023) patent data include IT patents (hardware and software patents)?

See also:

- Allen, Gu, Jagtiani (2020) "A survey of fintech research and policy discussion." A review of fintech pros, cons, and many data sources.
- Thakor 2020 JFI

Comments and recommendations

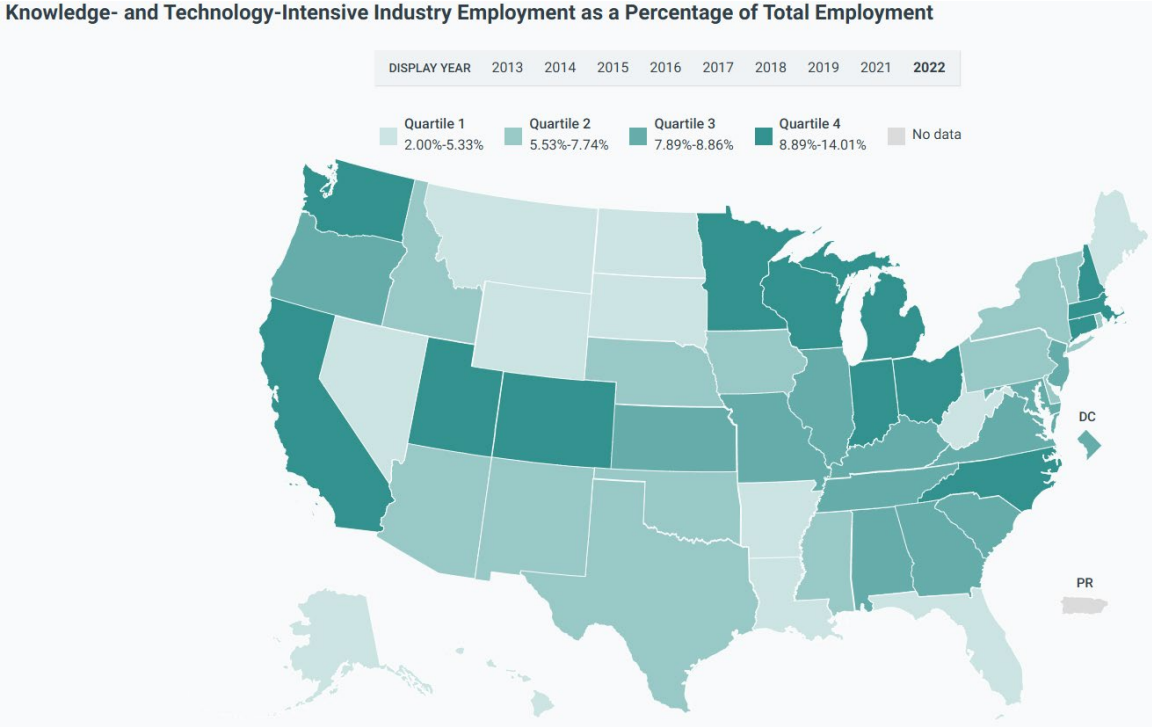
<u>Comment #3</u>. Instrumental variable approach.

Use *Neighbor State HSEI Businesses* (high science, engineering, and technology) in neighboring states as an instrument for financial innovation.

NSF website: https://ncses.nsf.gov/indicators/states/indicator/kti-percent-total-employment/

The data frequency is *annual*. Noisy data?

In this paper, data frequency for all other variables is *quarterly*.



Comments and recommendations

<u>Comment #4</u>. Financial innovation & operational risk, by event type.

Findings:

ET1: Internal Fraud – unauthorized activity, theft & fraud involving at least 1 internal party

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(+)***

Need to explain *why* only for these two event types the results are statistically significant. It's surprising that no significant effects in other event types.

Comments and recommendations

Comment #5. Financial innovation & operational risk, by business line.

Related to my Comment #4.

Findings:

- By event type: Significant results only for EF and CPBP event types
- By patent type: Significant results only for patents related to payments, security, commercial & retail banking, currency & insurance innovation.

Recommendation:

It's likely that higher and more frequent operational losses are concentrated within particular business lines.

Redo the analysis **separately for different business lines**. (Corporate finance, trading & sales, retail banking, commercial banking, payment & settlement, agency services, asset management, retail brokerage.)

Comments and recommendations

Comment #6. Mitigating effect of risk management.

Findings:

- Interact RMI with #patents.
- RMI*#patents coefficient is (–)***. Mitigating role of RMI on effect of fin. innovation on oper. risk.
- However, coefficient of stand-alone RMI is insignificant. All else equal, for a BHC with no patents risk management quality has no effect on operational risk.

	(1)	(2)
	LtA	LtA
Ln(N Patents)	15.191***	4.464***
	(0.006)	(0.004)
Ln(N Patents) × RMI	-13.277**	
	(0.011)	
RMI	1.255	
	(0.496)	
Ln(N Patents) × RMI (0/1)		-4.174***
		(0.007)
RMI (0/1)		-0.387
		(0.530)
Controls	Yes	Yes
Observations	797	797
Adjusted R^2	0.194	0.189

2 possible explanations:

- RMI data frequency is annual. The rest of the variables are quarterly. Frequency mismatch. Noisy?
- What are the components of RMI? Perhaps, correlated with some controls?

Summary

- ✓ The topic is timely:

  How does financial innovation contribute to banks' performance (upward and downward)?
- ✓ The paper is well written.
- ✓ I thoroughly enjoyed reading the paper!
- ✓ Solid contribution to literature on operational risk in banks.

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Thank you!

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