The Shadow Cost of Bank Capital Requirements

Roni Kisin
Washington University in St. Louis

Asaf Manela
Washington University in St. Louis

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Capital Requirements Policy Debate

- Prominent economists and policy-makers call for a substantial increase in capital requirements for financial intermediaries
- Benefits: reduced risk of costly disruptions and bailouts
- Proposals met fierce and successful opposition from banks
- Banks' *private costs* play a central role in shaping regulation
- But, these costs have not been measured empirically

Revealed Preference Approach

Look at what banks do, not what they say

- Banks used a costly loophole to bypass capital requirements
  - ABCP loophole (Acharya, Schnabl, and Suarez, 2013)
- Banks trade off loophole's cost vs. benefit of reduced capital
- Loophole use reveals the shadow costs of capital requirements
- Avoids estimating demand elasticities and other unobservables (Anderson and Sallee, 2011)

Results Summary

Substantially increasing capital requirements only modestly affects bank profitability

- 10 pp increase (e.g., from 6% to 16%) would cost all banks that exploited the loophole combined
  - $2.2 billion for Tier 1 risk-based capital ratio
  - $2.2 billion for Tier 1 leverage ratio
  - $1.6 billion for Total risk-based capital ratio
- Average bank's cost is $143 million, or 4% of annual profits
- No more than $3.7 billion for all US banks combined

Regulatory Capital Ratios

US Banks are considered *well-capitalized* by their regulator if

1. Leverage ratio $= \dfrac{\text{Tier 1 capital}}{\text{Average total assets}} \geq 3\%$ to 5%
2. Tier 1 risk-based capital ratio $= \dfrac{\text{Tier 1 capital}}{\text{Risk-weighted assets}} \geq 6\%$
3. Total risk-based capital ratio $= \dfrac{\text{Total risk based capital}}{\text{Risk-weighted assets}} \geq 10\%$

- Banks face greater regulatory scrutiny if not well-capitalized
- Banks keep a capital cushion to prevent regulatory scrutiny (Berger, DeYoung, Flannery, Lee, and Oztekin, 2008)

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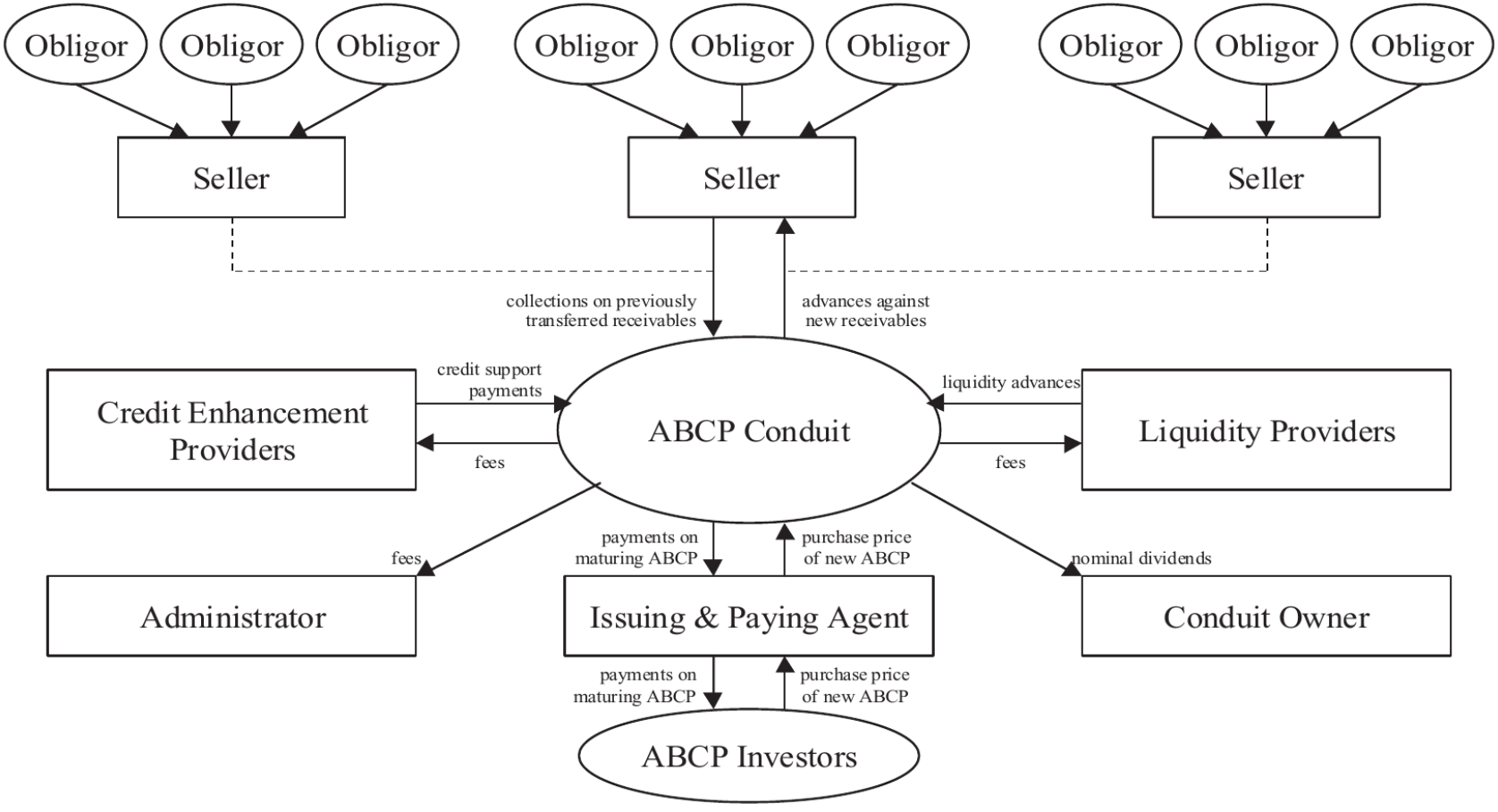
Asset-backed Commercial Paper (ABCP) Programs



Source: Moody's (2003)

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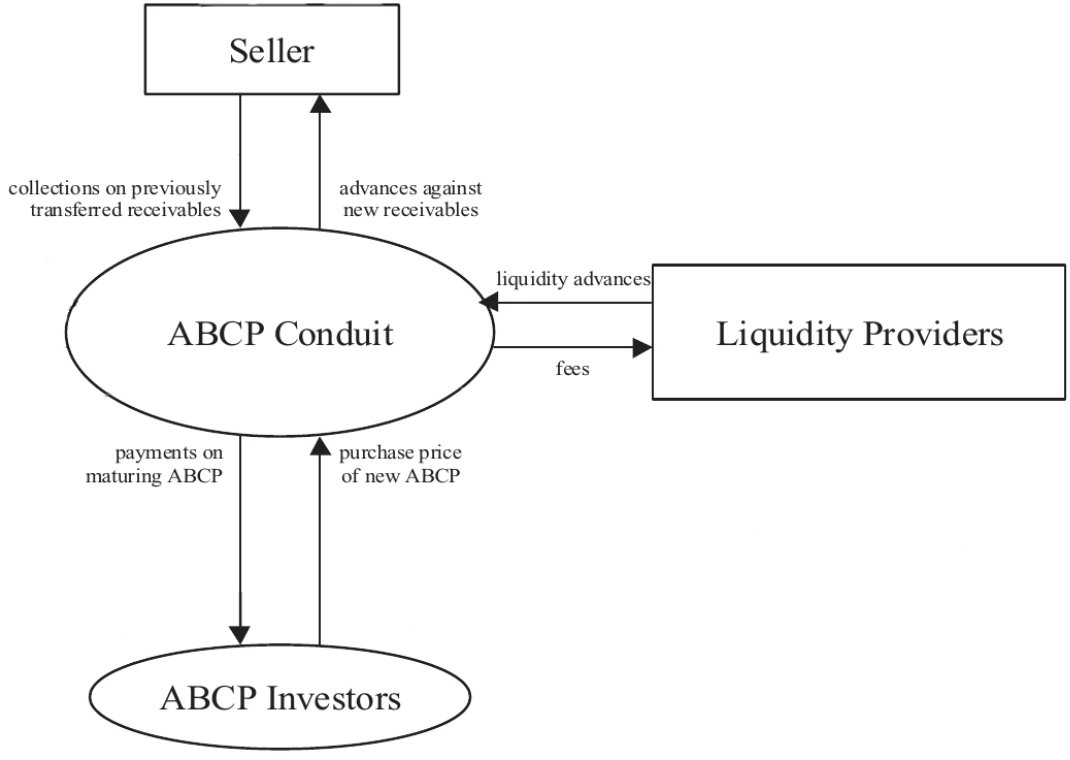

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Regulatory Treatment of ABCP Liquidity Guarantees

- ABCP liquidity guarantees got special regulatory treatment
- Their conversion factor into balance sheet equivalents was
  - $\beta_{ABCP} = 0\%$ until September 2004
  - $\beta_{ABCP} = 10\%$ until January 2010 when loophole was closed
- Acharya, Schnabl, and Suarez (2013): financing assets through ABCP is securitization without risk transfer
  - Special treatment was justified by conditionality of guarantees
  - But, short-term ABCP stops rolling over long before long-term assets stop performing
  - Liquidity guaranteeing bank effectively assumes all the risk in the loans, without a capital charge
- Role of ABCP loophole was widely recognized at the time

Banks

- Oligopolistic banks maximize profits

$$\max_{\mathbf{r},k,\theta} \Pi = \sum_j \left[r_j - c\left(k\right) - \alpha\theta\right] q_j\left(\boldsymbol{r}\right) - I\left(\theta > 0\right) \times F$$

subject to a regulatory capital constraint

$$K\left(\boldsymbol{q}, k, \theta\right) \geq \sigma$$

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$$\underbrace{\alpha}_{\text{cost}} = \underbrace{\lambda K_\theta}_{\text{benefit}}$$

where λ is the shadow price per dollar of the capital constraint

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$$-\frac{\partial \Pi^*}{\partial \sigma}\frac{1}{Q} = \lambda \leq \frac{\alpha}{K_\theta} \tag{1}$$

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Discussion

$$-\frac{\partial \Pi^*}{\partial \sigma}\frac{1}{Q} = \lambda = \frac{\alpha}{K_\theta} \text{ if } \theta \in (0,1)$$

1. λ measures each bank's marginal compliance costs in equilibrium
   - But, regulatory changes apply to the whole industry
   - Maybe, but then bank would suffer less because competitors also suffer
2. Envelope theorem holds constant the endogenous choice variables (interest rates, capital structure, ABCP share)
   - But, a substantial tightening would include second-order effects
   - Maybe, but these choices are made to mitigate the loss in profits

- In both cases, we would likely *overestimate* the total effect

Shadow Costs of Regulatory Capital Constraints

- Leverage ratio shadow cost

$$\lambda^{T1Lev} = \frac{\alpha}{K^{T1Lev}} \times \frac{A}{Q}$$

- Tier 1 risk-based capital ratio shadow cost

$$\lambda^{T1RB} = \frac{\alpha}{K^{T1RB}} \times \frac{Q^r}{(1-\beta_{ABCP})\sum_j w_j q_j}$$

- Total risk-based capital ratio shadow cost

$$\lambda^{TotRB} = \frac{\alpha}{K^{TotRB}} \times \frac{Q^r}{(1-\beta_{ABCP})\sum_j w_j q_j}$$

- Shadow costs of binding constraints are positive, and zero otherwise

Sufficient Conditions for Identification

C1 Constrained banks exploit the loophole

C2 Constrained banks do not exhaust the loophole ($\theta \in (0, 1)$)

C3 Marginal borrowers do not value loans financed with ABCP conduits differently from those financed with other sources

- C1 and C2 are verified empirically
- C3 holds because dollars are dollars from the borrower's perspective
  - If conduits created additional value we would overestimate the shadow cost

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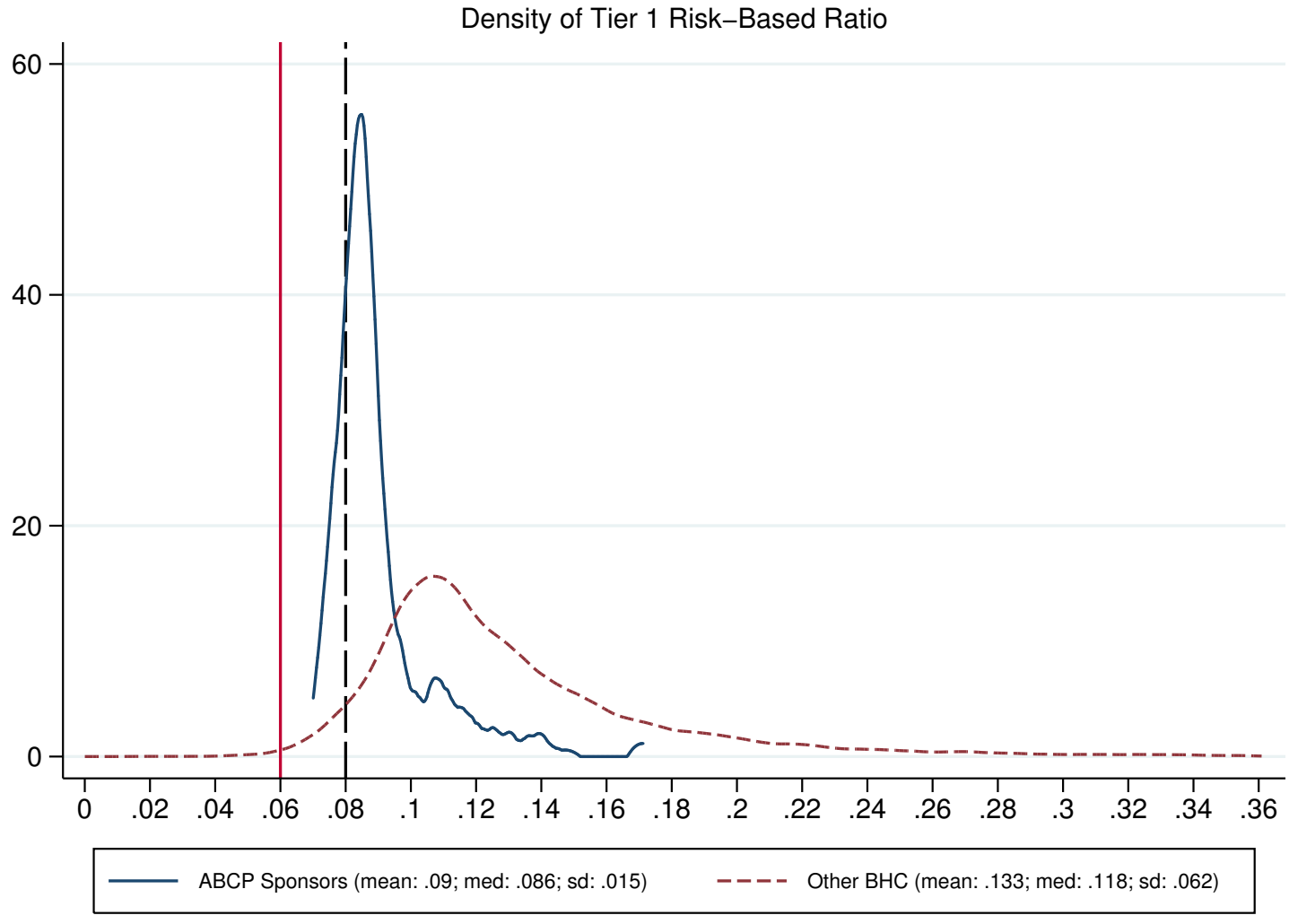
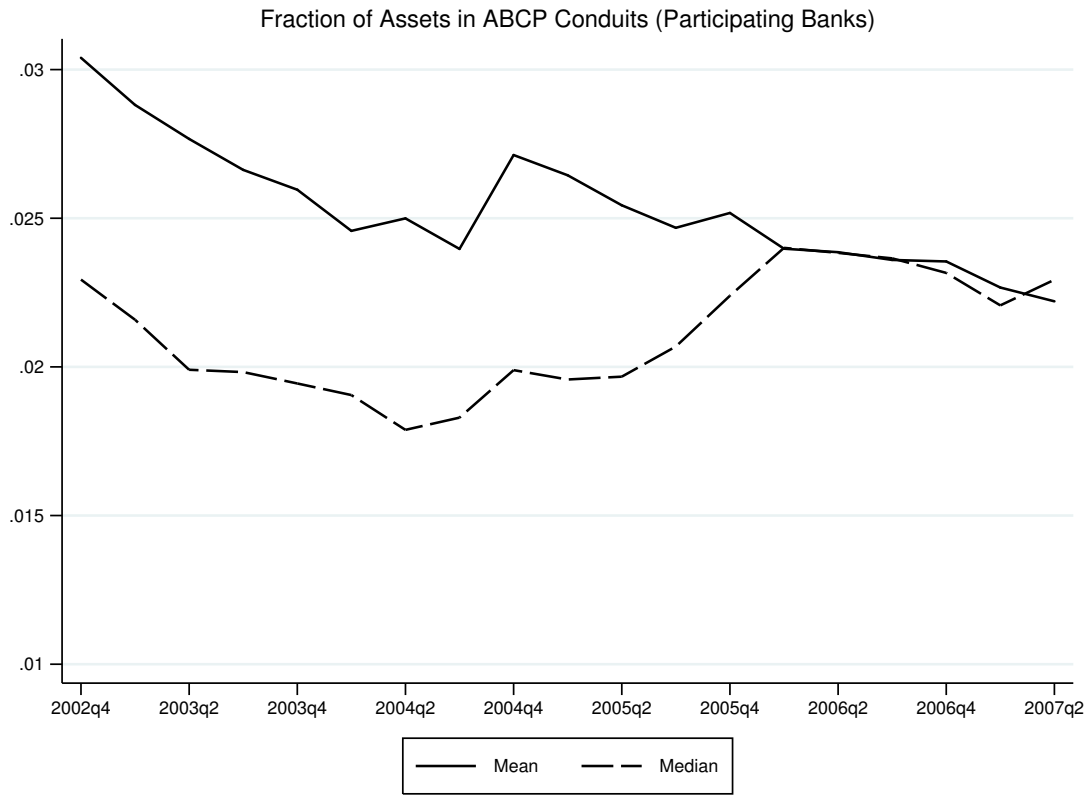
C1: Constrained Banks Exploit the Loophole

Fig. 3: ABCP sponsors bunch-up closer to the regulatory "well-capitalized" threshold



C2: Constrained Banks do not Exhaust the Loophole

Fig. 5: Average share of total assets financed with ABCP $\theta \approx 3\%$



- ABCP shares for different asset types are also interior

Estimating the Shadow Cost of Capital Requirements

Shadow cost for bank i in quarter $t = \lambda_{it} = \frac{\alpha_t Q_{it}^r}{K_{it}(1-\beta_{ABCP})\sum_j w_j q_{ijt}}$

- Some of the inputs are easy and some are hard to quantify

Estimating the Shadow Cost of Capital Requirements

Shadow cost for bank i in quarter $t = \lambda_{it} = \frac{\alpha_t Q^r_{it}}{K_{it}(1-\beta_{ABCP})\sum_j w_j q_{ijt}}$

- Regulatory risk-weighted assets Q^r_{it} and capital ratio K_{it}
  - Straightforward since BHC's report these every quarter

Estimating the Shadow Cost of Capital Requirements

Shadow cost for bank i in quarter $t = \lambda_{it} = \frac{\alpha_t Q_{it}^r}{K_{it}(1-\beta_{ABCP})\sum_j w_j q_{ijt}}$

- ABCP conversion factor β_{ABCP} applied to off-balance sheet commitments to provide liquidity to ABCP facilities is readily available
- $\beta_{ABCP} = 0\%$ prior to September 2004
- $\beta_{ABCP} = 10\%$ September 2004 until January 2010
- In January 2010 this particular loophole was closed

Estimating the Shadow Cost of Capital Requirements

Shadow cost for bank i in quarter $t = \lambda_{it} = \frac{\alpha_t Q^r_{it}}{K_{it}(1-\beta_{ABCP})\sum_j w_j q_{ijt}}$

- Total on and off-balance assets q_{ijt} with risk weight w_j is the sum of
  1. On-balance sheet assets (BHC reports)
  2. Converted off-balance sheet assets (BHC reports)
  3. ABCP liquidity guarantees by the bank (Moody's)
- We do not have risk weights for ABCP assets
- Assume first same weight distribution as rest of assets
- Robustness tests show our benchmark estimates are not sensitive to this assumption

Estimating the Shadow Cost of Capital Requirements

Shadow cost for bank i in quarter $t = \lambda_{it} = \frac{\alpha_t Q^r_{it}}{K_{it}(1-\beta_{ABCP})\sum_j w_j q_{ijt}}$

- The incremental cost of conduit assets

$$\alpha_t = \left(r_t^{ABCP,30d} - r_t^{CP,30d}\right)(1-\tau)$$

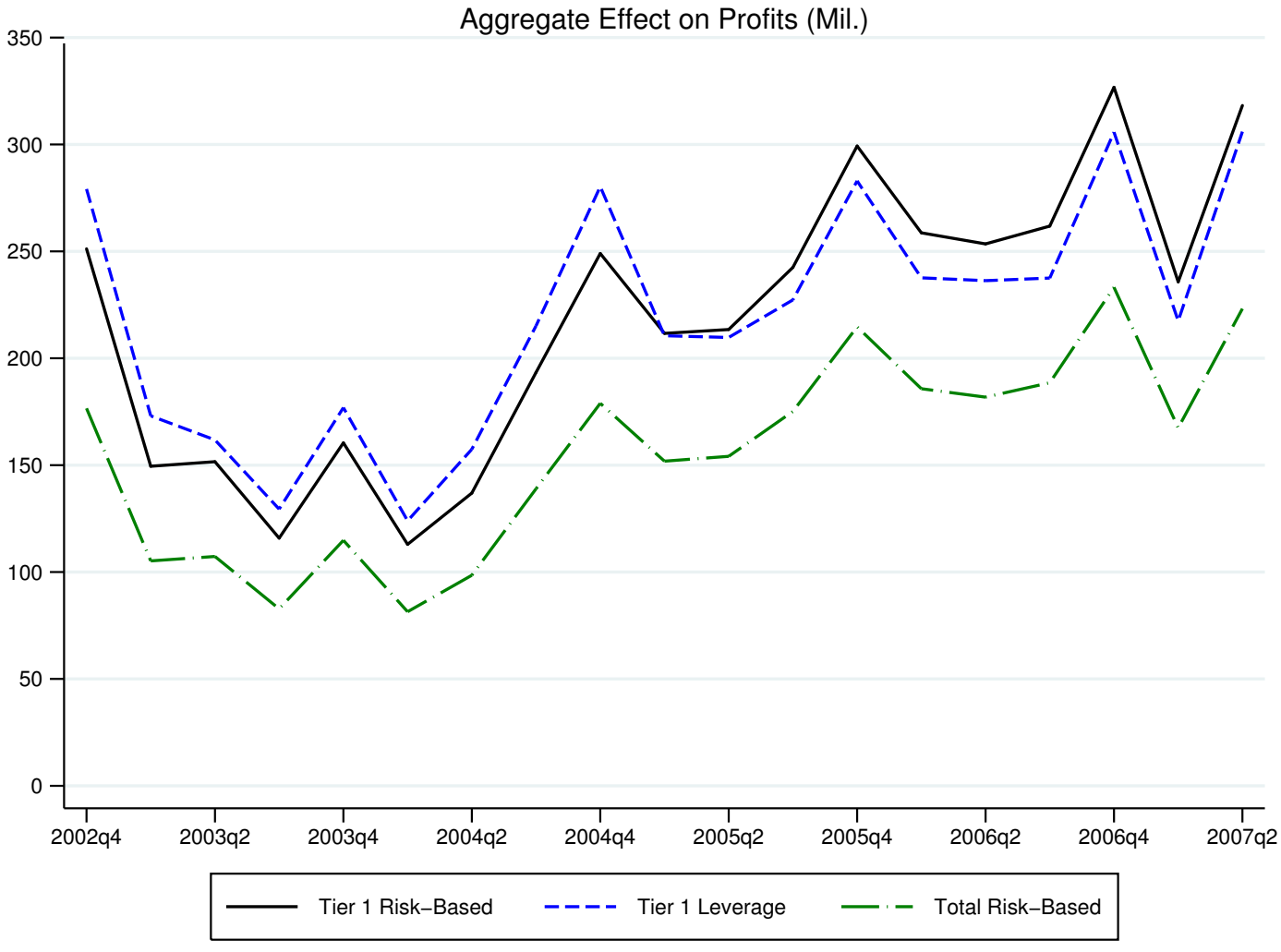
- $r_t^{ABCP,30d}$ is 30-day AA ABCP rate from the Fed
- $r_t^{CP,30d}$ is 30-day AA financial CP rate from the Fed
- $\tau = 35\%$ is corporate tax rate
- If no debt-tax-shield, estimates increase by half
- Robustness section places bounds on the incremental costs

Tbl. 3: Shadow Costs of 1 pp Increase in Regulatory Ratios

	Shadow Cost			Change in Profit (Mil.)			Change in Profit/Profit			N
	T1 RB	Tot RB	T1 Lev	T1 RB	Tot RB	T1 Lev	T1 RB	Tot RB	T1 Lev	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BANK OF AMERICA	0.0032	0.0023	0.0038	-40.9	-29.2	-47.6	-0.0025	-0.0018	-0.0030	19
BANK OF NEW YORK	0.0034	0.0022	0.0010	-13.4	-8.81	-3.83	-0.0097	-0.0063	-0.0030	19
BANK ONE	0.0023	0.0016	0.0021	-8.66	-6.30	-7.87	-0.0024	-0.0017	-0.0021	7
CITIBANK	0.0031	0.0023	0.0044	-50.7	-37.1	-71.9	-0.0028	-0.0021	-0.0041	19
COMPASS BANK	0.0030	0.0022	0.0029	-1.01	-0.76	-0.97	-0.0025	-0.0019	-0.0024	19
FIFTH THIRD BANK	0.0028	0.0023	0.0024	-3.36	-2.71	-2.83	-0.0031	-0.0025	-0.0025	19
FLEET	0.0029	0.0021	0.0023	-7.11	-5.15	-5.68	-0.0039	-0.0028	-0.0031	6
FNB OMAHA	0.0030	0.0023	0.0028	-0.39	-0.30	-0.36	-0.0037	-0.0028	-0.0035	8
JPMORGAN CHASE	0.0032	0.0022	0.0031	-48.1	-34.2	-45.2	-0.0067	-0.0047	-0.0068	19
KEYBANK	0.0031	0.0020	0.0021	-3.63	-2.37	-2.47	-0.0038	-0.0025	-0.0026	8
MARSHALL-ILSLEY	0.0034	0.0023	0.0029	-1.78	-1.21	-1.46	-0.0025	-0.0017	-0.0021	19
MELLON BANK	0.0027	0.0017	0.00071	-4.66	-3.02	-1.10	-0.0058	-0.0037	-0.0014	19
PNC BANK	0.0030	0.0021	0.0024	-3.41	-2.42	-2.65	-0.0026	-0.0018	-0.0020	19
STATE STREET	0.0021	0.0018	0.0010	-10.4	-9.10	-4.39	-0.011	-0.0096	-0.0048	19
SUNTRUST	0.0036	0.0024	0.0029	-6.62	-4.49	-5.36	-0.0037	-0.0025	-0.0030	19
US BANK	0.0031	0.0021	0.0025	-7.97	-5.28	-6.29	-0.0019	-0.0012	-0.0015	19
WACHOVIA	0.0034	0.0024	0.0031	-21.4	-14.8	-18.9	-0.0034	-0.0024	-0.0031	19
ZIONS	0.0028	0.0019	0.0024	-1.36	-0.90	-1.11	-0.0028	-0.0019	-0.0024	19
Mean	0.0030	0.0022	0.0025	-14.3	-10.2	-14.1	-0.0043	-0.0031	-0.0030	
Std. Error	[0.00020]	[0.00013]	[0.00028]	[4.39]	[3.16]	[5.42]	[0.00073]	[0.00058]	[0.00041]	

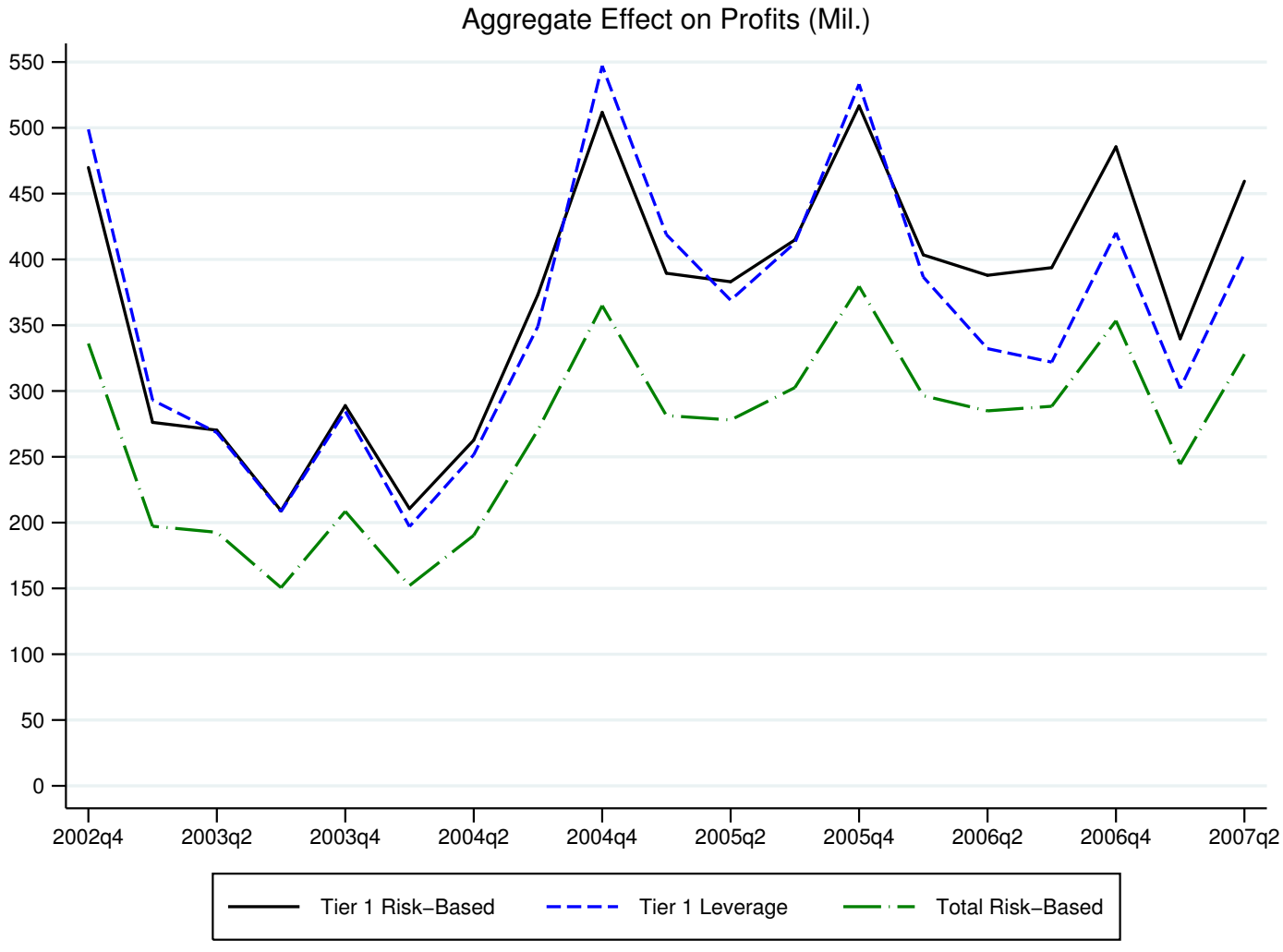
Aggregate Cost for ABCP-participating Banks

Fig. 6: Stable quarterly estimates from 0.8 to 3 billion dollars for a 10 pp increase



Aggregate Cost for All U.S. Banks, Upper Bound Estimate

Fig. 6: $3.7 billion on average for a 10 pp increase



Aggregate Cost During the Financial Crisis

- We focus on the pre-crisis period because it reveals the shadow cost of capital regulation during normal times
- Adjustment costs play a minor role pre-crisis
- But, during the crisis banks would probably reduce their ABCP exposure quickly, if they could do so cheaply
- Same 10pp increase at height of crisis period costs $58 billion
- Intuitively, relaxing constraints in times of stress is valuable

How can these costs be so modest?

- Effect on profits during an economic expansion
- After banks utilized all available tools to mitigate the impact
- Not cost of issuing additional equity
  - Hanson, Kashyap and Stein (2011):
    - 10pp increase would raise WACC by 25-45bp
  - Baker and Wurgler (2013):
    - 10pp increase would raise WACC by 60-90bp
- Not effect of distressed deleveraging
  - Peek and Rosengren (1997): large effect on quantity of lending
- A small shadow cost means
  - Banks significantly overstate the cost of capital effect, or
  - Banks can neutralize the effects of higher requirements
- One might still worry banks' would restrict lending
  - We find small effects on lending quantities and interest rates

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Broader Context

- We show how bank capital regulation loopholes can be used to produce estimates of its shadow cost
- Micro studies of the effect of regulation on industry participants and market outcomes
  - Anderson and Sallee (2011): the effect of regulatory fuel-economy standards on automakers
- Macro-finance studies of constrained financial intermediaries
  - Calibration targets for macro models with financial frictions (He and Krishnamurthy; Brunnermeier and Sannikov, 2013)
  - Koijen and Yogo (2013): the shadow cost of statutory reserve regulation for life insurers
  - A-S loophole approach avoids fully specifying the competitive equilibrium and estimating demand elasticities, markups, etc.
- Recent calibrations:
  - Nguyen (2014): GE endogenous growth model with risk shifting
  - Gornall and Strebulaev (2014): Financing as a supply chain

Unmeasured Costs of ABCP Financing (α)

- Benchmark: $\alpha_t = \left(r_t^{ABCP,30d} - r_t^{CP,30d}\right)(1-\tau)$
- We relax this assumption and instead place upper bounds on α using the FOC for economic capital ratio k

$$\tilde{\alpha}_{it} = \frac{K_{\theta,it}}{K_{k,it}} c'\left(k_{it}\right) \tag{2}$$

- In practice, $c'\left(k_{it}\right)$ is hard to measure but can be bounded

$$c'(k) = r_e - (1-\tau) r_d + k\frac{\partial r_e}{\partial k} + (1-\tau)(1-k)\frac{\partial r_d}{\partial k} \tag{3}$$

$$\leq r_e - (1-\tau) r_d \tag{4}$$

- Attain a tighter bound assuming α is uniform across banks

$$\bar{\alpha}_t \leq \min_i \frac{K_{\theta,it}}{K_{k,it}} \left[r_{e,it} - (1-\tau) r_{d,it}\right] \tag{5}$$

- Alternatively, assuming a M&M world with taxes

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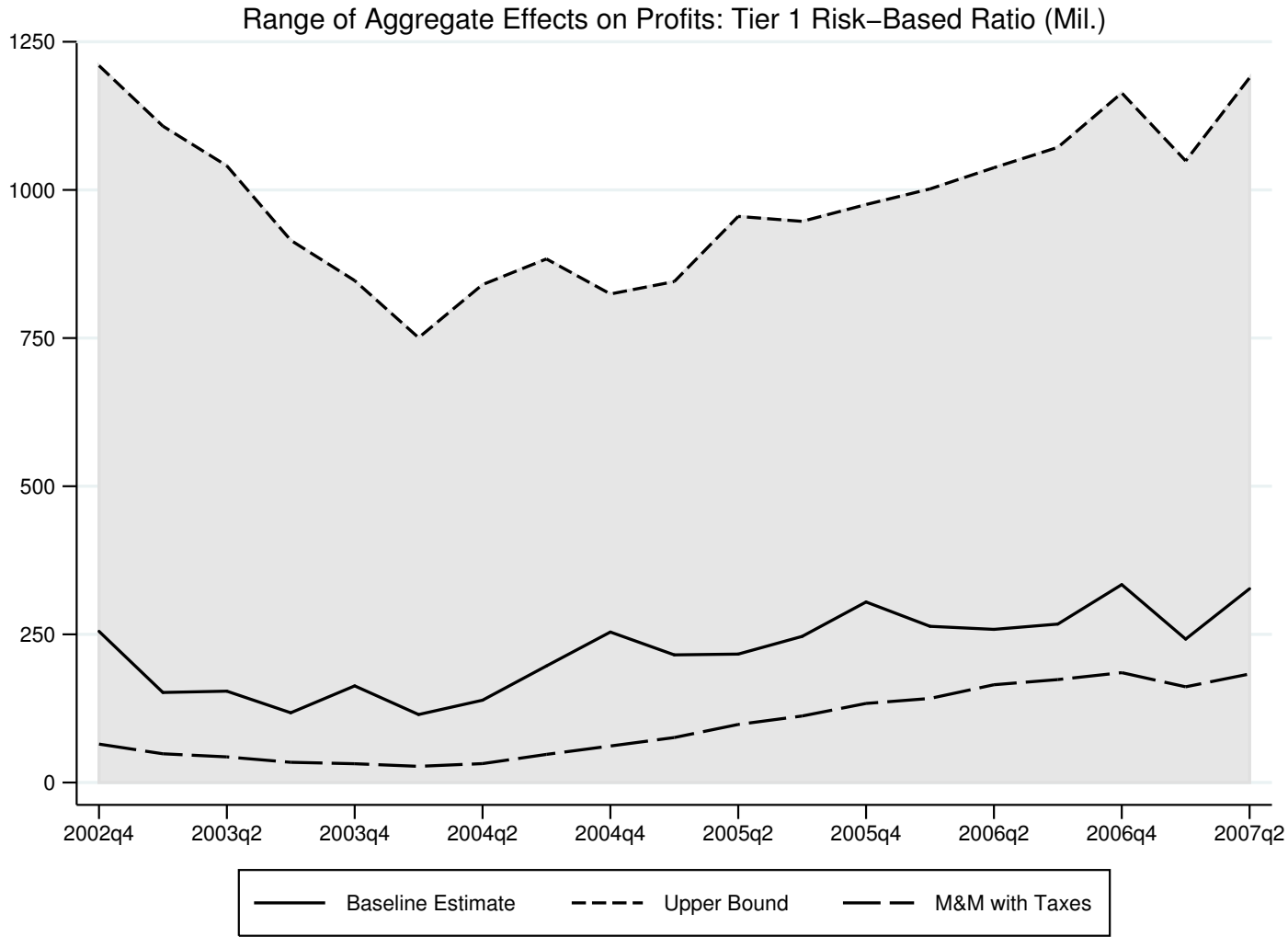
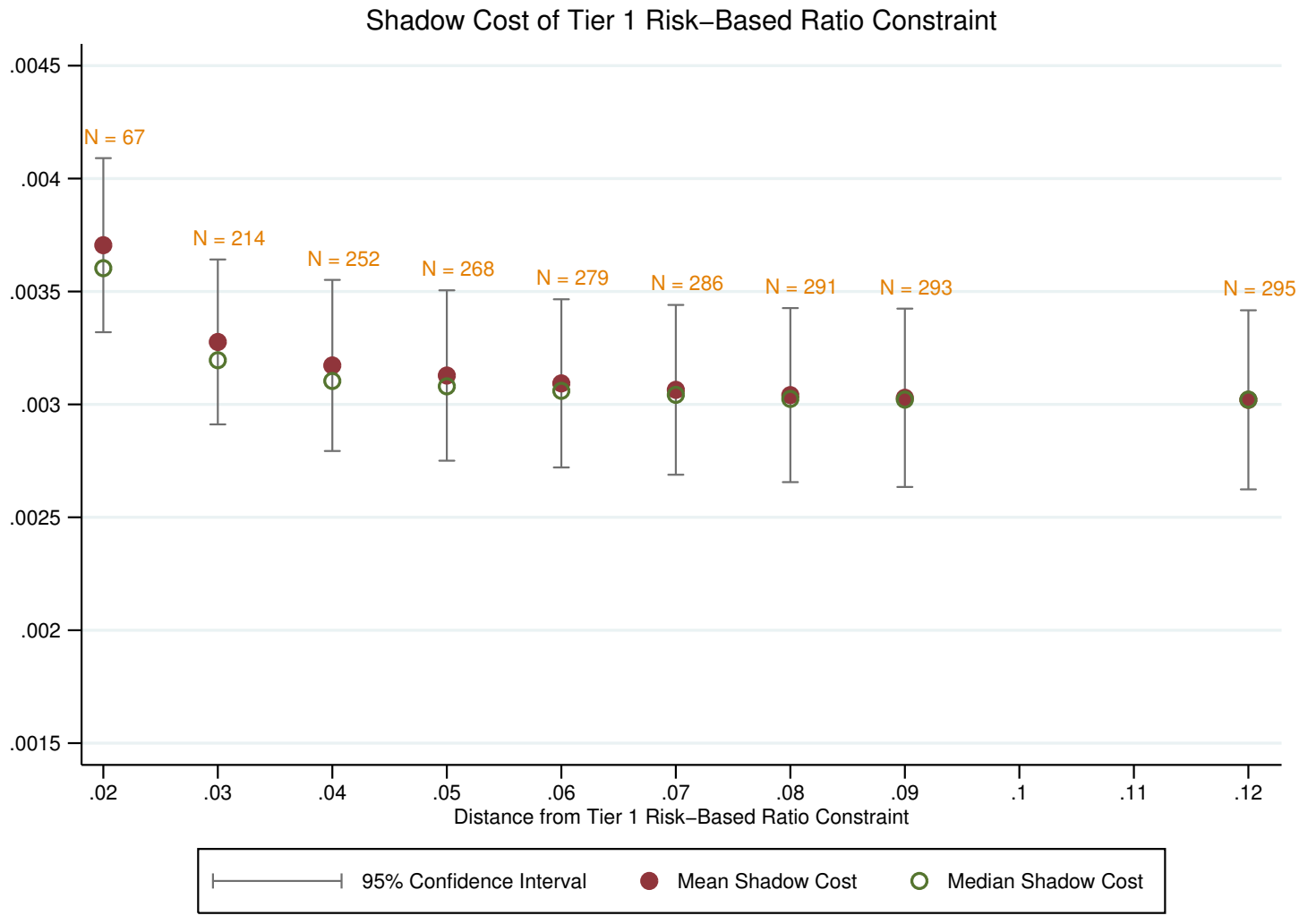
Unmeasured Costs of ABCP Financing (α)

Upper bounds on α imply shadow costs 4.5 times higher than benchmark estimates



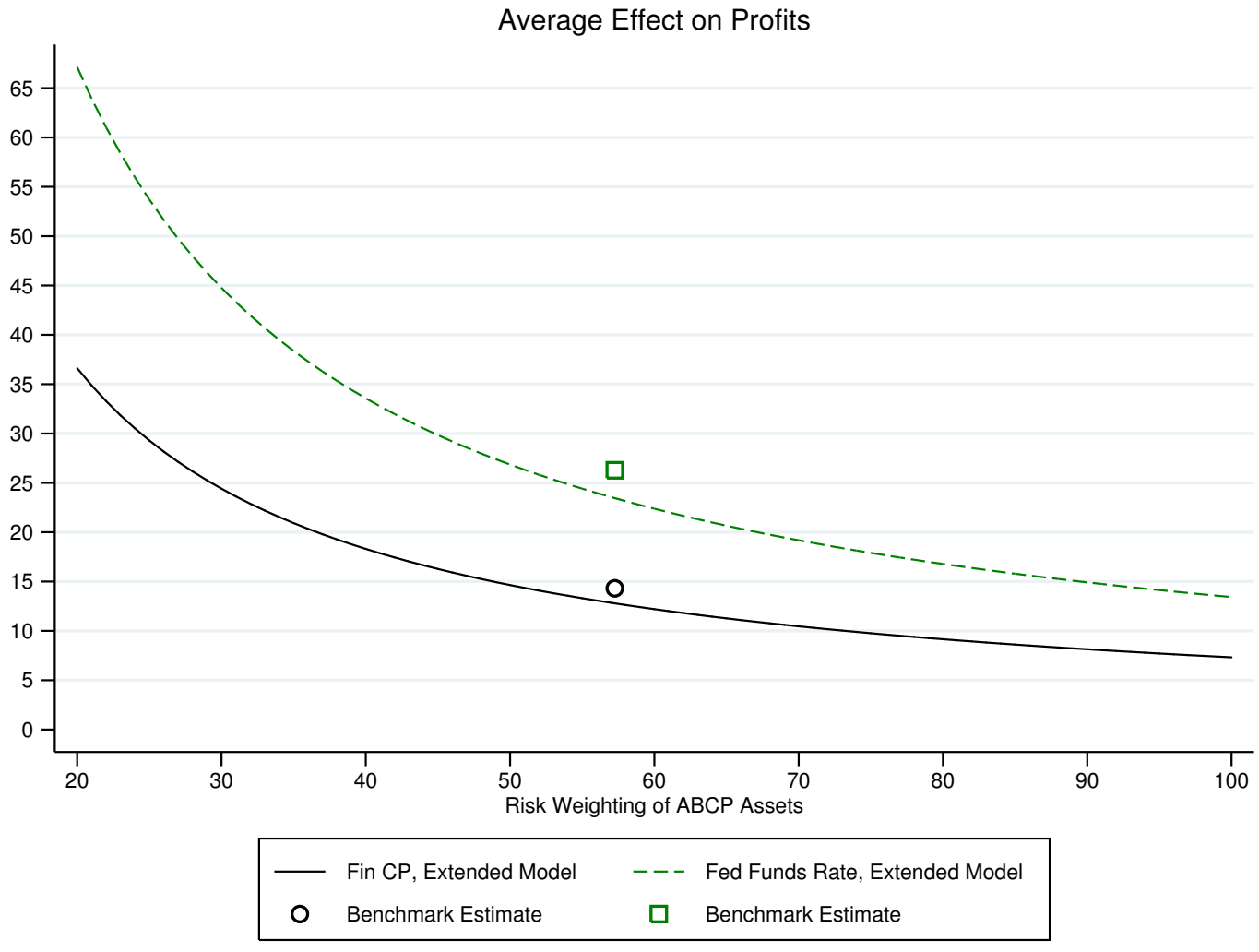
Alternative Definitions of a "Binding Constraint"

Fig. 7: Estimates increase only slightly as we focus on banks closer to threshold



Risk Weighting of Conduit Assets

Fig. 8: Estimates are 50% smaller if most assets have high risk-weights to 150% larger for the lowest risk-weight



Potential Value from ABCP Financing

- So far assumed regulatory constraints are the only reason to use ABCP conduits
- What if the arrangement created additional value?
- Let ABCP financing reduce the marginal cost by $\gamma > 0$

$$\mathcal{L} = \sum_j \left[r_j - \left(c\left(k\right) - \gamma\theta_j \right) - \alpha\theta_j \right] q_j\left(\mathbf{r}\right) + \lambda Q\left[K\left(\boldsymbol{q}, k, \theta\right) - \sigma \right]$$

- Shadow cost becomes

$$\lambda = \frac{\alpha}{K_{\theta_j}} - \frac{\gamma}{K_{\theta_j}} \tag{7}$$

- Our benchmark estimates *overestimate* the shadow cost

European Banks

- Due to the low quality of international data, we exclude European banks from our main analysis
- European ABCP-participating banks
  - Face similar rules, so interesting to compare with US estimates
  - Have a significant US presence
- The average shadow cost estimate for the tier 1 risk-based ratio is 0.0038, compared to 0.0030 for US banks

Interest Rates and Cost of Capital

- What is the effect on interest rates and the cost of capital?
- Suppose the bank was forced to raise equity to comply with tighter regulation
  - Cannot change its lending or loophole use
- We get an upper bound on the effect on the cost of capital

$$\frac{dc}{d\sigma} \leq \lambda$$

- Implies a 10 pp increase in tier 1 risk-based capital ratio would increase the cost of capital by at most 3 bp
- Also bounds the increase in lending interest rates to 3 bp

Lending

- What is the effect on the quantity of lending Q?
- Suppose the bank passed all the increase in costs to borrowers (extreme)

$$\frac{dQ}{Q} = -\frac{\lambda}{r-c} \times d\sigma$$

- Then a 10 pp increase in tier 1 risk-based capital ratio would reduce bank assets by 1.5%

Comparison with Prior Estimates

- Prior literature provides estimates of the increase in the cost of capital (dc) due to an increase in regulatory capital ratios
- Kashyap, Hanson and Stein (2010): 10 pp increase would raise WACC by 25-45 bp
  - Modigliani-Miller model with taxes
  - Cost of capital increases only because of loss of debt-tax-shield
  - Banks comply by increasing their equity ratio (cannot avoid)
- They provide an important benchmark if assumptions hold
- Our estimates show effect after banks act to mitigate costs

Conclusion

or: How We Learned to Stop Worrying and Love the Loophole

- We calculate the shadow cost of bank capital requirements
- Loophole use reveals banks' perceived compliance cost
- Find modest effects:
  - 10 pp increase, say from 6% to 16%, reduces banks aggregate annual profits by $2 billion
- Latest revision of US bank regulation increased capital requirements by much smaller amounts
  - Same total risk-based capital ratio (10%)
  - 2 pp higher tier 1 risk-based capital ratio (8%)
  - 2 pp higher leverage ratio (5%)
- We expect a hardly noticeable effect on bank profitability
- Our approach could be applied more broadly to study regulation of financial intermediaries
- Calibration targets for structural macroeconomic models

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Many Opinions and Theories, But No Empirical Estimates

The costs are ...

High. "a more restrictive leverage ratio [...] will negatively impact affected banking organizations' earnings and profitability" (Bankers Associations on 2012 Proposal)

Zero. "High equity requirements are such an incredible bargain to society: the significant benefits of more equity are actually free!" (Admati and Hellwig, 2013)

Negative? (Allen, Carletti, and Marquez, 2009; Mehran and Thakor, 2011)

Risk-weighted Assets

- Risk weight w_j applied to each asset of risk group j
- Four major risk weights groups:
  - 0% (cash)
  - 20% (OECD sovereign debt)
  - 50% (residential mortgages)
  - 100% (corporate loans)
- Securitized assets get 20–200% weights based on ratings
- Conversion factor $\beta \in [0, 1]$ converts off-balance sheet items
- Leverage ratio denominator is on-balance sheet assets ($w = 100\%$, $\beta = 0$).

Role of ABCP loophole was widely recognized at the time

"If the bank were to provide a direct corporate loan, even one secured by the same assets, it would appear on the bank's balance sheet as an asset and the bank would be obligated to maintain regulatory capital for it. An ABCP program permits the Sponsor (i.e., the commercial bank) to offer receivable financing services to its customers without using the Sponsor's balance sheet or holding incremental regulatory capital."

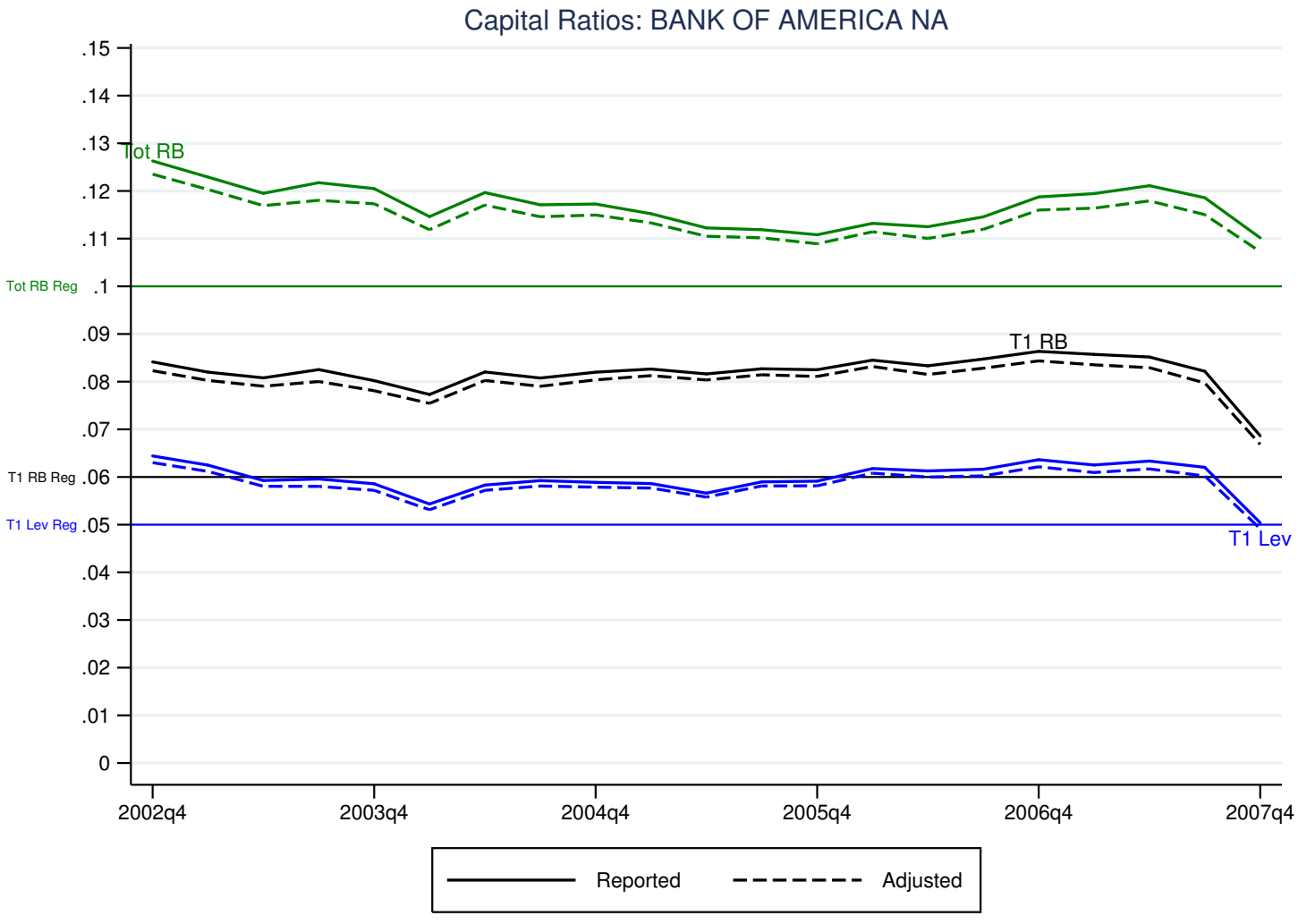
Moody's (2003)

"We don't simply look at the assets, although we do due diligence. We know the sponsors, the entity. But we also look through to the liquidity support providers. And we wouldn't buy any asset-backed commercial paper conduit unless we're 100 percent sure that they are fully supported by a bank institution."

Steven Meier, Chief Investment Officer, State Street

C1: Constrained Banks Exploit the Loophole

Fig. 4: A closer look at 4 most active ABCP sponsors



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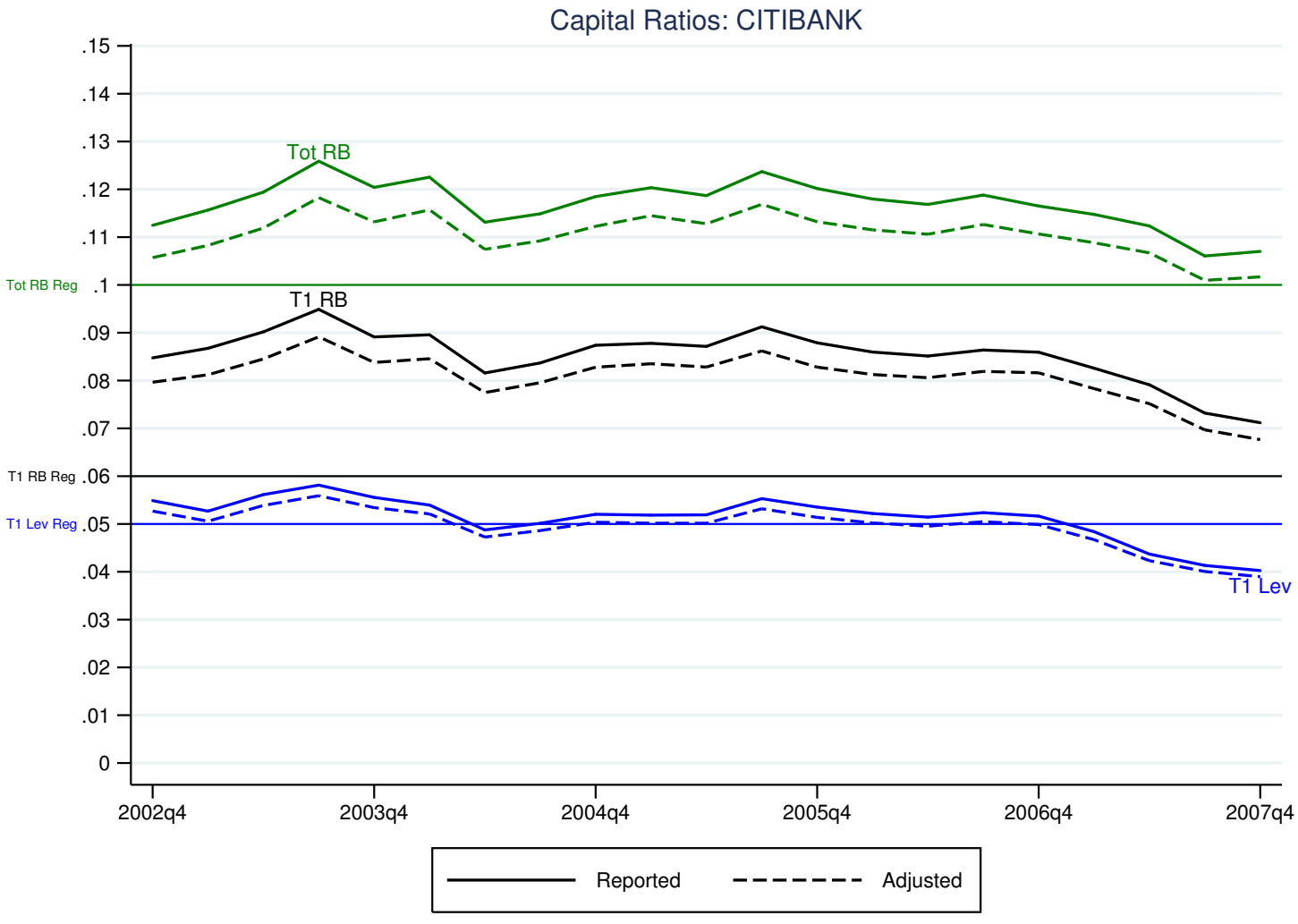

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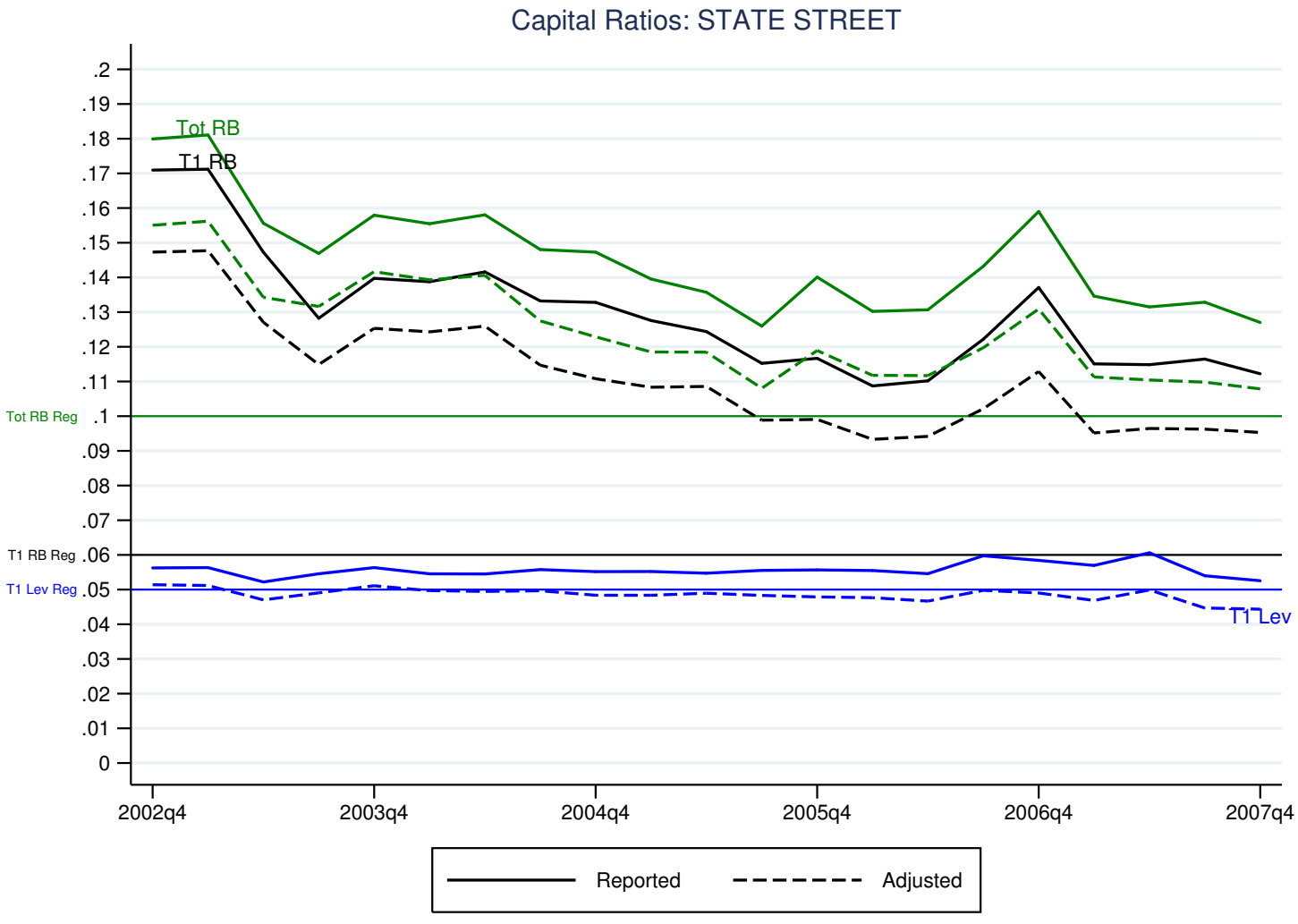

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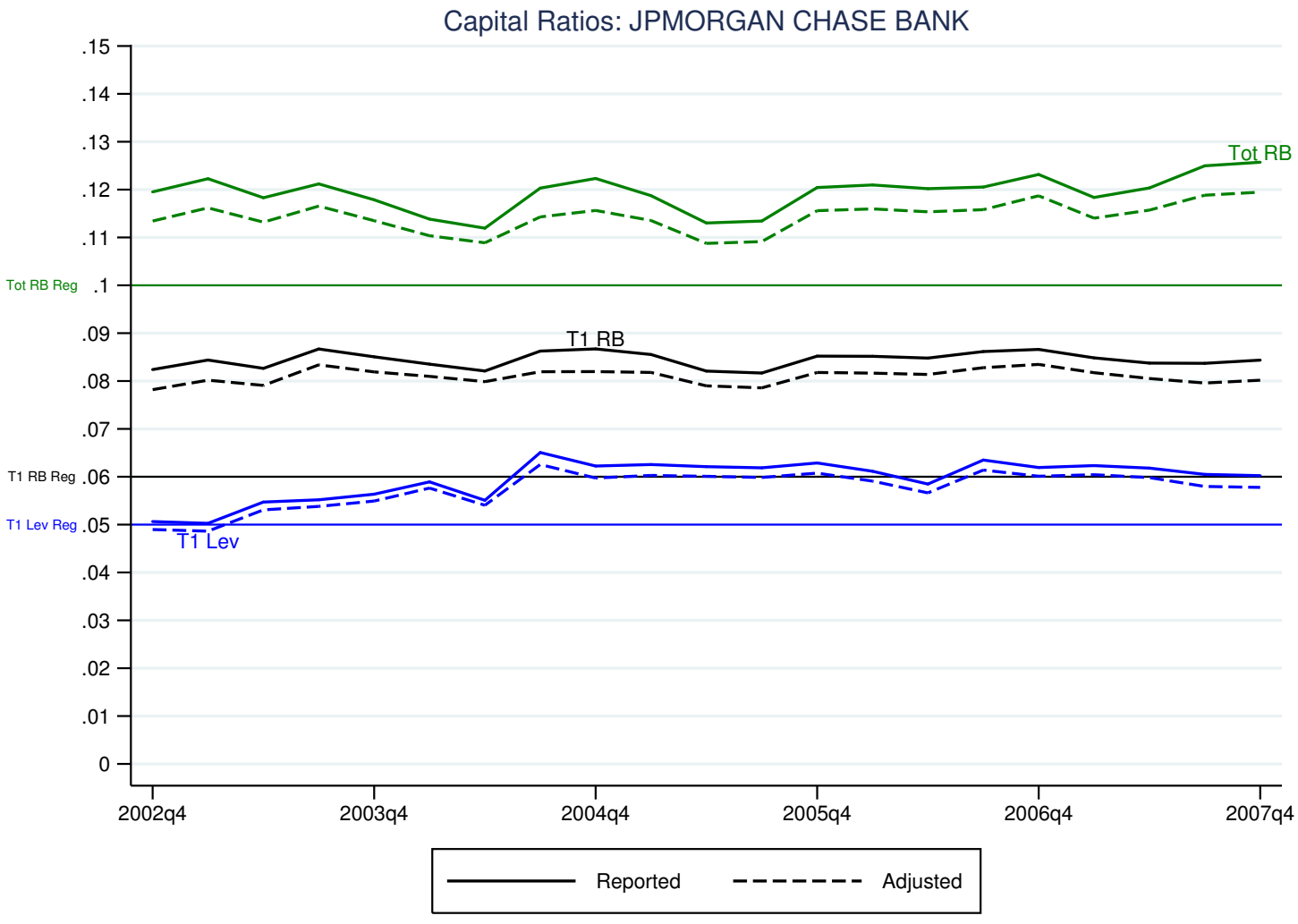
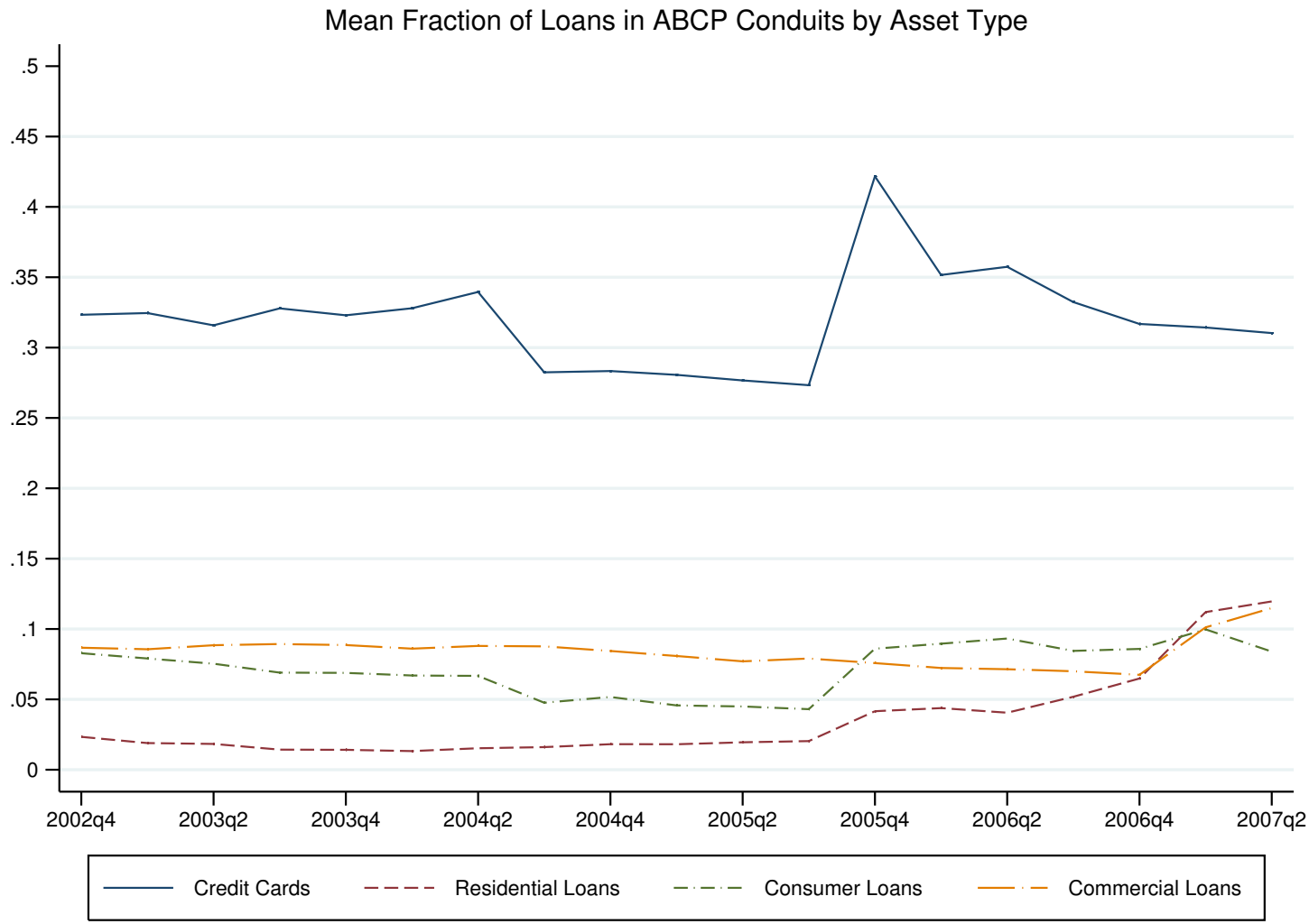


C2: Constrained Banks do not Exhaust the Loophole

Fig. 5: ABCP shares for different asset types are also interior



Loophole Use in a Dynamic Model

Not much changes in the dynamic model, but adjustment costs can bias results

- λ_t captures per-period shadow cost of compliance
- The effect of a permanent increase in σ on the bank's *present value* of profits discounted at rate $\delta \in (0,1)$ is

$$-\frac{\partial V_t}{\partial \sigma}\frac{1}{Q_t} = E_t\left[\sum_{s=0}^{\infty}\delta^s \lambda_{t+s}\frac{Q_{t+s}}{Q_t}\right] = \frac{\lambda_t}{1-\delta(1+g)} \tag{8}$$

- Costs of a permanent increase accrue long after rules revision
- Allowing for loophole use adjustment costs κ

$$\lambda_t \leq \frac{\alpha_t + \kappa\left\{L_t - L_{t-1} - \delta E_t\left[L_{t+1} - L_t\right]\right\}}{\frac{\partial K_t}{\partial \theta_{t+1}}} \tag{9}$$

- Allowing for anticipation of financial crisis

$$\lambda_t = \frac{\alpha_t + \pi_t \kappa \delta E_t\left[L_{t+1} | z_{t+1} = 0\right]}{\frac{\partial K_t}{\partial \theta_{t+1}}} \tag{10}$$

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