WHEN DERIVATIVES MEET LEVERAGE RATIO: RUNNING OUT OF OPTIONS?

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WHAT HAPPENS WHEN DERIVATIVES MEET BASEL III LEVERAGE RATIO?

1. $$\frac{\text{Tier 1 capital}}{\text{asset+exposure(derivatives,repo \& other)}} \geq 3\%$$
   - How to measure exposure for a derivative portfolio?

2. The US Supplemental Leverage Ratio (SLR): 5% (GSIB) or 6% (GSIB IDI)

3. Intended as a backstop to risk-based capital requirement, the SLR is binding on margin for many derivative businesses, particularly for cleared equity futures options.

ISSUE 1. RELY ON NOTIONAL TO MEASURE RISK EXPOSURE

❖ Off Balance Sheet (B/S) exposure is calculated by Current Exposure Method (CEM).

- Exposure at Default (EaD) = Current Exposure (CE) + Potential Future Exposure (PFE)

✓CE is net MTM value, can be offset by Variation Margin (VM).

✓PFE = Notional * Conversion Factor (CF)

- There is no adjustment for option delta.

Remaining Maturity	Equity	Interest Rate	Commodities
<= 1 year	6%	0%	10%

ISSUE 2&3. NOT SUFFICIENTLY RECOGNIZE NETTING & MARGIN

- Under CEM, netting benefit is capped at 60% of PFE, regardless of risk.
  - Options trade at many strikes. Consider
  - ✓ Long a call of Emini S&P 500 futures at strike of 2500
  - ✓ Short a call of Emini S&P 500 futures at strike of 2495
- Under CEM, posted margin only offsets CE, but not PFE.
- On B/S assets include cash margin posted by clients.

RESPONSES TO ISSUES OF BASEL III LR

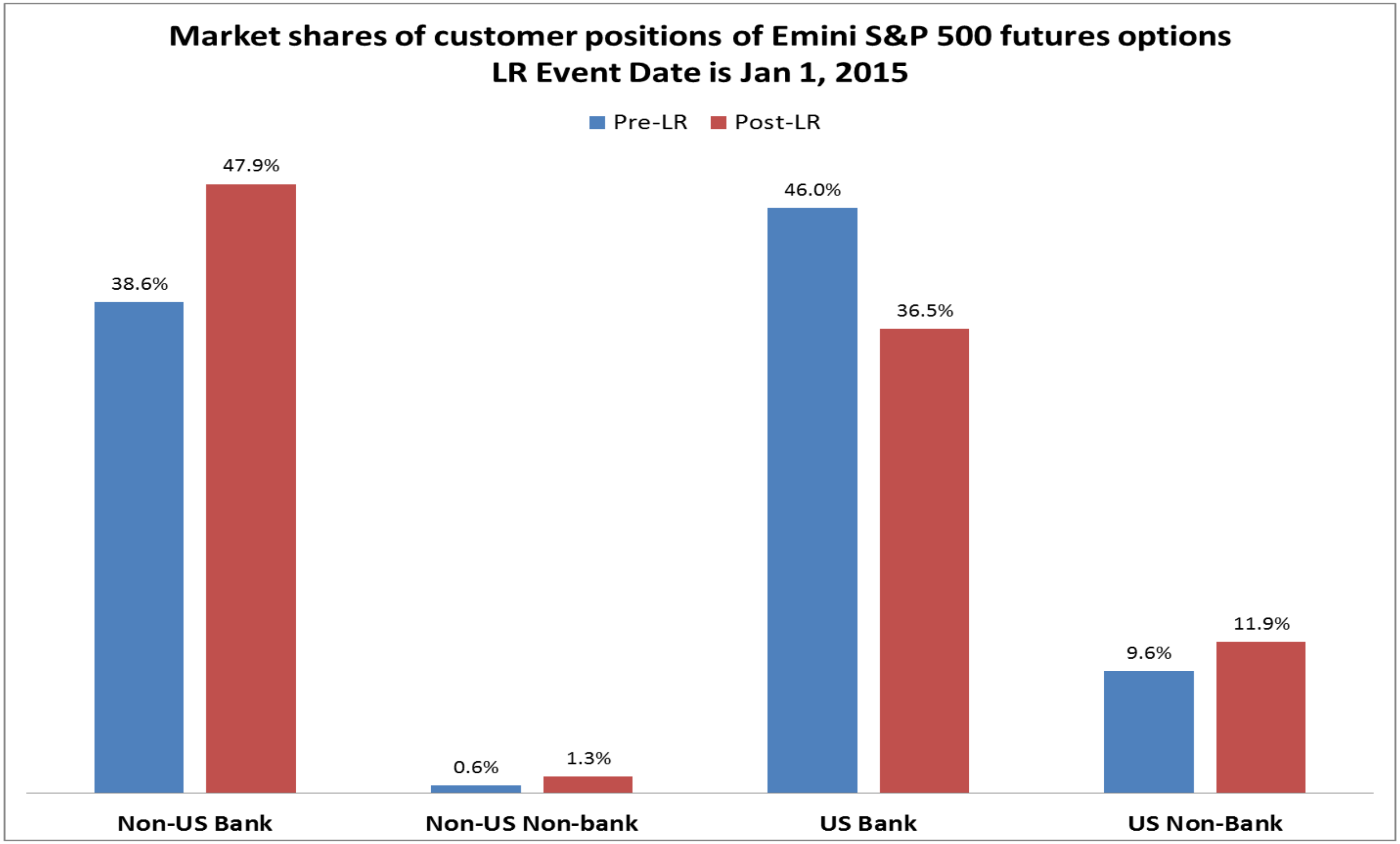
1. Portfolio compression
   - Replace with smaller positions but similar risk
   - CME completed 5 compression cycles for equity futures options (1/3 OI reduction ~250mm capital savings)
2. Derecognize client cash margin from B/S
   - Pass income back to clients
3. VM as settlement (US)
   - Set every contract's maturity to 1 day
4. Proposed to adopt SACCR (delta, netting, margin)
5. Proposed to adjust e-SLR (US)

CAPTURE BASEL III LR IMPACT USING DIFF-IN-DIFF TESTS

- Study FCMs (Futures Commission Merchants)
  - provide client clearing in derivatives
- Use Jan 2015 leverage disclosure date as "event date"
- Empirical strategy relies on various levels of heterogeneity:

1. Banks vs. non-banks
2. U.S. banks vs. non-US banks
3. Client vs. House Positions
4. Low Delta vs. High Delta Options
5. Equity vs. Treasury Futures Options
   - CF is 6% for equity and 0% for Treasury

BASEL III LR HAS CHANGED THE COMPETITIVE LANDSCAPE



LITERATURE EXAMINING BASEL III LR IMPACTS ON FINANCIAL MARKETS

- Corporate bond
  1. Bessembinder et al (2018)
- Repo
  2. Kotidis and van Horen (2018)
  3. Bicu et al (2017)
  4. Allahrakha et al (2016)
  5. Anbil and Senyuz (2018) “window dressing”
- Cleared Interest Rate Swaps
  6. Acosta-Smith et al (2018)

DATA

- Daily positions of every futures option are reported to the CFTC:
  - Daily market share of positions
    - by institution types: bank vs non-bank, US vs non-US
    - by account types: customer vs house
    - by low delta vs high delta
  - S&P 500 futures options vs Treasury futures options
- Sample period: Feb 2013—Jan 2018
  - Jan 1, 2015 is the "leverage ratio event date"

HYPOTHESES AND DIFF-IN-DIFF TESTS

- Hypothesis 3. Bank customer positions, as a fraction of total customer positions (bank + nonbank), should fall more for US institutions relative to the changes for non-US institutions.

$$y_{i,t} = \frac{Z_t(i, bank, customer)}{Z_t(i, bank, customer) + Z_t(i, nonbank, customer)}.$$

- For $i \in \{US, nonUS\}$, RHS is:

  regress it on $D_{post}, D_{US}, D_{post}D_{US}$

- Hypothesis 4. US bank positions, as a fraction of total US positions (bank + nonbank), should fall more for customer accounts relative to house accounts.

$$y_{i,t} = \frac{Z_t(US, bank, i)}{Z_t(US, bank, i) + Z_t(US, nonbank, i)}.$$

- For $i \in \{Customer, House\}$, RHS is:

  regress it on $D_{post}, D_{customer}, D_{post}D_{customer}$

DIFF-IN-DIFF REGRESSION RESULTS

Table 4: Diff-in-Diff for Options Clearing, Bank Share

	Bank Share					
		E-mini			Treasuries	
	Cust Accts	US Accts	Full	Cust Accts	US Accts	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.015***	0.403***	0.052***	−0.067***	0.037***	0.001***
	(0.002)	(0.038)	(0.018)	(0.006)	(0.005)	(0.000)
US	−0.160***		−0.811***	−0.163***		−0.044***
	(0.004)		(0.017)	(0.006)		(0.001)
PostxUS	−0.060***		0.351***	0.077***		0.036***
	(0.011)		(0.035)	(0.012)		(0.002)
Customer		0.717***	0.066***		−0.141***	−0.023***
		(0.013)	(0.019)		(0.011)	(0.001)
PostxCust		−0.479***	−0.068***		−0.027**	−0.068***
		(0.046)	(0.019)		(0.012)	(0.002)
USxCust			0.650***			−0.118***
			(0.016)			(0.003)
PostxUSxCust			−0.412***			0.041***
			(0.041)			(0.004)
Constant	0.988***	0.110***	0.921***	0.975***	0.954***	0.998***
	(0.002)	(0.010)	(0.018)	(0.002)	(0.005)	(0.000)
Observations	2,518	2,518	5,036	2,518	2,518	5,036
Adjusted R^2	0.882	0.741	0.846	0.765	0.881	0.885

* p< 0.10, ** p< 0.05, *** p < 0.01; Standard errors are in parentheses.

CONCLUSIONS

- The implementation of Basel III leverage ratio is binding for cleared equity futures options.
- Since Jan 1, 2015, market share for equity futures options has shifted from institutions that are more constrained by LR to those less constrained.
  - The shift is more pronounced for customer accounts.
  - The shift is more pronounced for low delta options.
- We do not find similar shifts in Treasury futures options markets.

APPENDIX

HYPOTHESES AND DIFF-IN-DIFF TESTS

1. Customer positions, as a fraction of total cleared positions (customer + house), should fall more for US banks in the post-LR period relative to the change in customer positions for non-US banks.

2. Customer positions, as a fraction of total cleared positions (house + customer), should fall more for US banks in the post-LR period relative to the change in customer positions for US non-banks.

3. Bank customer positions, as a fraction of total customer positions (bank + nonbank), should fall more for US institutions relative to the changes for non-US institutions.

4. US bank positions, as a fraction of total US positions (bank + nonbank), should fall more for customer accounts relative to house accounts.

5. Only consider banks. US banks customer clearing should lose more market share to non-US bank customer clearing, relative to US and non-US banks' house activity.

6. Only consider customer accounts. US banks lose market share in customer clearing to US nonbanks, relative to non-US institutions.

7. Effects are stronger for low-delta options (deep out of the money calls and puts).

DIFF-IN-DIFF TESTS

- $D_{US} = 1$ (US) or 0 (EU)
- $D_{bank} = 1$ (Bank) or 0 (nonbank)
- $D_{customer} = 1$(Customer) or 0 (House)
- $D_{post} = 1$ if and only if the date is after Jan 1, 2015
- Define $Z_t(US, bank, customer)$ as the total option position of customer accounts at US banks on day t.
- Define the other 7 $Z_t(\cdot,\cdot,\cdot)$ similarly.

CUSTOMER SHARE

- Hypothesis 1: Customer positions, as a fraction of total cleared positions (customer + house), should fall more for US banks in the post-LR period relative to the change in customer positions for EU banks.

$$y_{i,t} = \frac{Z_t(i, bank, customer)}{Z_t(i, bank, customer) + Z_t(i, bank, house)}.$$

- RHS is, for $i \in \{US, EU\}$,

  regress it on $D_{post}, D_{US}, D_{post}D_{US}$

- Hypothesis 2. Customer positions, as a fraction of total cleared positions (house + customer), should fall more for US banks in the post-LR period relative to the change in customer positions for US nonban

$$y_{i,t} = \frac{Z_t(US, i, customer)}{Z_t(US, i, customer) + Z_t(US, i, house)}.$$

- RHS is, for $i \in \{Bank, nonbank\}$,

  regress it on $D_{post}, D_{bank}, D_{post}D_{bank}$

CUSTOMER SHARE

Table 3: Diff-in-Diff Regressions for Options Clearing, Customer Share

	Customer Share					
	E-mini			Treasuries		
	Bank CM Accts	US Accts	Full	Bank CM Accts	US Accts	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.001***	0.229***	0.017***	0.018***	0.054***	0.014***
	(0.000)	(0.019)	(0.004)	(0.004)	(0.019)	(0.004)
US	−0.009***		−0.309***	−0.134***		−0.048***
	(0.000)		(0.011)	(0.006)		(0.005)
PostxUS	−0.021***		0.211***	0.042***		0.040***
	(0.002)		(0.013)	(0.007)		(0.006)
Bank		0.316***	0.016***		−0.169***	−0.083***
		(0.017)	(0.004)		(0.017)	(0.004)
PostxBank		−0.248***	−0.017***		0.006	0.004
		(0.021)	(0.004)		(0.021)	(0.005)
USxBank			0.300***			−0.086***
			(0.012)			(0.009)
PostxUSxBank			−0.232***			0.002
			(0.014)			(0.009)
Constant	0.998***	0.673***	0.981***	0.903***	0.937***	0.985***
	(0.000)	(0.017)	(0.004)	(0.003)	(0.017)	(0.004)
Observations	2,518	2,518	5,036	2,518	2,518	5,036
Adjusted R^2	0.687	0.813	0.853	0.845	0.903	0.913

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are in parentheses.

BANK SHARE

- Hypothesis 3. Bank customer positions, as a fraction of total customer positions (bank + nonbank), should fall for US institutions relative to the changes for non-US institutions.

$$y_{i,t} = \frac{Z_t(i, bank, customer)}{Z_t(i, bank, customer) + Z_t(i, nonbank, customer)}.$$

- For $i \in \{US, nonUS\}$, RHS is:

  regress it on $D_{post}, D_{US}, D_{post}D_{US}$

- Hypothesis 4. US bank positions, as a fraction of total US positions (bank + nonbank), should fall more for customer accounts relative to house accounts.

$$y_{i,t} = \frac{Z_t(US, bank, i)}{Z_t(US, bank, i) + Z_t(US, nonbank, i)}.$$

- For $i \in \{Customer, House\}$, RHS is:

  regress it on $D_{post}, D_{customer}, D_{post}D_{customer}$

BANK SHARE

Table 4: Diff-in-Diff for Options Clearing, Bank Share

	Bank Share					
		E-mini			Treasuries	
	Cust Accts	US Accts	Full	Cust Accts	US Accts	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.015***	0.403***	0.052***	−0.067***	0.037***	0.001***
	(0.002)	(0.038)	(0.018)	(0.006)	(0.005)	(0.000)
US	−0.160***		−0.811***	−0.163***		−0.044***
	(0.004)		(0.017)	(0.006)		(0.001)
PostxUS	−0.060***		0.351***	0.077***		0.036***
	(0.011)		(0.035)	(0.012)		(0.002)
Customer		0.717***	0.066***		−0.141***	−0.023***
		(0.013)	(0.019)		(0.011)	(0.001)
PostxCust		−0.479***	−0.068***		−0.027**	−0.068***
		(0.046)	(0.019)		(0.012)	(0.002)
USxCust			0.650***			−0.118***
			(0.016)			(0.003)
PostxUSxCust			−0.412***			0.041***
			(0.041)			(0.004)
Constant	0.988***	0.110***	0.921***	0.975***	0.954***	0.998***
	(0.002)	(0.010)	(0.018)	(0.002)	(0.005)	(0.000)
Observations	2,518	2,518	5,036	2,518	2,518	5,036
Adjusted R^2	0.882	0.741	0.846	0.765	0.881	0.885

* p< 0.10, ** p< 0.05, *** p < 0.01; Standard errors are in parentheses.

US SHARE

- Hypothesis 5. Only consider banks. US banks customer clearing should lose more market share to EU bank customer clearing, relati banks' house activity.

$$y_{i,t} = \frac{Z_t(US, bank, i)}{Z_t(US, bank, i) + Z_t(EU, bank, i)}.$$

- For $i \in \{Customer, House\}$, RHS is:

  regress it on $D_{post}, D_{customer}, D_{post}D_{customer}$

- Hypothesis 6. Only consider customer accounts. US banks lose market share in customer clearing to US nonbanks, relative to EU institutions.

- For $i \in \{Bank, Nonbank\}$, RHS i

$$y_{i,t} = \frac{Z_t(US, i, customer)}{Z_t(US, i, customer) + Z_t(EU, i, customer)}.$$

  regress it on $D_{post}, D_{customer}, D_{post}D_{customer}$

US SHARE

Table 5: Diff-in-Diff Regressions for Options Clearing, US Share

	US Share					
	Cust Accts	Bank Accts	Full	Cust Accts	Bank Accts	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.053***	0.074***	−0.005***	−0.207***	0.013*	−0.050***
	(0.008)	(0.014)	(0.001)	(0.023)	(0.008)	(0.011)
Bank	−0.404***		−0.137***	−0.443***		−0.289***
	(0.006)		(0.010)	(0.010)		(0.007)
PostxBank	−0.056***		0.078***	0.260***		0.063***
	(0.017)		(0.011)	(0.024)		(0.014)
Customer		−0.316***	−0.048***		−0.248***	−0.094***
		(0.014)	(0.005)		(0.010)	(0.007)
PostxCust		−0.182***	−0.048***		0.041***	−0.156***
		(0.022)	(0.007)		(0.012)	(0.017)
BankxCust			−0.267***			−0.154***
			(0.009)			(0.011)
PostxBankxCust			−0.134***			0.198***
			(0.017)			(0.019)
Constant	0.951***	0.862***	0.999***	0.876***	0.682***	0.970***
	(0.007)	(0.012)	(0.000)	(0.010)	(0.006)	(0.005)
Observations	2,518	2,518	5,036	2,518	2,518	5,036
Adjusted R^2	0.940	0.917	0.944	0.779	0.905	0.840

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are in parentheses.

DELTA BUCKETS

- Options with low (absolute) delta are generally less risky by traditional risk measures, e.g., delta, gamma, vega, etc., because they are deep out of the money.
- These options are therefore more likely constrained by LR.
- We thus expect all the previous effects to be stronger for low-delta options (deep out of the money calls and puts).
- Test: Add a dummy $1(|delta| < 0.1)$, and run the same regressions separately for calls and puts.

DELTA BUCKETS (CALLS)

Table 6: Diff-in-diff regressions for options clearing, with low-delta dummy, only calls

	Cust Share Bank Accts (1)	Cust Share US Accts (2)	Bank Share Cust Accts (3)	Bank Share US Accts (4)	US Share Cust Accts (5)	US Share Bank Accts (6)
Post	0.000	0.237***	−0.009***	0.331***	−0.065***	0.015
	(0.000)	(0.021)	(0.001)	(0.031)	(0.008)	(0.010)
US	−0.011***		−0.091***			
	(0.000)		(0.003)			
Bank		0.426***			−0.379***	
		(0.016)			(0.006)	
Cust				0.752***		−0.335***
				(0.010)		(0.008)
Low Delta	0.001***	0.060***	−0.007***	−0.113***	0.009*	0.015
	(0.000)	(0.010)	(0.001)	(0.007)	(0.004)	(0.011)
Post × US	−0.012***		−0.025***			
	(0.001)		(0.007)			
Post × Bank		−0.249***			−0.033**	
		(0.022)			(0.016)	
Post × Cust				−0.365***		−0.113***
				(0.037)		(0.015)
Post × Low Delta	−0.001**	0.042***	−0.014***	0.066***	−0.013*	0.001
	(0.000)	(0.014)	(0.002)	(0.017)	(0.007)	(0.018)
Low Delta × US	0.008***		−0.109***			
	(0.001)		(0.006)			
Post × Low Delta × US	−0.004**		−0.021**			
	(0.001)		(0.010)			
Low Delta × Bank		−0.051***			−0.016***	
		(0.010)			(0.006)	
Post × Low Delta × Bank		−0.046***			−0.021**	
		(0.014)			(0.009)	
Low Delta × Cust				−0.002		−0.022*
				(0.008)		(0.012)
Post × Low Delta × Cust				−0.101***		−0.035*
				(0.018)		(0.020)
Constant	0.998***	0.561***	0.992***	0.149***	0.945***	0.901***
	(0.000)	(0.015)	(0.001)	(0.009)	(0.004)	(0.007)
Observations	5,104	5,104	5,104	5,089	5,104	5,089
Adjusted R^2	0.609	0.771	0.804	0.754	0.895	0.835

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are in parentheses.

DELTA BUCKETS (PUTS)

Table 7: Diff-in-diff regressions for options clearing, with low-delta dummy, only puts

	Cust Share Bank Accts (1)	Cust Share US Accts (2)	Bank Share Cust Accts (3)	Bank Share US Accts (4)	US Share Cust Accts (5)	US Share Bank Accts (6)
Post	0.002***	0.255***	−0.012***	0.372***	−0.056***	0.060***
	(0.000)	(0.019)	(0.001)	(0.033)	(0.007)	(0.015)
US	−0.013***		−0.095***			
	(0.001)		(0.003)			
Bank		0.361***			−0.360***	
		(0.016)			(0.007)	
Cust				0.682***		−0.277***
				(0.017)		(0.014)
Low Delta	0.002***	0.114***	−0.006***	−0.133***	0.010**	−0.031**
	(0.000)	(0.012)	(0.001)	(0.010)	(0.005)	(0.015)
Post × US	−0.015***		−0.053***			
	(0.002)		(0.009)			
Post × Bank		−0.268***			−0.054***	
		(0.020)			(0.016)	
Post × Cust				−0.436***		−0.170***
				(0.039)		(0.018)
Post × Low Delta	−0.001***	−0.065***	−0.003	0.065***	0.012*	0.045**
	(0.000)	(0.014)	(0.002)	(0.022)	(0.007)	(0.018)
Low Delta × US	0.006***		−0.128***			
	(0.001)		(0.006)			
Post × Low Delta × US	−0.015***		−0.004			
	(0.003)		(0.007)			
Low Delta × Bank		−0.106***			−0.081***	
		(0.012)			(0.006)	
Post × Low Delta × Bank		0.049***			−0.007	
		(0.014)			(0.009)	
Low Delta × Cust				−0.000		−0.041***
				(0.011)		(0.013)
Post × Low Delta × Cust				−0.072***		−0.040**
				(0.023)		(0.017)
Constant	0.996***	0.622***	0.991***	0.213***	0.943***	0.861***
	(0.000)	(0.016)	(0.001)	(0.015)	(0.004)	(0.014)
Observations	5,104	5,104	5,104	5,104	5,104	5,104
Adjusted R^2	0.589	0.779	0.889	0.713	0.936	0.877

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are in parentheses.