CFTC Policy Brief

Assessing the Impact of the Basel III Leverage Ratio on the Competitive Landscape of US Derivatives Markets: Evidence from Options*

Richard Haynes† CFTC

Lihong McPhail‡ CFTC

Haoxiang Zhu§ MIT and CFTC

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†Supervisory Economist, the Office of the Chief Economist, CFTC, rhaynes@cftc.gov

‡Senior Economist, the Office of the Chief Economist, CFTC, lmcphail@cftc.gov

§Associate Professor of Finance, MIT Sloan School of Management and Academic Consultant, the Office of the Chief Economist, CFTC, hzhu@cftc.gov

Executive Summary

This policy brief provides evidence that the implementation of the Basel III leverage ratio has had a measurable effect on the competitive landscape of US derivatives markets.

Though US banks have long been subject to a leverage ratio that required capital only against on-balance-sheet assets,[1] Basel III requires capital also against off-balance-sheet exposures for derivatives and other businesses. For derivatives, under the new leverage rules,[2] exposures are largely based on the notional value of the positions, with minimal risk adjustment, and do not fully recognize position offsets and risk-mitigating collateral. As of Jan. 2015, large banks have been required to make quarterly public disclosures of their leverage ratio, although the effective dates of full compliance came later.

As a result of these changes, market participants argue that the leverage ratio has become the binding constraint for certain, often low-risk derivatives businesses. One area where the leverage ratio appears binding is client clearing. Because banks have provided roughly 80-90% of derivatives client clearing services in the US, as measured by customer collateral,[3] the leverage ratio could substantially shift the competitive landscape in US client clearing services.

We test this hypothesis using data on S&P 500 E-mini futures options, products where the leverage ratio demands particularly high capital relative to risk. We compare client clearing services prior to the Jan. 2015 disclosure date to those after. Using daily data on the customer and house positions of clearing members from Feb. 2013 to Jan. 2018, we confirm that the market share of clearing intermediation has shifted from firms subject to higher leverage requirements to those subject to lower requirements. For example, before Jan. 2015, 46% of all E-mini futures option positions were held in customer accounts at US banks; after Jan. 2015, this number declines to an average of 36.5%. By contrast, during that same period, customer positions in E-mini futures options cleared through EU banks, which are subject to a lower leverage ratio, increased from 38.6% to 47.9% of the total. The shift in market shares is most evident in low-delta options, which have relatively small risk for a given notional amount. These trends are absent in US Treasury futures options, which are subject to a lower leverage ratio requirement.

[1] Capital rules like Basel II required zero or little capital from bank clearing members against their cleared derivatives customer business.

[2] See Giancarlo and Tuckman (2018) swap dealer capital chapter for a summary of capital treatment of derivatives under various rules.

[3] Financial data for US derivatives clearing members, known as Futures Commission Merchants (FCMs), can be found here.

1 Introduction

In this policy brief, we examine the effects of the Basel III leverage ratio on the competitive landscape of US derivatives markets. We test these effects using data on S&P 500 E-mini futures options, products where the leverage rule demands particularly high capital levels relative to risk. To do this, we explore the important institutional feature that leverage ratio requirements are heterogeneous across regions and institution types. Because Global Systemically Important Banks (G-SIBs) were required to publicly disclose their leverage ratios, on a quarterly basis, starting in Jan. 2015, we use this date to differentiate between the pre-leverage ratio period (pre-LR) and the post-leverage ratio period (post-LR). Using daily data related to customer and house cleared positions, we test the following hypotheses.

- Option positions should shift from banks (subject to the Basel III leverage ratio) to nonbanks (not subject to the ratio).[4]
- Option positions should shift from US G-SIBs (subject to a higher leverage ratio, i.e., the enhanced supplementary leverage ratio) to banking affiliates of EU firms (subject to a lower ratio).
- Option positions should shift from customer accounts to house accounts, since customer cash collateral, a clearing bank asset, increases capital requirement.
- These shifts should be more pronounced for low-delta options, which have relatively small risk for a given notional amount.
- These shifts should be less pronounced in derivative classes that demand less capital under the leverage rules. Our comparison will be to Treasury futures options.

We find that all five hypotheses are confirmed in the data. For S&P 500 E-mini futures options, client clearing intermediation has shifted from firms subject to a higher leverage requirement (e.g., US G-SIBs) to firms subject to a lower leverage requirement (e.g., EU banks and US non-banks). This shift has been more pronounced for products that demand more capital relative to their risk (e.g., low-delta E-mini futures options) than for products that demand less capital relative to their risk (e.g., Treasury futures options). These shifts are statistically significant and economically material.

Our analysis contributes to a growing literature on addressing the impacts of the Basel III leverage ratio on financial markets. Specifically, in the US repo market, analyses indicate

[4] US nonbank clearing members are subject to the CFTC's capital requirement, which is in general more risk-based.

that bank broker-dealers decrease their overall repo borrowing but increase their relative use of repo backed by riskier collateral,[5] and liquidity decreased.[6] Also in the US repo market, EU banks' "window dressing" behavior—reducing their repo activities around quarter-ends and month-ends, relative to other time periods—became more pronounced after Basel III's leverage ratio disclosure date.[7] In the Gilt (UK government bond) repo market, liquidity decreased after UK regulators announced their version of the leverage ratio in Dec. 2011.[8] Finally, at the bank holding company level, data from the 2017 Federal Reserve's stress tests suggest that the most binding constraint for most US G-SIBs is the leverage ratio requirement.[9]

The effect of the leverage ratio in derivatives clearing and in other low-risk activities such as repo has generated much discussion and action among policymakers and market participants. For example, industry responses include compressing portfolios to reduce notional amounts,[10] providing non-bank customers direct access to central clearing,[11] and moving segregated client cash margin off banks' balance sheets.[12] US banking regulators have also responded to reduce leverage requirement by issuing guidance on the treatment of variation margin payments[13] and a proposal to adjust the enhanced supplementary leverage ratio (e-SLR).[14] Finally, the global effort of replacing the relatively risk-insensitive Current Exposure Method by one that is more risk-sensitive (the Standardized Approach for Measuring Counterparty Credit Risk (SA-CCR))[15] is underway.

[5] See Allahrakha, Cetina, and Munyan (2016). They find that the shift happened after the Federal Reserve published its draft SLR rule in June 2012.

[6] See Duffie (2016) for a discussion of how balance sheet constraint affects liquidity.

[7] See Anbil and Senyuz (2018). They use 2014 Q2 as the start of the leverage ratio disclosure date, based on the rationale that the banks' first disclosure in 2015 Q1 must also include three quarters of historical leverage ratios.

[8] See Bicu, Chen, and Elliott (2017).

[9] See Greenwood, Hanson, Stein, and Sunderam (2017) and Duffie (2018).

[10] For instance see here for one example of option compression services.

[11] Clearinghouses that either offer, or have proposed, direct clearing solutions include Eurex, LCH, and CME. In these solutions, the clients usually manage the collateral and margin exchange directly with the clearing house, but they still need clearing members (usually dealer banks) to provide guarantee fund contributions and insurance against client default.

[12] For example, *Risk* reports an example where customer cash margin is removed from the balance sheet by passing on all income generated by the cash margin back to customers. See https://www.risk.net/awards/5360866/otc-client-clearer-of-the-year-citi.

[13] For the guidance, see https://www.federalreserve.gov/supervisionreg/srletters/sr1707a1.pdf. This treatment, as a practical matter, sets the remaining maturity of a cleared swap to one day, thus reducing exposure and required capital. For a discussion on how this treatment may further distort capital treatment of derivatives, see Giancarlo and Tuckman (2018) p.67.

[14] See https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20180411a1.pdf.

[15] For a description of SA-CCR, see BIS (March 2014), "The Standardised Approach for Measuring Counterparty Credit Risk Exposures." Also see the US Treasury report of Oct. 2017, which recommends removing

2 Basel III and the Leverage Ratio

To increase the resilience of the banking system and address the shortcomings of existing regulations, Basel III ushered in a new, more comprehensive set of capital and liquidity requirements for banks. Many of the capital requirements are designed to be risk-based measures. Basel III also imposes a leverage ratio, defined as the ratio of Tier 1 capital to total leverage exposure. The leverage ratio is designed to be a backstop to the risk-based standard. Though the Basel Committee proposed a 3% minimum leverage ratio, US regulators set a higher leverage ratio, known as the enhanced supplementary leverage ratio (e-SLR) for systemically important institutions. US G-SIBs must maintain an SLR of at least 5% on a consolidated basis, and their depository subsidiaries must maintain an SLR of at least 6%.[16]

The denominator of the Basel III leverage ratio, the total leverage exposure, includes both on-balance-sheet assets and off-balance-sheet exposures for derivatives. Important for our purposes, on-balance-sheet assets include cash collateral posted by client. That is, any cash margin posted by the client, which effectively reduces credit exposure, actually increases the capital requirement in the leverage ratio. Therefore, client cash margin increases a bank's cost of providing clearing services to customers.

Off-balance-sheet exposures for the derivatives book are derived using the Current Exposure Method (CEM), developed in 1988. Under the CEM, off-balance sheet exposure is defined as the sum of Current Exposure (CE) and Potential Future Exposure (PFE).

CE is the net Mark-to-Market (MTM) value of derivatives within a given "netting set." For cleared derivatives, CE is effectively zero, since variation margin is posted on a daily basis.

PFE is typically defined as the maximum expected credit exposure over a specified period of time calculated at some level of confidence. Under CEM, PFE is defined using a combination of net and gross risk exposures. Specifically, the CEM methodology defines the PFE of a portfolio as

$$\text{PFE} = 0.4 \times A_{gross} + 0.6 \times NGR \times A_{gross}. \quad (1)$$

initial margin for centrally cleared derivatives from the SLR denominator and making risk-adjustments, like delta-adjustments, for calculating the leverage exposure on option positions. The Treasury report also recommends a transition from the current calculation methodology for derivative exposure (the CEM) to a calculation that factors in portfolio risk more explicitly. Specifically, one proposed alternative to CEM is SA-CCR, developed by the Basel committee in 2014. The SA-CCR methodology, by acknowledging delta adjustments, among other things, is more risk-sensitive than CEM. However, netting and margin offset under SA-CCR is still limited.

[16]See Supplementary Leverage Ratio, Davis Polk.

Table 1: Conversion Factors for Equity and Interest Rate Derivatives under the Current Exposure Method

Remaining Maturity	Equity	Interest Rates
$\leq$ 1 year	6%	0%
$>$ 1 year & $\leq$ 5 years	8%	0.5%
$>$ 5 years	10%	1.5%

Here, A_{gross} is the adjusted gross notional of a portfolio, where the notional of each individual instrument in the portfolio is adjusted by multiplying by the appropriate conversion factor (see Table 1). NGR is the net-to-gross ratio, and is defined as the ratio of net current mark-to-market (MTM) value and gross current MTM value of the portfolio. NGR is intended to measure the extent of hedging and netting, but it can be argued that NGR does not properly measure netted risk.[17] Netting is limited here due to the contributions of the first term, $0.4 \times A_{gross}$. In general, highly netted portfolios can reduce the PFE only up to 60%. Unlike the CE calculation, the PFE calculation does not allow for any margin offsets, so the posting of initial margin provides no capital benefit.

To illustrate the CEM methodology, we provide a numerical example on the following hypothetical and simple derivative portfolio. Suppose that the current level of the S&P 500 index is 2500 and a customer of a bank clearing member enters three derivatives trades: (a) buys one call option on the E-mini S&P 500 futures with a strike price of 2500, expiring at the end of the month; (b) shorts one put option with the same strike and maturity; and (c) shorts one S&P 500 futures contract at the price of 2500. Given the offsetting payments of these instruments, this portfolio is close to riskless, if held to maturity.[18] The leverage calculation, however, is quite different. Because a single E-mini futures contract has a notional of 50 times the S&P 500 index value, the portfolio's total gross notional is $3 \times 2500 \times 50 = \$375,000$ and gross PFE is $375,000 \times 0.06 = \$22,500$. According to equation (1), the PFE for the portfolio of three trades is $0.4 \times \$22,500 + 0.6 \times 0 \times \$375,000 = \$9,000$, because the net current MTM value of the portfolio at trade inception is zero. The clearing bank's exposure increases by $\$9,000$ plus whatever initial margin is posted. If the leverage

[17] For a description of NGR, see BCBS (June 2013), "The non-internal model method for capitalising counterparty credit risk exposure." For a discussion of the limitations of NGR, see Giancarlo and Tuckman (2018) p.90.

[18] There is one subtlety here: monthly and weekly options are European, but other options on the E-mini futures contracts are American, not European. For American options, the put-call parity would not hold exactly but only approximately. If the risk-free interest rate is close to zero, the approximation error is small.

ratio is binding, the clearing bank would need to raise equity that is equal to 5% or 6% of this exposure.

3 Hypotheses

To study the effect of the Basel III Leverage Ratio requirement, we explore the important institutional feature that leverage requirements are heterogeneous across regions and institution types. Specifically, we test the following five hypotheses.

- The Leverage Ratio affects banks more than non-banks. While clearing members affiliated with banks are subject to the Basel III LR requirement (in addition to other Basel III requirements), non-bank clearing members that clear for customers in the US are subject to the CFTC's net liquid asset approach. The latter requires capital to be at least 8 percent of margin, which is generally a risk-based measure.

- The Leverage Ratio affects US banks more than non-US banks. While the leverage ratio is benchmarked at 3% of total leverage exposure in Europe as recommended by Basel III, the US e-SLR is set at 5%–6% for US G-SIBs and their banking subsidiaries. (US banks that are not G-SIBs are subject to 3% leverage ratio, the same as EU banks.)

- The Leverage Ratio affects customer activity more than house activity. As mentioned above, cash margin posted by customers to a bank is treated as on-balance-sheet exposure of the bank and is counted toward the bank's leverage exposure. This treatment effectively increases the cost of providing client clearing services, relative to trading on the bank's house account.

- The Leverage Ratio affects low (absolute) delta options more than high (absolute) delta options. As mentioned above, the leverage calculation is based on notional with limited recognition of position offsets. This treatment effectively increases the cost of providing clearing for options with low (absolute) delta values (i.e. those deep out of the money), compared with high (absolute) delta options.

- The Leverage Ratio has a larger effect on derivatives classes that are associated with a higher conversion factor. As explained in Section 2, the conversion factor is a linear multiplier used to convert portfolio notional values to PFEs, which count toward the total exposure of a bank. Because of this, asset classes with higher conversion factors have higher associated PFEs. For derivatives with a maturity less than a year, equity derivatives have a conversion factor of 6%, while interest rate derivatives have a conversion factor of zero (implying a zero PFE-related charge).

4 Data and Evidence From Options Markets

Starting on Jan. 1, 2015, G-SIBs and other large banking institutions were required to make public disclosures related to the Basel III leverage ratio. While the leverage ratio is not yet in effect, it is reasonable to assume that public disclosures still put a reputational constraint on banks. For example, reporting a leverage ratio significantly lower than the required minimum or even the peer average could signal institutional weakness, and negatively impact share prices, funding costs, and business prospects. We thus label days before the Jan. 1, 2015 as "pre-LR" and days after Jan. 1, 2015 as "post-LR". While we believe that the Jan. 1, 2015 date is a reasonable choice, it is important to note that like many other regulations, the leverage rule does not come in as a "big bang," but over an extended period of discussion, consultation, and final adoption.

Our analysis focuses on S&P 500 E-mini futures options and US Treasury futures options. As discussed before, under the CEM methodology, equity derivatives are subject to a much higher conversion factor than Treasury derivatives, so we expect the effect of leverage requirement to be stronger for equity derivatives. Our sample period is from Feb. 2013 to Jan. 2018, for about 1,259 trading days. Given the cutoff date of Jan. 1, 2015, there are about 477 trading days pre-LR and about 782 trading days post-LR.

The CFTC collects daily information from clearing members on their option positions for each contract. Five data fields uniquely identify each option contract: the option type (American vs European), whether the option is a call or a put, the expiration date of the option, the expiration date of the underlying futures contract, and the option strike price. For the purposes of this report, positions are aggregated at the level of the clearing member, with separate aggregates for the member's house account and the member's customer accounts. Customers are aggregated together into a single group. We classify each clearing member into different categories based on a few different metrics: the jurisdiction of their parent company (US, EU, Asia Pacific), the institution type (banks that clear for customers, non-banks that clear for customers, and self-clearers who do not hold customer positions), and the account type (house, customer). As discussed earlier, the e-SLR levels are only applicable to US G-SIBs and their banking affiliates, which account for about 99.8% of open positions out of all positions held by US banks. Our results only show US and EU institutions because

Asian institutions account for less than 1% of positions. Similarly, we focus on banks and non-banks that clear for customers because self-clearers account for less than 1% of open positions.

Table 2: Market shares of Clearing Members in S&P 500 E-mini futures options (Panel A) and Treasury futures options (Panel B) by region, bank/nonbank, and customer/house. Pre-LR and post-LR refer to dates before and after the mandatory leverage disclosure date of Jan. 1, 2015, respectively.

Panel A: S&P 500 E-mini Futures Options					
	Pre-LR	Post-LR		Pre-LR	Post-LR
US	60.8%	50.7%	EU	39.2%	49.3%
US Bank	46.5%	37.6%	EU Bank	38.6%	48.0%
US Non-bank	14.3%	13.1%	EU Non-bank	0.6%	1.3%
US Bank House	0.5%	1.1%	EU Bank House	-	-
US Bank Customer	**46.0%**	**36.5%**	EU Bank Customer	**38.6%**	**47.9%**
US Non-bank House	4.7%	1.2%	EU Non-bank House	-	-
US Non-bank Customer	**9.6%**	**11.9%**	EU Non-bank Customer	0.6%	1.3%

Panel B: US Treasury Futures Options					
	Pre-LR	Post-LR		Pre-LR	Post-LR
US	51.0%	52.9%	EU	49.0%	47.1%
US Bank	42.9%	44.9%	EU Bank	47.9%	42.8%
US Non-Bank	8.1%	7.9%	EU Non-bank	1.2%	4.3%
US Bank House	10.0%	7.6%	EU Bank House	4.6%	3.3%
US Bank Customer	**32.9%**	**37.3%**	EU Bank Customer	43.2%	39.5%
US Non-bank House	0.5%	-	EU Non-bank House	-	-
US Non-bank Customer	7.6%	7.8%	EU Non-bank Customer	1.1%	4.3%

Table 2 reports the market shares of each of the eight "clearing member groups:" {US, EU} × {Bank, non-bank} × {customer, house}, pre-LR and post-LR, for S&P 500 E-mini futures options and Treasury futures options, including all maturities and all strikes. Numbers below 0.5% are indicated as "-". The market shares are calculated for each group on each trading day and then averaged across days. We observe that the vast majority of option positions sit in customer accounts at US and EU banks. For S&P 500 E-mini futures options, positions in US banks' customer accounts fell from 46.0% of the total pre-LR to 36.5% post-LR, a 9.5% reduction, while positions in EU banks' customer accounts increased from 38.6% to 47.9%; and positions in US nonbank's customer accounts increased from

9.6% to 11.9%. Further, despite US banks losing customer share in S&P 500 E-mini futures options, their market share of US Treasury futures options increased from 32.9% to 37.3%. These shifts in market shares are shown to be statistically significant by panel regressions using the difference-in-difference technique.

The difference between E-mini futures options and Treasury futures options is consistent with the way they are treated in the calculation of leverage ratio. Recall from Table 1 that the conversion factor for interest rate derivatives (including Treasury futures options) with maturity less than a year is 0, contrasting with the higher 6% conversion for equity derivatives. Because actively traded futures options in practice almost always have tenors less than a year, we would expect that higher leverage requirement for US banks would show up in equity options but not in Treasury options.

Figure 1: Share of Customer Option Positions on E-mini and Treasury Futures held by US institutions, bank vs non-bank

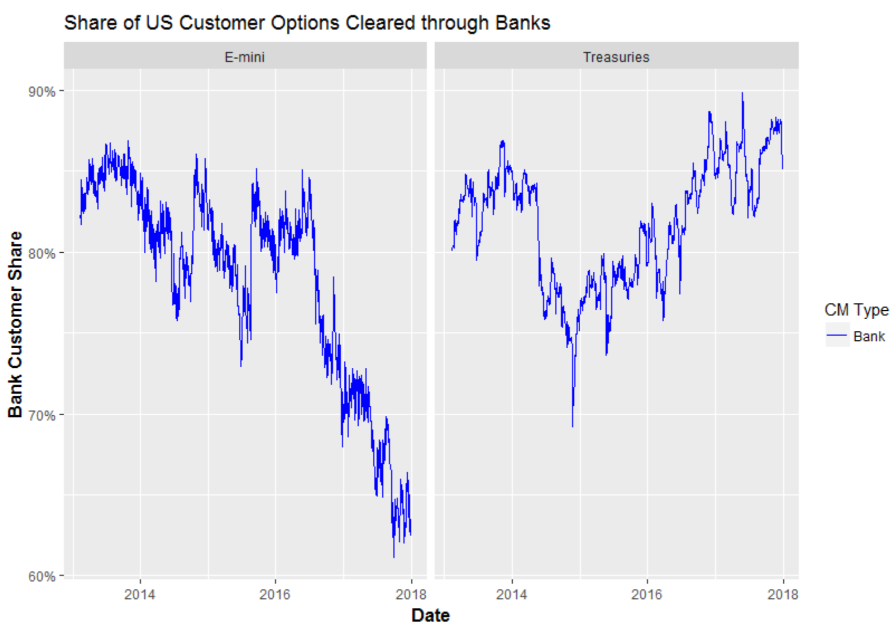


Figure 2: Share of Customer Option Positions on E-mini and Treasury Futures held by banks, US vs EU

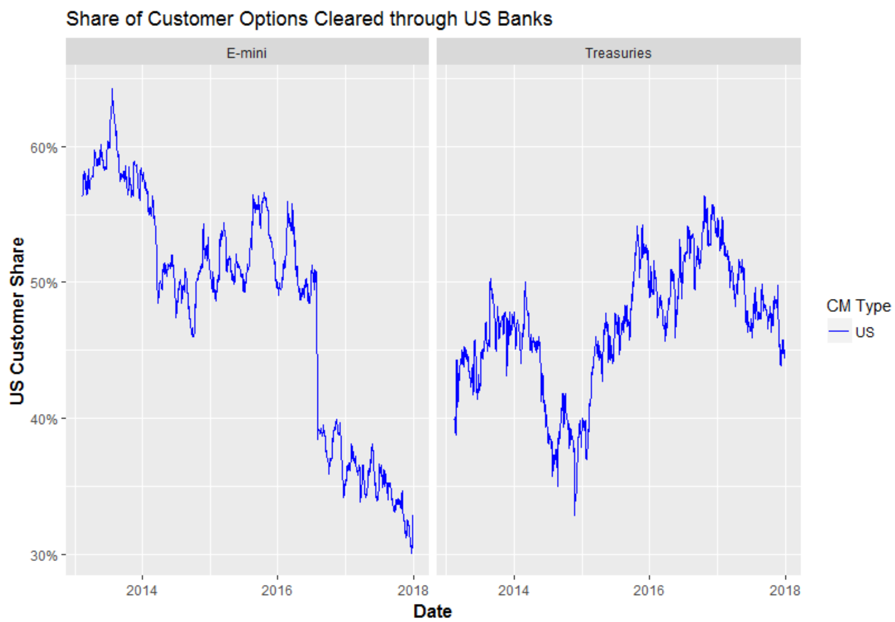


Figure 1 presents the fraction of US customer positions held by banks in the E-mini and Treasury futures options contracts. Across the sample period, the banks' market share in customer positions in E-mini options fell significantly from over 85% to just under 65%, while banks' market share in customer positions in Treasury options remained stable. Similarly, Figure 2 shows the fraction of customer option positions held by US banks (as opposed to EU banks). The US bank market share fell over our sample period, but, once again, we do not see a similar trend in Treasury futures options.

Differentiation among options of various strikes provides additional evidence. Figures 3 and 4 provide a breakdown of customer positions into those held at EU banks and those held at US banks, across various delta buckets. Put options and call options are shown separately. For example, the bars labeled "0" mean that the call option delta is in the interval $(0, 0.1]$ and the put option delta is in the interval $[-0.1, 0)$. In the figures, the pre-LR period is shown in blue and post-LR period is in red.

Confirming the aggregate statistics of Table 2, the figures show that activities in E-mini futures options (with conversion factor 0.06) have shifted from US banks to EU banks, whereas the pattern for Treasury futures options (with conversion factor 0) is in the opposite direction. In addition, because leverage calculations are partially based on notional measures, the greatest divergence between capital requirements and option risk usually arises for low-delta options. We see in Figure 3 and 4 that the shift of option positions from US to EU banks tends to be larger for lower-delta options. The differences may be somewhat hard to see, but are statistically significant.

Figure 3: Share of US Customer Put Option Positions by Region, Pre-LR vs Post-LR

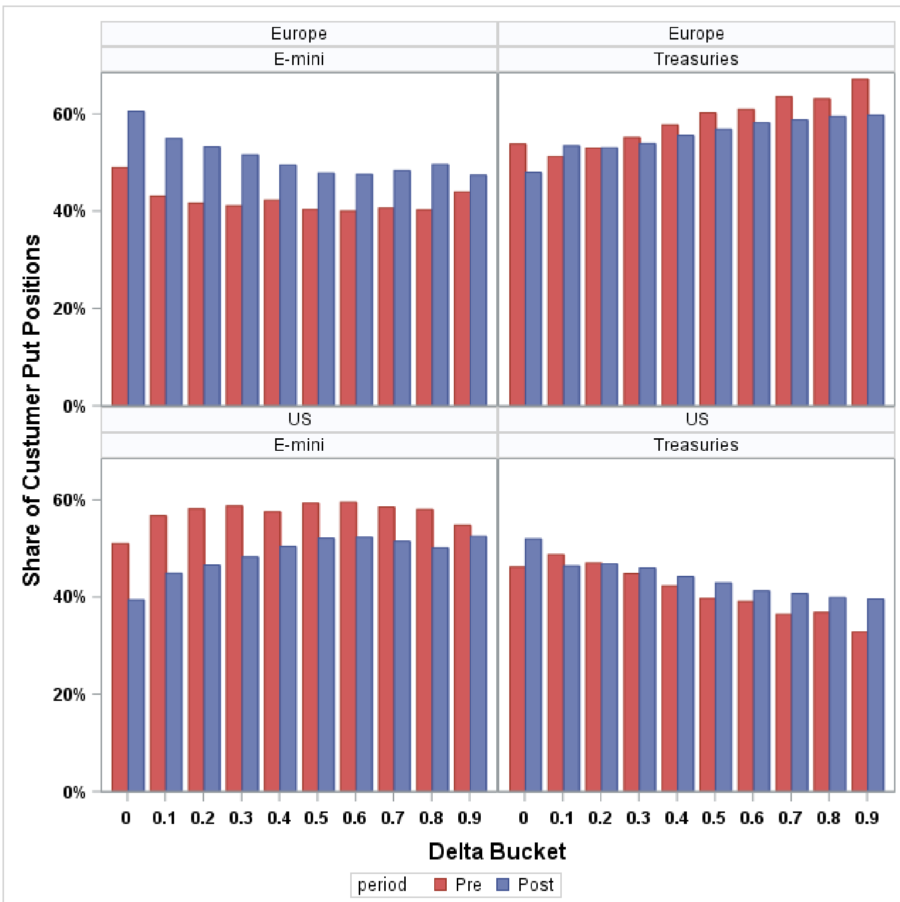
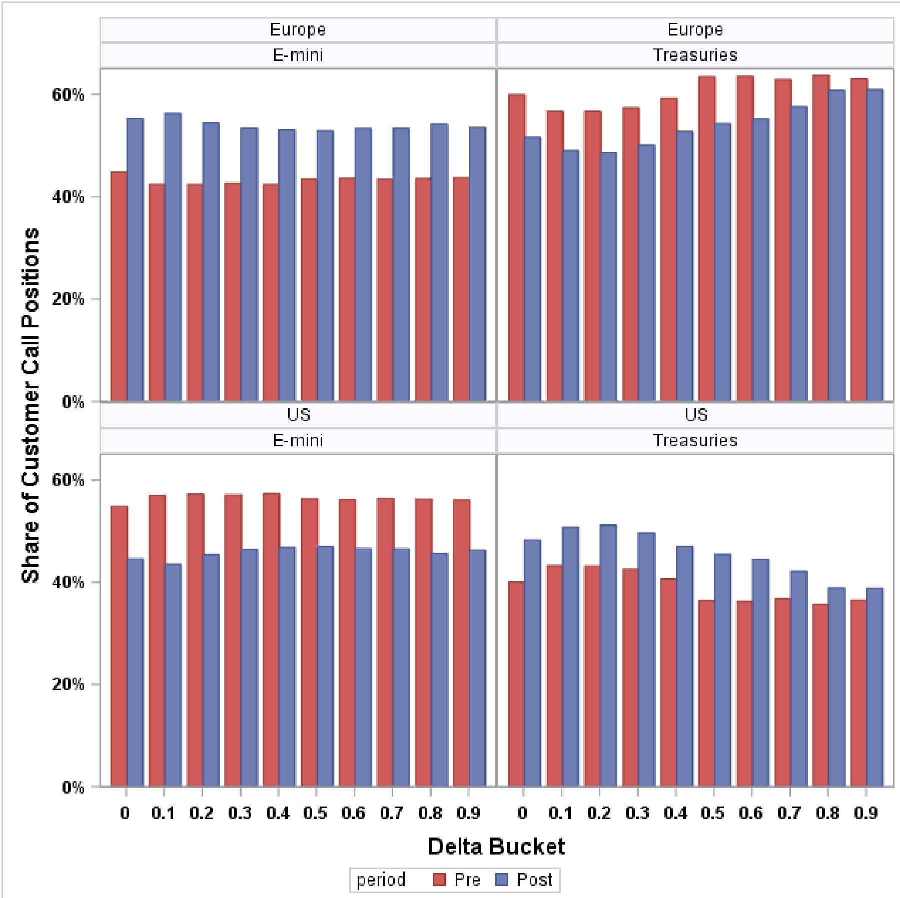


Figure 4: Share of US Customer Call Option Positions by Region, Pre-LR vs Post-LR



These conclusions can be demonstrated more formally in panel regressions using the difference-in-difference technique. All hypotheses outlined in Section 3 are confirmed in the data. The regression results are not reported here but are available in a companion working paper, Haynes, McPhail, and Zhu (2018).

5 Concluding Remarks

The evidence presented here contributes to the ongoing debates on whether various parts of the capital regime have resulted in unintended reallocations of activities. Some policy changes have already been put in place based on an evolving understanding of market structure issues and the feedback from market participants. This report is part of a growing body of quantitative evidence, focusing on one segment of derivatives where the leverage ratio may be especially binding. We show that the leverage ratio has differential impacts across various types of market participants and across product classes. In particular, we show that heterogeneous calibrations of the leverage ratio have shifted market activities toward less constrained market segments, and by a large amount. This change in the competitive landscape could, in turn, have important implications on market liquidity, the distribution of risks in financial markets, and access to key market infrastructure such as central clearing. Further analysis on these indirect effects should better clarify which policy adjustments, if any, would be the most beneficial.

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