Banks Exposure to Interest Rate Risk and the Transmission of Monetary Policy

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What we do in the paper

- What is income gap?:

Δ (cash flows) = (interest sensitive assets – liabilities) x Δshort rate

income gap

- Effect on cash-flows potentially large:
    - bank-level data (BHC) over 1986-2011
    - Aggregate gap = +20% of aggregate assets
    - +100bp $\rightarrow$ earnings = + 0.2 x 100bp = +0.2% of assets

- Our question: how does it affect lending ?

Contributions

- Document income gap
  - with bank-level data; large panel
  - Cross-section vs. time-series
  - Hedging seems minor:
    - Gap x interest affects cash flows & stock prices
    - Purnanandam (07), Begeneau & al (12), English&al (13)

- Show impact on lending
  - Using cross-sectional variation in income gap & time variation in interest rates
  - Failure of M&M in banks
    - Kashyap & Stein (95,00), Campello (01)

literature

- Monetary policy channel
  - use micro data to control for credit demand
  - kashyap&stein (95,00): size, liquidity
  - campello (02): internal capital markets

- Interest rate risk:
  - Non financials: chava-purnanandam (07); chernenko&faulkender (11)
  - Flannery&James (84); Vickery (2008); English&al. (2012)
  - purnanandam (07): capital structure.
  - begeneau, piazessi, schneider (12): speculation

- Investment-to-cash flow sensitivity in CF

Roadmap

1. Documenting income gap

2. Effect on lending

BHC "Call Reports" codebook

Schedule HC-H—Interest Sensitivity[1]

	Dollar Amounts in Thousands	BHCK
1. Earning assets that are repriceable within one year or mature within one year		3197
2. Interest-bearing deposit liabilities that reprice within one year or mature within one year included in item 13.a.(2) and 13.b.(2) on Schedule HC, Balance Sheet................................		3296
3. Long-term debt that reprices within one year included in items 16 and 19.a on Schedule HC, Balance Sheet................................		3298
4. Variable-rate preferred stock (includes both limited-life and perpetual preferred stock).....................		3408
5. Long-term debt reported in Schedule HC, item 19.a on the Balance Sheet that is scheduled to mature within one year................................		3409

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1. Bank holding companies with foreign offices have the option of excluding the smallest of such non-U.S. offices from co
ule. Such bank holding companies may omit the smallest of their offices in foreign countries when arrayed by total asse
assets of the excluded offices do not exceed 50 percent of the total assets of the bank holding company's assets in for
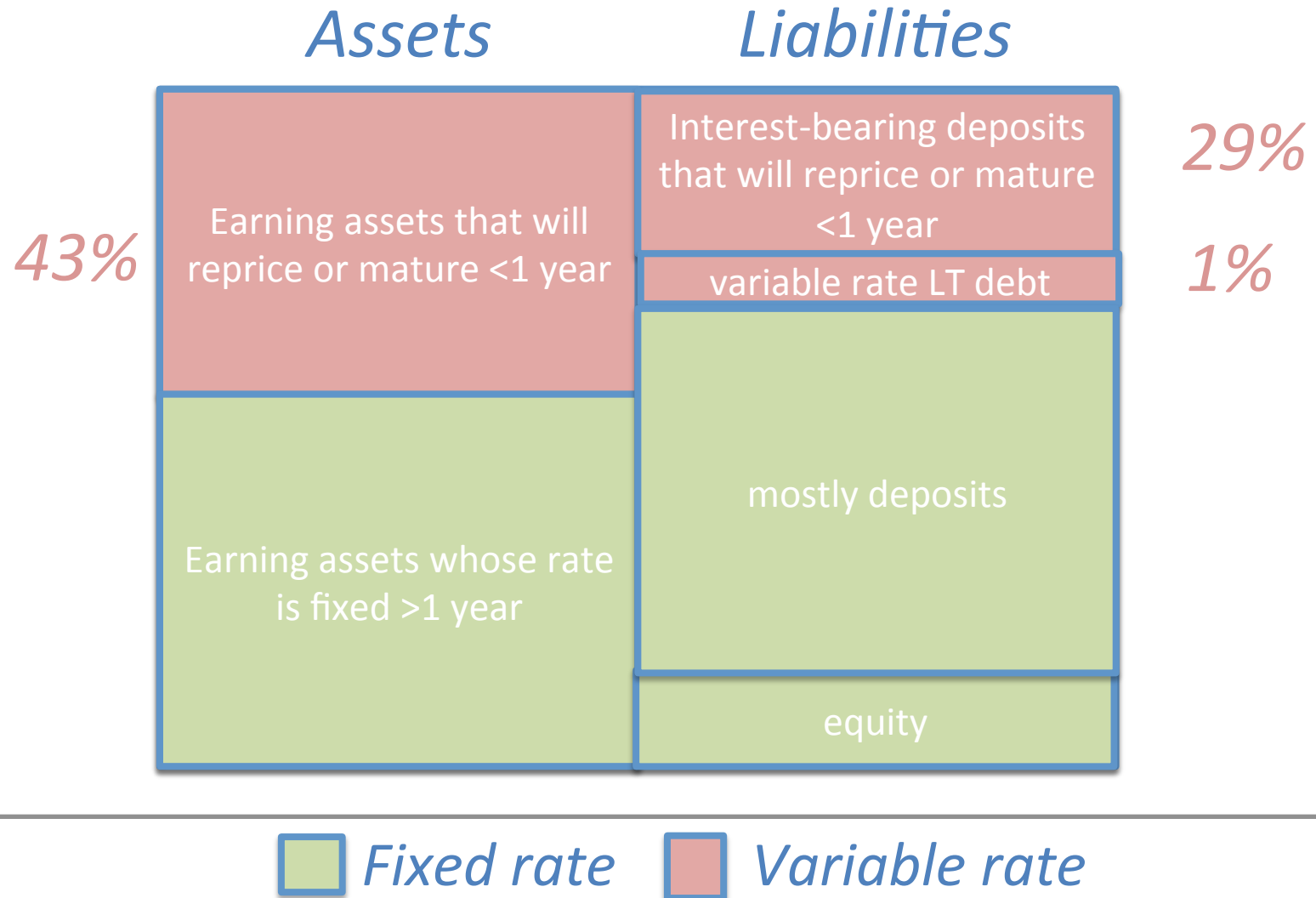10 percent of the bank holding company's total consolidated assets as of the report date.

Descriptive Statistics

- mean gap = 13% of assets

- Cross-sectional dispersion: p25=0%, p75=25%

- Aggregate gap = 20% of aggregate assets

How come average gap is >0 ?
- ST liabilities do not include transaction and savings deposits (rightly so: Hannan&Berger (1991))

"Average bank" in the BHC data

Assets | Liabilities

43% Earning assets that will reprice or mature <1 year

29% Interest-bearing deposits that will reprice or mature <1 year

1% variable rate LT debt

Earning assets whose rate is fixed >1 year

mostly deposits

equity

Fixed rate   *Variable rate*

Time-series of income gap
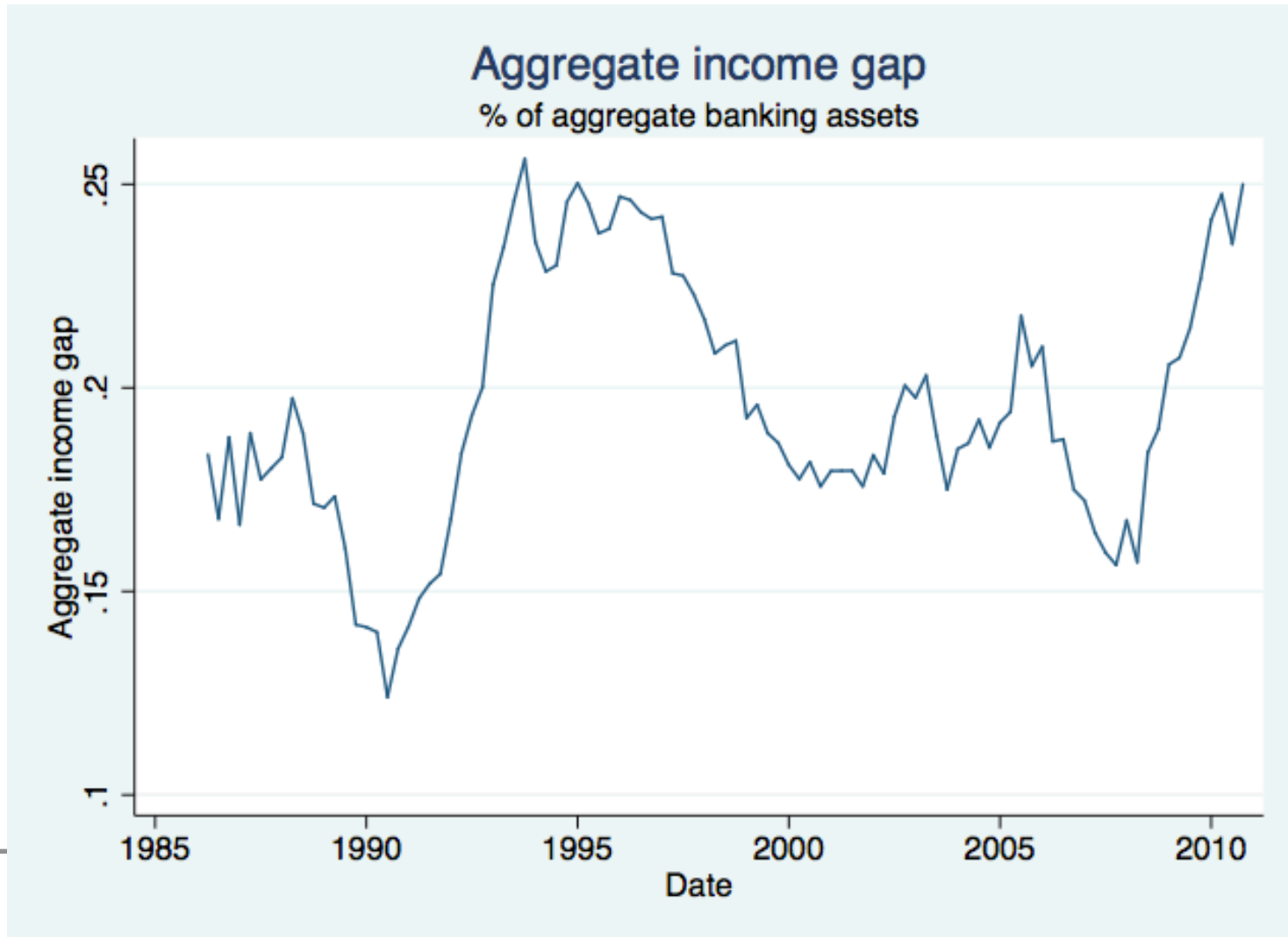
How much information is there?

- Our measure of Income gap is noisy:
    - Ignores exact repricing dates. (yearly horizon)
    - Hedging can mitigate accounting income gap impact.

- First look at impact on income directly:
    - Follows literature (Kashyap & Stein, Campello, etc.)
    - Regress **Δcash flow$_{it}$** on **Income Gap$_{it-1}$ x ΔFedFunds$_{t-k}$**
    - Control for:
        - **Bank Size$_{it-1}$ x ΔFedFund$_{st-k}$**, k=0,1,…,4
        - **Bank Equity Ratio$_{it-1}$ x ΔFedFund$_{st-k}$**, k=0,1,…,4
    - All variables normalized by lagged total assets

Noisy (5c per $ of gain), yet strongly significant

	$\Delta \text{Interest}_{it}$				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.018***	.018***	.016	.035***	.014
	(3)	(2.9)	(.77)	(3.3)	(1.6)
$Gap_{it-1} \times \Delta FedFunds_{t-1}$	.039***	.039***	.027*	.031***	.047***
	(6.3)	(5.9)	(1.7)	(3.1)	(4.9)
$Gap_{it-1} \times \Delta FedFunds_{t-2}$	.0035	.0033	.02	.0077	-.00023
	(.76)	(.67)	(1.5)	(.96)	(-.034)
$Gap_{it-1} \times \Delta FedFunds_{t-3}$	.0078	.005	.022	-.0057	.013*
	(1.6)	(1)	(1.5)	(-.64)	(1.9)
$Gap_{it-1} \times \Delta FedFunds_{t-4}$	-.0083*	-.0075	-.023	.0032	-.021***
	(-1.8)	(-1.6)	(-1.5)	(.43)	(-3.2)
N	28588	24931	3657	8237	12770
r2	.11	.11	.12	.13	.094
Sum of gap coefficients	.05	.05	.06	.07	.05
p-value of gap coefficients	0	0	0	0	0
p-value of equality test		.83		.19	
Sum of size coefficients	0	0	0	0	0
p-value of size coefficients	0	0	.23	.63	0
Sum of equity coefficients	0	-.01	.02	0	.05
p-value of equity coefficients	.88	.83	.88	.92	.09

No difference between large&small banks

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Hedging does not matter – not surprising here

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Placebo Regression: Non Interest Income

	ΔNon Interest Income$_{it}$				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	-.0083	-.0077	-.036	-.029	.013
	(-.54)	(-.51)	(-.47)	(-1.4)	(.45)
$Gap_{it-1} \times \Delta FedFunds_{t-1}$	.04**	.042**	.11	.071***	.0066
	(2.4)	(2.5)	(1.5)	(3.1)	(.2)
$Gap_{it-1} \times \Delta FedFunds_{t-2}$	.0033	.0012	-.037	-.00013	.00046
	(.24)	(.09)	(-.44)	(-.0062)	(.017)
$Gap_{it-1} \times \Delta FedFunds_{t-3}$	-.013	-.02	.013	-.039	.028
	(-.99)	(-1.5)	(.23)	(-1.5)	(1.3)
$Gap_{it-1} \times \Delta FedFunds_{t-4}$	-.031**	-.018	-.087	-.0028	-.075**
	(-2)	(-1.3)	(-1.1)	(-.16)	(-2.3)
N	22671	20993	1678	7704	8699
r2	.91	.91	.91	.9	.89
Sum of gap coefficients	0	0	-.03	0	-.02
p-value of gap coefficients	.58	.85	.69	.96	.32
p-value of equality test			.71		.44
Sum of size coefficients	0	0	-.02	0	0
p-value of size coefficients	.25	.66	.17	.61	.22
Sum of equity coefficients	.14	.07	.48	-.04	.4
p-value of equity coefficients	.2	.5	.2	.76	.05

No effect, as expected

Effect on interest income leads to effect on earnings

	$\Delta Earnings_{it}$				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.031***	.031***	.071*	.041***	.038**
	(3.6)	(3.5)	(1.7)	(2.8)	(2.4)
$Gap_{it-1} \times \Delta FedFunds_{t-1}$	.032***	.035***	-.015	.051***	.028*
	(3.2)	(3.4)	(-.41)	(2.7)	(1.8)
$Gap_{it-1} \times \Delta FedFunds_{t-2}$	.0022	.0042	-.029	-.018	.019
	(.25)	(.45)	(-1.1)	(-1.1)	(1.4)
$Gap_{it-1} \times \Delta FedFunds_{t-3}$	.011	.0079	.045	.017	.0093
	(1.3)	(.91)	(1.4)	(.97)	(.67)
$Gap_{it-1} \times \Delta FedFunds_{t-4}$	.0017	.0014	.019	.013	-.012
	(.21)	(.16)	(.61)	(.83)	(-.87)
N	26992	23453	3539	7856	11975
r2	.21	.22	.25	.24	.22
Sum of gap coefficients	.07	.07	.09	.1	.08
p-value of gap coefficients	0	0	.01	0	0
p-value of equality test			.74		.36
Sum of size coefficients	0	0	0	0	0
p-value of size coefficients	0	0	.94	.48	.05
Sum of equity coefficients	.15	.17	.16	-.03	.27
p-value of equity coefficients	.17	.13	.57	.75	.18

# No effect of hedging (consistent with Begeneau et al. 2012)

	$\Delta Earnings_{it}$				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.031***	.031***	.071*	.041***	.038**
	(3.6)	(3.5)	(1.7)	(2.8)	(2.4)
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Sum of equity coefficients	.15	.17	.16	-.03	.27
p-value of equity coefficients	.17	.13	.57	.75	.18

Effect on Market Values

		$\Delta MarketValue_{it}$			
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.68**	.76**	.57	1.4***	.78*
	(2.1)	(2.2)	(.57)	(2.6)	(1.8)
$Gap_{it-1} \times \Delta FedFunds_{t-1}$	.46	.41	1	.71	.74*
	(1.5)	(1.2)	(1.1)	(1.1)	(1.7)
$Gap_{it-1} \times \Delta FedFunds_{t-2}$	.18	.18	-.23	.65	-.062
	(.59)	(.55)	(-.28)	(1.1)	(-.14)
$Gap_{it-1} \times \Delta FedFunds_{t-3}$	.16	.094	.27	-.9*	.9**
	(.56)	(.32)	(.24)	(-1.7)	(2.5)
$Gap_{it-1} \times \Delta FedFunds_{t-4}$	.27	.31	.18	.82*	-.33
	(1.3)	(1.4)	(.2)	(1.8)	(-.97)
N	15556	13372	2184	4684	7931
r2	.33	.33	.43	.34	.35
Sum of gap coefficients	1.8	1.8	1.8	2.6	2
p-value of gap coefficients	0	0	.04	0	0
p-value of equality test			.94		.37
Sum of size coefficients	.04	-.03	.03	0	.08
p-value of size coefficients	.12	.53	.72	.94	.02
Sum of equity coefficients	3.8	4	4	4.8	4.4
p-value of equity coefficients	.17	.2	.51	.38	.15

Remark: implies earnings multiple of 25

Response to the 2004-2006 tightening:

Stock prices of US banks
by quartile of interest rate exposure as of 2003
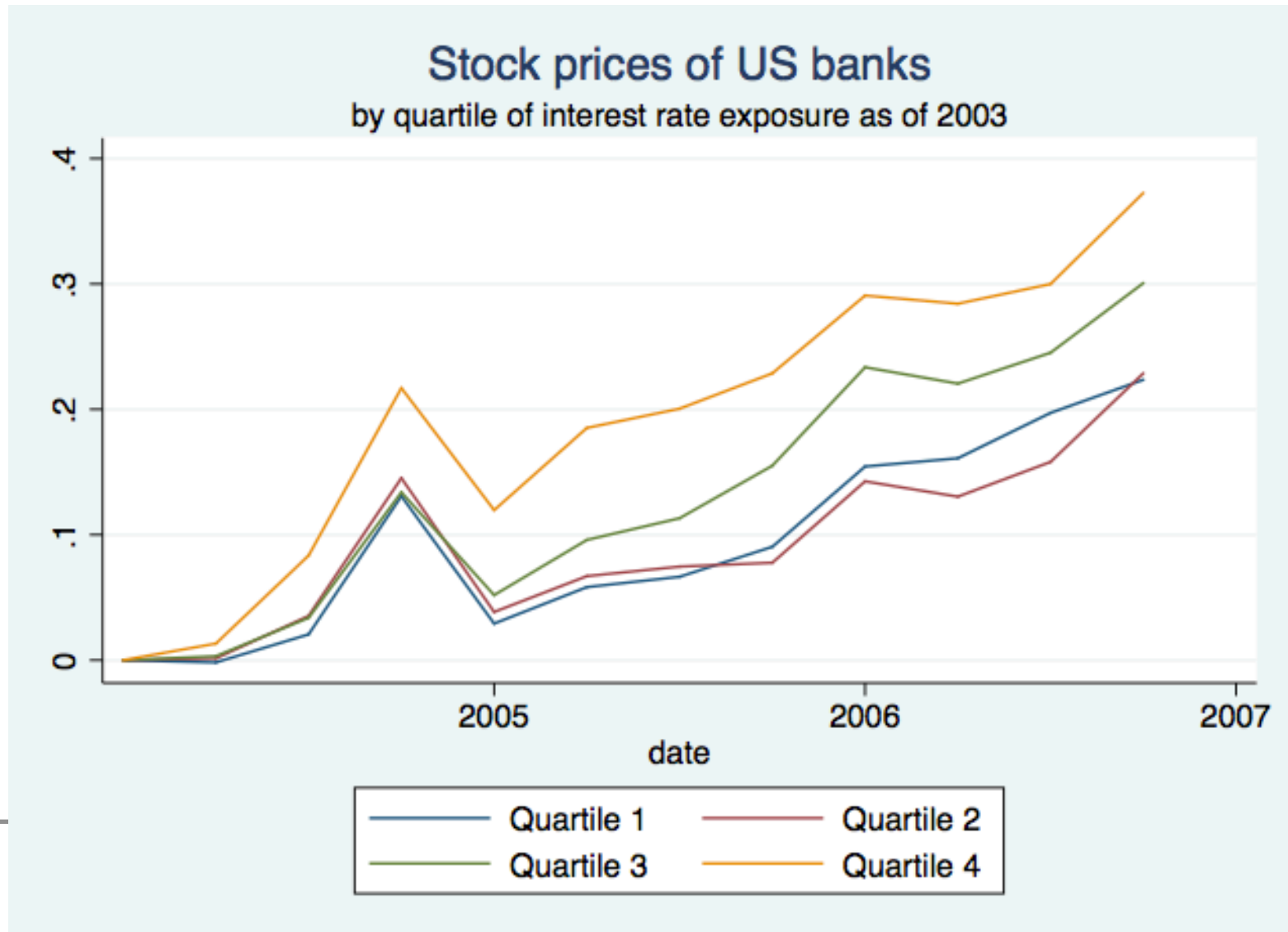
Macro relevance: impact on aggregate bank earnings

Table 6: Explaining Aggregate Bank Earnings with Income Gap

Dependent Variable	Aggregate Banks Earnings / Assets$_t$			
	Robust OLS		Newey-West	
	(1)	(2)	(3)	(4)
Fed Funds Rate$_t$	.00075	-.1***	-.1*	-.097*
	(.1)	(-3)	(-2)	(-2)
Income Gap$_{t-1}$ × Fed Funds$_t$		.59***	.59**	.58**
		(3.6)	(2.5)	(2.4)
Income Gap$_{t-1}$		-.009	-.009	-.0089
		(-.9)	(-.57)	(-.54)
Trend				.000017
				(.42)
Observations	98	97	97	97
R^2	.00016	.22		

Does it affect lending?

- Follow literature (Kashyap & Stein, Campello)

- Regress Lending Growth$_{it}$ on:

  – **Income Gap$_{it-1}$ x ΔFedFunds$_{t-k}$** k=0,1,…,4

  – **Bank Size$_{it-1}$ x ΔFedFund$_{st-k}$,** k=0,1,…,4

  – **Bank Equity Ratio$_{it-1}$ x ΔFedFund$_{st-k}$,** k=0,1,…,4

+100bp and gap from 25th to 75th ➜ Loan Growth: + 0.4 ppt.

	$\Delta \log(C\&I)$				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.013	.18	-2	.036	-.58
	(.02)	(.25)	(-.99)	(.03)	(-.56)
$Gap_{it-1} \times \Delta FedFunds_{t-1}$	.82	.72	2.6*	.7	1.1
	(1.2)	(.96)	(1.7)	(.55)	(1)
$Gap_{it-1} \times \Delta FedFunds_{t-2}$	1.1	1.1	.92	.2	.66
	(1.6)	(1.4)	(.53)	(.14)	(.7)
$Gap_{it-1} \times \Delta FedFunds_{t-3}$	1.4**	1.3*	1.5	3.3**	1.9**
	(2)	(1.7)	(.73)	(2)	(2.2)
$Gap_{it-1} \times \Delta FedFunds_{t-4}$	-1.3**	-1.2*	-1.6	-1.7	-2.4***
	(-2.1)	(-1.8)	(-.77)	(-1.2)	(-2.6)
N	29614	25577	4037	8440	12994
r2	.097	.095	.17	.081	.12
Sum of gap coefficients	2	2	1.4	2.6	.72
p-value of gap coefficients	0	0	.58	.03	.5
p-value of equality test		.79		.25	
Sum of size coefficients	.23	.19	.96	.15	.29
p-value of size coefficients	0	.2	0	.74	.01
Sum of equity coefficients	-12	-12	-12	2.6	-22
p-value of equity coefficients	.05	.07	.52	.76	0

Equity and size also go in the right direction

Effect smaller on large banks but difference insignificant

	$\Delta\log$(C&I)				
	All	Small	Big	No Hedge	Some Hedge
$Gap_{it-1} \times \Delta FedFunds_t$	.013	.18	-2	.036	-.58
	(.02)	(.25)	(-.99)	(.03)	(-.56)
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Hedging reduces sensitivity to gap, but difference is insignificant

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Credit multiplier

- How many $ of ΔLoans do we get per additional $ of ΔEarnings?
  - We know that $1 of income gap → 7 cents of earnings
  - And estimate that 1$ of income gap → 81 cents of loans

➔ Multiplier = 0.81 / 0.07 = 11

Duration Gap vs. Income Gap

- Flows vs. stock effect ?
- When we include short and long rates x gap, only short rates x gap are significant

Robustness

1. Control for Liquid Assets x ΔFedFund
    –   Kashyap & Stein (2000), reduces obs. to 1993-2011
    –   not same sample: BHC not call reports

2. Alternative specification used in the literature:
    –   Time series of cross-sectional « loan to gap » sensitivity regressed on interest rates.

Conclusion

- Heterogeneity in income gap leads to differences in reaction to monetary policy

- When rates increase, banks with higher income gap tighten credit less

- Can be interpreted as reaction of risky investment to cash-flow shocks
    - →an instrument would be great