Banks' Non-Interest Income and Systemic Risk

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Motivation (1)

- Recent crisis showcase of large risk spillovers from one bank to another increasing systemic risk

- Two types of activities
  - Deposit taking and lending
    - Bernanke 1983, Fama 1985, Diamond 1984, James 1987, Gorton and Pennachi 1990, Calomiris and Kahn 1991, and Kashyap, Rajan, and Stein 2002
    - Bank lending channel for transmission of monetary policy

      Bernanke and Blinder 1988, Stein 1988, Kashyap, Stein and Wilcox 1993
  - Other activities (non-interest income) Table I Figure 1
    - Trading income
    - Investment banking and venture capital income
    - Others (fiduciary income, deposit services charges, credit card fees etc.)

Motivation (2)

- Philip Angelides, Chairman of Financial Crisis Inquiry Commission
  - These banks have become trading operations… It's the centre of their business

- *Paul Volcker, Statement before the US Senate's Committee on Banking, Housing, & Urban Affairs*
  - *"The basic point is that there has been, and remains, a strong public interest in providing a "safety net" – in particular, deposit insurance and the provision of liquidity in emergencies – for commercial banks carrying out essential services (emphasis added). There is not, however, a similar rationale for public funds – taxpayer funds – protecting and supporting essentially proprietary and speculative activities (emphasis added)"*

Motivation (3)

- Are non-conventional banking activities (non-interest income) associated with higher or lower systemic risk?
- What is the economic magnitude of the *specific* non-interest activity on systemic risk?
- Is there a relationship in the levels of *pre-crisis* non-interest income and the bank's stock returns earned *during the crisis*?

Bottom line in advance (1)

- We find that systemic risk is higher for banks with a higher non-interest income to interest income ratio. One s.d. shock to this ratio increases its systemic risk contribution by 11.6% when measured by Δ*CoVaR and 5.4% when SES*

– Consistent with Shleifer and Vishny (2010) model of activities where banks who do not have enough 'skin in the game' leads to higher systemic risk

- Consistent with Song and Thakor (2007) where such transaction activities lead to higher risk

– Consistent with Fang, Ivashina and Lerner (2010) who find private equity investments by banks to be highly procyclical, and to perform worse than those of nonbank-affiliated private equity investments.

Bottom line in advance (2)

- Glamour banks, high leverage banks, and larger banks contributed more to systemic risk
  - The result on size is consistent with those found in Adrian and Brunnermeier (2010) and with the general idea that larger firms contribute more to systemic risk

Bottom line in advance (3)

- Both trading income and investment banking/ venture capital income to be *equally* significantly related to systemic risk. No such result for other income

  – A one standard deviation shock to a bank's trading income increases its systemic risk contribution by 5% in $\Delta CoVaR$ and 3.5% in *SES,* whereas a one standard deviation shock to its investment banking/ and venture capital income increases its systemic risk contribution by 4.5% in $\Delta CoVaR$ and 2.5% in *SES*

Bottom line in advance (4)

- Banks with higher trading income one-year before the recession earned lower returns during the recession period
- No such significant effect was found for investment banking/venture capital income
- We also find that larger banks earned lower stock returns during the recession
- Interestingly, banks who were doing well one-year before the recession continued to do well during the recession

Caveats

•Sample is commercial banks, effect might be much larger if include other financial institutions such as insurance companies, investment banks, investment companies

•Consistent with prior literature, not saying it is causal in a structural equation sense (very important caveat)

•Cannot differentiate proprietary trading from client requested trading or market making

•Could change when have new crisis (stationarity issue)

Related Literature (1)

- Systemic risk measures
  - Adrian and Brunnermeier ('08): $\Delta CoVaR$
    - difference between the *CoVaR* conditional on a bank being in distress and the *CoVaR* conditional on a bank operating in its median state
  - Acharya, Pedersen, Philippon,& Richardson ('10): SES
    - systemic expected shortfall which is the expected amount a bank is undercapitalized in a systemic event in which the entire financial system is undercapitalized
  - Allen, Bali and Tang ('10):*CATFIN* measure
    - principal components of the 1% *VaR* and expected shortfall, using estimates of the generalized Pareto distribution, skewed generalized error distribution, and a non-parametric distribution

Related Literature (2)

- Brownlees and Engle (2010): Marginal Expected Shortfall
  - expected loss of a bank's equity value if the overall market declined substantially
- Billio, et. al (2010): PCA and Granger causality tests
  - interconnectedness between returns of hedge funds, brokers, banks, insurance
- Tarashev, Borio, and Tsatsaronis (2010): Shapley values
  - based on a bank's default probabilities, size, and exposure to common risks
- Chan-Lau (2010): CoRisk
  - captures the extent to which the risk of one institution changes in response to changes in the risk of another institution while controlling for common risk factors
- Huang, Zhou, and Zhu (2009, 2010): DIP
  - deposit insurance premium (*DIP*) measures a bank's expected loss conditional on the financial system being in distress exceeding a threshold level

Related Literature (3)

- Non-interest income on bank's risk
  - Stiroh (2004) and Fraser, Madura, and Weigand (2002) finds that non-interest income is associated with more volatile bank returns
  - DeYoung and Roland (2001) find fee-based activities are associated with increased revenue and earnings variability.
  - Stiroh (2006) finds that non-interest income has a larger effect on individual bank risk in the post-2000 period
  - Acharya, Hassan and Saunders (2006) find diseconomies of scope when a risky bank expands into additional sectors for Italian banks

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Systemic Risk: ΔCoVaR

- Value at Risk (VaR^i) measures bank *i*'s worst expected loss at *q*% confidence level over a given time interval (q=1%)

$$Probability(R^i \leq VaR_q^i) = q$$

- $CoVaR^{system|i}$ measures the *VaR* of financial system conditional upon bank *i* being in distress

- Percentage of asset value that entire financial system might lose with probability *q* conditional on that the asset loss of bank *i* is at its VaR^i

$$Probability(R^{system} \leq CoVaR_q^{system|i} \mid R^i = VaR_q^i) = q$$

Systemic Risk: ΔCoVaR

- $CoVaR^{system|i,median}$ measures the *VaR* of financial system conditional upon bank *i* being in its median state

- Percentage of asset value that entire financial system might lose with probability *q* conditional on that the asset return of bank *i* is at its median level

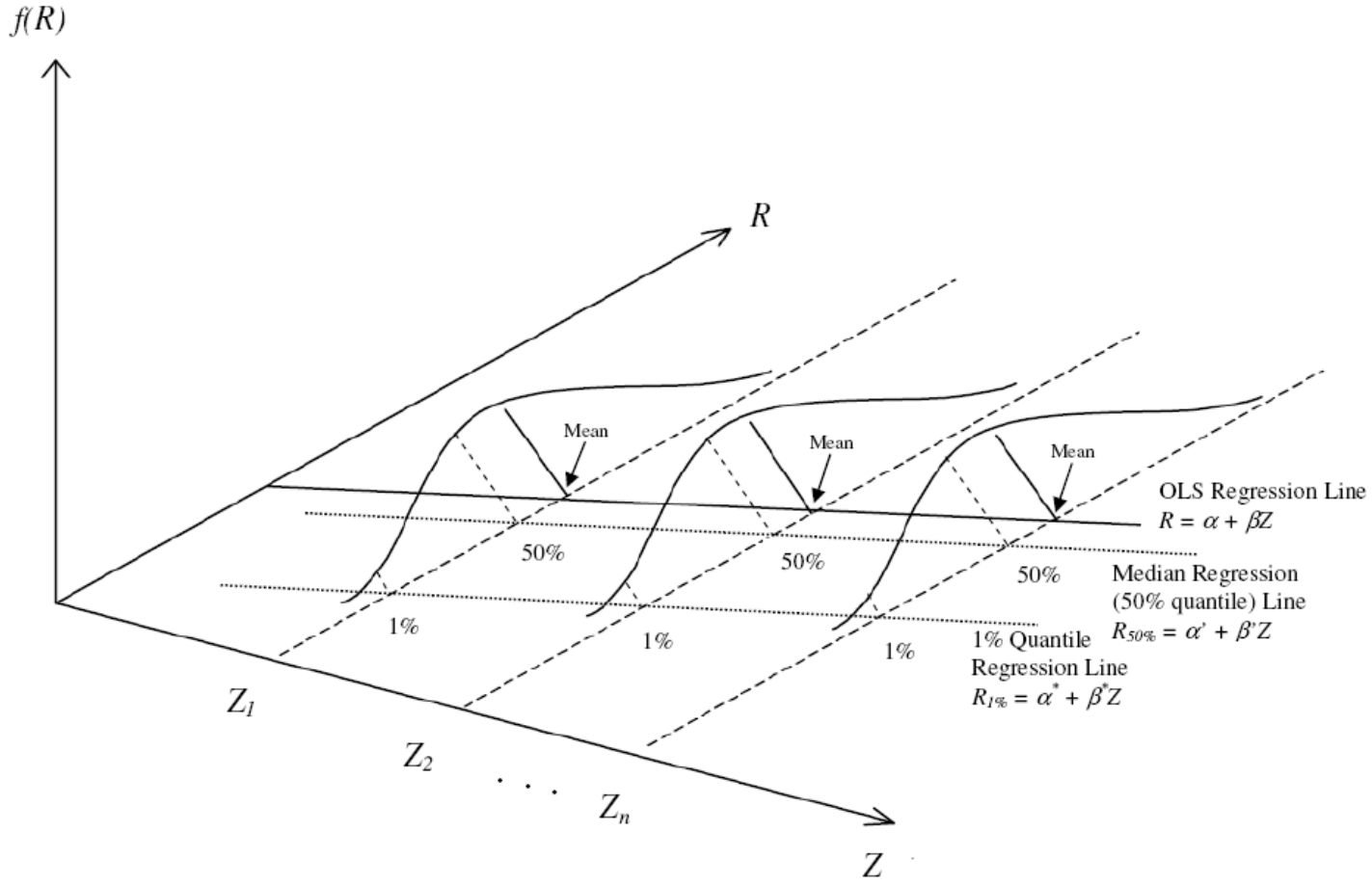
$$Probability(R^{system} \leq CoVaR_q^{system|i,median} \mid R^i = median^i) = q$$

- Bank *i*'s systemic risk is the difference between the financial system's *VaR* conditional on bank in distress ($CoVaR^{system|i}$), and the financial system's *VaR* conditional on bank operating in its median state ($CoVaR^{system|i,median}$)

$$\Delta CoVaR_q^i = CoVaR_q^{system|i} - CoVaR_q^{system|i,median}$$

Systemic Risk: Quantile Regression

- Regress to qth quantile (50% quantile is median), not to mean



Systemic Risk: ΔCoVaR

- 1% quantile regression

$$R_t^i = \alpha^i + \beta^i Z_{t-1} + \varepsilon^i$$

$$R_t^{system} = \alpha^{system|i} + \beta^{system|i} Z_{t-1} + \gamma^{system|i} R_{t-1}^i + \varepsilon^{system|i}$$

- 50% quantile (median) regression

$$R_t^i = \alpha^{i,median} + \beta^{i,median} Z_{t-1} + \varepsilon^{i,median}$$

- Macroeconomic factors (Z_{t-1}): volatility, liquidity, change in risk-free rate, change in term structure, change in credit spread, equity market return and real-estate return

Systemic Risk: ΔCoVaR

- Predict bank *i*'s *VaR* and median asset return using the coefficients α and β estimated in quantile regressions

$$VaR_{q,t}^{i} = \hat{\alpha}^{i} + \hat{\beta}^{i} Z_{t-1}$$

$$R_{t}^{i,median} = \hat{R}_{t}^{i} = \hat{\alpha}^{i,median} + \hat{\beta}^{i,median} Z_{t-1}$$

- Predict financial system's CoVaR conditional on bank *i* in distress

$$CoVaR_{q,t}^{system|i} = \hat{R}_{t}^{system} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} Z_{t-1} + \hat{\gamma}^{system|i} VaR_{q,t}^{i}$$

Systemic Risk: ΔCoVaR

- Predict financial system's CoVaR conditional on bank *i* operating in median state

$$CoVaR_{q,t}^{system|i,median} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} Z_{t-1} + \hat{\gamma}^{system|i} R_t^{i,median}$$

- Bank *i* 's systemic risk is the difference between financial system's CoVaR if bank *i* is at risk and financial system's CoVaR if bank *i* is in median state

$$\Delta CoVaR_{q,t}^{i} = CoVaR_{q,t}^{system|i} - CoVaR_{q,t}^{system|i,median}$$

Systemic Risk: *SES* Estimation

- Acharya, Pedersen, Philippon and Richardson (2010) propose the Systemic Expected Shortfall (*SES*) measure to capture a bank's contribution to a systemic crisis due to its expected default loss

- *SES* is the expected amount that a bank is undercapitalized in a future systemic event in which the overall financial system is undercapitalized

- Systemic crisis event is when aggregate banking capital at time t is less than the target capital

Systemic Risk: *SES* Estimation

- Empirically define systemic crisis event as the 5% worst days for the aggregate equity return of the entire banking system

- Realized *SES* is the stock return of bank *i* during the systemic crisis event (the worst 5% market return days at calendar quarter *t*)

$$SES_t^i(\%) = E\left[r_t^i - k_t \cdot lev_t^i \,\middle|\, R_t < K_t \cdot LEV_t \right]$$

Regressions

- Non-interest income and systemic risk:

$$SystemicRisk_t = \phi_0 + \phi_1 M2B_{t-1} + \phi_2 LEV_{t-1} + \phi_3 AT_{t-1} + \phi_4 AT_{t-1}^2 + \phi_5 N2I_{t-1} + \varepsilon_t$$

- Non-interest Income (N2I) components: trading, investment banking & venture capital and others

$$SystemicRisk_t = \phi_0 + \phi_1 M2B_{t-1} + \phi_2 LEV_{t-1} + \phi_3 AT_{t-1} + \phi_4 AT_{t-1}^2 + \phi_5 T2I_{t-1} + \phi_6 IBVC2I_{t-1} + \varepsilon_t$$

- Newey-West standard error estimates in pooled regression

Data

- 1986-2008
- Quarterly intervals
- 534 unique banks
- SIC codes 60-67 matched with FR Y-9C (no investment banks, brokerages, insurance companies, mutual funds)
- CRSP: Daily return => Weekly return
- Compustat: Financial variables
- FR Y-9C: Noninterest Income, Interest Income, C&I loan
- Fed NY: LIBOR, Treasury
- FHFA: House price index
- NBER: Economic cycle dates

Empirical Results (1)

- Non-interest income and systemic risk
  - Glamor banks, highly leveraged, and larger banks

Table V

- Trading income and investment banking & venture capital income predicts systemic risk
  - Similar magnitude for investment banking and venture capital income than for trading income

Table VI

Empirical Results (2)

- Bank's return during the crisis on its pre-crisis firm characteristics

Table VII

Robustness

- Is it interest income?
  - No — Table VIII; Table IX
- Using CRSP market return as proxy for overall economy?
  - Yes — Table X; Table XI
- Cross-sectional v. time-series?
  - Cross-sectional — Table XII

Policy and caveats

- Non-traditional income is associated with systemic risk
- Maybe charge a Pigovian tax/charge/premium which is counter-cyclical
- Sample is commercial banks, effect might be much larger if include other financial institutions such as insurance companies, investment banks, investment companies
- Not saying it is causal in a structural equation sense
- Cannot differentiate proprietary trading from client requested trading or market making
- Could change as have new crises (stationarity issue)

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Table I

Bank Name	1989	2000	2007
Citigroup	0.21	0.89	0.50
Bank of America	0.21	0.38	0.48
Chase	0.16	0.67	0.76
Wachovia	0.14	0.35	0.38
Wells Fargo	0.19	0.57	0.53
Suntrust	0.18	0.27	0.35
US Bank	0.18	0.50	0.55
National City	0.19	0.38	0.31
Bank of New York Mellon	0.21	0.67	1.39
PNC Financial	0.13	0.68	0.69
Average	0.18	0.53	0.59

Non-interest income ratio to interest income ratio (N2I) is defined below and the data are taken from the Federal Reserve Bank reporting form FR Y9C:

$$N2I = \frac{Noninterest\ Income}{Net\ Interest\ Income} = \frac{BHCK4079}{BHCK4107}$$

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Figure 1

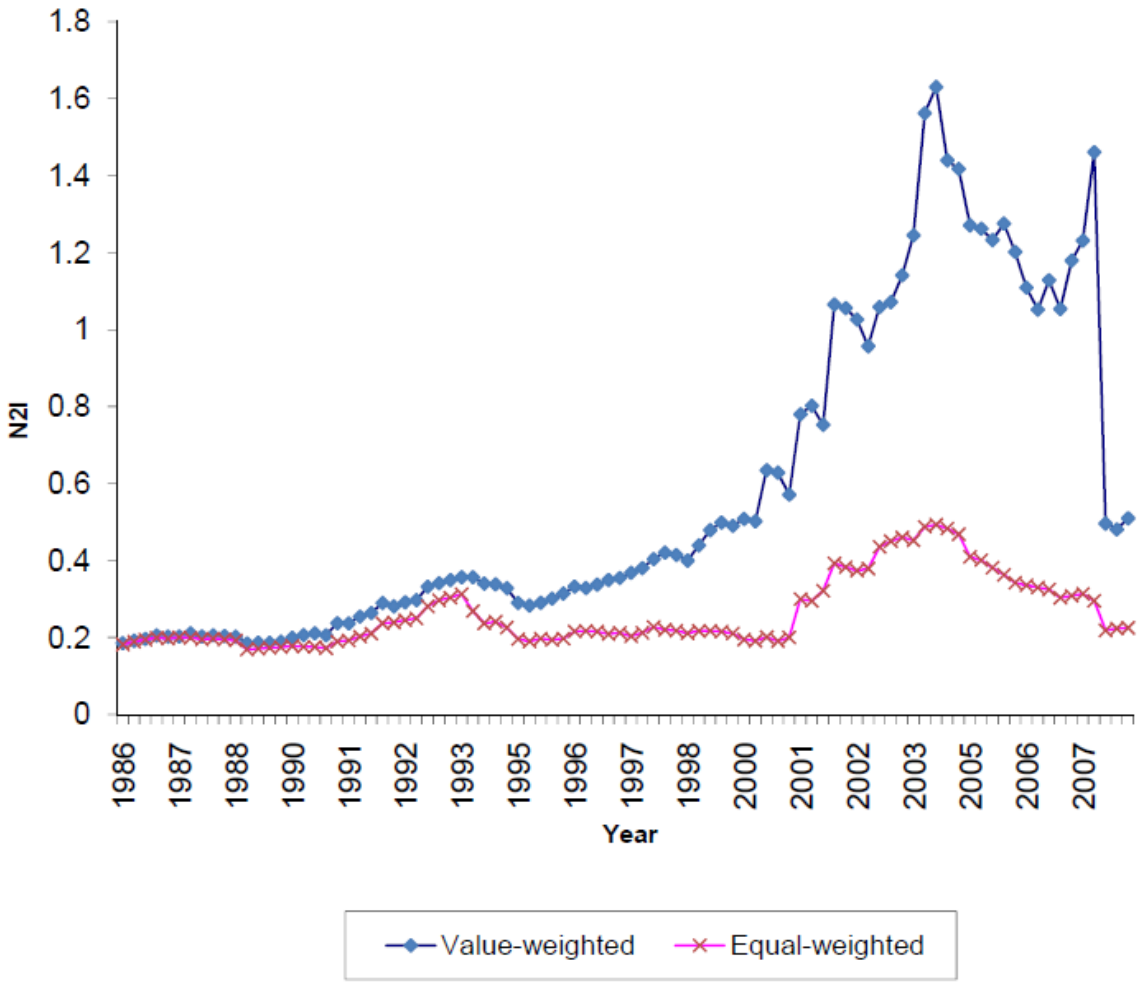

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Table V

Dependent Variable:	$\Delta CoVaR_t$		Realized SES_t	
	(1)	(2)	(3)	(4)
Market to Book $_{t-1}$		-0.0296***		-0.0632***
		(-3.25)		(-3.77)
Leverage $_{t-1}$		-0.0411***		-0.0704***
		(-2.76)		(-7.12)
Log (Total Asset) $_{t-1}$		0.0354		-0.209***
		(1.14)		(-5.54)
Log (Total Asset) squared $_{t-1}$		-0.00953***		0.0032
		(-9.21)		(0.23)
Non-interest Income to Interest Income $_{t-1}$	-0.525***	-0.168***	-0.514***	-0.216***
	(-5.07)	(-4.08)	(-4.71)	(-5.18)
Quarterly fixed-effects	Yes	Yes	Yes	Yes
N	23,085	23,085	23,085	23,085
Adjusted R-square	0.06	0.12	0.34	0.35
F-test	207.09	233.40	426.14	474.24

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Table VI

Dependent Variable:	$\Delta CoVaR_t$		Realized SES_t	
	(1)	(2)	(3)	(4)
Market to Book $_{t-1}$		-0.0827***		-0.0455
		(-3.61)		(-1.40)
Leverage $_{t-1}$		-0.0229***		-0.00314
		(-2.64)		(-0.27)
Log (Total Asset)$_{t-1}$		-1.191***		-3.116***
		(-6.55)		(-11.02)
Log (Total Asset) squared$_{t-1}$		0.0303***		0.0886***
		(5.05)		(9.74)
Trading Income to Interest Income $_{t-1}$	-0.751***	-0.258**	-1.106***	-0.631**
	(-4.93)	(-2.28)	(-3.99)	(-2.37)
IBVC Income to Interest Income $_{t-1}$	-0.186***	-0.122**	-0.218***	-0.12***
	(-2.73)	(-2.00)	(-3.55)	(-2.95)
Quarterly fixed-effects	Yes	Yes	Yes	Yes
N	9,603	9,603	9,603	9,603
Adjusted R-square	0.14	0.25	0.48	0.51
F-test	246.44	270.20	545.15	573.46

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Table VII

Dependent Variable: Return $_t$	(1)	(2)	(3)	(4)
Log (Total Asset) $_{t-1}$	-0.0305**	-0.0364**	-0.0321*	-0.0397**
	(-2.43)	(-2.50)	(-1.87)	(-2.19)
Leverage $_{t-1}$	0.0115	0.0124	0.0085	0.0098
	(1.46)	(1.58)	(1.04)	(1.21)
Short-term Funding $_{t-1}$			0.476	0.407
			(1.59)	(1.37)
Loan Commitment $_{t-1}$			-0.183	-0.117
			(-0.73)	(-0.46)
Dummy of top 25%tile Trading Income to Interest Income $_{t-1}$		-0.0940**		-0.0827*
		(-2.07)		(-1.77)
Dummy of top 25%tile IBVC Income to Interest Income $_{t-1}$		0.0851		0.0834
		(1.60)		(1.56)
Intercept	-0.110	-0.0280	-0.0526	0.0391
	(-0.52)	(-0.13)	(-0.21)	(0.16)
N	284	284	284	284
Adjusted R-square	0.03	0.06	0.03	0.06
F-test	4.23	3.85	2.97	2.93

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Table VIII

Dependent Variable:	$\Delta CoVaR_t$			Realized SES_t		
	(1)	(2)	(3)	(4)	(5)	(6)
Market to Book $_{t-1}$		-0.0252***	-0.0284***		-0.0559***	-0.0450***
		(-2.76)	(-2.76)		(-3.32)	(-2.61)
Leverage $_{t-1}$		-0.0414***	-0.0396**		-0.0709***	-0.0772***
		(-2.79)	(-2.49)		(-7.20)	(-7.55)
Log (Total Asset) $_{t-1}$		0.0346	0.0157		-0.211***	-0.147***
		(1.12)	(0.40)		(-5.61)	(-3.53)
Log (Total Asset) squared $_{t-1}$		-0.0094***	-0.00864***		0.00059	-0.00195
		(-9.15)	(-6.54)		(0.43)	(-1.30)
Net Interest Income to Total Asset $_{t-1}$			5.535			-18.61***
			(1.34)			(-4.05)
Non-interest Income to Total Asset $_{t-1}$	-21.66***	-7.512***	-7.405***	-22.74***	-10.73***	-11.09***
	(-11.16)	(-5.61)	(-5.40)	(-8.97)	(-5.89)	(-6.06)
Quarterly fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
N	23,085	23,085	23,085	23,085	23,085	23,085
Adjusted R-square	0.06	0.12	0.46	0.33	0.35	0.68
F-test	208.04	234.72	234.46	427.75	476.32	471.14

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Table IX

Dependent Variable:	$\Delta CoVaR_t$		Realized SES_t	
	(1)	(2)	(3)	(4)
Market to Book $_{t-1}$		-0.0825***		-0.0458
		(-3.61)		(-1.41)
Leverage $_{t-1}$		-0.0231***		-0.00347
		(-2.65)		(-0.29)
Log (Total Asset) $_{t-1}$		-1.193***		-3.116***
		(-6.60)		(-11.06)
Log (Total Asset) squared $_{t-1}$		0.03***		0.0886***
		(5.10)		(9.78)
Trading Income to Total Asset $_{t-1}$	-14.29***	-6.83***	-23.58***	-16.08***
	(-4.09)	(-2.56)	(-3.69)	(-2.71)
IBVC Income to Total Asset $_{t-1}$	-13.37***	-7.584***	-15.14***	-7.446***
	(-3.49)	(-2.82)	(-2.69)	(-2.41)
Quarterly fixed-effects	Yes	Yes	Yes	Yes
N	9,603	9,603	9,603	9,603
Adjusted R-square	0.14	0.25	0.48	0.51
F-test	246.44	270.66	545.15	573.35

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Table X

Dependent Variable:	$\Delta CoVaR_t$		Realized SES_t	
	(1)	(2)	(3)	(4)
Market to Book $_{t-1}$		-0.183***		-0.0632***
		(-8.60)		(-3.14)
Leverage $_{t-1}$		-0.0142		-0.0704
		(-0.78)		(-0.61)
Log (Total Asset) $_{t-1}$		0.00528		-0.209***
		(0.15)		(-5.19)
Log (Total Asset) squared $_{t-1}$		0.0064***		0.00629***
		(5.30)		(3.22)
Non-interest Income to Interest Income $_{t-1}$	-0.783***	-0.433***	-0.447***	-0.216***
	(-4.00)	(-3.60)	(-4.92)	(-4.45)
Quarterly fixed-effects	Yes	Yes	Yes	Yes
N	23,168	23,168	23,168	23,168
Adjusted R-square	0.04	0.06	0.31	0.32
F-test	89.93	116.14	417.76	465.74

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Table XI

Dependent Variable:	$\Delta CoVaR_t$		Realized SES_t	
	(1)	(2)	(3)	(4)
Market to Book $_{t-1}$		-0.184***		-0.0285
		(-4.61)		(-0.93)
Leverage $_{t-1}$		-0.0161		0.0167
		(-1.03)		(0.79)
Log (Total Asset) $_{t-1}$		-0.66**		-2.887***
		(-1.99)		(-10.32)
Log (Total Asset) squared $_{t-1}$		0.0122		0.0833***
		(1.21)		(9.23)
Trading Income to Interest Income $_{t-1}$	-1.531*	-0.887	-1.187***	-0.819***
	(-1.81)	(-1.12)	(-3.77)	(-2.58)
IBVC Income to Interest Income $_{t-1}$	-0.219**	-0.131**	-0.201***	-0.109***
	(-2.07)	(-2.01)	(-4.07)	(-2.89)
Quarterly fixed-effects	Yes	Yes	Yes	Yes
N	9,601	9,601	9,601	9,601
Adjusted R-square	0.03	0.05	0.45	0.48
F-test	27.34	47.03	535.00	552.77

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Table XII

Year	Quarter	# Changes	# TotalBanks	$\frac{\#Changes}{\#TotalBanks}$	Year	Quarter	# Changes	# TotalBanks	$\frac{\#Changes}{\#TotalBanks}$
1986	4	1	49	2%	1998	1	5	206	2%
1987	1	2	50	4%	1998	2	13	196	7%
1987	2	2	50	4%	1998	3	6	208	3%
1987	3	1	53	2%	1998	4	2	215	1%
1987	4	2	54	4%	1999	1	7	223	3%
1988	1	1	53	2%	1999	2	11	227	5%
1988	2	4	55	7%	1999	3	5	221	2%
1988	3	2	56	4%	1999	4	9	228	4%
1988	4	1	57	2%	2000	1	9	233	4%
1989	1	1	57	2%	2000	2	21	229	9%
1989	2	0	55	0%	2000	3	11	232	5%
1989	3	0	56	0%	2000	4	9	235	4%
1989	4	0	58	0%	2001	1	8	247	3%
1990	1	0	59	0%	2001	2	26	241	11%
1990	2	3	57	5%	2001	3	8	225	4%
1990	3	3	55	5%	2001	4	8	227	4%
1990	4	2	62	3%	2002	1	9	185	5%
1991	1	3	63	5%	2002	2	14	200	7%
1991	2	4	62	6%	2002	3	6	244	2%
1991	3	2	67	3%	2002	4	4	252	2%
1991	4	1	77	1%	2003	1	11	271	4%
1992	1	0	77	0%	2003	2	14	258	5%
1992	2	8	78	10%	2003	3	8	257	3%
1992	3	4	79	5%	2003	4	3	266	1%
1992	4	3	79	4%	2004	1	2	269	1%
1993	1	0	79	0%	2004	2	21	266	8%
1993	2	4	79	5%	2004	3	8	258	3%
1993	3	4	82	5%	2004	4	4	253	2%
1993	4	0	81	0%	2005	1	6	248	2%
1994	1	6	82	7%	2005	2	10	248	4%
1994	2	4	82	5%	2005	3	12	249	5%
1994	3	7	135	5%	2005	4	4	257	2%
1994	4	4	142	3%	2006	1	7	251	3%
1995	1	3	142	2%	2006	2	23	238	10%
1995	2	13	146	9%	2006	3	8	244	3%
1995	3	5	148	3%	2006	4	6	234	3%
1995	4	7	155	5%	2007	1	5	237	2%
1996	1	6	150	4%	2007	2	13	226	6%
1996	2	6	164	4%	2007	3	8	225	4%
1996	3	4	164	2%	2007	4	7	217	3%
1996	4	4	166	2%	2008	1	7	217	3%
1997	1	2	161	1%	2008	2	14	221	6%
1997	2	12	176	7%	2008	3	12	222	5%
1997	3	8	180	4%	2008	4	10	216	5%
1997	4	6	195	3%				Mean	4%