Banks' Non-Interest Income and Systemic Risk

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Motivation (1)

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

- Two types of banking 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)
    - Trading income
    - Investment banking and venture capital income
   - Others: fiduciary income, deposit services charges, credit card fees

Non-interest to interest income ratio

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:

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

Non-interest to interest income ratio
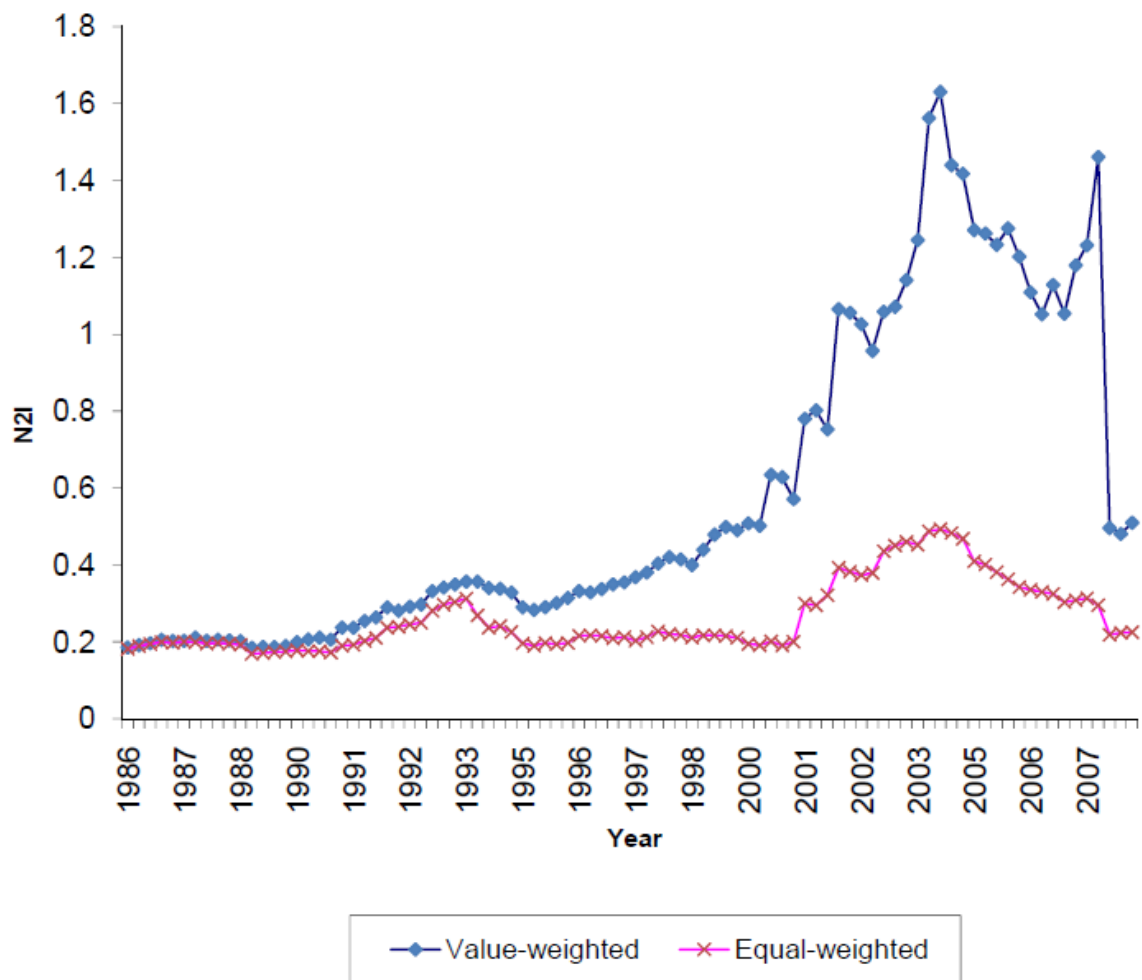
Motivation (2)

- 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 <u>essential services</u>. There is not, however, a similar rationale for public funds – taxpayer funds – protecting and supporting essentially proprietary and <u>speculative activities</u>"*

Research Questions

- Are non-conventional banking activities (non-interest income) associated with higher or lower systemic risk?

- What is the economic magnitude of the *specific* non-conventional banking activity (trading and venture banking) 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

- 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 $\Delta CoVaR$ *and 5.4% when SES*

- Glamour banks, high leverage banks, and larger banks contributed more to systemic risk

- Both trading income and investment banking/venture capital income to be *equally* significantly related to systemic risk

- Banks with higher trading income one-year before the recession earned lower returns during the recession period

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
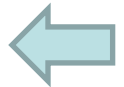
  - Acharya, Pedersen, Philippon,& Richardson ('10): SES
    - systemic expected shortfall which is the expected amount a bank is undercapitalized in a systemic event in which the entire financial system is undercapitalized
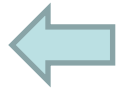
  - Allen, Bali and Tang ('10):*CATFIN* measure
    - principal components of the 1% *VaR* and expected shortfall, using estimates of the generalized Pareto distribution, skewed generalized error distribution, and a non-parametric distribution

Related Literature (2)

- 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

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
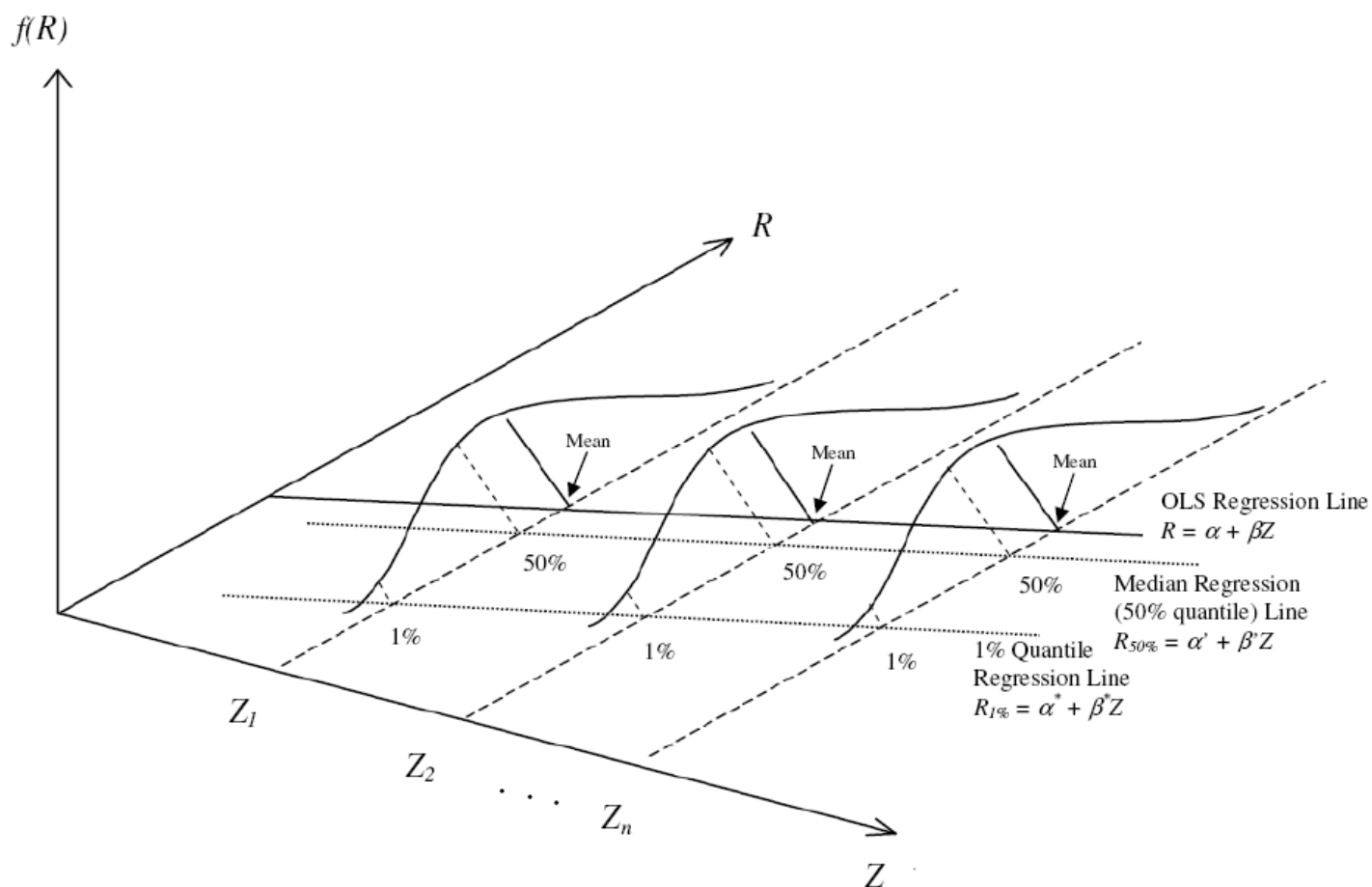
Systemic Risk: ΔCoVaR

- 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

- 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

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
  - Glamour banks, highly leveraged, and larger banks

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

Empirical Results (2)

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

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

Empirical Results (3)

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

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

Robustness (1)

- Is it interest income? No

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

Robustness (2)

- Is it interest income?   No

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

Robustness (3)

- Systemic risk contributions the real economy? Yes
  - Using CRSP market return as proxy for overall economy

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

Robustness (4)

- Systemic risk contributions the real economy? Yes
  - Using CRSP market return as proxy for overall economy

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

Robustness (5)

- Cross-sectional v. time-series?   Cross-sectional

Year	Quarter	# Changes	# TotalBanks	#Changes / #TotalBanks	Year	Quarter	# Changes	# TotalBanks	#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%

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)