CFTC INTERIM STAFF REPORT

CLEARED DERIVATIVES MARKETS: MARCH – APRIL 2020

2021

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BACKGROUND

This is an interim staff report that provides preliminary analysis and findings related to activity in the cleared derivatives markets regulated by the Commodity Futures Trading Commission[1] (CFTC) during March and April of 2020. The goal of this ongoing analytical work is to assess the impact of the COVID-19 shock on multiple parts of the financial system: central counterparties (CCPs), clearing members (CMs), and their clients.[2]

Cleared derivatives markets are strongly interconnected with other markets, including but not limited to uncleared swaps, securities, physical commodities, loans, etc. Since the cleared derivatives markets operate within the broader financial system, it is difficult to definitively determine the extent of risk transmissions from cleared derivatives markets to the broader system, or vice versa. However, there is broad consensus that the COVID-19 pandemic resulted in a large external shock to these markets as well as the global financial and economic system as a whole.

The scope of this interim report includes CCPs and CMs operating within the CFTC's jurisdiction, including exchange-traded and cleared futures and options on futures (F&O), cleared interest rate swaps (IRS), and cleared credit default swaps (CDS).

EXECUTIVE SUMMARY

- The almost-complete shut-down of global economic and social activity due to the pandemic was unprecedented, socially and economically, similar in short-term effect though not in length to other major historical global events, *e.g.*, the World Wars.[3]
- The shock to economic activity resulted in single day price moves that were more extreme than any move recorded during the past few decades in a number of asset classes.

[1] See https://www.cftc.gov/.

[2] Clearing member and member are used interchangeably in this document. Clearing members may have both house (their own) and client account trades cleared through the CCP. Related, the term "client" is intended to be synonymous with the term "customer" as defined in CFTC regulation 1.3.

[3] See a report by the United Nations, titled Everyone Included: Social Impact of COVID-19 (available at https://www.un.org/development/desa/dspd/everyone-included-covid-19.html).

- Given these extreme (and often historic) market moves, CCPs observed a significantly higher frequency of product-level initial margin (IM) breaches[4] across many cleared derivatives products.
- However, analysis of portfolio (not product) breaches shows that both the size and frequency of portfolio-level breaches were well within risk management tolerances. In addition, major CCPs had sufficient pre-funded collateral in the form of IM to cover any potential clearing member defaults. There is also evidence that larger portfolios tend to have more diversified exposures, which potentially helps offset gains and losses both within and across CCPs.
- Initial analysis reveals that changes in aggregate IM flows do not provide conclusive evidence that these models and associated practices were excessively procyclical.[5] Product-level IM change analysis for some key benchmark futures contracts shows that CCPs' margin models tend to spread the effects of volatility spikes across multiple days. However, CFTC staff continue to study the performance of CCP margin models to address these questions.
- Product-level IM requirement changes are not always correlated with IM changes at an account or portfolio level due to portfolio changes over time. Thus, changes in total account or portfolio-level IM requirements for clearing members, individually or collectively, are not a reliable proxy for measuring the changes in product-level IM requirements. Further, many of the largest CCPs under CFTC's jurisdiction have in place explicit measures to mitigate margin responses to volatility changes.
- The CFTC regulatory data from this period illustrates rich behavioral heterogeneity across different types of clients (also referred to as participants in the sections below) – e.g. hedge funds, asset managers, insurance companies, pension funds, etc. There is evidence of significant re-positioning of exposures across these different types of market participants during periods of elevated volatility; this re-positioning often can result in large changes in account level IM requirements, independent of other factors.
- The complex nature of these markets makes it difficult to examine causal relationships between margin requirements and trading liquidity in underlying markets. Staff continues to assess if CCP margin calls caused funding or liquidity strains on market

[4] An exceedance or breach means that the loss on a product or account from a market move was larger than the prefunded resources designed to cover market moves. Some breaches are expected by design since derivatives are not fully collateralized. Detailed explanations will follow.

[5] Procyclicality references the tendency of IM to increase as volatility, one measure of anticipated risk, increases and vice versa. Margin models are risk sensitive by design and regulation. However, prudent risk management should not lead to excessively low IM levels which might lead to undesired, rapid increases in IM as volatilities spike. Such a model could be considered excessively procyclical.

participants, though margin calls often represented a small fraction of available liquid resources for larger institutions.[6] Initial analysis indicates that although CCPs allow members and clients to post high-quality non-cash collateral to meet IM obligations, during March 2020 the level of posted cash collateral grew at a cumulative rate of 50%, in line with the growth of other types of commonly collected collateral, like high quality sovereign debt.

- CCP rules typically require clearing members to meet variation margin (VM) obligations with cash. Given the severity of daily price moves and related daily mark-to-market margin calls, VM requirements usually dominated CCP margin flows, often representing levels that were multiples of other sources of collateral demand such as IM calls.

[6] *See, e.g.*, Financial Stability Board's, Holistic Review of the March Market Turmoil, at 25 ("CCP margin calls' impact on overall liquidity can be considered by pairing margin call data with clearing members' and clients' available liquid resources, where initial comparisons suggest relatively small overall magnitudes. An initial comparison between the increase in IM posted to CCPs in March relative to banks' available cash (focusing on the US, UK, EU and Japan) shows the former representing 2-3%."). Available at https://www.fsb.org/2020/11/holistic-review-of-the-march-market-turmoil/.

INTRODUCTION

The CFTC's Division of Clearing and Risk (DCR) conducts ongoing regulatory oversight of registered CCPs[7] and their members. Supervisory oversight by CFTC staff is based on a comprehensive set of regulations implementing the US Commodity Exchange Act (CEA)[8], including requiring granular reporting from CCPs and other cleared market participants. Staff oversees a thorough supervisory program to ensure regulatory compliance, and performs ongoing, independent quantitative risk assessments of CCPs, their members, clients, and the larger clearing ecosystem.

The COVID-19 pandemic was (and continues to be) a source of unprecedented shock to global markets, resulting in extreme, rapid shifts in global output, consumption, and unemployment.[9] This economic shock quickly impacted financial markets, with asset classes such as equities and fixed income logging volatility levels not experienced since the global financial crisis of 2007-2009 (GFC). This volatility resulted in broad market stress, in some cases even for products generally believed to be relatively risk-free. As they had done during the GFC, central banks around the world responded with a number of market support programs, such as re-establishing purchases of sovereign bonds to aid market liquidity and, in some cases, playing a more active role in primary and secondary markets for corporate bonds and money market instruments.

Given its sheer size and breadth, the COVID-19 pandemic served as a real-world stress test of risk management frameworks of CCPs and their participants. The U.S. cleared derivatives market adapted to the pandemic with relatively little systemic disruption given the size and speed of market moves, the magnitude of liquidity shocks, and the unprecedented changes to operational structures prompted by work-from-home measures, which in some cases included all employees of a firm. However, given the severity and persistence of the shocks, reviews of market health during the most extreme periods of early 2020 and responses by market participants to these stresses are warranted.

This interim report summarizes the findings of DCR Risk Surveillance Branch staff's ongoing analysis of cleared derivatives market activity, primarily during March and April of 2020.

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[7] CFTC-registered CCPs are known as Derivatives Clearing Organizations (DCO).

[8] See https://www.cftc.gov/LawRegulation/CommodityExchangeAct/index.htm.

[9] For example, US unemployment rose from 3.5% to just under 15% over the course of two months, with US GDP falling around 31% in the second quarter on an annualized basis. See COVID-19 and the US Economy (available at https://crsreports.congress.gov/product/pdf/R/R46606) for a comprehensive overview of the economic impact.

Much of the analysis below is informed by the detailed data collected by the CFTC from both CCPs and clearing members. These data sources include confidential periodic and ad-hoc reports provided to the CFTC by these registrants. These data sets, as noted above, complement published academic analysis and analytical work in reports published by others, which often use publicly available data and tend to focus on product or CCP level analysis.[10] Because the confidential CFTC regulatory data are usually reported at an account level (both the positions held by an account as well as the IM posted), staff analysis can pair enhanced aggregate, public disclosures with detailed portfolio-level analysis. The analysis and findings discussed in this report leverage this account level data available to CFTC staff

For example, there have been numerous studies published in the past year using publicly available data.[11] These studies tend to focus on aggregate IM[12] and VM[13] flows, and product-level IM changes and breaches. However, because rights to collateral are at the portfolio/account level, product-level IM breaches do not necessarily translate into portfolio breaches or defaults by members and their clients. If an account (whether at the clearing member or client level) contains some products with losses in excess of product-level margin, and others with excess margin (or gains), there will be a margin deficit only to the extent that the losses associated with product level breaches exceed the excess held for other positions. The account-level analysis presented below indicates that while price changes caused a large number of IM breaches at a product-level, at an account level, whether CM or client, breaches were insignificant.

This interim report relies primarily on daily IM and VM balance and flow data. IM and VM calls are key components of a CCP's risk management toolkit.[14]

Cleared derivatives markets do not operate in isolation and are a mechanism for shifting risk away from entities that do not want to bear it and towards ones that are willing to do so. The markets serve as price discovery mechanisms for the real economy as well as a means of

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[10] For example, quarterly CPMI-IOSCO risk disclosures published by CCPs offer a standardized disclosure format for CCP risks, including resources held to offset such risks. See https://www.iosco.org/library/pubdocs/pdf/IOSCOPD475.pdf.

[11] https://www.world-exchanges.org/our-work/articles/procyclicality-ccp-margin-models-systemic-problems-need-systemic-approaches; https://www.fia.org/sites/default/files/2020-10/FIA_WP_Procyclicality_CCP%20Margin%20Requirements_1.pdf; https://www.isda.org/a/3jjTE/COVID-19-and-CCP-Risk-Managament-Frameworks-January-2021.pdf.

[12] IM is collateral that must be provided at the opening of a position to cover a potential future exposure in case of counterparty default.

[13] VM is collateral that is exchanged to cover mark-to-market changes or payment obligations.

[14] Analysis of the mutualized guarantee fund and related issues will be covered in future white papers.

hedging other market risks (e.g. spot commodity markets). While this report focuses on the cleared derivatives markets, similar dynamics were also documented in securities markets and uncleared derivatives markets during early 2020.[15]

CFTC staff offers this analysis as a resource to inform the discussion of broad policy questions raised by the events of early 2020. Many of these questions focus on funding and liquidity demands prompted by market volatility, as well as the resources held by market participants to meet such demands. This interim analysis informs some of these questions via detailed quantitative analysis; however, this single report does not seek to be comprehensive. At the end of the analysis below, staff offers additional questions which require additional analysis, whether by staff or others.

The report does include analysis of some of the factors behind changes in IM requirements for a variety of cleared derivatives instruments across multiple asset classes, including cleared futures and swaps markets. The report also provides evidence of the diversity of behavior among different types of market participants – intermediaries and clients – across different asset classes. It does not include an analysis of other aspects of CCP risk management, such as the potential risks of non-default losses[16] and CCP available resources to cover such potential losses.

Because analysis is ongoing, staff anticipates future reports speaking to other aspects of risk management by CCPs and market participants during high volatility times. Staff intends to focus on three sets of concerns raised by some market participants: first, that some CCP margin models may have been too procyclical during early 2020; second, that margin calls for cleared derivatives may have caused strains in some funding and liquidity markets (the so-called "dash-for-cash"); and third, that these margin calls contributed to stresses in trading conditions in other critical markets such as cash or US Treasuries.

This interim report shares insights gained from the granular and confidential data available to the CFTC that go beyond what the aggregate IM and VM balances and flows available to the public can show. Further, the data suggests these aggregates hide important details needed to make reliable policy decisions pertaining to CCP margin models and systemic risk. Additional analysis is necessary to differentiate: a) the impact of behavioral changes of market participants as they reacted to the unprecedented severity of the COVID-19 shocks from b) reactions of CCP

[15] See *supra* note 6.

[16] Non-default losses (NDL) are losses due to incidents other than the default of a clearing member, including but not limited to custodial failure, fraud, theft, operational failure, and cyber-attacks.

and intermediary risk management arrangements (including cleared margin models) to these shocks.

CCP RESOURCES

An overview of the resources held by a CCP to protect itself and the rest of the market from the default of one or more of its members may provide context for the analysis of flows to and from a CCP. Resources can be classified into a few broad categories. The first classification divides resources into: a) non-mutualized resources which can only be used to cover the losses associated with a specific defaulting member, and b) mutualized resources which can be used to cover losses related to the default of any member. The second classification includes both pre-funded resources, and committed (but not pre-funded) resources, such as assessments. Assessments are always mutualized resources, whereas pre-funded resources fall into both mutualized and non-mutualized categories.

Non-mutualized resources act as a first line of defense for the CCP, as they are typically the first resources consumed after a member default. Non-mutualized resources are primarily composed by IM posted by the member to cover potential losses in either the house (its own) account or the accounts of its clients[17] (if the member clears for clients). Each CCP deploys its own margin model and calibrates this model to cover most, but typically not all, of the possible losses resulting from a member default (for example, the model may set IM to cover 99% of the expected one-day moves).[18] Minimum IM requirements are usually calibrated to protect against not only market price movement risks, but also liquidity risks, position concentration risks, jump to default risks, and so on.

As a supplementary resource in the waterfall, CCPs typically next devote a fixed amount of their own resources to meet defaults that are not covered by the defaulter's resources held by the CCP; this is frequently referred to as "skin-in-the-game."

CCPs typically additionally require that members contribute to a mutualized pool of resources commonly referred to as the guaranty fund. If the (pre-funded) guaranty fund is still not

[17] Typically, house IM can be used to cover losses in the house or (where permitted by CCP rules) the client accounts, but client IM can only cover losses in the latter, to an extent consistent with the relevant legal framework (including, in the context of cleared swaps, Legally Separated Operationally Commingled (LSOC)). See https://secure.fia.org/files/css/magazineArticles/article-1528.pdf for a tutorial on LSOC.

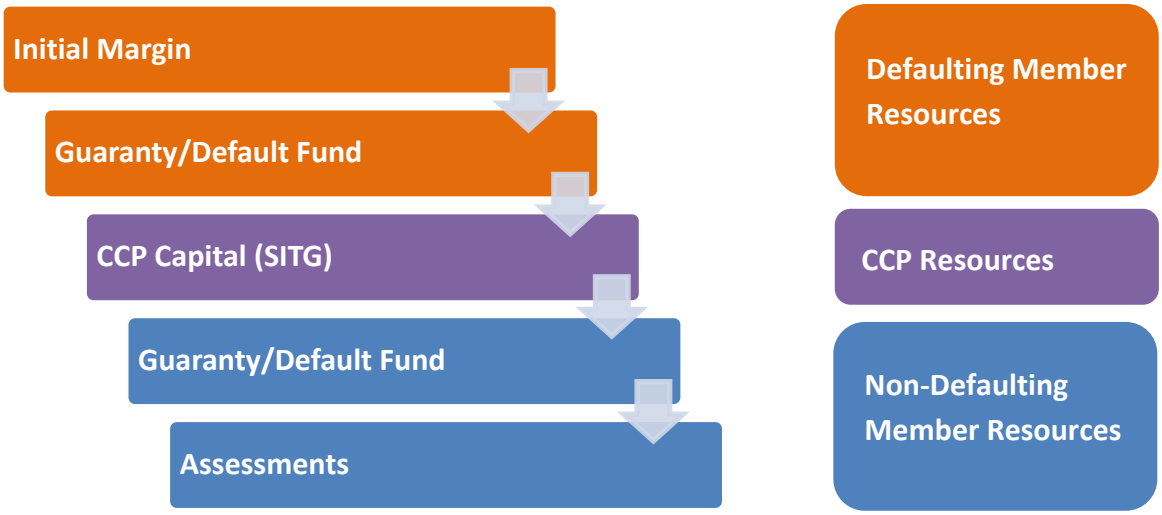
[18] Typically, if a clearing member defaults, the CCP may use all of the clearing member's posted margin to meet their obligations, regardless of the product that the margin was posted for initially. Accordingly, while the CCP may set margin levels for particular products to achieve a 99% (or higher) coverage, where the member has a diverse portfolio, the effective level of protection for the member's entire portfolio may be higher due to the diversification effect.

sufficient to meet losses, the CCP typically has the contractual right to call for a specified amount of additional resources from surviving members, a process known as assessment.

For the registered systemically important CCPs, CFTC Regulation 39.33 requires the CCP to have enough pre-funded resources to cover potential losses due to the default of the two members creating the largest combined exposure in extreme but plausible conditions.

Figure 1 provides a stylized graphical summary of typical CCP resources as well as the order of use in a typical default "waterfall" scenario. Actual resource waterfalls may be more complex and differ by CCP.

Figure 1: Stylized CCP Resource Waterfall



CCP DEMANDS

The CCP collects the resources described above to protect the CCP against losses resulting from the default of one or more members. These losses occur if a member fails to satisfy margin calls. VM payments generally represent daily mark-to-market (MTM) changes in the market value of a cleared portfolio due to changes in the market prices of the products in the portfolio. VM is collected and paid daily and is passed from members and clients with MTM losses to members and clients with MTM gains; because each long position at the CCP has a matching short position, these payments typically net out to approximately zero per CCP. Daily VM payment exchanges resets the MTM value of each portfolio to zero at the beginning of each trading day. VM payments are usually made in cash in the same currency as the underlying position.

CCPs also collect IM from members to cover anticipated potential future (not past) market price movements. The CCP is exposed to the risk that a defaulter may fail to pay MTM losses (VM) when called. Moreover, because it takes time to hedge or liquidate the portfolio of a defaulted member, the CCP may suffer additional losses on the portfolio during this post-default period. CCPs' calibration of minimum IM requirements is designed to cover these potential future losses. Unlike VM, IM is a one-way posting[19] from the member to the CCP, rather than a pass-through. Also, unlike VM, IM can typically be satisfied using high quality, but non-cash collateral. Depending on the policies and rule book of the CCP, eligible collateral may include sovereign debt, and debt of government-sponsored entities ("agency debt"), and to a limited extent, precious metals, corporate debt, exchange traded funds, and/or equities. All non-cash collateral is subject to appropriate "haircuts."[20] Collectively, IM and VM exchange help ensure that the CCP can adequately risk manage both realized and unrealized member losses.

Additionally, CCP clearing members that clear for clients require additional collateral from their clients in excess of the IM minimums set by the CCP. Additional collateral standards differ by clearing member and client, and reflect the clearing member's risk assessment of their client's creditworthiness, trading practices, trading volume, and overall risk profile.

During periods of extreme stress and market price volatility, both VM and IM calls typically increase – the underlying margin models are risk-based and therefore are generally[21] structured to respond to current market conditions. Additionally, increases in the volume of net trading and hedging activity are also correlated with stress and can contribute to increases in VM and IM collected by CCPs and their members.

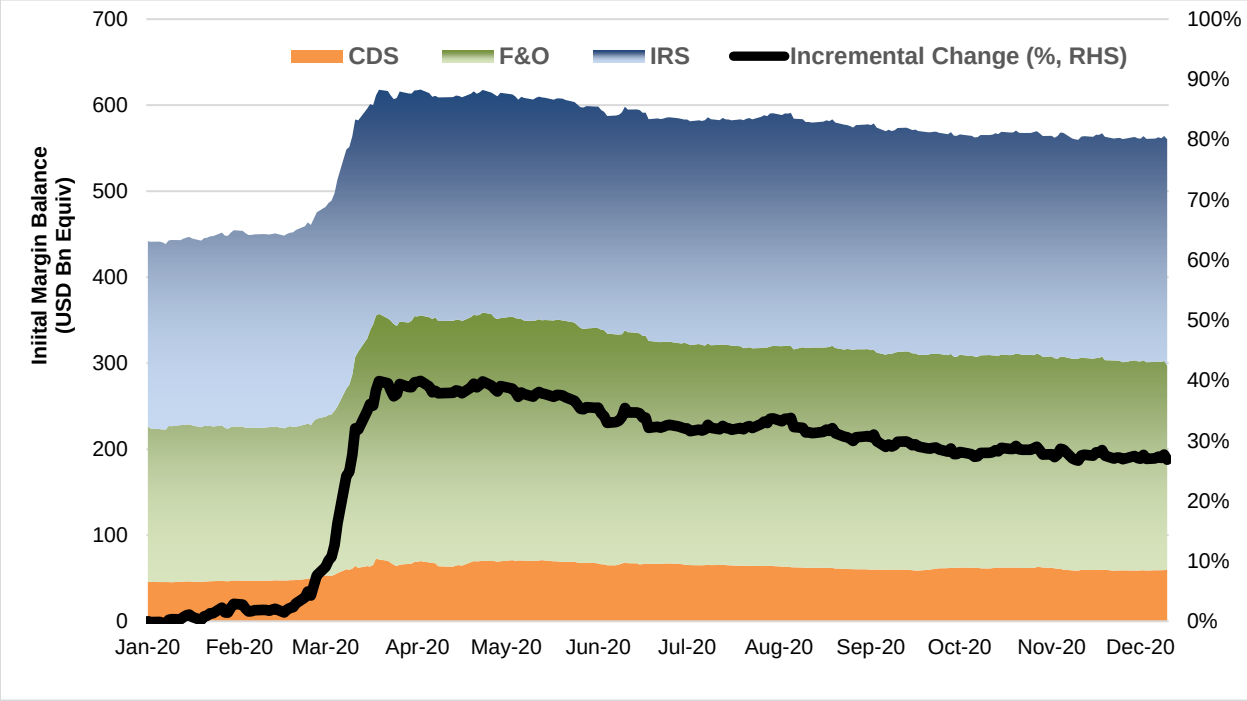
Due to these factors, increases in the frequency and magnitude of VM and IM calls occurred at all major US derivatives CCPs during the COVID-19 period, especially during late February and early March 2020. Figure 2 provides a summary of IM balance trends in select cleared derivatives markets in 2020, disaggregated by cleared derivatives asset class.

[19] Unlike uncleared bilateral swaps where each party may post collateral to the other, the CCP will always collect collateral from, and never post collateral to, its members (though it will return excess IM).

[20] The value allowed for non-cash collateral will be a percentage (*i.e.*, 100% less a "haircut") of the current market value of that asset. Larger haircuts are generally applied to riskier or more volatile assets. For example, a 5% haircut means the asset's allowed value for margin would be 95% of its current market value.

[21] It should be noted that risk-based IM could be designed to *not* respond excessively to current market conditions, for example, by requiring a high stress-scenario calibration or a time-dependent weight that favors past instead of current or more recent price moves.

Figure 2: IM Balances by Cleared Derivatives Asset Class



From the beginning of 2020 to late March 2020, minimum IM balance requirements rose by approximately 40%, from around 450 billion USD equivalent to just over 600 billion USD equivalent in minimum IM requirements across select CFTC regulated CCPs.[22] Most of this increase occurred during the most volatile market period in the first half of March 2020. Since March 2020, aggregate minimum IM requirements remain elevated, with a slow downward drift as market price volatility reverts to reflect more "normal" market conditions while continuing to reflect the heightened price volatility from the severe economic disruption of the COVID-19 pandemic.

Moreover, in considering the impact of increases in IM rates on member liquidity, it is also important to consider the time over which such increases are implemented. For example, some CCPs, as a matter of policy, endeavor to implement IM changes over a number of days rather than all at once, in an effort to mitigate liquidity impacts.[23]

[22]Except where explicitly highlighted, all the exhibits and other quantitative evidence presented in this interim report are based on data received by the CFTC pursuant to CFTC Regulation 39.19(c)(1).

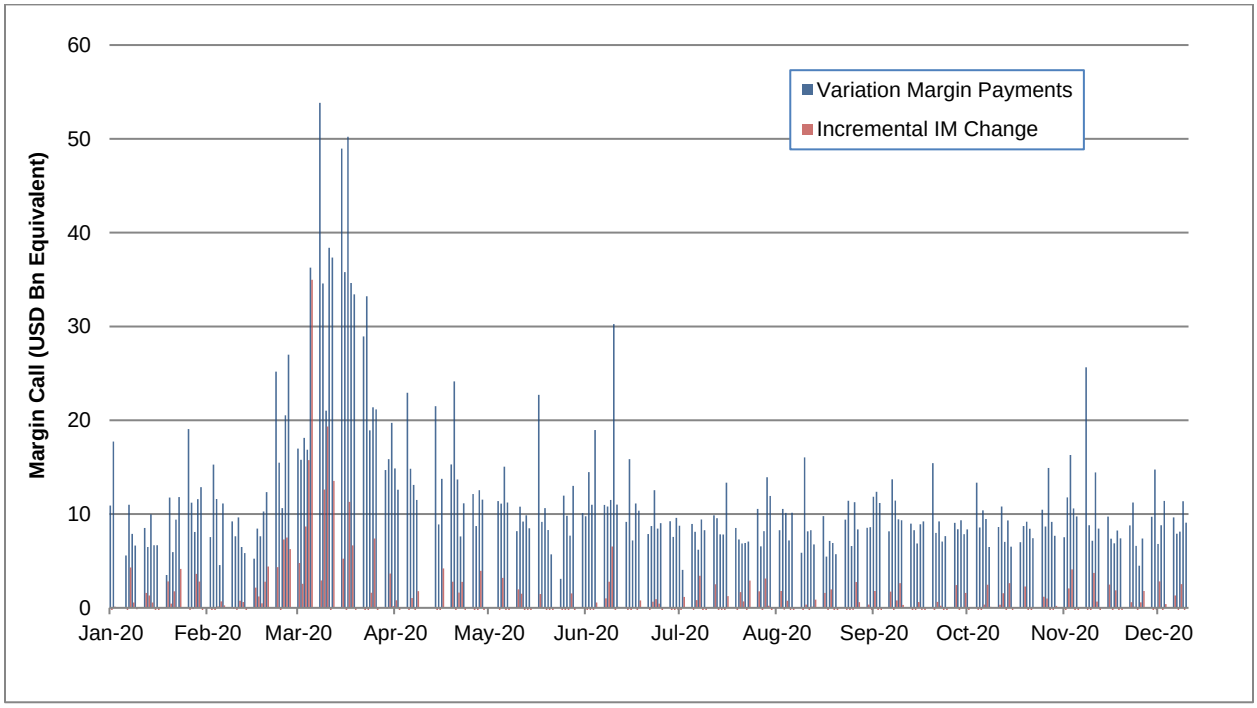
[23] See section titled "Concluding Remarks and Future analysis" for a discussion on the interaction of IM changes in response to shocks and potential impact on broader market liquidity.

Though increases in minimum IM requirements were large relative to normal periods, demands on funding and liquidity due to VM calls (generally, MTM changes) usually exceeded incremental IM calls (often to a significant degree), even during March 2020.

Figure 3 provides a comparison between aggregate incremental IM calls and aggregate daily VM calls, with VM payment requests shown in blue and aggregate incremental IM requests shown in red.[24]

Daily VM calls are determined by marking to market the portfolios of clearing members and their clients; changes in incremental IM balance requirements are driven by margin models reacting to changes in market prices, changes in market price volatility, and model changes themselves. Hence, substantial care should be exercised in drawing any conclusions from analyzing just aggregate VM flows and IM balances during early 2020. Changes in the portfolio composition of members and their clients (both volume and net directionality) serve as important drivers of minimum IM requirements. Further, portfolios with large exposures to options can experience significant variations in minimum IM requirements as options positions go in and out of the money.

Figure 3: Aggregate Daily Incremental IM and Gross VM Calls



[24] Figure 3: The y-axis is floored at zero. There were days for which aggregate IM levels decreased (which would be represented by a negative number in the chart). Given the focus of the comparison, these changes are omitted.

In 2020, aggregate VM calls exceeded incremental IM calls. VM calls averaged approximately 17 billion USD equivalent per day and incremental IM calls averaged approximately 3 billion USD equivalent during the first quarter of 2020, with peaks of 53 billion and 34 billion USD equivalent, respectively.

Statistic	Aggregate Marginal IM Calls	Aggregate VM Calls
Mean	3	17
Peak	34	53

In USD Bn Equivalents

In addition to the difference in magnitude, there is also typically a difference in eligible deliverable collateral between VM and IM calls. The majority of CCPs require VM payments to be made in cash in the currency of the underlying position; whereas, IM calls may be satisfied by posting any of the broader list of acceptable collateral types allowed by the CCP, subject to a haircut. Figure 4 and Figure 5 show the various collateral types utilized by CCP clearing members during the period of interest, 30-40% of which were in cash. In late March, cash collateral posted increased as liquidity demands increased. Figure 6 and Figure 7 show the cumulative percent changes in cash and non-cash assets (roughly 50% and 5%, respectively) during March across a select number of CCPs[25] to highlight the notable movement into cash amid the rising volatility.

[25] Information in this section comes from aggregated payments and collateral data provided by the following CCPs: Chicago Mercantile Exchange (CME), Eurex Clearing, ICE Clear Credit (ICC), ICE Clear Europe (ICEU), ICE Clear US (ICUS), LCH Ltd, LCH SA, Minneapolis Grain Exchange (MGEX), Nodal Clear, and Options Clearing Corporation (OCC).

Figure 4: Collateral Types for Selected CCPs

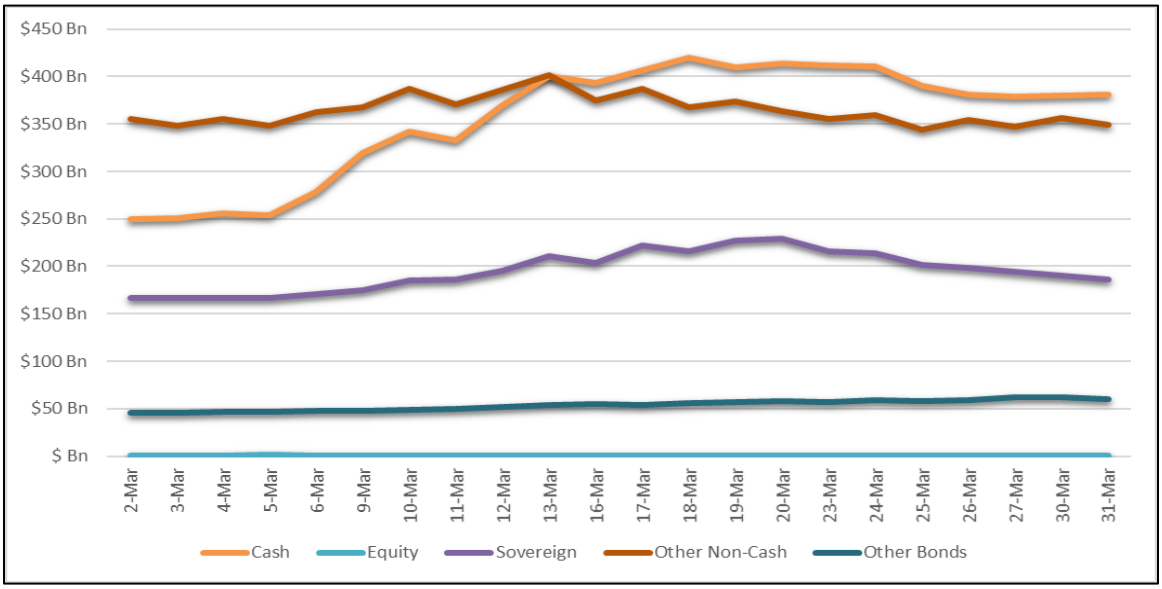


Figure 5: Cash vs. Non-Cash Collateral for Selected CCPs

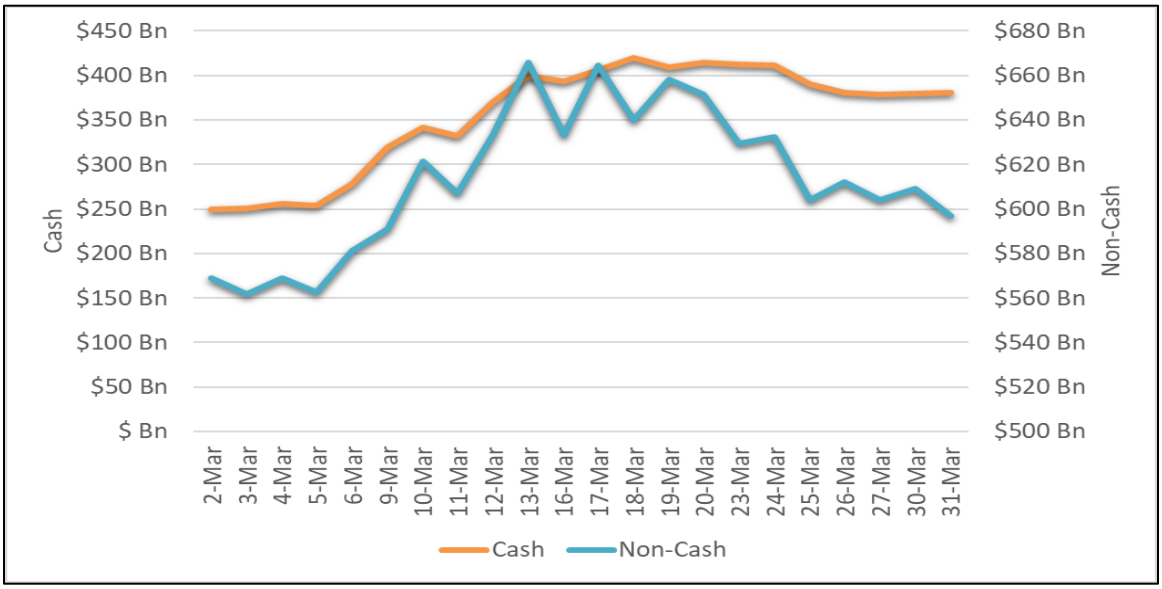


Figure 6: Cash Collateral Percentage Changes

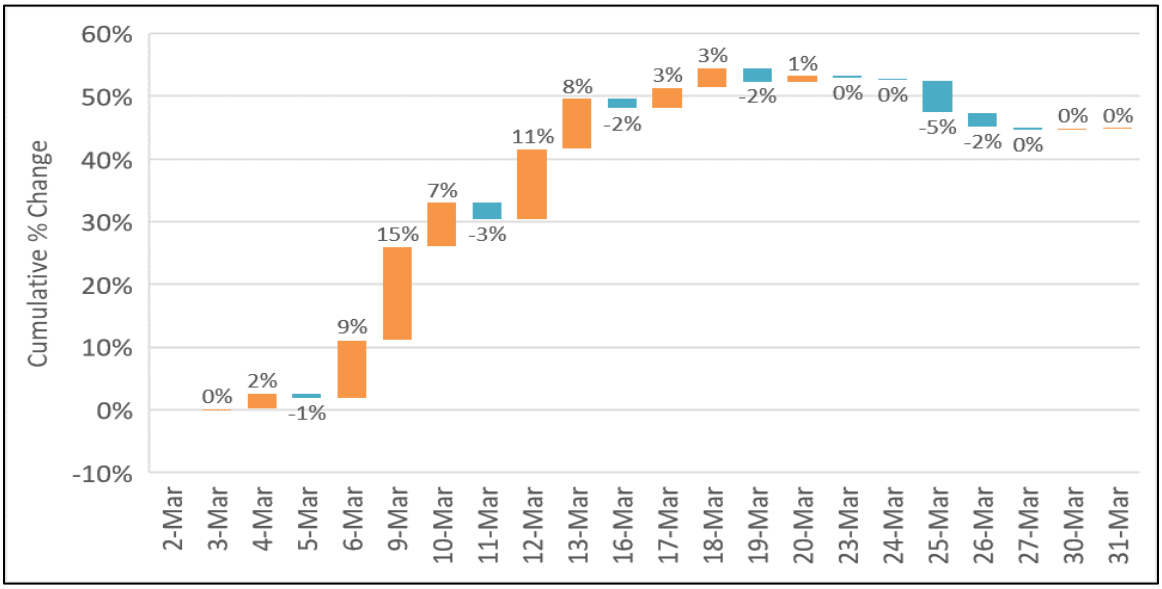
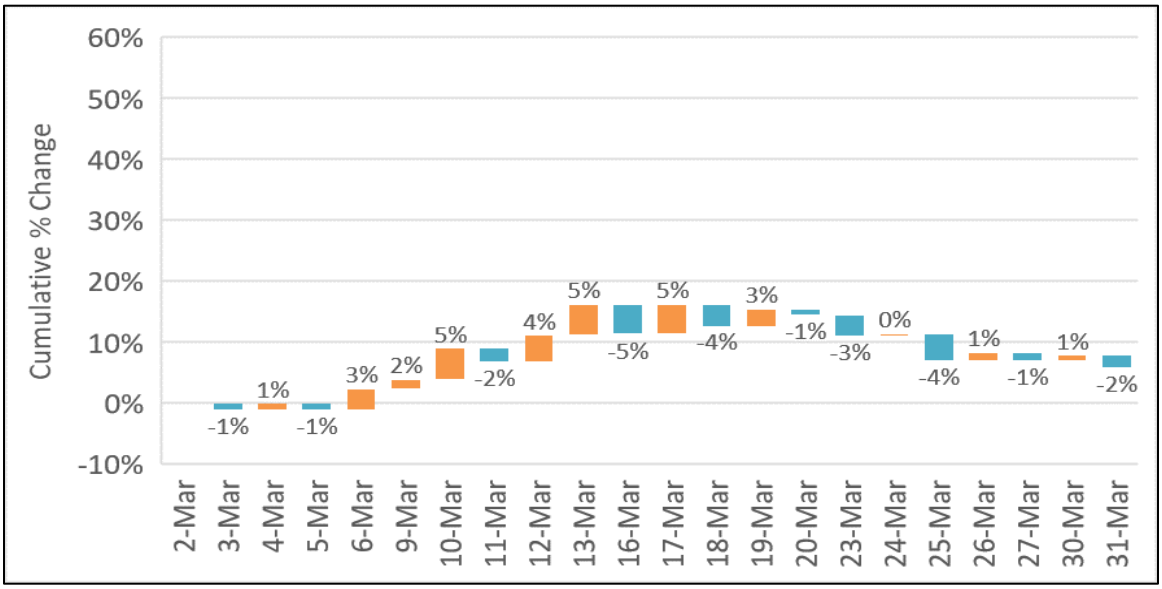


Figure 7: Non-Cash Collateral Percentage Changes



Later sections of this report will focus on specific disaggregated margin flow results by market participant types, to highlight that the magnitude of IM changes was often highly dependent on the nature of derivatives activity and participant type. In broad strokes, participants that held positions that were at least partially hedged (e.g. calendar or product spreads that assisted with off-setting risk across their portfolios) were less exposed to changes in volatility than those with purely directional exposures. In addition, participants that had more flexibility to adjust

positions in response to volatility changes may have shifted exposures in ways that led to reduced absolute IM changes (or even experienced net IM decreases).

THE 99% FACTOR

Any analysis of the resilience of the clearing system during March-April 2020 should note that no risk management system can be designed to absorb all potential shocks. For CCPs, IM acts as the first risk mitigation step in a default management waterfall. Functionally, as described above, IM is collected to ensure that the CCP has sufficient resources to cover losses in most market conditions after the default of a clearing member. Regulations usually require the design and calibration of IM models be conservative, such as CFTC Regulation 39.13(g)(2)(iii)[26] or the Principles for Financial Market Infrastructures[27] (PFMIs) that require IM collected by a CCP to be sufficient to meet a single-tailed 99% confidence level standard within a pre-specified historical lookback period and holding/liquidation period.[28] As a matter of practice, CCPs typically aim for a much higher coverage standard – often closer to 99.7%. Over a ten-year period, this higher level of coverage should mean that market moves for only 8 individual days would generate product or portfolio losses in excess of posted IM levels (assuming a MPOR of one day and 252 trading days per year).

IM therefore is not designed to cover all potential losses associated with all hypothetical price moves. The 99% (or even the 99.7%) standard accepts the fact that there are some price moves which are so extreme that they will fall in the 1% (or 0.3%) of the proverbial "tail" of the distribution of price movements. In these cases, the CCP would rely on diversification effects in clearing members' portfolios to mitigate extreme price moves of individual assets and, if IM is insufficient, the other resources in the default waterfall such as the guaranty/default fund, CCP capital, and clearing member assessments.[29]

COVID-19: EXTREME TAIL EVENT

Staff compared the largest market price moves during the March-April 2020 period to moves since 2000 for the most active cleared contracts to quantify how price changes compared to the

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[26] 17 C.F.R. § 39.13(g)(2)(iii).

[27] See Principle 6, key consideration 3, in CPMI–IOSCO, Principles for Financial Market Infrastructures (Apr. 2012), *available at* *http://www.iosco.org/library/pubdocs/pdf/IOSCOPD377-PFMI.pdf.*

[28] This liquidation time period, known as the margin period of risk (MPOR), represents the estimated period of time to liquidate or transfer the positions of the defaulted clearing member. For cleared futures subject to CFTC oversight, the MPOR is typically one day, while for cleared swaps, the MPOR is typically five days. *See* CFTC Regulation 39.13(g)(2)(ii), 17 C.F.R. § 39.13(g)(2)(ii).

[29] These can be further supplemented by additional liquidity and capital requirements for clearing members.

pre-2020 historical distribution. Staff observed that the market price volatility in 2020 was notable for its abruptness as much as, or perhaps more than, its absolute magnitude.

CLEARED FUTURES & OPTIONS

Figure 8 compares the S&P 500 Index from its February 2020 high to its eventual low to the most recent broad equity index bear markets in 2001 and 2008. While 2001 and 2008 recorded larger overall drops on a percentage basis, the speed of the 2020 moves meant that the S&P 500 Index lost more than 30% in less than 30 trading days, compared to approximately 250 trading days for 2001 and 2008.

Figure 8: S&P 500 Index Performance During Recent Bear Markets

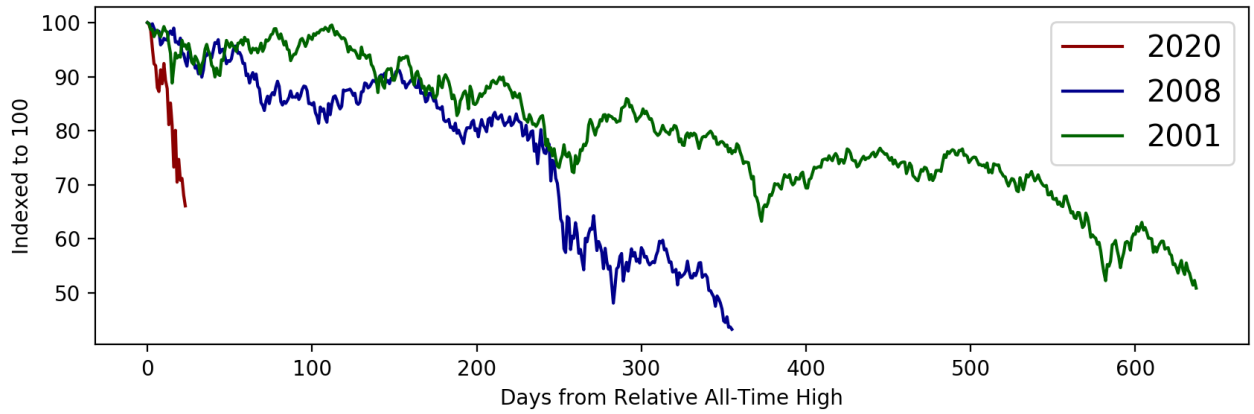
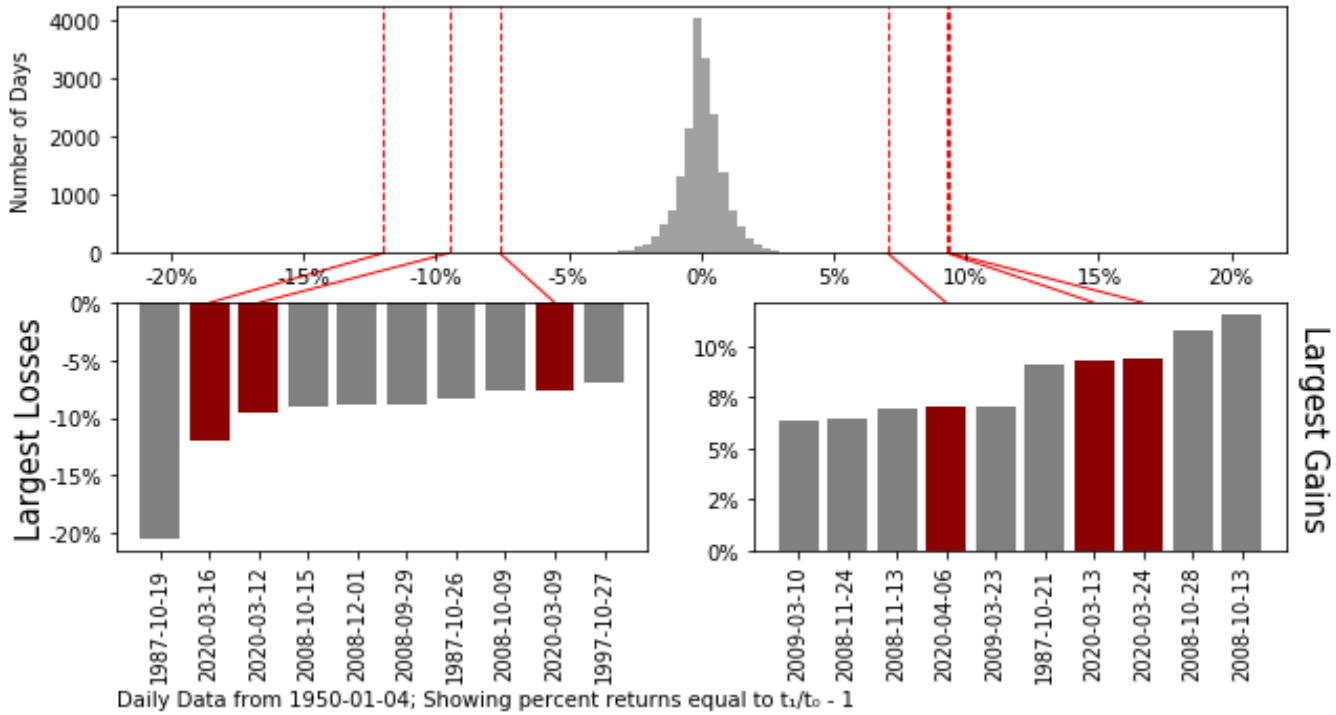


Figure 9 displays a few of the largest single day index value changes in the S&P 500 Index.[30] The top panel displays a histogram of daily index moves and links to details of the largest gains and losses in the lower two panels. While this set of index value changes includes many moves from the volatile 2008 period, these were often spread out over multiple months. In contrast, six of the largest S&P 500 single-day moves (either up or down) came in a single month in 2020.

[30] Source: Bloomberg Finance L.P. Ticker: SPX Index.

Figure 9: S&P 500 1-Day Index Price Return Distributions



The rapid decline in equity futures markets was mirrored in benchmark prices in other asset classes. Figure 10 and Figure 11 below graph the largest single-day historical up and down moves in the 10-year U.S. Treasury rates[31] and the front month West Texas Intermediate (WTI) crude oil futures contracts,[32] with dates in 2020 highlighted in red. Early 2020 represented a significant fraction, and sometimes a majority, of these top 10 moves across both of these benchmarks.

[31] Source: Bloomberg Finance L.P. Ticker: USGG10YR Index.

[32] Source: Bloomberg Finance L.P. Ticker: CL1 Comdty.

Figure 10: 10-year US Treasury Rate Change Distributions

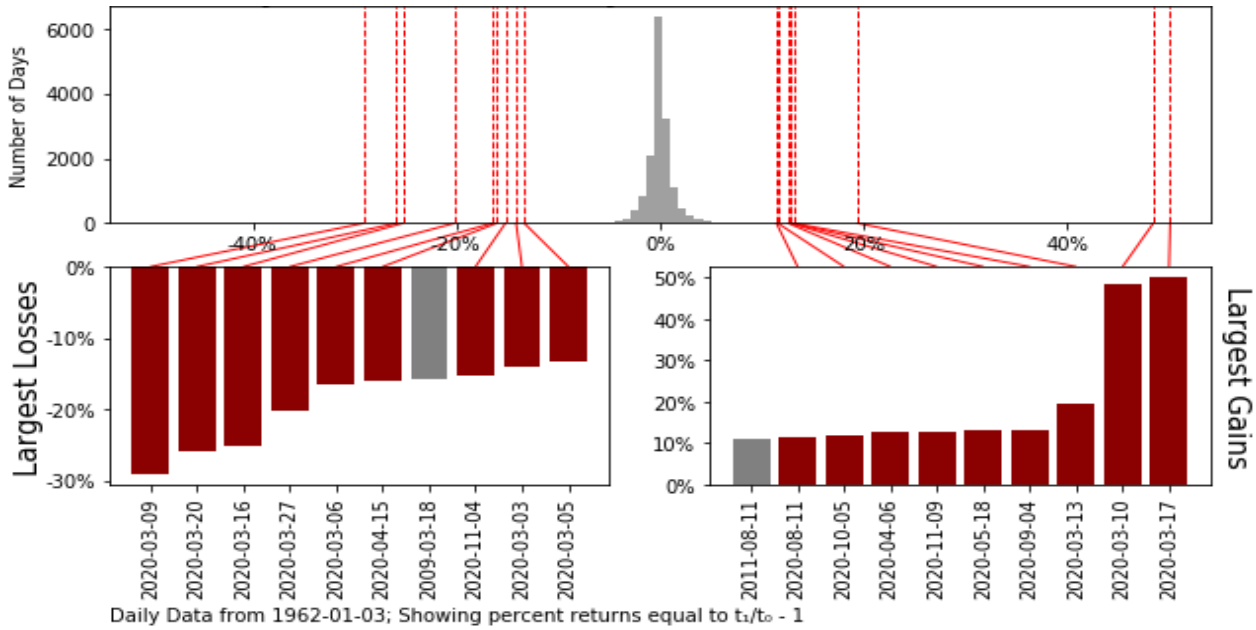


Figure 11: WTI Oil 1-Day Futures Price Return Distributions

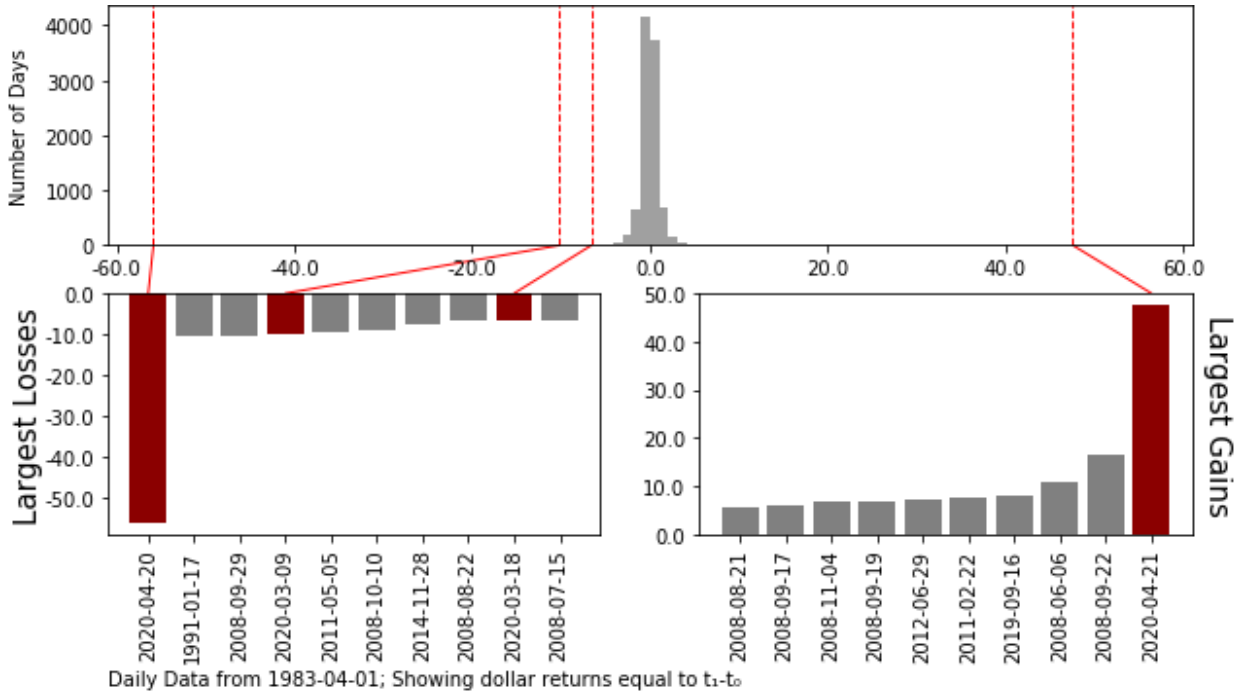


Table 1 lists some of the largest price moves during 2020 for five major price benchmarks and highlights percentile rank for the year relative to the data available for that particular index. Note that all of these price moves exceed the 99.7 percentile that many CCP models use for calibration. Additional results are listed in Table 4 in Appendix 2.

Table 1: 2020 Percentile Ranks of Index Gains and Losses

Date	Index	Percentile Rank	Percent Return
9-Mar-20	10Y U.S. Gov Rate	100.00%	(29%)
20-Apr-20	Front Month WTI	100.00%	(306%)
16-Mar-20	S&P 500 Index	100.00%	(12%)
20-Mar-20	10Y U.S. Gov Rate	99.99%	(26%)
12-Mar-20	S&P 500 Index	99.99%	(10%)
16-Mar-20	10Y U.S. Gov Rate	99.99%	(25%)
16-Mar-20	Federal Funds Rate	99.99%	(77%)
27-Mar-20	10Y U.S. Gov Rate	99.98%	(20%)
6-Mar-20	10Y U.S. Gov Rate	99.97%	(16%)
15-Apr-20	10Y U.S. Gov Rate	99.97%	(16%)
9-Mar-20	Front Month WTI	99.97%	(25%)
9-Mar-20	S&P 500 Index	99.96%	(8%)
27-Apr-20	Front Month WTI	99.96%	(25%)
4-Nov-20	10Y U.S. Gov Rate	99.95%	(15%)
3-Mar-20	10Y U.S. Gov Rate	99.95%	(14%)
18-Mar-20	Front Month WTI	99.95%	(24%)
5-Mar-20	10Y U.S. Gov Rate	99.94%	(13%)
1-Apr-20	10Y U.S. Gov Rate	99.94%	(13%)
10-Jun-20	10Y U.S. Gov Rate	99.93%	(12%)
13-Mar-20	VIX Index	99.93%	(23%)

Date	Index	Percentile Rank	Percent Return
17-Mar-20	10Y U.S. Gov Rate	100.00%	50%
30-Apr-20	Front Month WTI	100.00%	25%
10-Mar-20	10Y U.S. Gov Rate	99.99%	49%
2-Apr-20	Front Month WTI	99.99%	25%
24-Mar-20	S&P 500 Index	99.99%	9%
13-Mar-20	10Y U.S. Gov Rate	99.99%	19%
13-Mar-20	S&P 500 Index	99.98%	9%
4-Sep-20	10Y U.S. Gov Rate	99.98%	13%
19-Mar-20	Front Month WTI	99.98%	24%
18-May-20	10Y U.S. Gov Rate	99.97%	13%
29-Apr-20	Front Month WTI	99.97%	22%
6-Apr-20	S&P 500 Index	99.97%	7%
9-Nov-20	10Y U.S. Gov Rate	99.97%	13%
6-Apr-20	10Y U.S. Gov Rate	99.96%	13%
5-May-20	Front Month WTI	99.96%	20%
5-Oct-20	10Y U.S. Gov Rate	99.95%	12%
23-Apr-20	Front Month WTI	99.95%	20%
11-Aug-20	10Y U.S. Gov Rate	99.95%	11%
26-Mar-20	S&P 500 Index	99.94%	6%
22-Apr-20	Front Month WTI	99.94%	19%

Note: Front Month WTI relative returns for 21-Apr-2020 were excluded from the Gains table. The price change from -$37.63 to $10.01 produces nonsensical results.

Index	Start Date
Front Month WTI	1983
10Y U.S. Gov Rate	1962
Federal Funds Rate	1954
VIX Index	1990
S&P 500 Index	1950

CLEARED SWAPS: CREDIT DEFAULT SWAPS

The GFC dramatically affected credit spreads expressed by the CDX North American Investment Grade Credit Default Swap Index[33] (CDX.NA.IG, see Figure 12) moving from approximately 80 basis points (bps) in late 2007 to 280 bps by November 2008. The CDX North American High Yield Credit Default Swap Index[34] (CDX.NA.HY, see Figure 13) also faced large spread increases, ranging from 210 bps in late 2007 to approximately 1,900 bps in March 2009.

Spring 2020 events proved to be even more impactful, with extreme moves condensed into a window of a few days rather than months. While the spread changes from start to finish during the GFC were larger than those observed during the March to April 2020 period, the rapid movements during the latter period generated large CDS spread moves both up and down over the course of only days and weeks instead of months.

For example, from January 2020 to March 2020, the CDX.NA.IG index widened from approximately 40 bps to 150 bps, and the CDX.NA.HY index moved from approximately 275 bps to 870 bps. During this period, large percentage moves were concentrated, with spread increases of over 33% in CDX.NA.IG and 25% in CDX.NA.HY on March 9 alone.

Figure 12: CDX.NA.IG

[33] Source: Bloomberg, Ticker: CDX IG CDSI GEN 5Y Corp.

[34] Source: Bloomberg, Ticker: CDX HY CDSI GEN 5Y SPRD Corp.

Figure 13: CDX.NA.HY

Table 2: Credit Default Swap Index Price Change Historical Percentiles

	Largest Spread Widening Since 2010			Largest Spread Tightening Since 2010		
Index	**Date**	**% Rank**	**% Change**	**Date**	**% Rank**	**% Change**
CDX NA IG	9-Mar-20	100.0%	33%	21-Sep-20	100.0%	-27%
CDX NA HY (spreads)	9-Mar-20	100.0%	25%	13-Mar-20	99.9%	-18%
iTraxx Euro IG	9-Mar-20	100.0%	32%	11-Mar-16	100.0%	-20%
iTraxx Crossover	6-Oct-14	100.0%	37%	11-Mar-16	99.9%	-14%
iTraxx Senior Financials	24-Jun-16	99.9%	34%	12-Oct-11	99.9%	-20%
iTraxx Sub Financials	6-Oct-14	100.0%	68%	19-Mar-20	100.0%	-19%
iTraxx Japan IG	9-Mar-20	100.0%	45%	25-Mar-20	99.9%	-19%
CDX Emerging Market Sovereigns (spreads)	21-Sep-20	100.0%	32%	31-Dec-17	100.0%	-29%

All CDS indexes above reference the 5-year tenor.

BREACHES

The product-level analysis in Table 1 illustrates that during March-April 2020, price moves across multiple cleared futures asset classes often exceeded even the heightened 99.7% standard used in some CCP margin models. However, this analysis does not yet compare the size of these price moves against the IM levels specified by the model. One traditional approach to quantifying the actual (not calibrated) coverage level of a margin model is to count the number of days when changes in the value of a product exceeds the required IM for the product – for the purposes of this report, an occurrence of this type is defined to be a margin "breach." Related to this, for the days when price moves generated losses in excess of posted

IM, staff quantified on a percentage basis the magnitude of the breach. The analysis below provides a review of the count and magnitude of IM breaches for both cleared futures and swaps during early 2020.

CLEARED FUTURES & OPTIONS

Figure 14 summarizes product-level breach information for a set of benchmark futures contracts across major asset classes for the period between February 24, 2020 and April 21, 2020, representing roughly the peak of market volatility.

The top half of the chart shows the number of daily breaches during the first half of the year, with the ring "dot" scaled by size of open interest and left clear inside to allow smaller contracts to be seen. The color scheme orders contracts by asset class and then by size of breaches so similar contracts are assigned similar colors.

The bottom half assigns nominal values to the size of the breaches. This calculation ignores the fact that long and short positions can offset risk. The variable "Breach Dollar Importance" is defined as Open Interest * (Dollar PnL[35] - IM), and the variable "Contract Dollar Outstanding" is defined as Open Interest * IM. The aggregate, theoretical, nominal value of breaches is highest on March 9, 2020 and stood at approximately 66 billion USD equivalent.

Aggregating actual profits and losses using account level position information for the CCPs represented in the chart below reveals that the maximum actual or realized size of breaches was less than 2.5 billion USD equivalent (3.6% of the theoretical sum of 66 billion USD equivalent) on any given day during the March-April 2020 period. In plain-English, this chart indicates that potential risks facing mutualized resources is much lower than what a simple sum of product breaches suggests. Per staff estimates, actual account breaches during the time period across the CCPs represented in the chart below and aggregate the breaches across all settlement accounts at all the represented CCPs, the potential impact on mutualized resources was less than 2.5 billion USD on any given day. Further, even this is a conservative estimate of the potential risk to mutualized resources as it supposes all accounts with breaches would default at the same time.

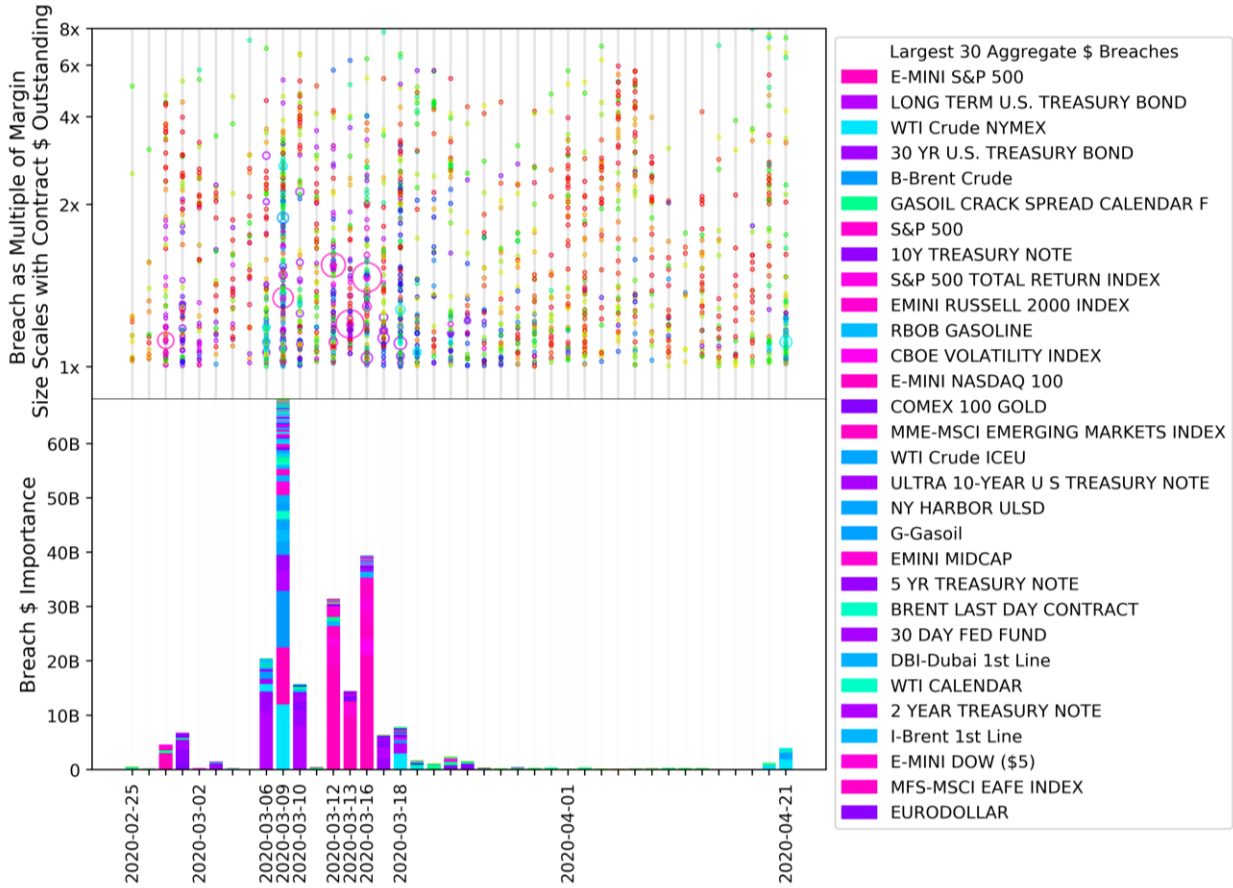
Staff notes that Figure 14 should be used as an indication of the frequency and concurrency of large market moves across a broad range of risk factors and as opposed to an accurate representation of the risk CCPs faced. Since an individual portfolio will often hold both long and short positions in the same product and have exposures to products that may not have

[35] Dollar PnL is the USD equivalent profit or loss for a single contract. IM is the Initial margin required for a long or short position in a single contract.

breached, the dollar figures shown in the lower half of the chart are significantly higher than the actual nominal value of portfolio breaches.

The legend is ordered by the sum of breach USD equivalents importance (defined later in this section) over the period shown; the E-mini S&P 500 Index[36] contract listed and cleared at CME[37] had the largest aggregate breach in USD equivalents.

Figure 14: Futures Contract Breaches Throughout 2020



OI*$ Breach Threshold to Display: 1,000, Weekdays Tested: 41, Series Tested: 690, Series Shown: 388, Unique Contracts: 12196, Potential Contract Breaches: 416107, Contract Breaches: 7218, Breach Percent: 1.73%
Breach Dollar Importance = Open Interest * (Dollar PnL - Initial Margin),
Contract Dollars Outstanding = Open Interest * Initial Margin

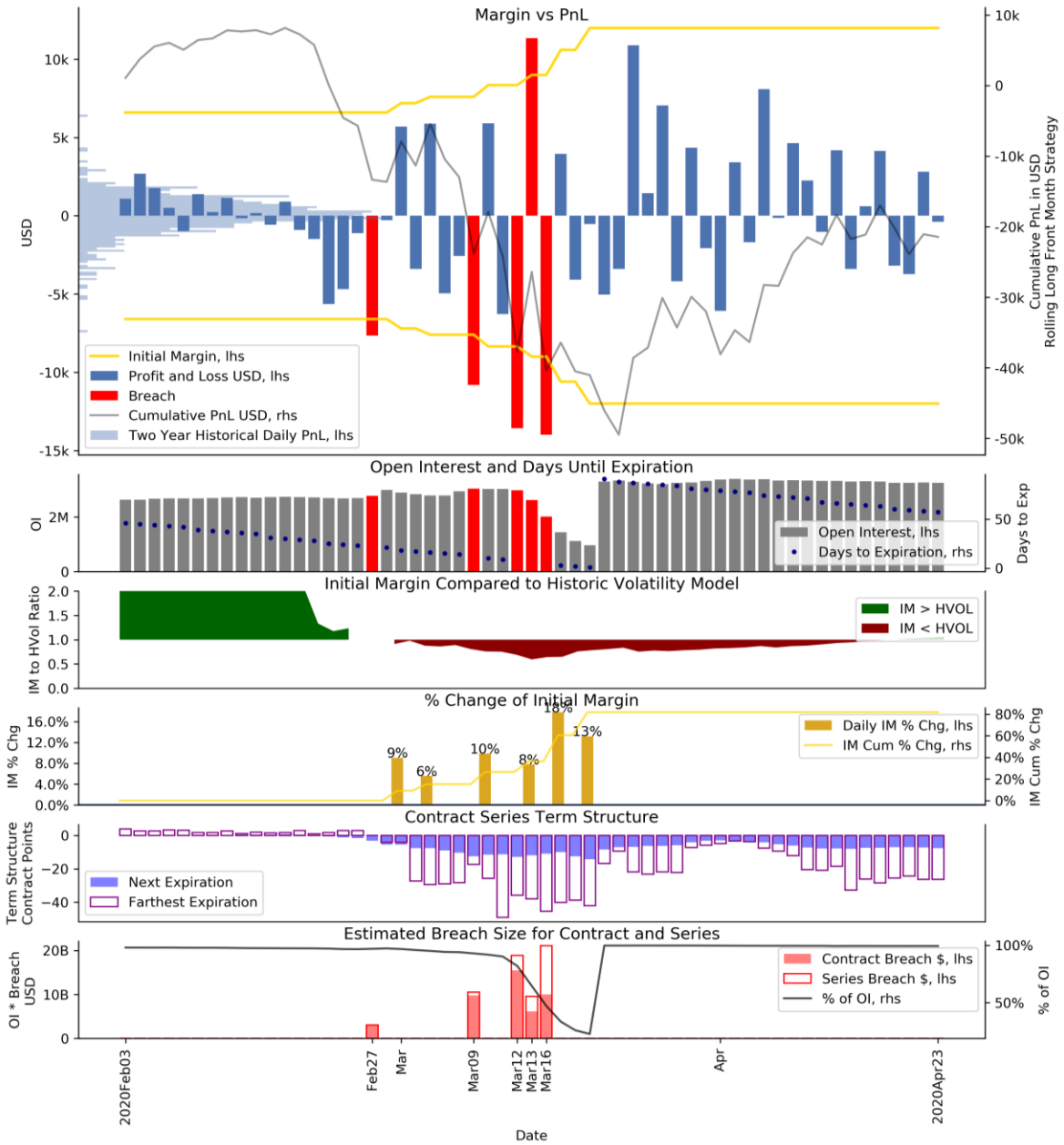
The following set of charts highlight breaches in specific benchmark futures contracts, beginning with the E-mini S&P 500 Index futures contract, and then interest rate, crude oil, and

[36] See https://www.cmegroup.com/trading/equity-index/us-index/e-mini-sandp500_contract_specifications.html.

[37] See https://www.cmegroup.com/company/cme.html.

VIX futures. Similar charts for benchmark contracts in other asset classes are in Appendix 1.[38] Figure 15 displays a consolidated dashboard with information about E-mini S&P 500 futures.

Figure 15: E-mini S&P 500 Futures



The top most subplot in Figure 15 titled "Margin vs PnL" has blue bars representing the profits and losses of a single contract from the perspective of a long position. A breach is when the loss

[38] Most futures contracts are margined against a one-day margin period of risk, so the charts in the futures section primarily compare one-day market movements to margin levels.

on the contract is larger than the IM in force on that day; in these charts, the bars are colored red when a breach occurs. The figure shows four breaches for long exposure and one breach for short exposure in the first half of 2020. Long exposure is considered a different risk factor from short exposure. The gray line in the background tracks the cumulative returns and shows the initial crash followed by a significant rebound. The gray line follows the cumulative returns of the rolling strategy and not the price level of the contract.

The roll strategy shown in these charts rolls the exposure on the day after the front month expiration. This strategy has the benefit of being straight forward calculation and shows the complete contract history including expiration. However, the front month contract may not always be the contract with the most open interest, especially as expiration approaches and market participants roll positions into contracts that are farther from expiry.

Figure 16: Daily Return Histogram

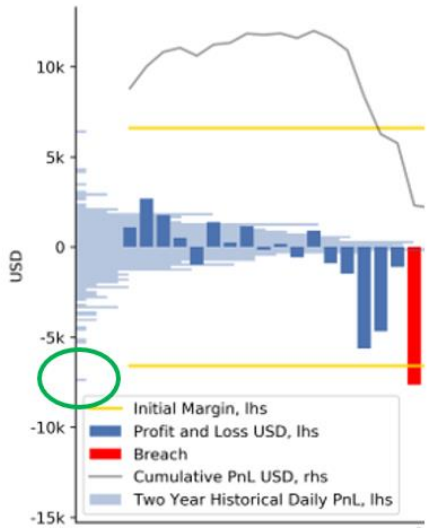


Figure 16 highlights the daily return histogram positioned on the left axis in light blue to give profit and loss context back to the beginning of 2018. IM requirements are displayed as gold lines and show how the CCP increased IM in response to greater volatility. Figure 16 shows only one daily returns in excess of IM requirements at the start of February 2020 (highlighted here with a green circle) and suggests IM requirements were appropriately calibrated relative to recent history.

Figure 17: Open Interest and Days Until Expiration

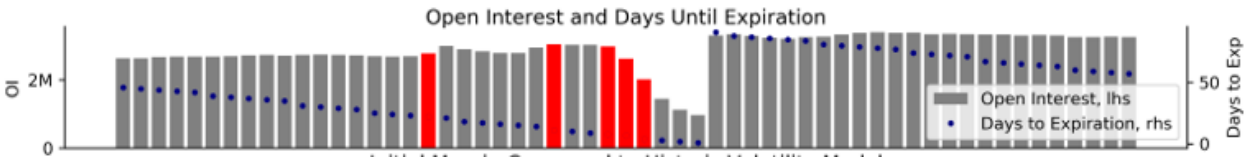


Figure 17 titled "Open Interest and Days Until Expiration" (the second subplot) displays additional information about rolling futures contract series, such as the open interest and days until expiration of the contract. Figure 17 shows that the front month breaches had significant open interest and occurred prior and during the time participants were rolling to the next nearest contract. The front month contract usually has the highest open interest in most cleared futures contract series.

Figure 18: Initial Margin Compared to Historic Volatility Model

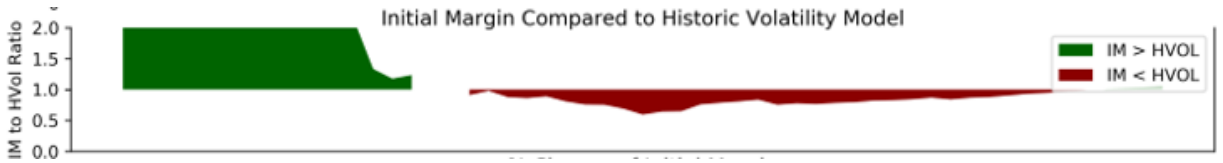


Figure 18 titled "Initial Margin Compared to Historic Volatility Model" (the third subplot) compares IM requirements to a simple backward-looking model that uses the maximum of 2-year standard deviation of daily futures returns and a more responsive exponentially weighted moving standard deviation model with an alpha of 0.06.[39] The maximum of these two measures is then multiplied by 2.33 to estimate the one tail 99% value-at-risk (VaR).

While this methodology makes a number of simplifying assumptions that make it inadequate for a production model, such as returns following a normal distribution, it is a conceptual framework that serves as a benchmark to check for large divergences from standard practice. IM is compared to this benchmark, and the plot is green when IM is above the level implied by the benchmark and red when it is below it. Figure 18 shows that the E-mini S&P 500 Index futures contract IM requirement was more than two times what this benchmark would suggest at the start of 2020. As the market responded to COVID-19 and volatility increased, IM requirements slightly undershot what the benchmark would suggest by the red portion in the middle of the chart.

[39] Alpha is the exponentially weighted moving standard deviation, which represents the weight the most recent observation holds in the calculation. For example, an alpha of 0.06 means the most recent data point receives a 6% weight in a function that is calculated recursively. Higher alphas make a model more responsive to current volatility.

Later in this report, staff examines the manner in which CCPs' margin models reacted to the shocks. The third subplot in the chart above can be interpreted as indicative of the fact that CME was not as reactive as the benchmark when breaches started occurring in early March. This is explained by a general CCP policy to introduce IM requirement changes gradually, if possible, to avoid unneeded liquidity strains.

Figure 19: % Change of Initial Margin

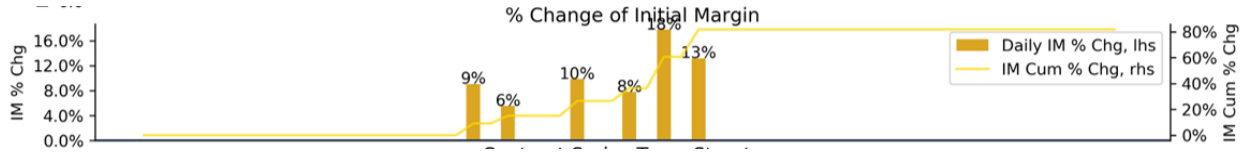


Figure 19 titled "% Change of Initial Margin" shows the relative and cumulative percent changes in IM requirements during the period for the front month E-mini S&P 500 Index futures contract. It shows that CME raised IM requirements seven times during the period. IM ended up almost 80% higher than where it started at the beginning of February 2020, but this happened over multiple days with no individual or single day IM increase greater than 20%.

Figure 20: Contract Series Term Structure

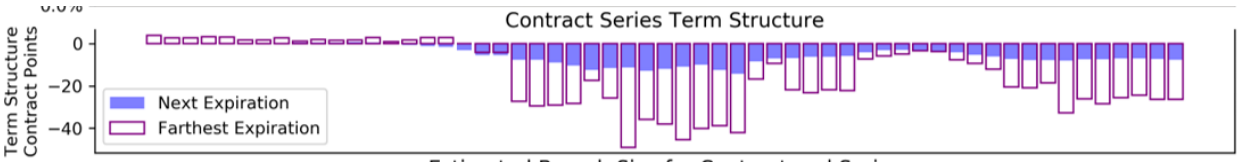


Figure 20 titled "Contract Series Term Structure" compares the front month contract's settlement price to longer dated contracts. The blue bar is the spread in contract points to the next nearest expiration's settlement price. If the bars are below the zero line, it indicates that the next contract is at a lower price level. This shows that contracts farther out were pricing slightly above the next-to-expire contract at the beginning of 2020, but the relationship reversed when the crisis hit. The hollow purple bars show the same comparison to the farthest contract in the series. This subplot helps determine how unique a move was to the front month contract, the potential roll yield, and changes in the series term structure.

Figure 21: Estimated Breach Size for Contract and Series

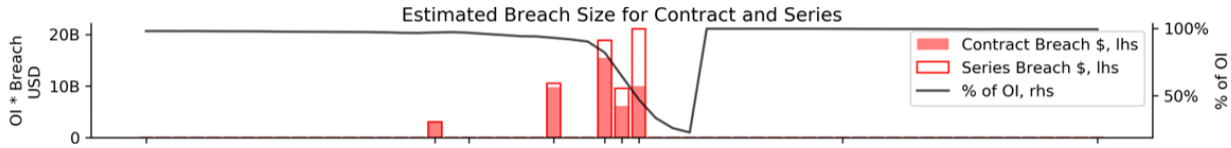


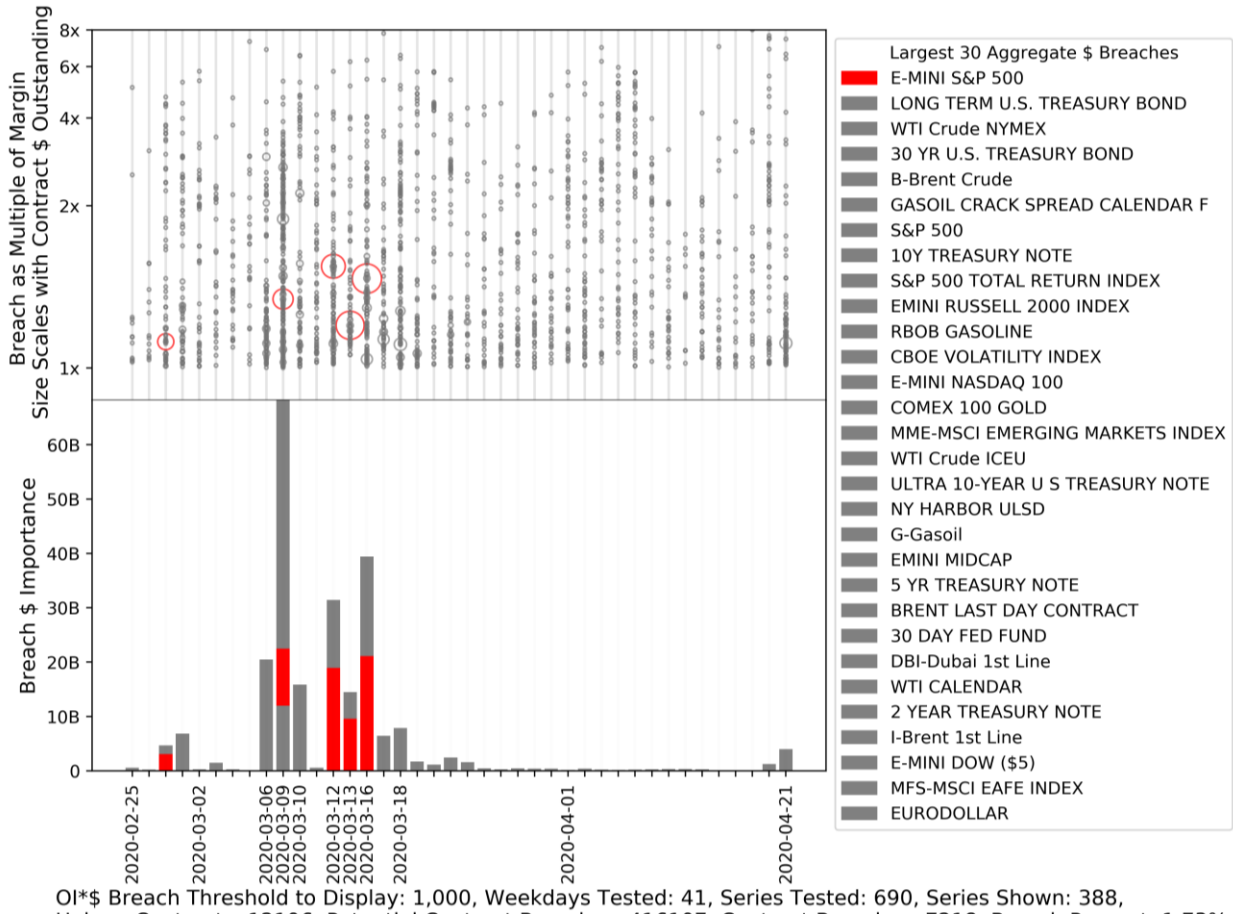
Figure 21 titled "Estimated Breach Size for Contract and Series" provides further information about the rest of the contract series. The solid black line plots the percentage of open interest

that the front month contract holds relative to the entire contract series, and it shows the front month contract typically holds almost all of the open interest until expiration approaches. The solid red bars show an estimate of breach importance by multiplying the dollar breach amount by the contract's open interest. The hollow red bar shows the sum of the same calculation for all contracts in the series. Here Figure 21 shows the dollar breach size was mostly in the front month contract for the first two breaches. As the roll progressed it shows the dollar breach size attributed to the front month contract shown as solid red was proportional to the percent of open interest in the lead contract.

COMPARING AGGREGATE AND SERIES VIEWS

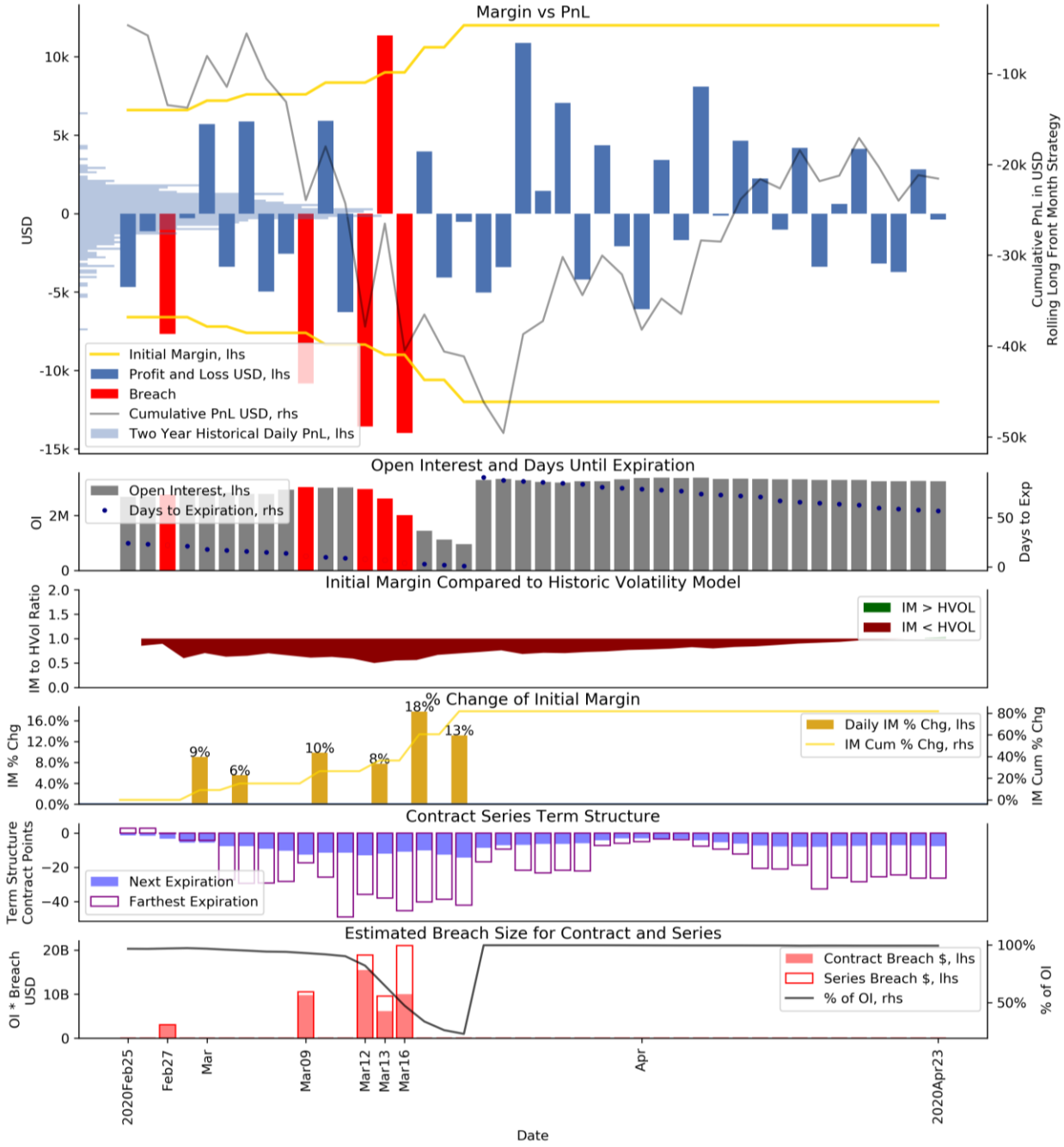
In this side note, staff compares and links two of the diagnostic charts presented in this report. Figure 22 titled "Future Contract Breaches" (Aggregate Chart) monitors the majority of futures contracts for losses over IM requirements and is a duplicate of Figure 14: Futures Contract Breaches Throughout 2020 except for coloring. Figure 22 highlights CME's E-mini S&P 500 Index futures contract in red. Figure 23 titled "E-Mini S&P 500 Futures" (Series Chart) shows data from the same contract series highlighted in the Aggregate Chart, focusing on the contract in the series closest to expiration. The same breaches are presented on both charts as red. The Aggregate Chart puts the breaches of the individual contract series in a wider market context, while the Series Chart allows one series to be examined in detail. The data that sets the size of the bar in the Aggregate Chart are Loss Over Initial Margin (LOIM) multiplied by a netted Open Interest for all expirations in a contract series. This corresponds to the bottom pane on the Series Chart titled "Estimated Breach Size for Contract and Series", which shows how the dollar breach size is divided between the front month contract and the rest of the series. The size of the red bar on the Aggregate Chart corresponds to the size of the hollow and solid red bar on the Series Chart. This comparison also highlights that the Aggregate Chart does not distinguish between breaches for longs versus shorts and lacks other key details about IM performance. While the Aggregate Chart gives a broad sense of market impact and flags potential issues, more granular analysis is often needed.

Figure 22: Futures Contract Breaches: Aggregate Chart



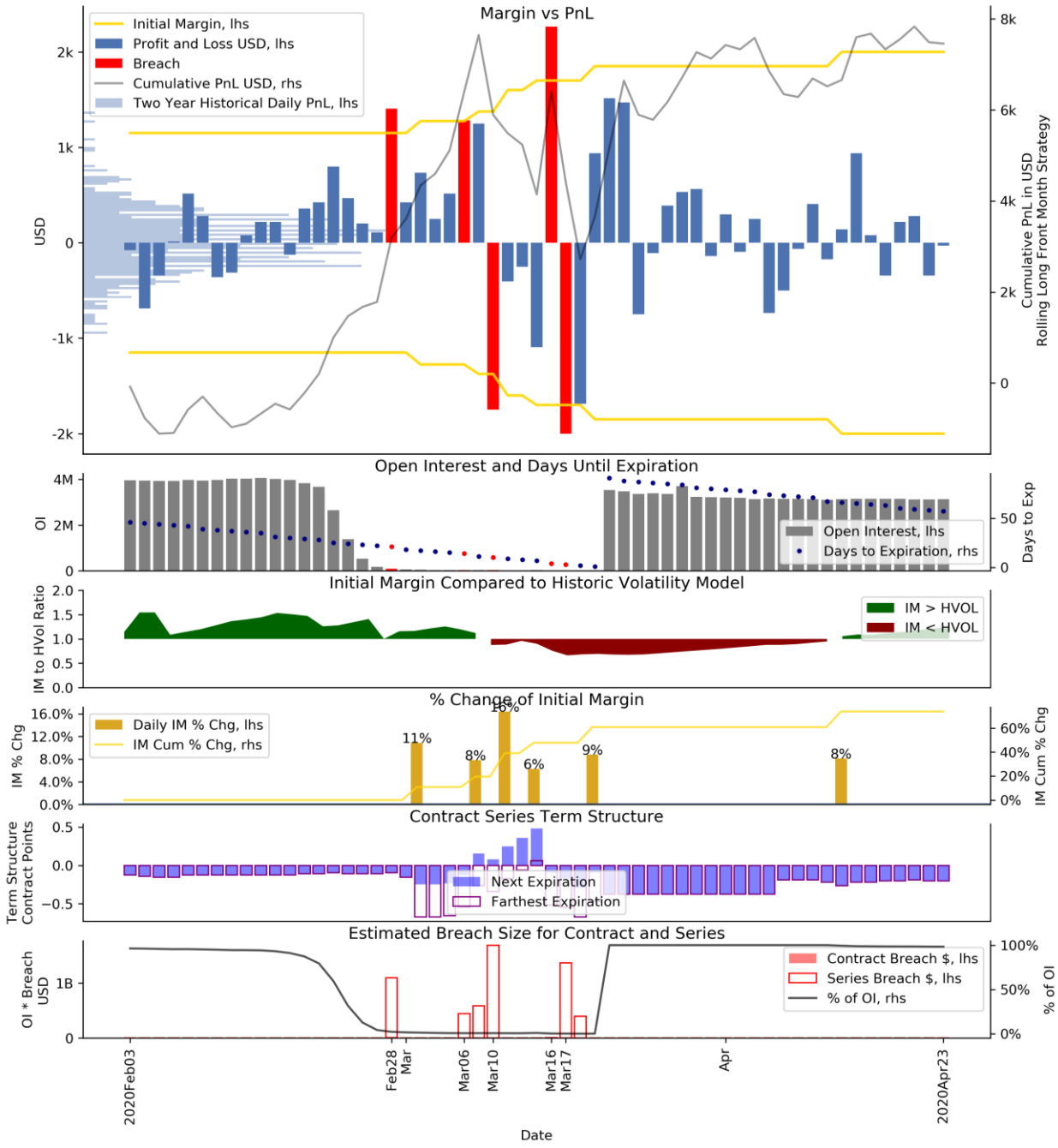
OI*$ Breach Threshold to Display: 1,000, Weekdays Tested: 41, Series Tested: 690, Series Shown: 388,
Unique Contracts: 12196, Potential Contract Breaches: 416107, Contract Breaches: 7218, Breach Percent: 1.73%
Breach Dollar Importance = Open Interest * (Dollar PnL - Initial Margin),
Contract Dollars Outstanding = Open Interest * Initial Margin

Figure 23: E-mini S&P 500 Index Futures: Series Chart (CME[40])



[40] Unless otherwise noted, the entity named in these charts is the CCP clearing that specific product, and not necessarily the futures exchange.

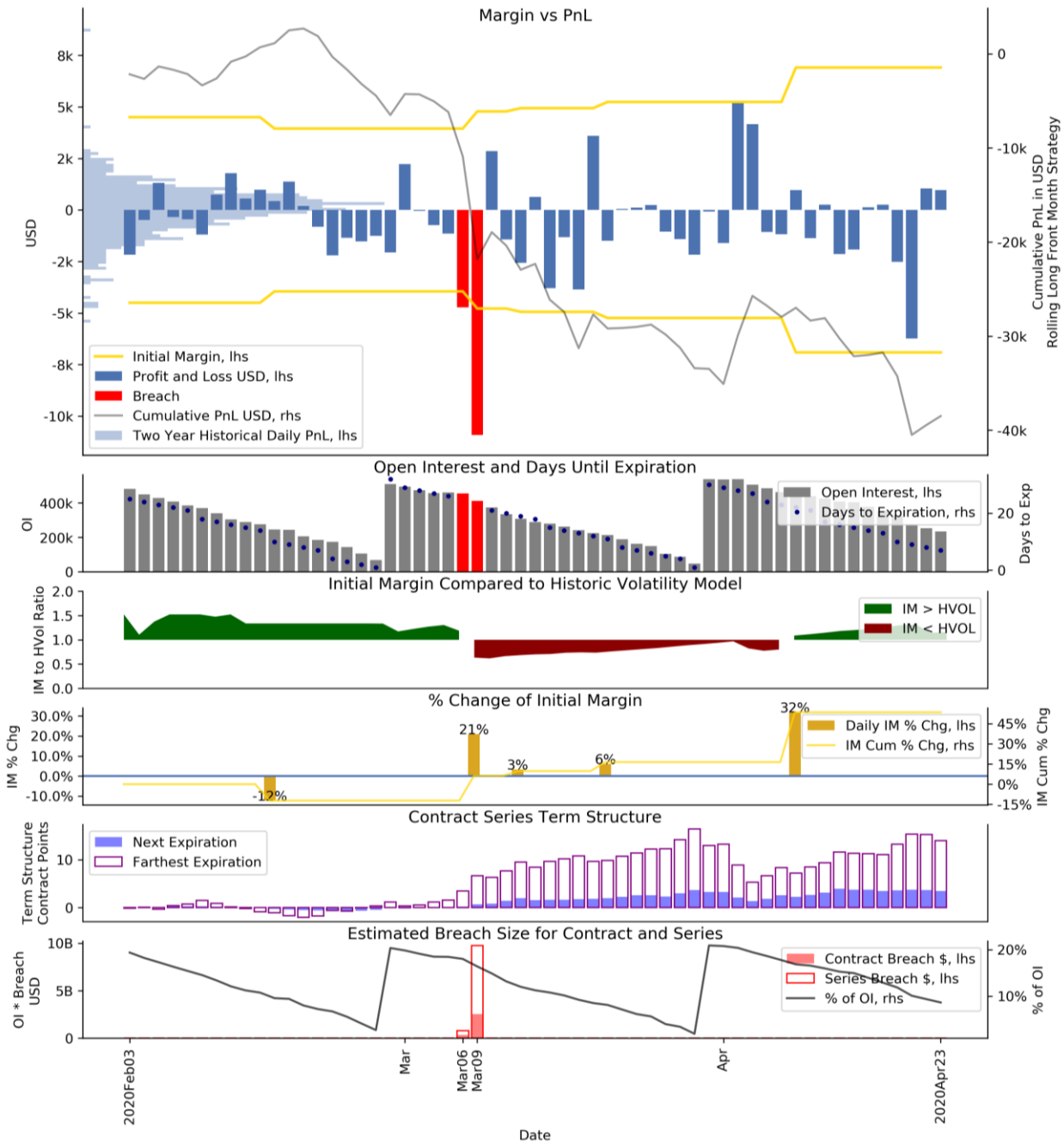
Figure 24: 10-year US Treasury Note Futures (CME)



Interest rate volatility was also at record highs during March 2020. The Federal Reserve responded by aggressively lowering interest rates, which caused spikes in fixed income volatility as seen by the rising gray line in the 1st subplot of Figure 24. At the start of 2020, IM was set at a level that would have experienced merely two breaches back to 2018, and it was higher than the historical volatility model benchmark. The front month series saw three breaches for short exposure and two breaches for long exposure. CME raised IM five times in increments ranging

from 6% to 16% in late February and March of 2020 to keep up with volatility. When the breaches occurred, most open interest had already rolled to longer dated contracts. As a result, most of the breaches occurred in the non-front month contracts, which is shown by the hollow red bars on the bottom subplot.

Figure 25: Brent Crude Oil Futures (ICEU)



Energy futures experienced increased volatility in the first half of 2020. In Figure 25, the gray line, in the background of the first subplot of that tracks the cumulative returns of the rolling strategy, showing the general downward trend of Brent crude oil prices. ICEU decreased IM early in 2020, likely due to seasonality effects, but IM was still above the historical volatility model, and would have experienced two breaches going back to 2018. Brent futures experienced the first breach in 2020 on March 6. ICE increased IM requirements by 21% on March 9 as Brent futures breached for the second time. This price change and the corresponding breaches occurred across the curve, as seen by the hollow red bar on the subplot. Additionally, the Brent futures curve shifted from a moderate downward slope at the start of 2020 to a significant upward sloping curve as front month oil prices dropped more than the rest of the curve. In April ICEU raised front month Brent crude oil futures IM by 32%, to address the increased volatility caused by disagreements between major oil producers with respect to setting quotas.

Figure 26: WTI Crude Oil Futures (CME)

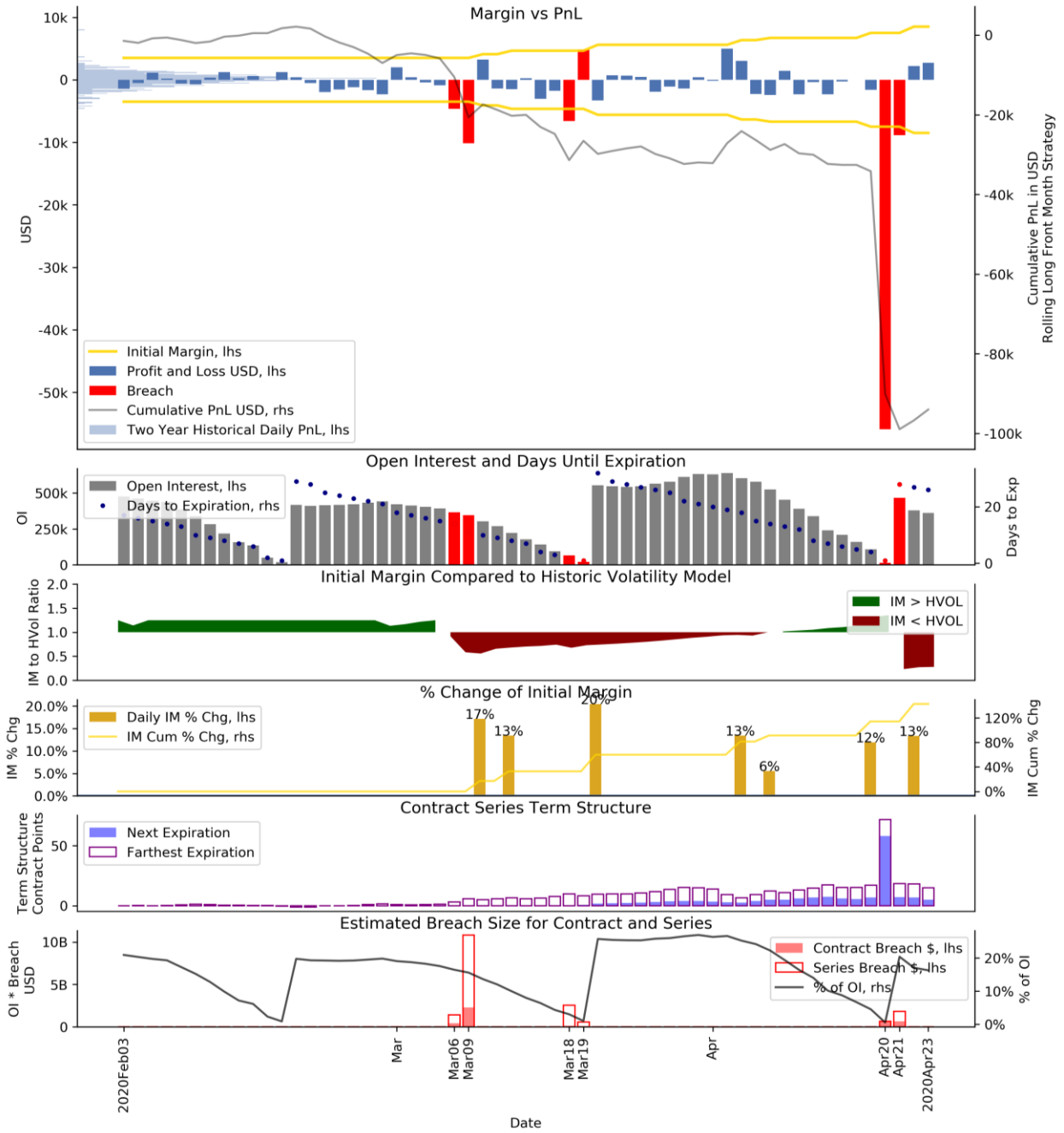


Figure 26 replicates the analysis above for the WTI futures contract. While both Brent and WTI are considered global benchmarks for the crude oil market, there are critical differences in

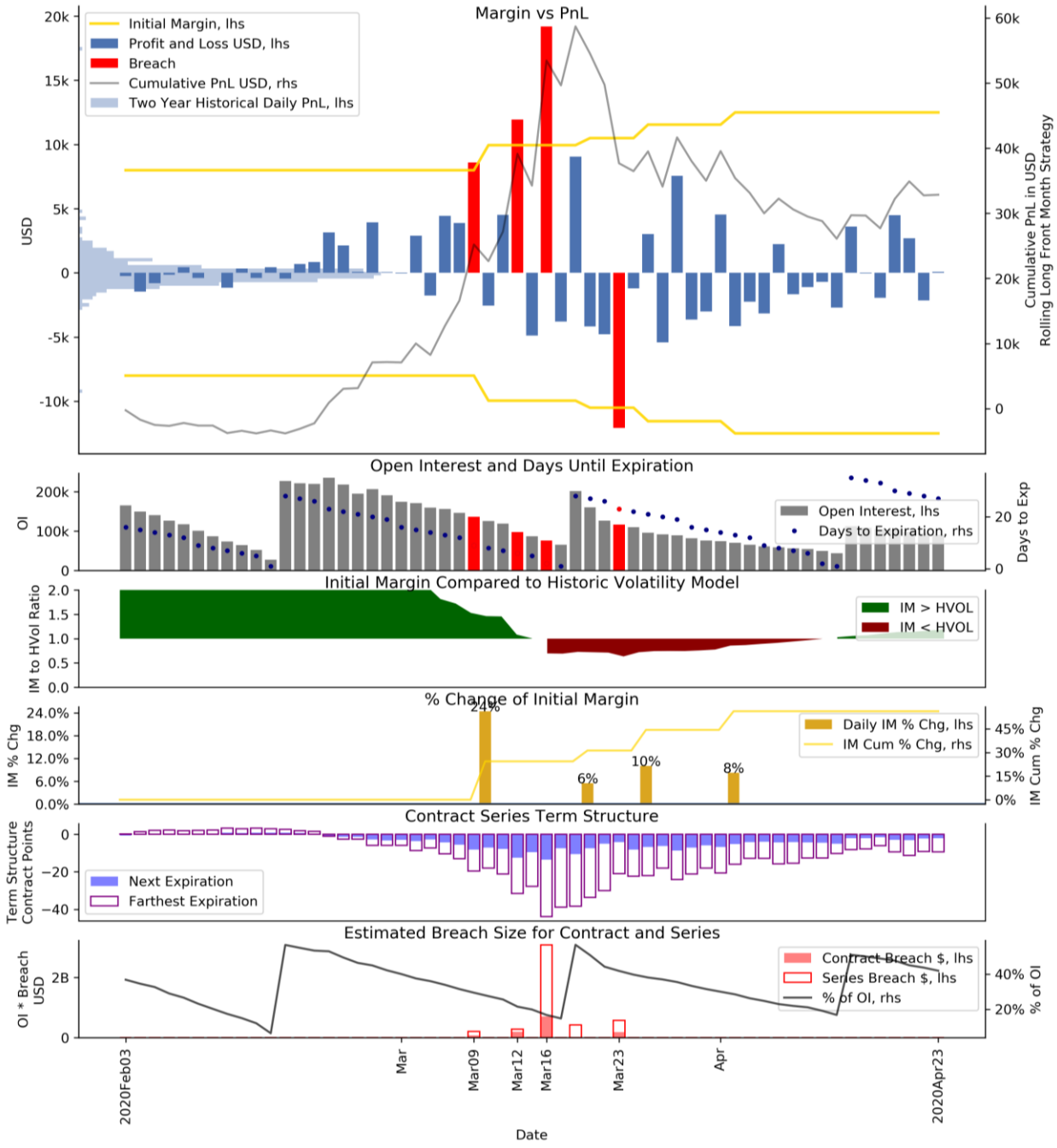
these two products, causing them to react differently to the economic shock from the pandemic.[41]

The immediate difference from Brent that jumps out is the significant down move on April 20. The second subplot shows that the WTI front month contract had relatively little open interest when the large move occurred, and it was on the contract's last trading day. The fifth subplot looks at the contract's term structure, and it suggests that the move was unique to the expiring contracts since the rest of the curve did not move nearly as much as the front month, and the curve's slope reverted after April 20, 2020. Further, the sixth subplot shows a solid red bar indicating the breach was only in the front month. If the rolling methodology was used to track the contract with consideration to the highest open interest, the roll would have occurred prior to the breach and would not be shown on the top plot.

The third subplot, which looks at the historical volatility model, highlights an issue with purely quantitative margin models. Historical volatility dramatically increased and would have increased IM requirements if volatility was the only factor a production IM model considered. However, the move was isolated to the front month's expiration and did not affect the rest of the series. Hence, if a CCP is bound to raise IM purely because of a volatility spike, it may be an overreaction to an event that is not expected to repeat, as the event may be peculiar to a final settlement of a specific contract.

[41] See CFTC Interim Staff Report titled "Trading in NYMEX WTI Crude Oil Futures Contract Leading up to, on, and around April 20, 2020", available at https://www.cftc.gov/media/5296/InterimStaffReportNYMEX_WTICrudeOil/download.

Figure 27: VIX Futures (OCC)



The CBOE Volatility Index (VX) Futures, more commonly known as VIX futures, also experienced record volatility. The VIX contract exhibits several characteristics that differentiate it from more typical futures, such as a tendency to jump and strong mean reversion that make the contract risk profile hard to manage. The histogram in the first subplot of Figure 27 shows at the start of 2020, IM for VIX futures was set at a level that would have resulted in zero breaches since the

beginning of 2018. But once volatility started to rise, several significant breaches occurred. OCC responded with several large IM increases, but market volatility increased at a faster rate. The sixth subplot shows that the entire series shifted upward, and breaches occurred throughout the curve. However, the fifth subplot, which examines term structure, shows how the series developed a significant downward slope as market participants expected volatility to eventually retreat from record highs.

CLEARED SWAPS: INTEREST RATE SWAPS

The concept of a product-level breach as conventionally tracked and measured in futures is less relevant in swap markets, especially IRS. Futures have standardized contract terms with monthly or quarterly expiration dates and, in turn, IM levels are commonly defined, and monitored, for these standardized contracts. In contrast, while market participants do trade IRS with standard coupon dates, (for example, fixed-floating swaps with IMM, or International Money Market, coupon dates) most of the trading activity is in swaps representing constant maturity expirations from the trade date. Typically, IRS expire an integer number of years (e.g. 5 or 10) from trade date. Nonetheless, to have some parallelism with the futures discussion, the charts below provide a product-level breach analysis for a few major IRS and CDS.

Figure 28 below compares the market moves (in blue) with the IM requirement (in red) for a cleared IRS paying floating 3-month USD LIBOR and receiving a fixed rate of 1.82%, with 10 million USD notional value and maturing in April 2026.

Figure 28: USD LIBOR Receive Fixed Swap

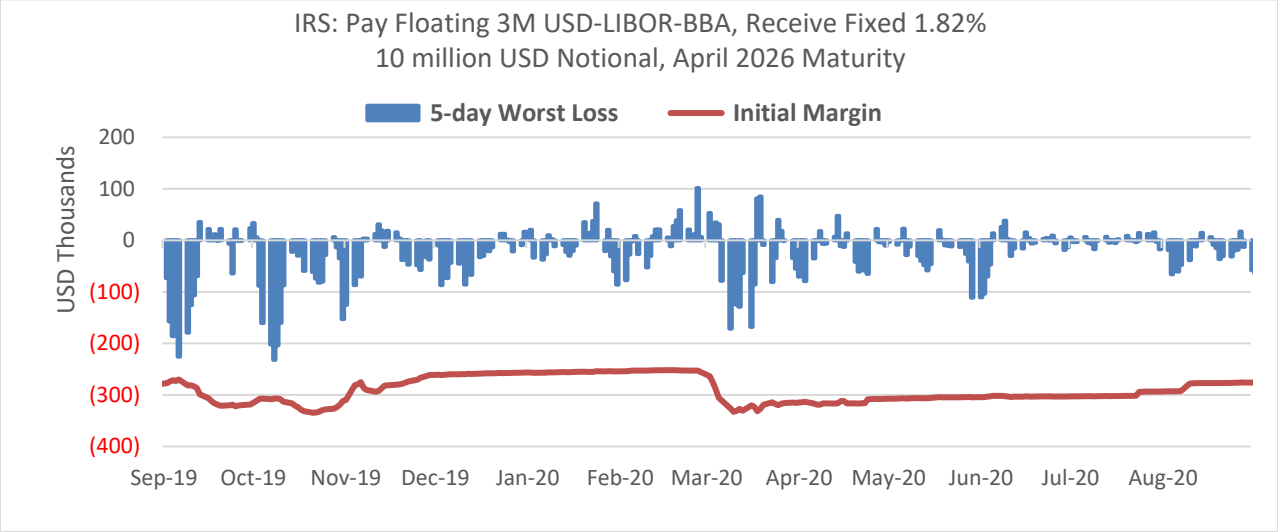
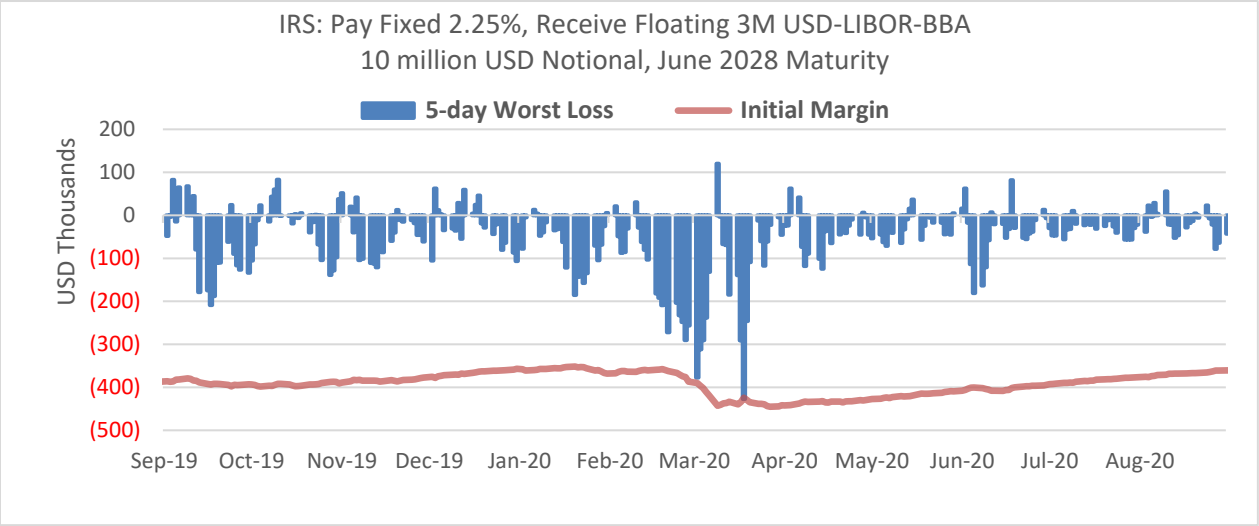


Figure 29 illustrates breaches for the USD swap paying a fixed rate of 2.25% and receiving floating-rate of 3-month USD LIBOR, with 10 million USD notional value and maturing in June

2028. As matched tenor USD LIBOR swap rates (approximately 8-year swap rates) fell from September 2019 to August 2020, the holder of the USD payer swap incurred mark-to-market losses as shown in Figure 29.

Figure 29: USD LIBOR Pay Fixed Swap



Back-testing of swap portfolios is more complex than back-testing futures portfolios because of the difference in the MPOR (roughly one day for futures and five days for swaps).[42] In order to identify product-level breaches for futures contracts, staff only needs to compare one-day market price changes to the level of required IM.[43] For swaps, staff needs to take into consideration multi-day moves. For the back-testing charts in Figure 28 and Figure 29, the portfolio composition is fixed on a given day (consisting of a single swap) and staff then calculated the static portfolio value changes over rolling five-day lookback periods. The maximum loss of the swap over that rolling five-day period is then compared to the IM requirement in place at the end of the lookback period.

The back-testing charts in Figure 28 and Figure 29 have two data series for the one-year period ending September 2020: the blue bars show the five-day MPOR worst losses defined above and the line represents the market risk component of the IM requirements. As with futures, any instance of the first exceeding the second is considered a breach. Figure 28 shows that the fixed receiver swap did not have any exceedances. As for the fixed payer swap shown in Figure 29, there was one exceedance on March 18 even with the steady increase in IM requirements starting in the last week of February.

[42] See *supra* note 28.

[43] Specifically, the market risk component of the margin requirement.

MARKET RISK COMPONENT BACK-TESTING

Most CCP margin models are designed and calibrated to cover a number of different components of the expected cost of liquidating a defaulting portfolio. For example, the calibration assumes that the liquidation will typically occur during stressed market conditions, so the expected cost is based on worst-case scenarios. Further, the IM models break down the expected cost into individual components: a market risk component to cover the basic price moves, a liquidation/concentration component for positions larger than the typical average trading volume and to account for a significantly large portion of the total exposure across all other market participants. Some of these incremental costs can increase much faster than a simple linear increase compared to the size and complexity of the portfolio.[44]

For the purposes of the analysis in this section, staff analyzed only the market risk component of IM requirements for cleared IRS portfolios. The analysis excludes liquidation/concentration components. For analysis purposes, this is a simplifying assumption of a material aspect of CCP margining practices.

CHANGES IN IM FOR STATIC INTEREST RATE SWAPS PORTFOLIOS

Multiple studies have been published regarding the volatility of IM during the COVID-19 period. [11] Much of this analysis provides an aggregate comparison of pre- vs post- COVID-19 IM comparisons but omit the individual drivers of this IM change. Changes in market volatility have a major effect on IM levels given the structure of margin models. However, in addition to these volatility changes, many cleared positions changed throughout the period; in many cases, portfolios reduced risk as volatility climbed, but in some cases risk exposures of individual cleared positions may have grown. Without controlling for these position changes, attributing IM changes for an individual account solely to the margin model can paint an inaccurate picture.

There are a few ways of controlling for these factors. For instance, some analysis, including that in the prior section, focuses on product level IM changes. Because this analysis isolates a single, static product, changes in margin levels are strictly due to the model, including model inputs. However, this calculation is often more theoretical than practical. Most cleared accounts hold a large number of individual products, with varying maturities that change through time. With that said, product-level analysis can provide insight as to how a portfolio's IM might change by

[44] See "CCP Supervisory Stress Tests: Reverse Stress Test and Liquidation Stress Test" for a discussion of these costs and some stress test analysis; available at https://www.cftc.gov/system/files/2019/05/01/cftcstresstest042019.pdf.

appropriately aggregating the results of the product level IM changes with the product breakdown of the account.

A second, more expansive, strategy to attribute IM changes strictly to model factors is to hold static positions constant (including maturities) and then sequentially running this static portfolio through the margin model. Though this isolates the model factors, it does require an exact understanding of the margin model to duplicate the calculations and can be computationally demanding. An alternative approach, which we use, holds positions constant but allows the positions to age through the analysis period.[45] By doing this, IM levels are those calculated by CCPs for a given portfolio.

Figure 30 below shows the total IM for static IRS positions with exposures only in USD-denominated swaps[46]. As demonstrated by the chart on the right, no day throughout the period had an aggregate IM increase of over 9% nor an IM decrease of greater than 0.7%. While the trough to peak aggregate IM change was 45.6%, it took 13 trading days to reach that peak change. More specifically, it took 8 trading days (from February 21st to March 4th) to attain an aggregate 20% increase in IM and another 3 days (to March 9th) to get to an aggregate 43.1% increase, with the peak IM level occurring on March 11th. From this peak to the following trough (from March 11th to April 2nd), aggregate IM only decreased by 2.5%, with no individual day having more than a 0.7% decrease.

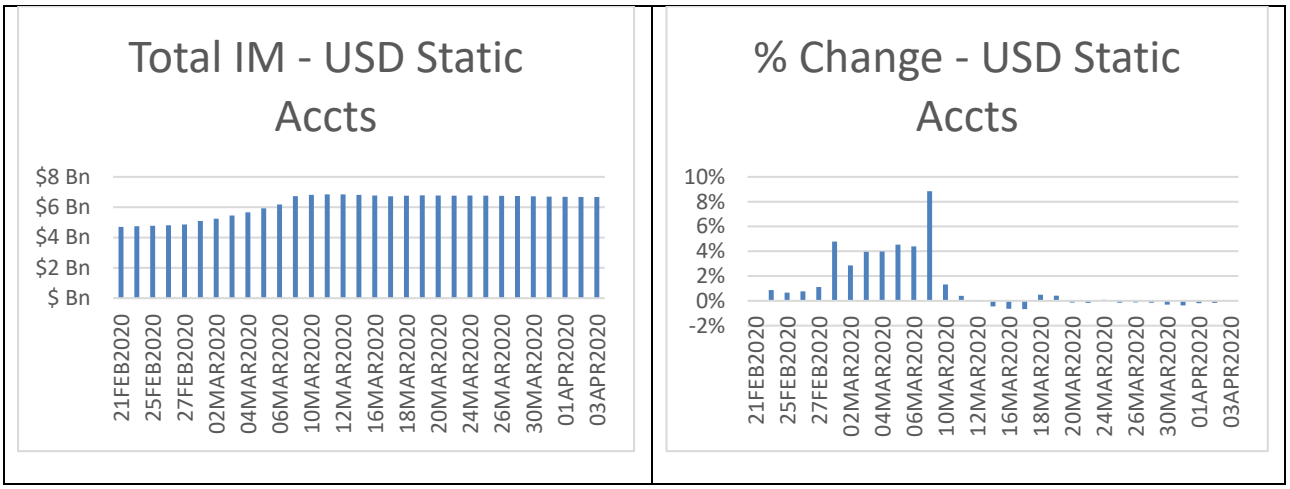
Further, there occurred a string of 7 consecutive trading days with an IM increase between approximately 3-9%. During this period, five of the seven days had USD 3M LIBOR tenors experience moves of 19 basis points or higher. On a day-to-day aggregate IM basis, the margin changes seen for the static accounts appeared proportionate to these base rate changes. A few market moves were especially large, though only two days in this period experienced a move in a tenor greater than 25 basis points, with the largest move approximately 45 basis points. Some of the biggest moves didn't occur until after March 9th, with 6 days after this seeing a tenor with a move of greater than 35 basis points. Even with these moves later in the observation period,

[45] To identify static accounts, a search was made for any position with no new trades placed between February 21st and April 3rd. Matured trades were allowed to drop off, which does mean some positions did not remain strictly constant through the period, though maturing trades near expiry have little risk. Stepping through the analysis period, the trades in the positions naturally reduce in tenor. The biggest effect from this daily change in maturity occurs when a trade's floating rate payment is fixed within the analysis period, thereby eliminating most of the forecasting risk from that one payment. This effect was most pronounced when a trade's ***last*** floating rate payment was fixed within the period, eliminating all forecasting risk and leaving only discounting risk. That effect will be discussed later.

[46] While many currencies exhibited volatility similar to USD, for the purposes of this discussion, only USD positions are analyzed. A future study will be done focusing on other non-USD, single currency portfolios as well as multicurrency portfolios.

the biggest one-day increase in aggregate IM was only 0.5%. So, while aggregate IM did rise from the end of February, reaching a peak on March 11th, the days following that had very small changes in IM despite experiencing exceptionally volatile conditions.

Figure 30: Total IM & Percentage IM Changes for Rates



While the data at the aggregate level is correlated with volatility levels, it is also important to look at trends at the individual account level. For this analysis, all accounts with a starting IM level below $1MM were excluded, to avoid statistical outliers while retaining the vast majority of risk in the observation set. After this filter, the range of daily percentage changes at the account level is still wide, with the largest increase in IM of 36.2% and the largest decrease of 41.3%.

Focusing on the accounts with decreases (those with movements against the aggregate trend), there were a small number of accounts that had a decrease of greater than 15%. In each of these cases, the factor driving IM change was the fact that significant fixing dates were within the observation period, often representing the last fixing date for large swaps in the portfolio, one of the factors noted above. In aggregate, all of the large IM decreases were caused by external or portfolio-specific factors and not CPP model risk parameters.

In contrast, factors driving IM increases (i.e. those portfolios where IM changes matched the trends at the aggregate level), were more varied. Contributors to the changes include volatility in individual risk factor tenors, volatility in the rates of different USD curves, and spread volatility both across curves and across tenors. A detailed and complete analysis for positive IM changes is likely to point to a combination of these factors, depending on the underlying portfolio. Overall, the accounts in this set experienced single day maximum IM increases ranging from 2.9 to 36.2%. Some of the accounts with the largest IM increases had significant swaps that were within days of their last floating rate fixing – in other words, a significant

portion of the remaining cash flows for the portfolio were affected by 3M LIBOR exactly when the fixings started to become extremely volatile.

Examination of many other accounts in this set lead to similar explanations for IM changes. In these cases, while increases were observed, the increases appeared in line with the volatility of the period. Additionally, IM increases moderated in the middle of the observation window, as seen at the aggregate level, and were after this almost always small on a relative basis. As stated at the beginning of this section, further analysis is needed to identify differences in model effects across single currencies and across portfolios with exposure to multiple currencies. With that said, while there are other methodologies for isolating model factors, the method used here provides useful insight as to the relationship between market volatility and the level (and source) of IM changes.

CLEARED SWAPS: CREDIT DEFAULT SWAPS

The cleared IRS section presented breach or back-testing analysis for IM for a few selected IRS. In this section, staff analyzes a few standard cleared CDS. March-April 2020 was a volatile period for credit markets. For example, the CDX.NA.IG index credit spread increased from 65 basis points to 150 bps in March and dropped to 80 bps in April. The large fluctuation in credit spreads exemplifies an extreme stress event, specifically in the month of March where more than one-half of all daily spread moves were in the tails of the return distribution.[47]

Symptomatic of the extreme nature of the pandemic shock, there was a spike in the number of product-level breaches in March-April 2020. The aggregate value of the breaches was also large. However, it is important to note that in each of these cases, both for futures as well as for swaps, this is often a purely mathematical exercise. Firms, especially the largest firms clearing at a CCP, tend to hold long and short positions in either the same product or in highly correlated products, and thus gains will often significantly offset losses on a portfolio, even if not at a product-level.

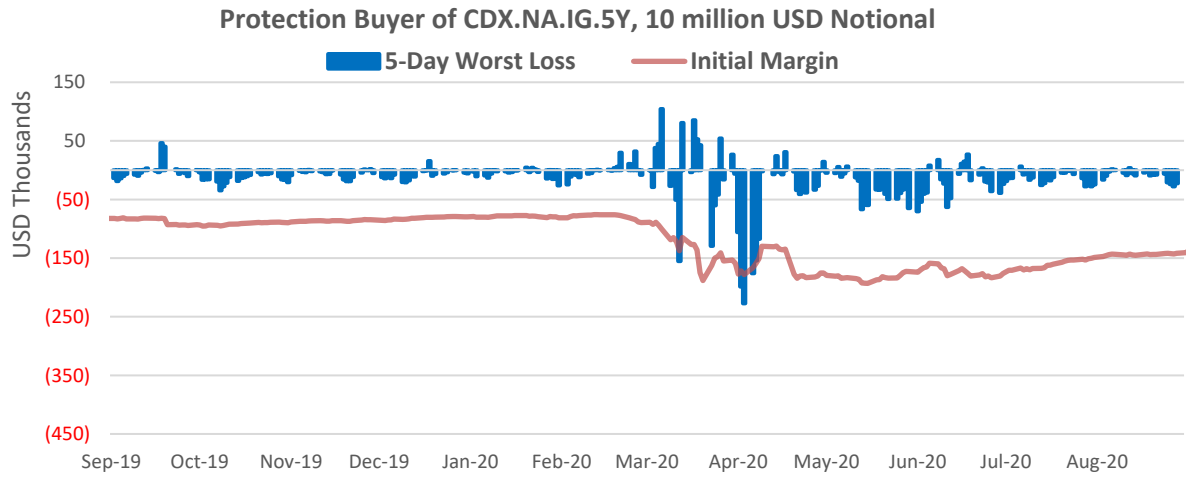
Account-level back-testing analysis reveals that during March-April 2020, IM exceedances were observed for both buyers and sellers of credit protection on CDX.NA.IG 5-year tenor contracts. The analysis below digs deeper into some of the asymmetry in impact depending on whether a position involves selling or buying protection for a credit default swap during the tenor of a swap contract.

[47] 13 out of 23 extreme daily spread moves for CDX.NA.IG index occurred during the month of March 2020. The extreme moves were defined as a 0.5 percentile on both the left- and right-side tail of the distribution constructed from the daily returns of credit spread changes from January 2012 to September 2020.

Figure 31 shows a back-testing graph for a protection buyer of CDX.NA.IG 5-year tenor and shows one exceedance on March 18 and a cluster of exceedances during the first week of April. Figure 32 shows a back-testing result for a protection seller of CDX.NA.IG 5-year tenor with one large exceedance in the first week of March. The protection seller of a credit default swap index instrument has an obligation to pay the protection buyer if there is a credit event. Therefore, IM requirements for the protection seller would be considerably higher given a greater probability associated with the increase in credit spread during the extreme market conditions experienced during that period.

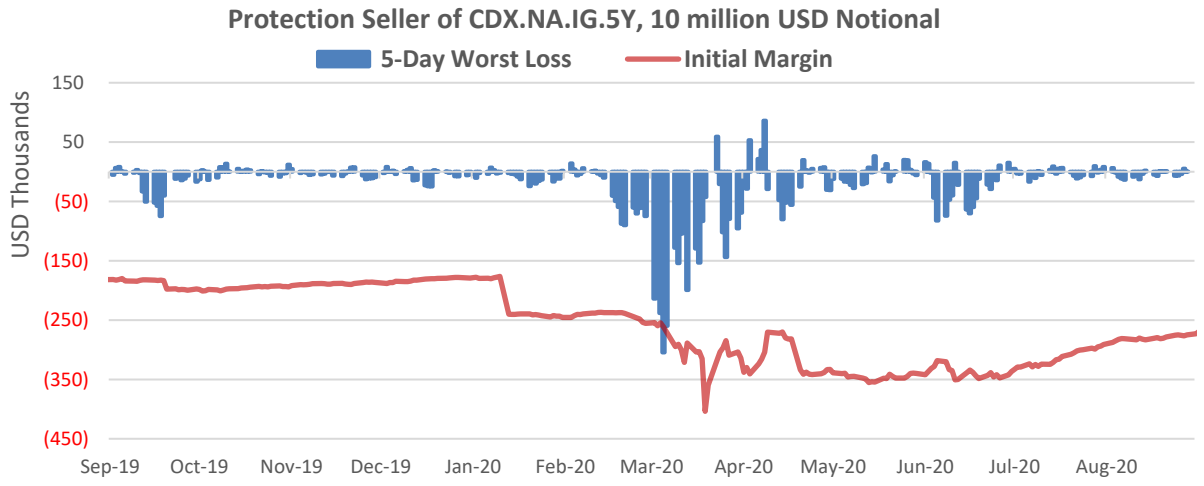
The swap contracts in both examples represent a cleared CDX.NA.IG 5Y credit default swap with a notional size of 10 million USD. The cluster of exceedances is mainly due to the fact that our analysis used the MPOR worst loss; this is similar to the approach described for IRS above.[48]

Figure 31: Buy Protection CDX.NA.IG.5Y



[48] In order to conduct a statistical test for model performance, staff applied appropriate adjustments to the cluster of exceedances.

Figure 32: Sell Protection CDX.NA.IG.5Y



PRODUCTS DO NOT DEFAULT; FIRMS DEFAULT

In the case of a member default, the CCP is tasked with transferring or liquidating the defaulting member's positions (including clients) and is subject to potential losses on the portfolio during this process. The defaulter's portfolio (especially in the case of a large clearing member which could pose stress on a CCP) may contain a large number of individual positions, some of which may have similar exposures while others represent offsetting exposures. Because of this, IM levels, and even breaches, at a product-level, though a useful input to margin models, may not be fully indicative or representative of the potential losses resulting from an actual default. Because of this, staff reviewed both public and confidential regulatory data sources that describe account-level coverage at the major cleared derivatives CCPs.

CLEARED FUTURES & OPTIONS

The Committee on Payments and Market Infrastructures (CPMI) and the Technical Committee of the Board of the International Organization of Securities Commissions (IOSCO) set guidelines for CCPs to make public certain risk management information and statistics.[49]

The public quantitative disclosures (PQD) published by CCPs on their websites provide some statistics on account-level breaches during Q1 and Q2 of 2020. Table 3 shows some of the

[49] *See* CPMI–IOSCO, Public quantitative disclosure standards for central counterparties (Feb. 2015), *available at* https://www.bis.org/cpmi/publ/d125.pdf.

breach statistics in Section 6.5 of the 2020 Q2 IOSCO CPMI disclosures. Field 6.5.1 shows the number of settlement account breaches that occurred during the preceding 12 months.

Table 3: CCP Breach Statistics

CCP	Account Breach Count Trailing 12 months (6.5.1)	Account Observations (6.5.2)	Account Coverage (6.5.3)
OCC	30	57,093	99.95%
CME F&O	8	28,026	99.97%
ICUS	4	15,810	99.97%
ICEU F&O	187	61,368	99.70%
NGX	38	42,217	99.91%

From the confidential regulatory data received by the CFTC, staff observed that while there were account-level breaches, these were small relative to the large number of accounts, and more importantly, the affected accounts were small in size, with typically directional portfolios.

Under the portfolio margining approach adopted by most CCPs, a set of risk-related positions (also referred to as a diverse portfolio) may be assessed a total IM requirement at the portfolio level that is less than the sum of IM on the individual components due to portfolio risk offsets. However, these reduction in IM requirement offsets tend to be conservative based on stressed correlations and only allow for offsets between products of a similar type. Further, in terms of the 99% coverage standard to count breaches, it is helpful to note that an extreme tail price change (greater than 99% of historical price moves) is more likely for a single product than for all products in a portfolio, so excess IM on products in a diversified portfolio helps to cover products that did breach IM requirements at the product level.

While diversity of holdings tends to increase with account size, large concentrated accounts do exist; CCPs, however, will typically subject these accounts to additional IM via add-ons to cover the higher cost of liquidating large concentrated positions.

Figure 33 below illustrates the diversified nature of market participant holdings of cleared futures positions, both client accounts and house accounts of clearing members.

Figure 33: Futures Portfolio Diversification

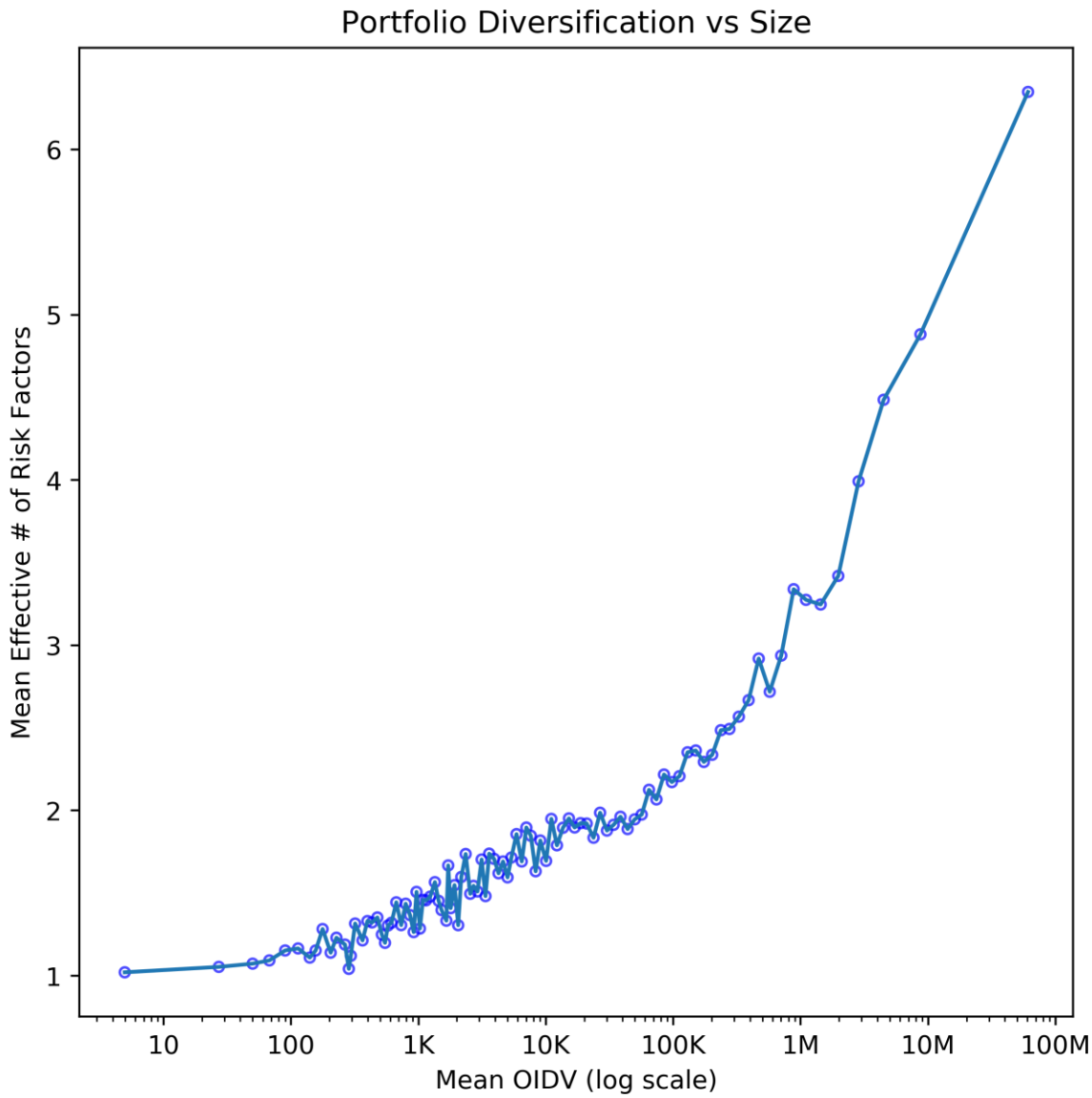


Figure 33 shows the tendency of larger portfolios as measured by Open Interest Dollar Volatility (OIDV)[50] to have more diversified exposures than smaller accounts by having exposure to a

[50] OIDV is a generalized method of estimating a portfolios size by estimating its dollar volatility in a way that can be attributed to specific contracts and compared across CCPs and asset classes. OIDV's main drawback in estimating portfolios size is it does not account for diversification across contract series.

The OIDV for a given contract series in a portfolio is calculated by

$$\text{OIDV} = \sigma * M * F * \left(\text{NP} + 0.1 * (\text{GP} - \text{NP})\right)$$

Where

greater number of contract series. The data in the figure are derived from cleared futures and options account level data by calculating the Herfindahl-Hirschman Index (HHI) metric for OIDV on a per series basis.[51] The inverse of the HHI represents the number of series in which the portfolio would have positions if the exposures were equally weighted as measured by OIDV and is shown for interpretability. Accounts are rank-ordered by OIDV and then aggregated into 100 groups of roughly 700 accounts each. The mean OIDV of the groups on the x-axis in log scale is plotted against the mean of the inverse of HHI for the group on the y-axis and labeled as "Mean Effective # of Risk Factors." A value close to one on the y-axis suggests the account only holds positions in one contract series. A value of six on the y-axis suggests the accounts in that group have equal exposure to six contract series. The figure shows that as the mean OIDV increases, accounts have exposure to an increasing number of contract series. As mentioned earlier, this diversification tends to lead to fewer account breaches. Looking at the account data behind published CCP PQD releases shows the same tendency for large accounts to breach less frequently that smaller accounts. Further, the data underlying PQD shows that the ratio of the absolute loss to IM tends to decrease as IM held increases suggesting larger account breach by a smaller percent of IM, likely due to diversification.

CLEARED SWAPS: INTEREST RATE SWAPS AND CREDIT DEFAULT SWAPS

Given that CCPs report granular account level reporting of cleared swaps positions and IM, staff conducted independent estimation of exceedances at both house and client account levels. The estimated breach counts were negligible. Staff compared these estimates with those reported by CCPs and found them to be consistent.

The drivers of IM changes for IRS have been discussed earlier. For CDS, the volatility surrounding the March 2020 COVID-19 event was concentrated over a small period of time, and it created an environment with significant trading and repositioning. The movement was so rapid that it impacted a broad range of firms when credit spreads widened but also when they quickly rebounded and tightened; spread changes were sizable in both directions. At the same

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σ is the standard deviation of the contract in points over the reference period,

M is the multiplier on the contract,

F is the exchange rate between the contract native currency and USD,

NP is the net delta position of the account in the contract series which includes options,

GP is the gross delta position of the account in the contract series which includes options

[51] Staff defines the HHI metric as the (Metric/∑(Group Level Metric))^2 – e.g. ($IM_{\text{Hedge Fund Entity}}$/∑(All Hedge Fund Entity IM on Day X))^2 . This definition is consistent with the Department of Justice's measurement for concentration risk: HHI ≤ 0.15 → not concentrated; 0.15 < HHI ≤ 0.25 → moderately concentrated; HHI > 0.25 → highly concentrated. (See also https://www.justice.gov/atr/herfindahl-hirschman-index.)

time, there was also increased trading amidst the volatility, which in turn caused IM changes for cleared CDS.

AGGREGATES MAY MASK UNDERLYING TRENDS

In the following sections, this report examines differences in behavior and impact among different categories of market participants. The analysis relies on gross or net notional outstanding, IM, and where feasible, asset-class specific measures of risk at the account level.

Collectively, the analysis provides a rich set of data points to explore the intersection of trading activity, risk exposure changes, and IM for different types of market participants: clearing members and their clients, classified as banks (acting as clients of clearing members rather than a clearing member itself), insurance companies, hedge funds, asset managers, and pension funds.[52]

The analysis explores the following questions:

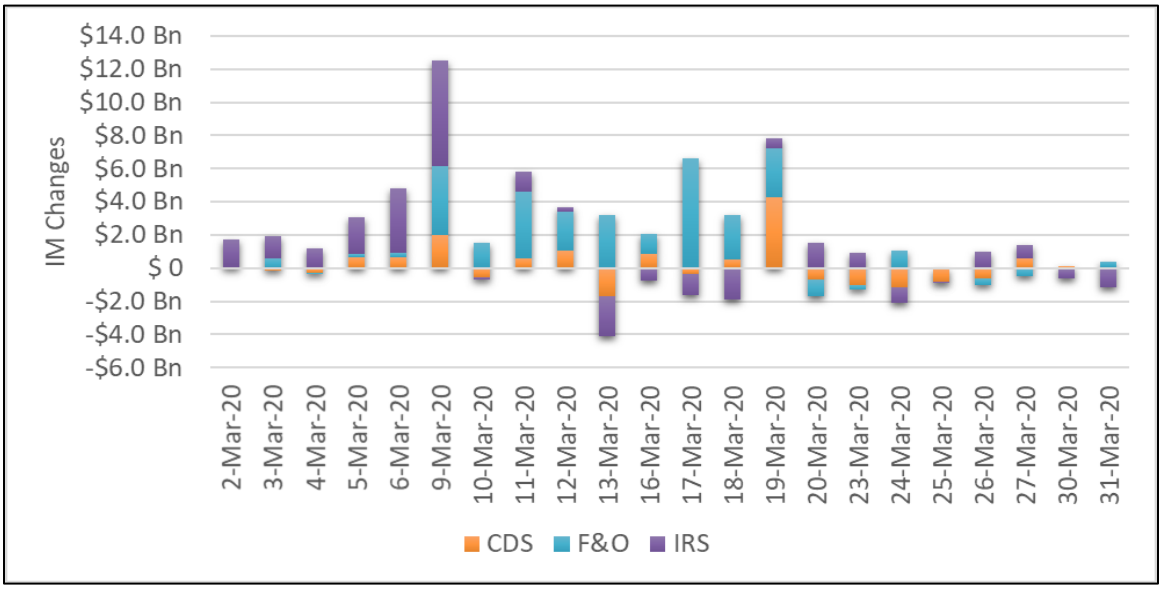
- Aggregate posted IM rose as a consequence of the economic shock and the subsequent market volatility. However, were there differences in the rate and size of change at less aggregate levels?
- Did IM increase for all market participants?
- What subset of participants responded by reducing their derivatives exposures, and which were generally static during the period of increased market movement?[53]

The findings presented earlier in this report have generally been aggregated across all accounts at an individual CCP or for a specific asset class. For instance, Figure 2 displays daily IM requirements by F&O, IRS, and CDS. Similarly, Figure 34 shows changes in IM for client accounts across selected CCPs regulated by the CFTC, with IM requirement delta patterns distributed heterogeneously by asset class. For example, on March 9, IRS recorded a significant increase in aggregate IM requirements, well in excess of other asset classes. On March 13, cleared futures and options recorded IM requirement increases, while aggregate IM requirements dropped for CDS and IRS.

[52] Some assets owned by banks, insurance companies, and pension funds are managed by asset managers and therefore are included in the asset manager category.

[53] Staff is also exploring additional questions, and results will be added to the report once the additional analysis is complete: 1) to what extent were changes in margin requirements due to margin model requirements versus changes in portfolio composition; 2) were margin changes correlated with volatility changes (i.e. did products with larger volatility changes experience larger margin increases); and 3) how did market participants (clearing members, and separately, clearing member clients) respond to IM and VM calls?

Figure 34: IM Changes Across Cleared Swaps, Futures, and Options: March 2020



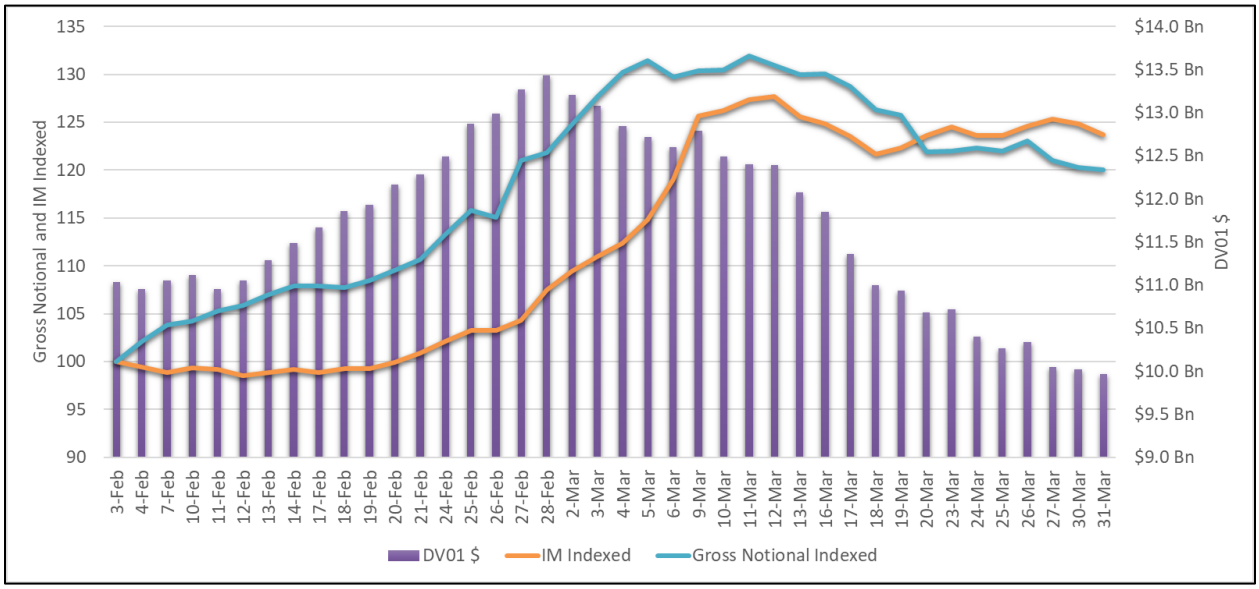
IMPACT AND BEHAVIORAL DIVERSITY: CLEARED IRS

Given differences in risk appetite and investment goals across participant types, staff expected a diverse set of reactions from market participants during stressed market conditions. These reactions are often dependent on the type of market shock. In cases where the shock event is expected, but there is uncertainty about outcome (as would be the case with an election or the scheduled release of key economic statistics), there can be active trading and exposure changes in the days and weeks prior to the event, with further activity and re-positioning once the outcome is known.

If the shock is mostly unexpected, as was the case with the COVID-19 pandemic, these adjustments can often occur in the days, weeks, or months during or after the event. Figure 35 provides a look at these position adjustments. The chart shows a normalized measure of IM and gross notional outstanding for cleared IRS, as well as the absolute value of aggregated, net DV01s[54] to show a measure of the directional risk of IRS. In Figure 35, the aggregate DV01 measure is calculated as the sum of the absolute value of individual account net DV01s.

[54] DV01 is a measure of directional risk in a portfolio (the change in value of the portfolio resulting from a one basis point, parallel increase in the underlying interest rate curve). Other market risks in the portfolio, such as changes in curve shape or in the basis between two reference rates, would not be directly captured by DV01.

Figure 35: Cleared IRS IM vs. Gross Notional: Cleared Clients Only



As highlighted earlier in Figure 2, aggregate IM requirements for cleared IRS increased in early March 2020 and remained at elevated levels, with a slight decline through the rest of the year as volatility returned to pre-pandemic levels. Figure 35 shows that during this same period, client gross notional totals for cleared IRS also increased, as clients generally increased the number and aggregate size of swaps held during the period. However, as volatility and IM levels increased at the end of February and the beginning of March, the aggregate level of directional interest rate risk held by clients started to fall as measured by the aggregate DV01 measure. As can be seen in subsequent charts, this decrease in interest rate delta risk was driven primarily by a few participant types that reduced directional risk exposures; in some cases, this was done by entering new swaps that offset existing directional interest rate risk in their portfolios, which sometimes led to higher gross notional totals but lower net directional interest rate risk.

Figure 36 through Figure 40 disaggregates Figure 35 into a few major cleared market client participant classes during February and March 2020: hedge funds, asset managers, insurance companies, banks (here, banks that are acting as clients of a clearing member rather than as clearing members themselves), and pension funds.

Figure 36: Cleared IRS IM vs. Gross Notional: Hedge Funds

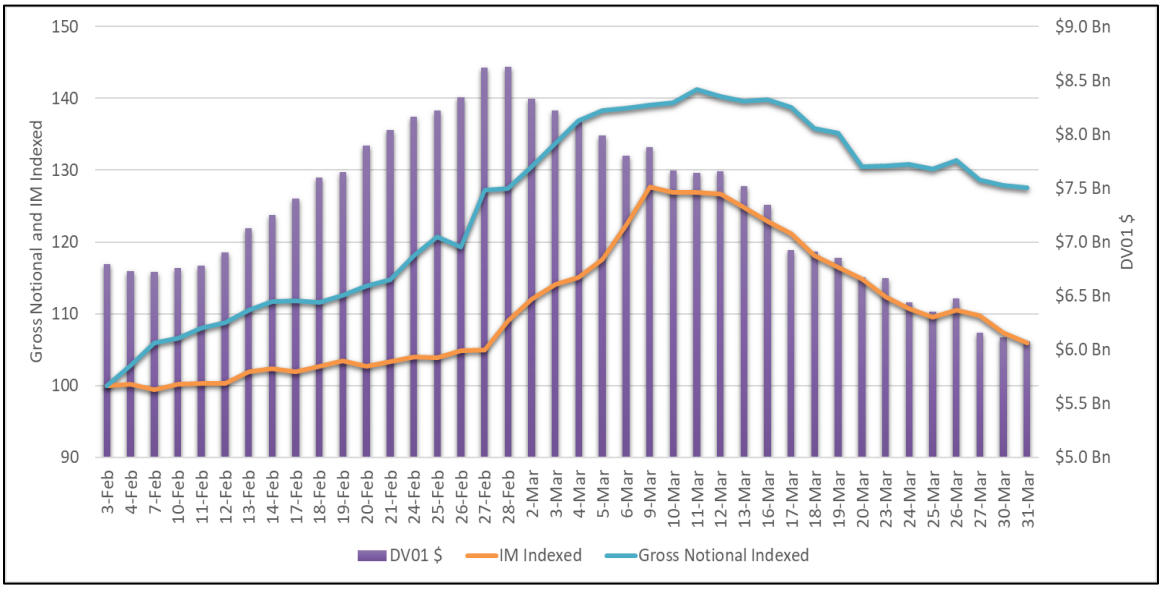


Figure 37: Cleared IRS IM vs. Gross Notional: Asset Managers

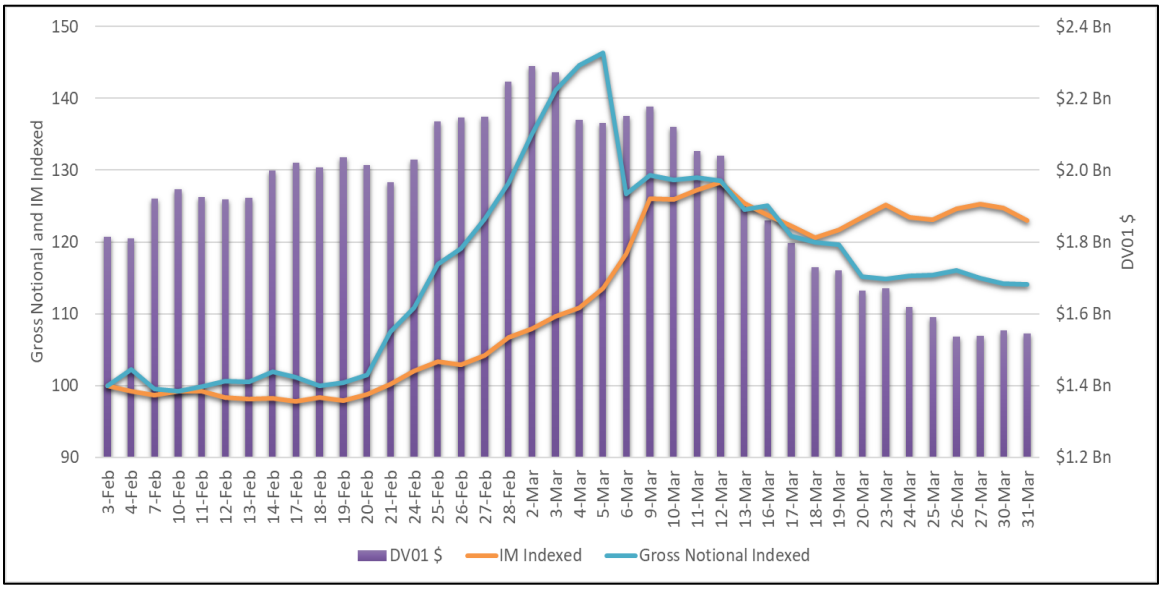


Figure 38: Cleared IRS IM vs. Gross Notional: Insurance Companies

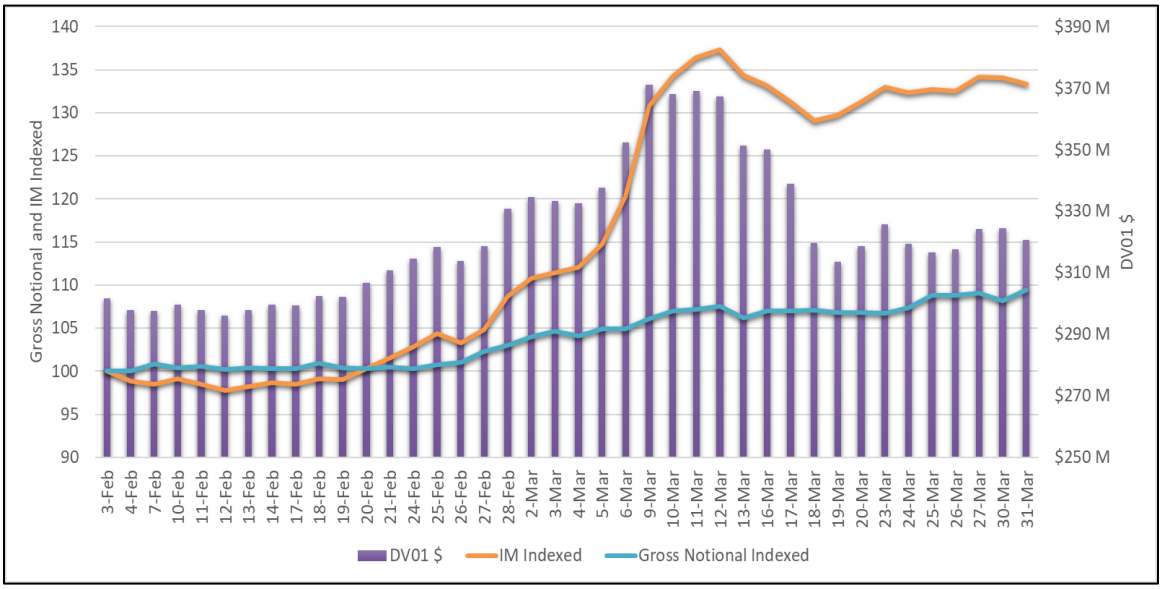


Figure 39: Cleared IRS IM vs. Gross Notional: Banks

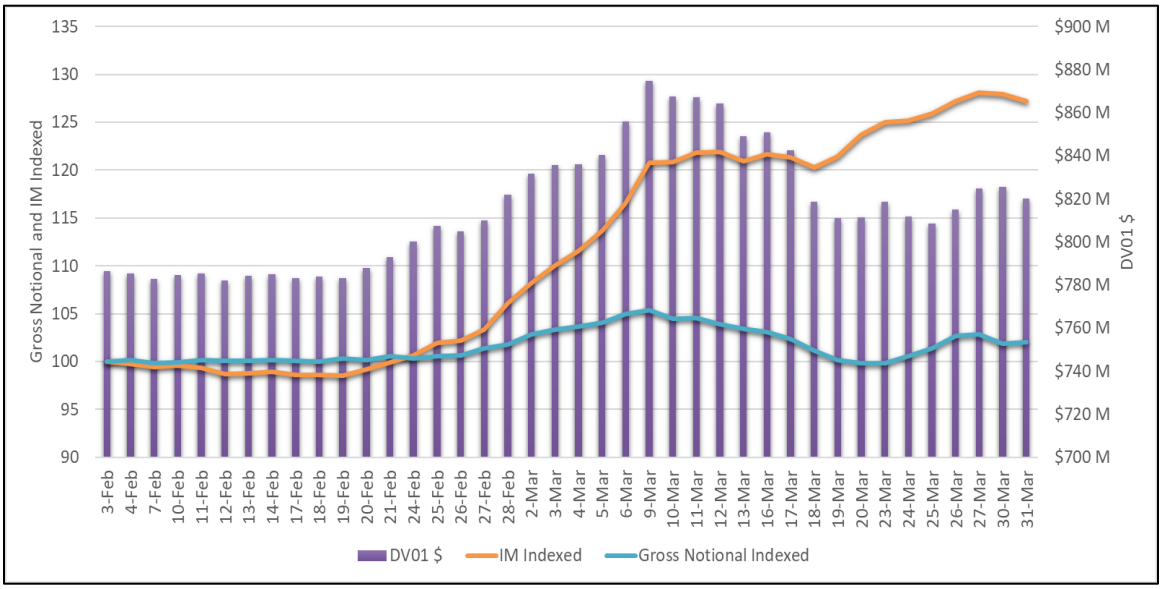
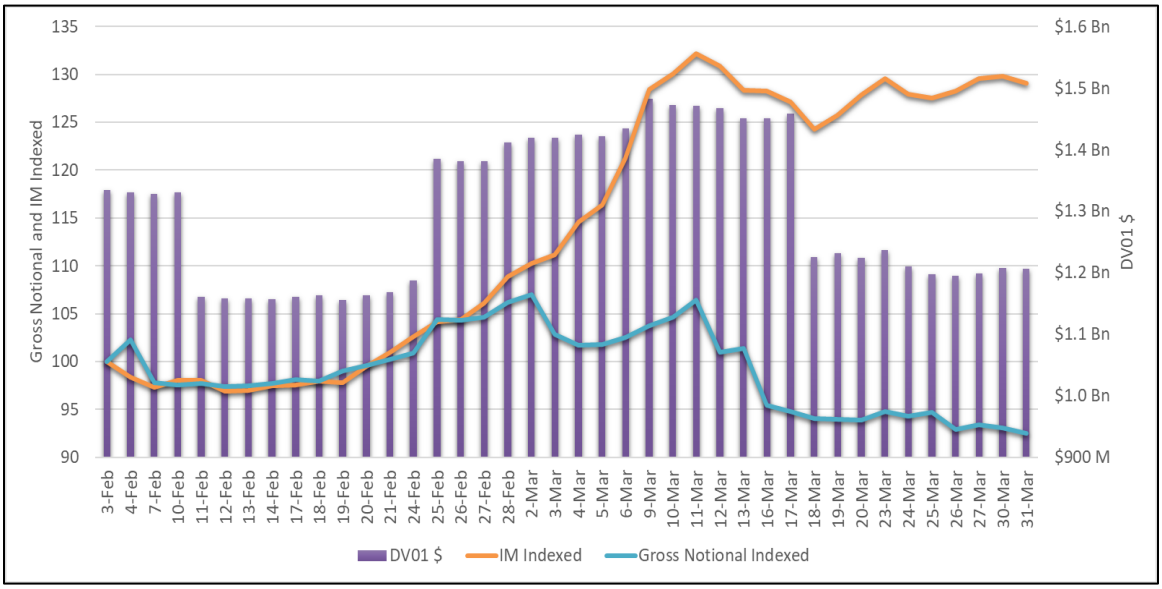


Figure 40: Cleared IRS IM vs. Gross Notional: Pension Funds



Clear differences in aggregate IM requirements, gross notional, and interest rate directional risk (expressed via DV01) during February and March are apparent across the participant classes. Though CCP IM requirements generally increased across participant types, the portfolio composition effect on IM is also a key variable here. For instance, reductions in hedge fund IM requirements were likely at least partially due to decreases in portfolio risk, behavior not observed to the same extent for banks, insurance companies, and pension funds. For example, while aggregate DV01 decreased roughly 30% for hedge funds from the peak, aggregate DV01 decreased 7% for non-clearing member banks, 15% for insurance companies, and 17% for pension funds. In addition, the directional interest rate risk reductions that did occur for non-clearing member banks, insurance companies, and pension funds occurred later in the period (roughly a week into March) than for the other client categories.

Figure 41 through Figure 43 focus narrowly on daily changes in IM for IRS across different types of clients during February and March 2020. For hedge funds, it is evident that despite the relatively larger size of gross notional exposures (Figure 44) relative to other categories, the risk as measured by changes in IM (Figure 43) is smaller than some of the other participant types. This may be due to them holding less directional portfolios than other categories or them holding positions in lower-risk swaps like those of low duration, resulting in a higher ratio of notional to risk.

Figure 41: Cleared IRS IM Changes by Client Account Type

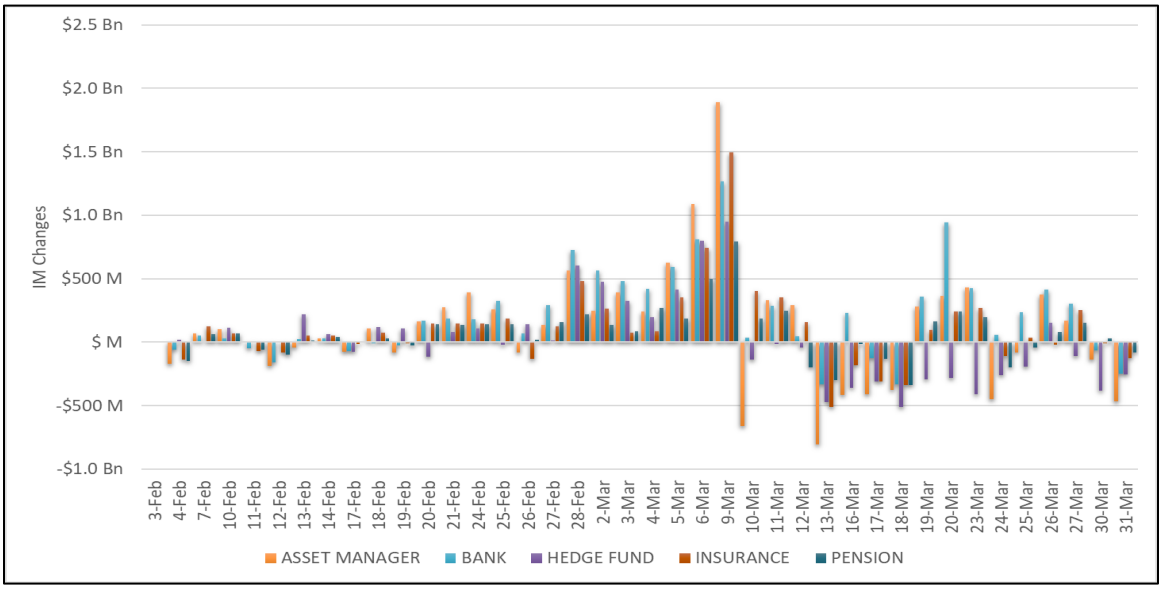


Figure 42: Cleared IRS IM % Changes by Client Account Type

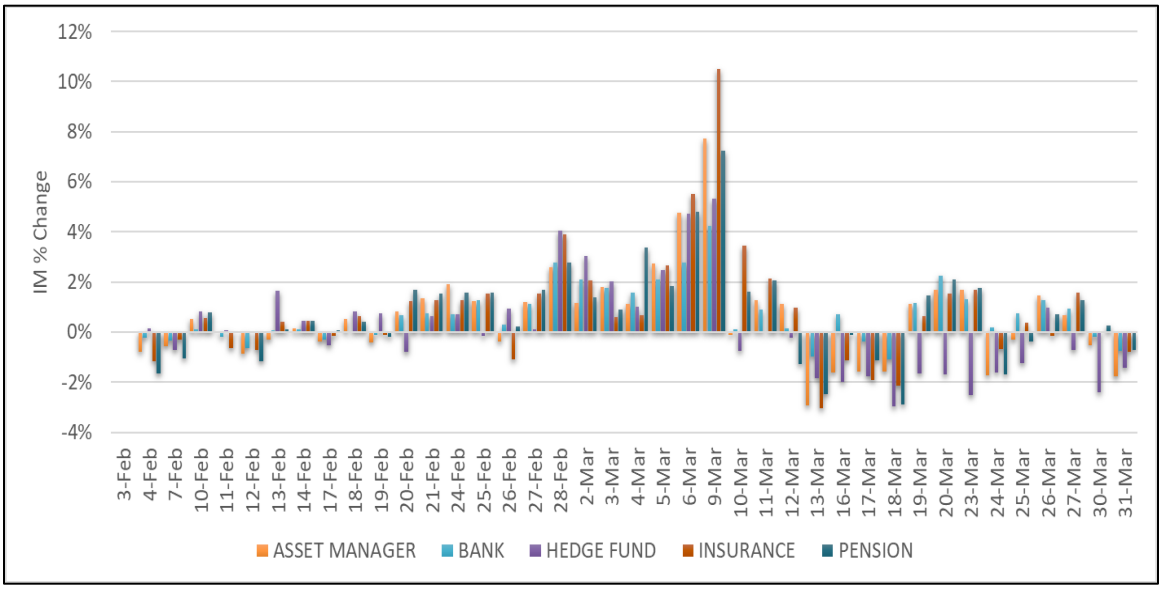
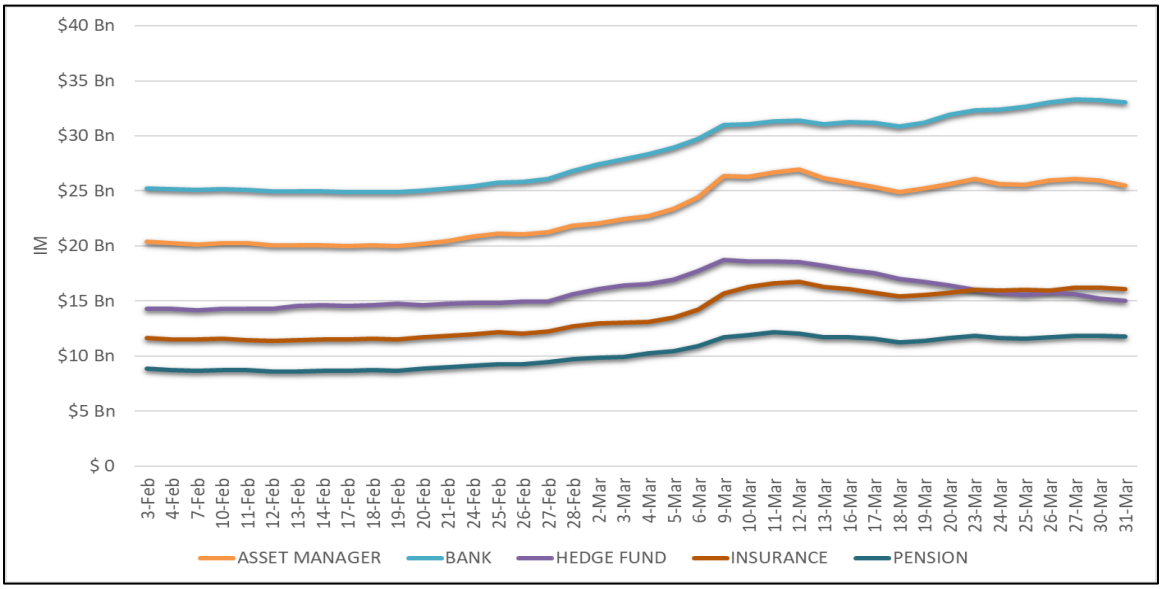


Figure 43: Cleared IRS IM Totals by Client Account Type



As can be seen in the plot above for illustrative purposes, asset managers (+$5.1 billion), banks (+$7.8 billion), hedge funds (+$770 million), insurance companies (+$4.4 billion), and pension funds (+$2.9 billion) all experienced increased aggregate IM requirements throughout March.

Figure 44: Cleared IRS Gross Notional Changes by Client Account Type

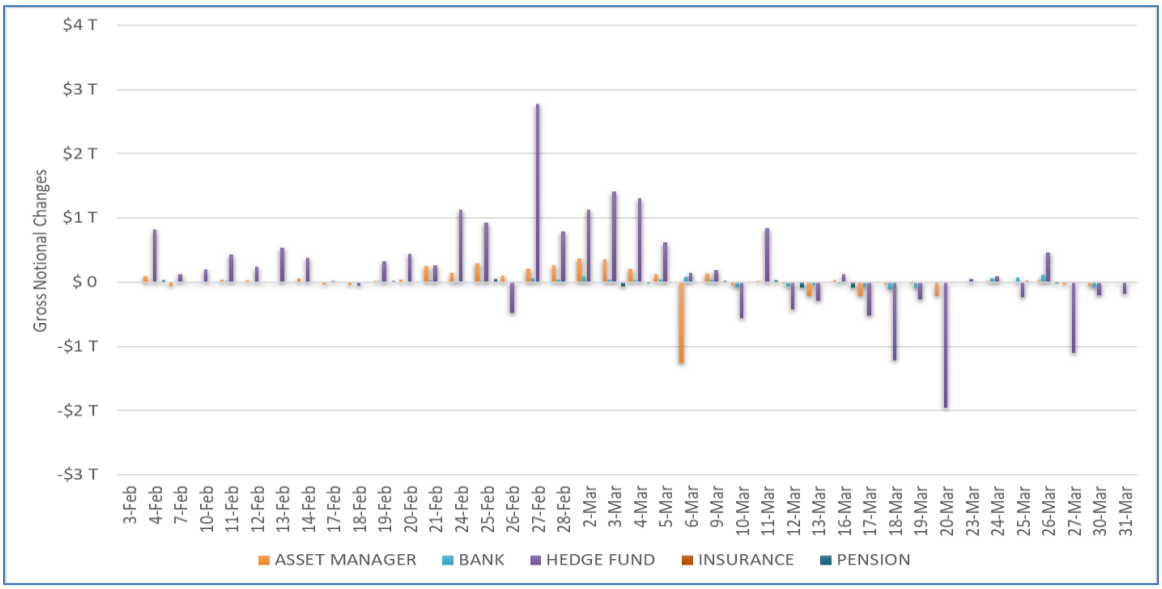
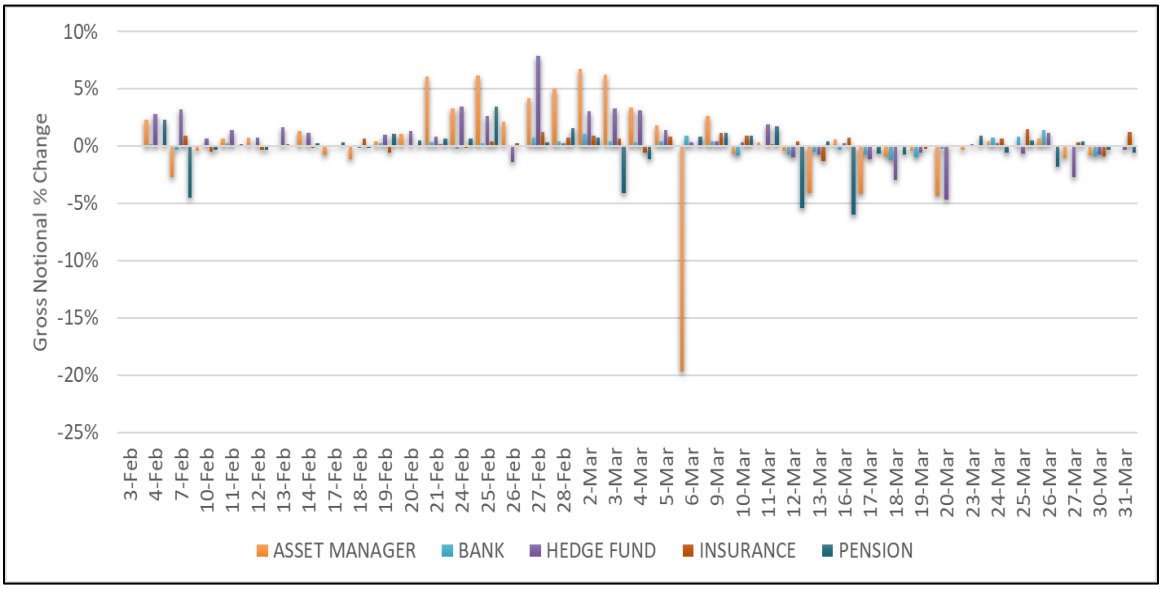


Figure 45: Cleared IRS Gross Notional % Changes by Client Account Type



Moving over to gross notional values, Figure 44 further emphasizes the differences between hedge funds and other participant types. Though on a risk basis, hedge funds represented a somewhat small fraction of the whole, their position changes as measured by gross notional dominated others. Given the large observed changes in gross notional and (sometimes) IM for hedge funds, staff dug further into this category of participants to identify whether these changes were driven by a few or by many firms. To do this, staff measured concentration risk via the HHI metric.[55] Using this approach, the March daily average HHIs for changes in gross notional and IM were 0.11 and 0.04, respectively, indicating that while gross notional changes were large, these were spread out across a wide set of hedge funds.

Figure 45 shows that when considering daily percent changes in gross notional, that the footprint of asset managers was relatively large as well. Although their gross notional outstanding was much smaller than that of hedge funds (but much bigger than insurance companies, pension funds, and (client) banks using the same measure), their percent changes in gross notional (especially around the March 5th and 6th timeframe) was significant compared to the other participant types.

But how do these trends compare to those of the clearing member positions themselves? The charts in Figure 46 through Figure 49 depict the changes in IM and gross notional outstanding experienced by house accounts with a focus on bank participant types – often subsidiaries of global systemically important banks (G-SIBs). With respect to IM and gross notional changes,

[55] See *supra* note 51.

there is general alignment (but smaller percentage moves) relative to client account behavior. From a dollar gross notional move view, this comparison further highlights how large some of the hedge funds' moves were as well.

Figure 46: Cleared IRS IM Changes: House Accounts

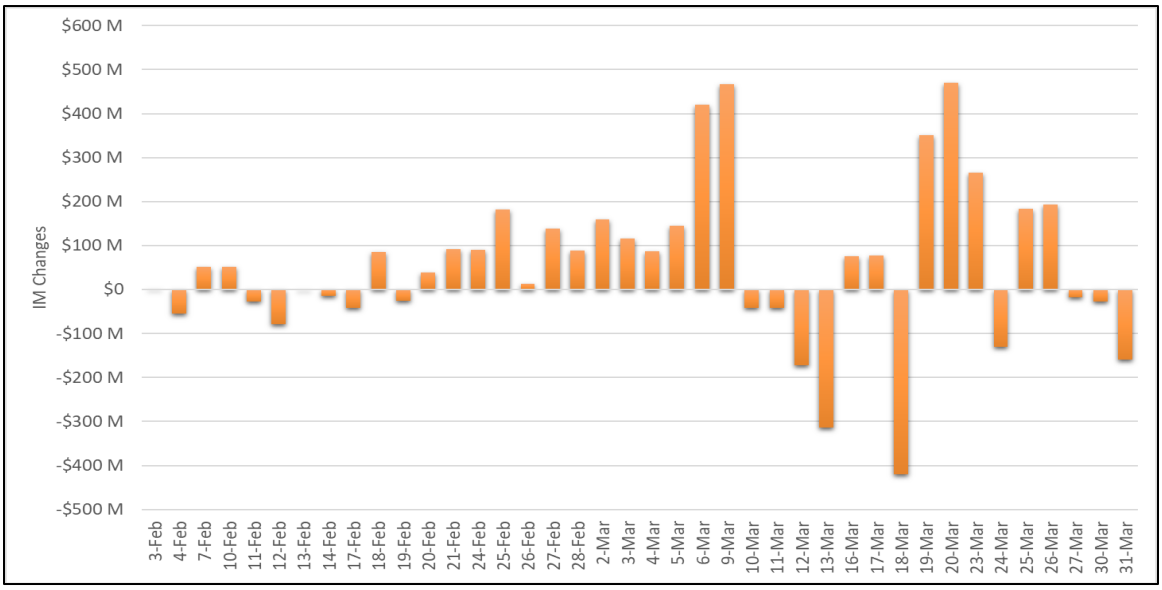


Figure 47: Cleared IRS IM % Changes: House Accounts

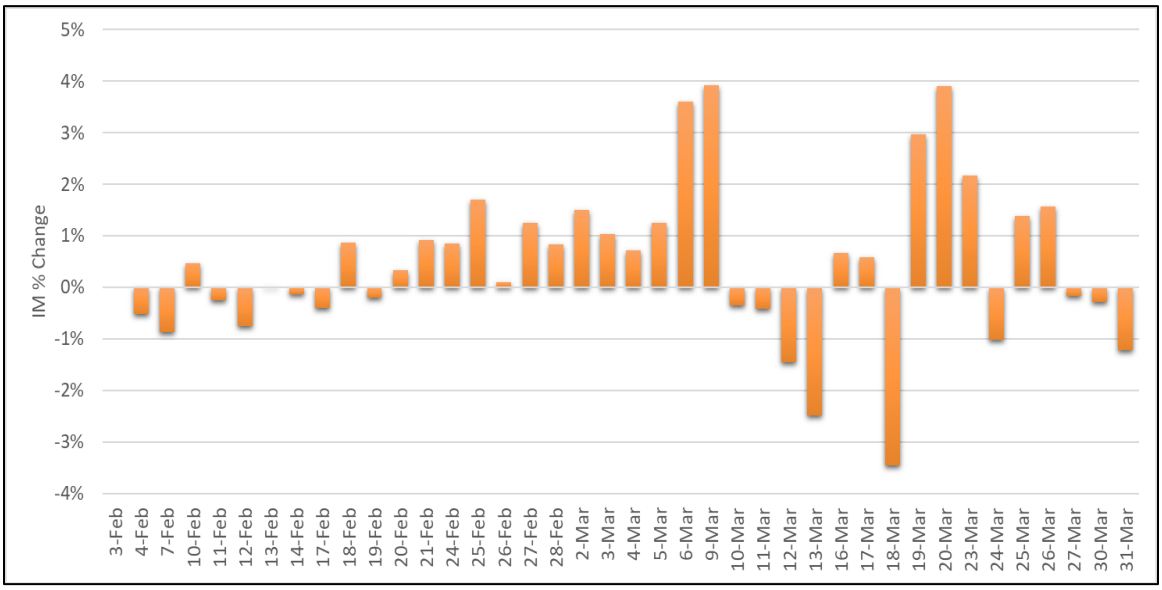


Figure 48: Cleared IRS Gross Notional Changes: House Accounts

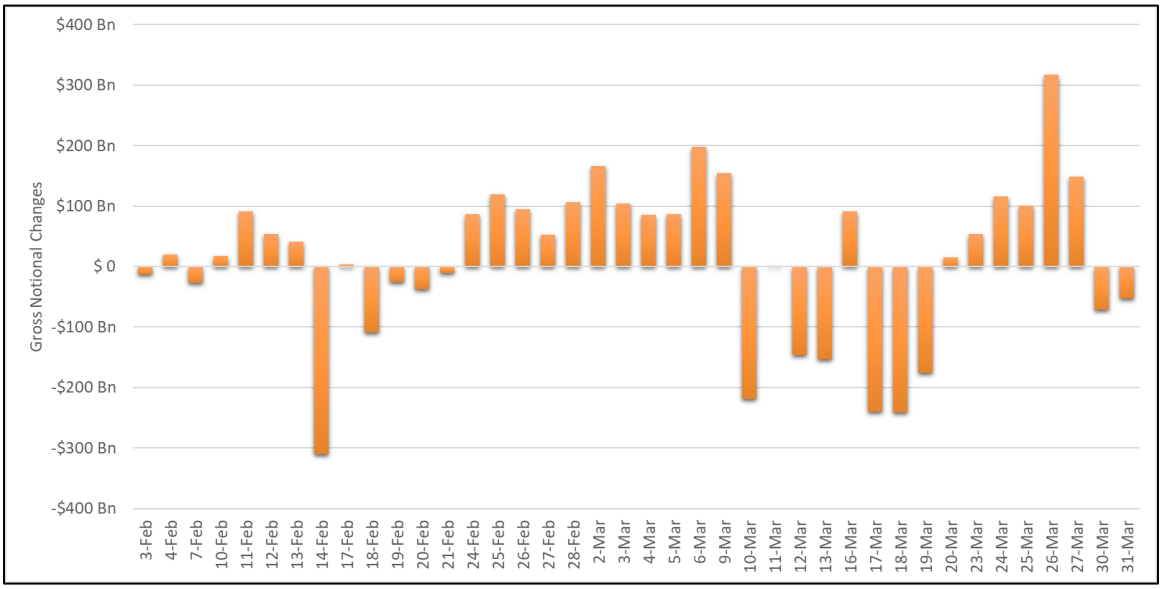
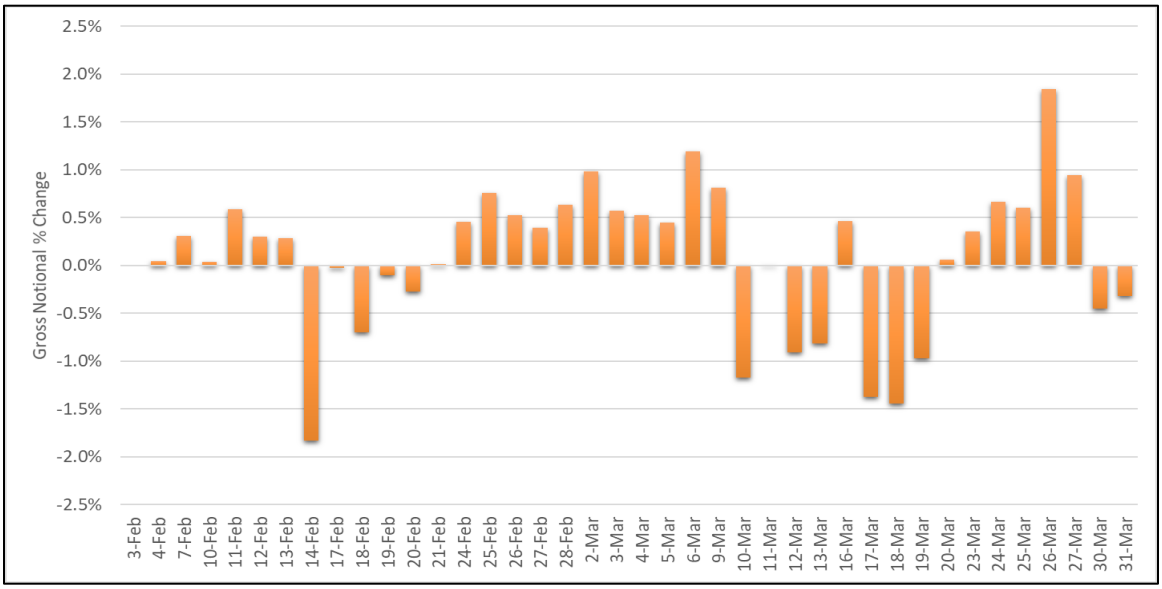


Figure 49: Cleared IRS Gross Notional % Changes: House Accounts

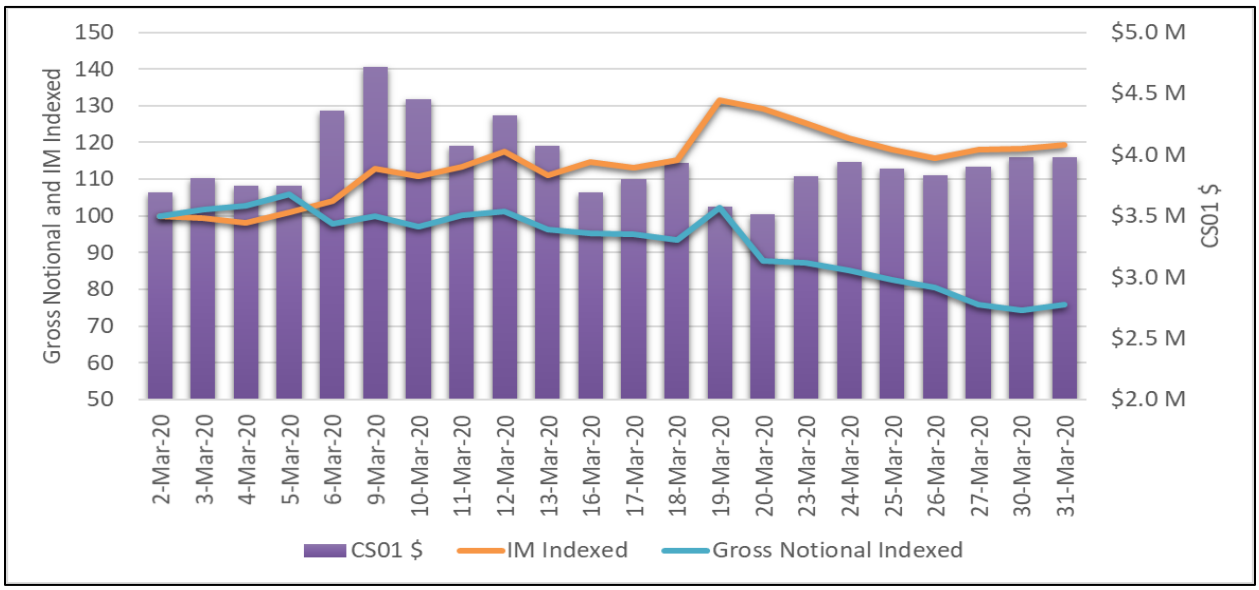


IMPACT AND BEHAVIORAL DIVERSITY: CLEARED CDS

In this section, the participant type analysis above is extended to CDS exposures cleared at CCPs registered with CFTC. As described earlier, March 2020 saw unprecedented volatility in credit markets with high yield and investment grade index spreads rising to 871 bps and 151 bps and maximum drawdowns of -20% and -5%, respectively. The volatility resulted in CCP increases to IM requirements for these contracts. Figure 50 presents percent changes in IM and gross

notional outstanding (as measured by the five-year notional equivalent[56]), and the USD value of a measure of risk, CS01, across clients for CDS during March 2020. Similar to DV01 for rates, CS01 measures the dollar value of a parallel, one basis point shift in the underlying credit spread curve.

Figure 50: Cleared CDS IM vs. Gross Notional



The charts in Figure 51 through Figure 55 below breakout these three variables for five different types of clients: hedge funds, asset managers, insurance companies, banks, and pension funds. As with IRS, the heterogeneity in activity and exposures across the different types of clients is evident in the CDS markets, too. The rates of increase in IM, for instance, are not the same across the different participant types. Hedge funds were increasing their gross notional exposures in late February and into March, but they decreased them starting the latter half of March at a much faster relative rate than the other participant types – down roughly 40%.

[56] The 5-year notional concept stems from the 2019 CFTC paper ENNs for Corporate and Sovereign CDS and FX Swaps (available at https://www.cftc.gov/sites/default/files/files/ENNs%20for%20Corporate%20CDS%20and%20FX%20Derivatives%20-%20ADA.pdf) and accounts for CS01 and spread volatility differences between the contract and a standard tenor 5-year CDS trading at a spread of 100 bps – effectively adjusting up or down the contract notional based on where it is trading relative to the 5-year benchmark CDS.

Figure 51: Cleared CDS IM vs. Gross Notional: Hedge Funds

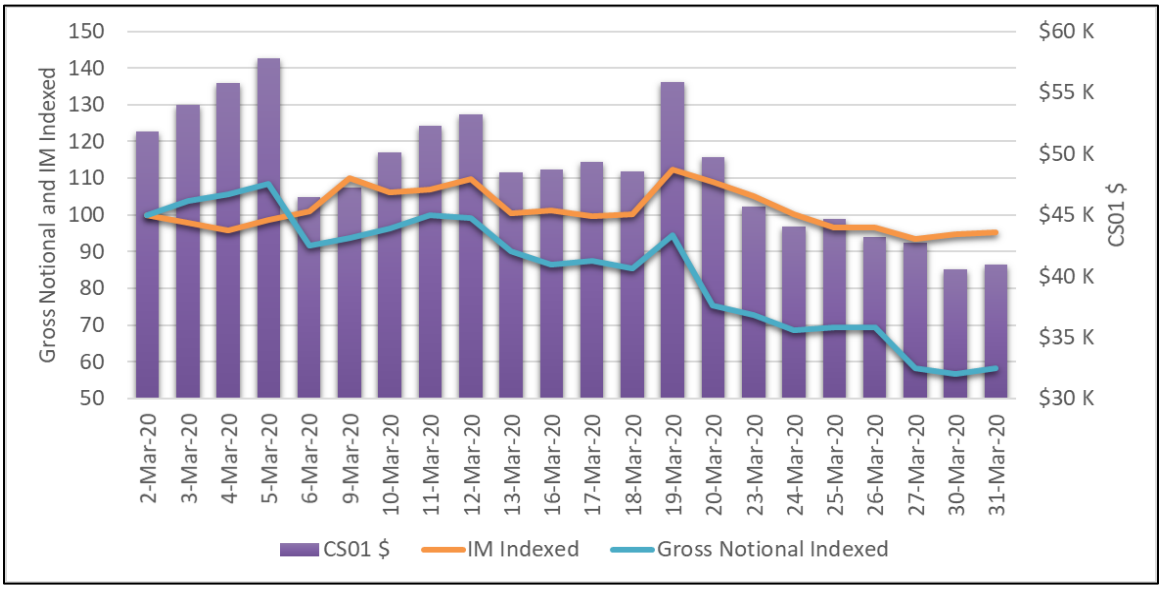


Figure 52: Cleared CDS IM vs. Gross Notional: Asset Managers

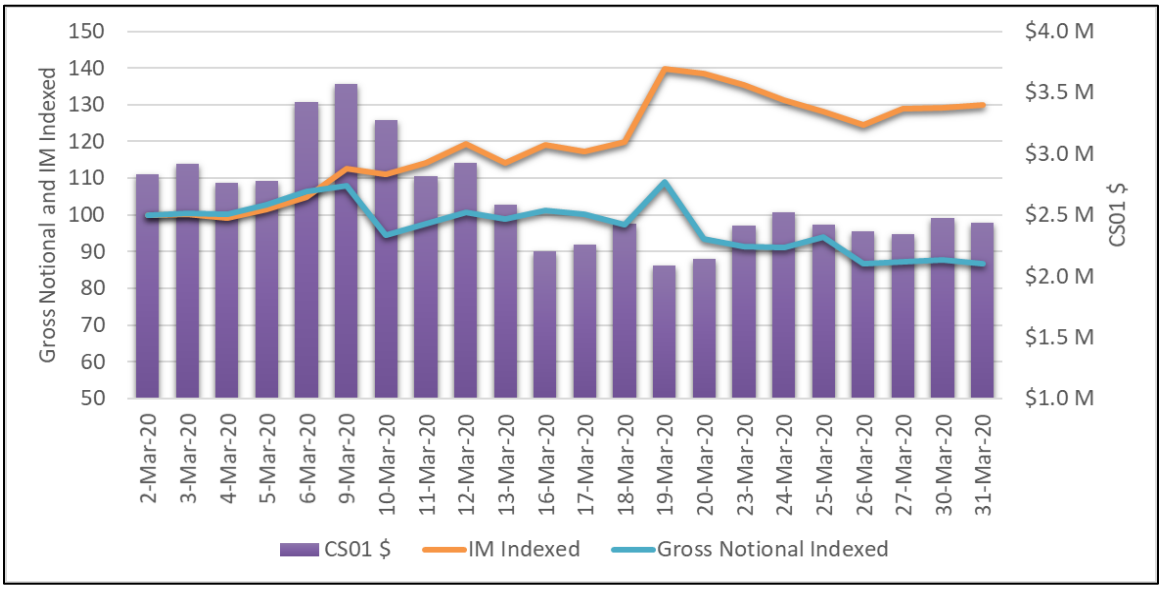


Figure 53: Cleared CDS IM vs. Gross Notional: Insurance Companies

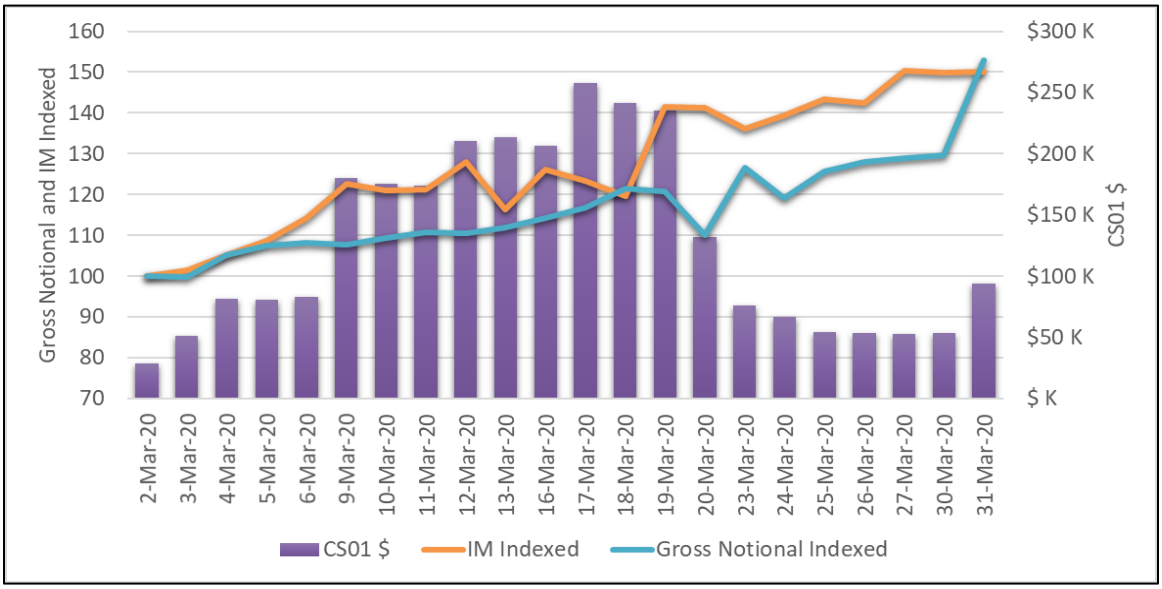


Figure 54: Cleared CDS IM vs. Gross Notional: Banks

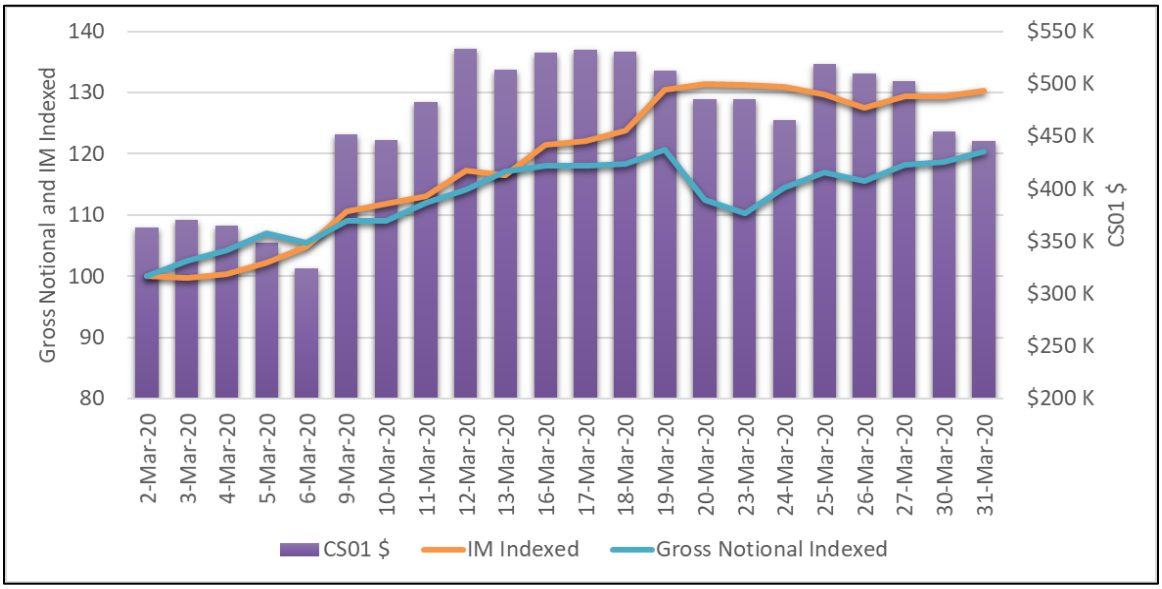
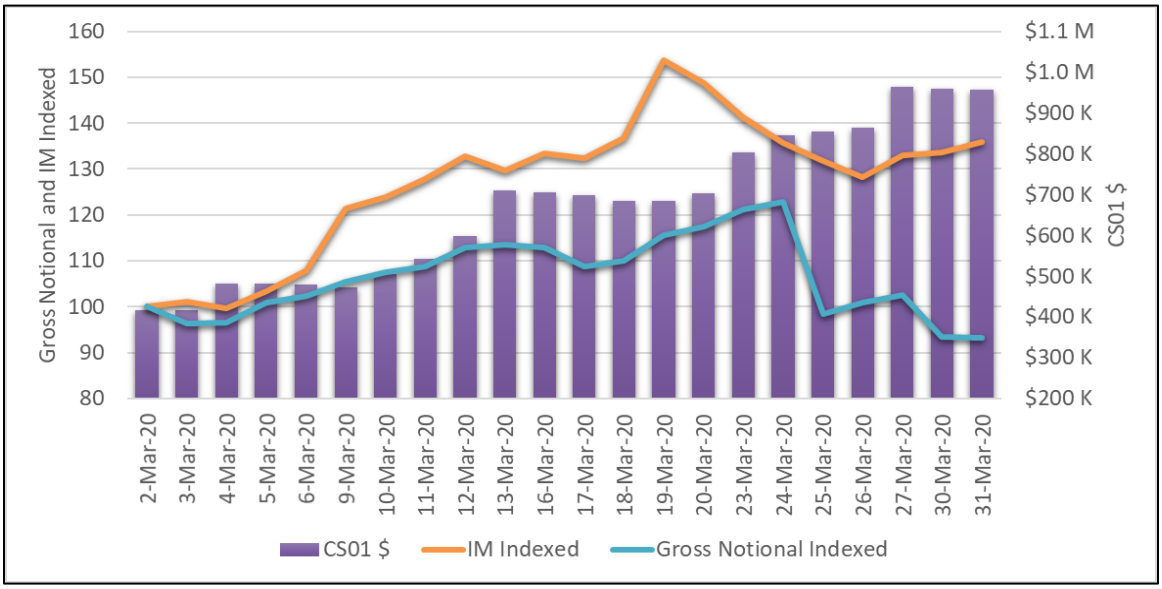


Figure 55: Cleared CDS IM vs. Gross Notional: Pension Funds



The total IM posted by hedge funds for these CDS positions remained roughly constant (Figure 51 and Figure 58) compared to increases for the other participants. To illustrate the most pronounced movement, insurance companies, on the other hand, increased their gross notional exposures by about 50%, and presumably due to the directional nature of their exposures, this resulted in higher relative IM requirements since IM increased roughly 50% as well.

Figure 56: Cleared CDS IM Changes by Client Account Type

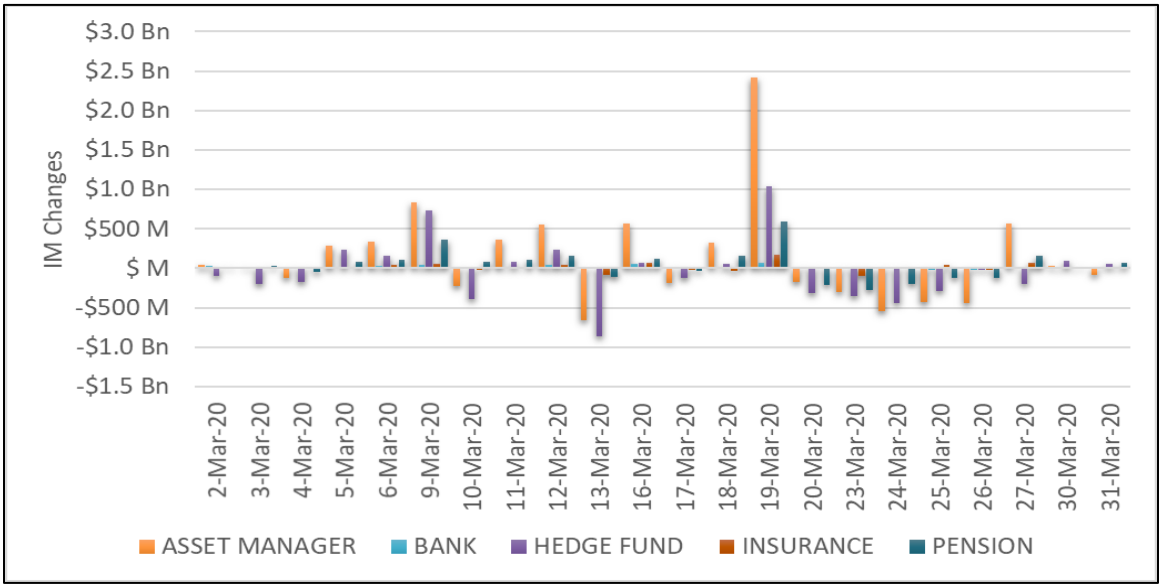


Figure 57: Cleared CDS IM % Changes by Client Account Type

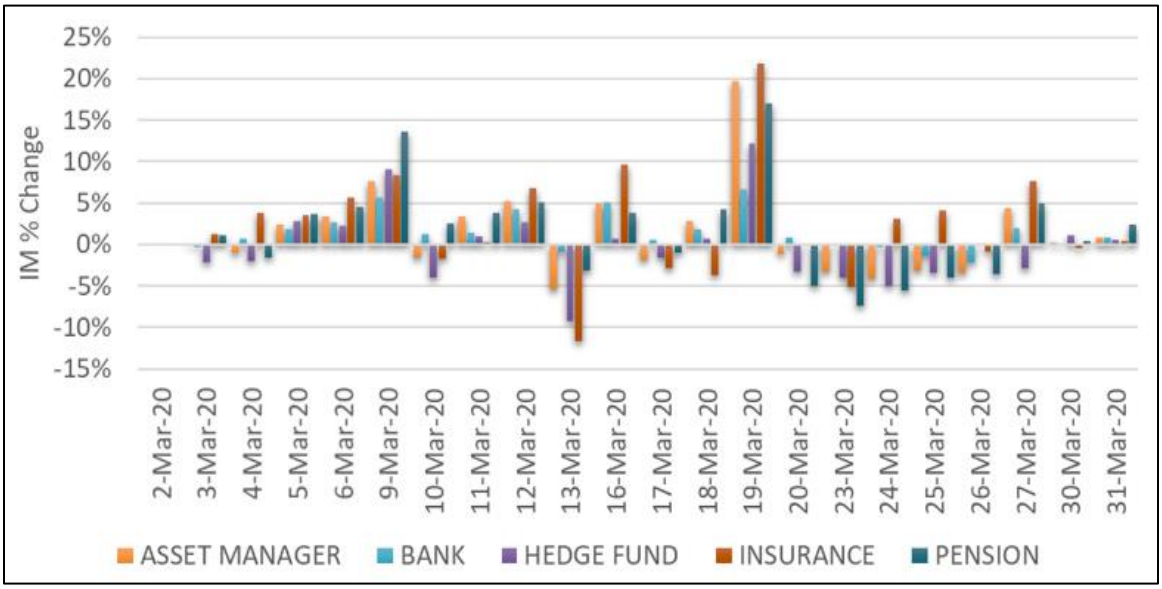
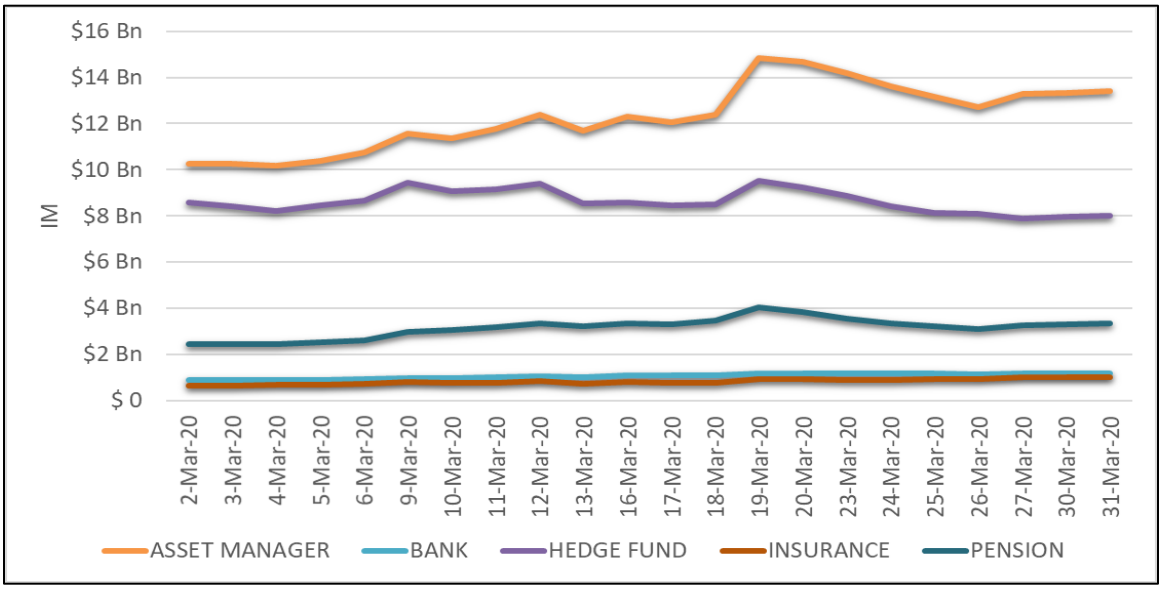


Figure 58: Cleared CDS IM Totals by Client Account Type



As can be seen in Figure 58 for further illustrative purposes, asset managers (+$3.2 billion), banks (+$300 million), insurance companies (+$360 million – small comparatively but the largest relative percent change in the group), and pension funds (+$925 million) experienced higher aggregate IM requirements throughout March, but hedge funds (-$570 million) experienced a slight decrease.

Figure 59 through Figure 62 below present a similar breakout for daily changes in gross and net notional outstanding during March 2020.

Figure 59: Cleared CDS Gross Notional Changes by Client Account Type

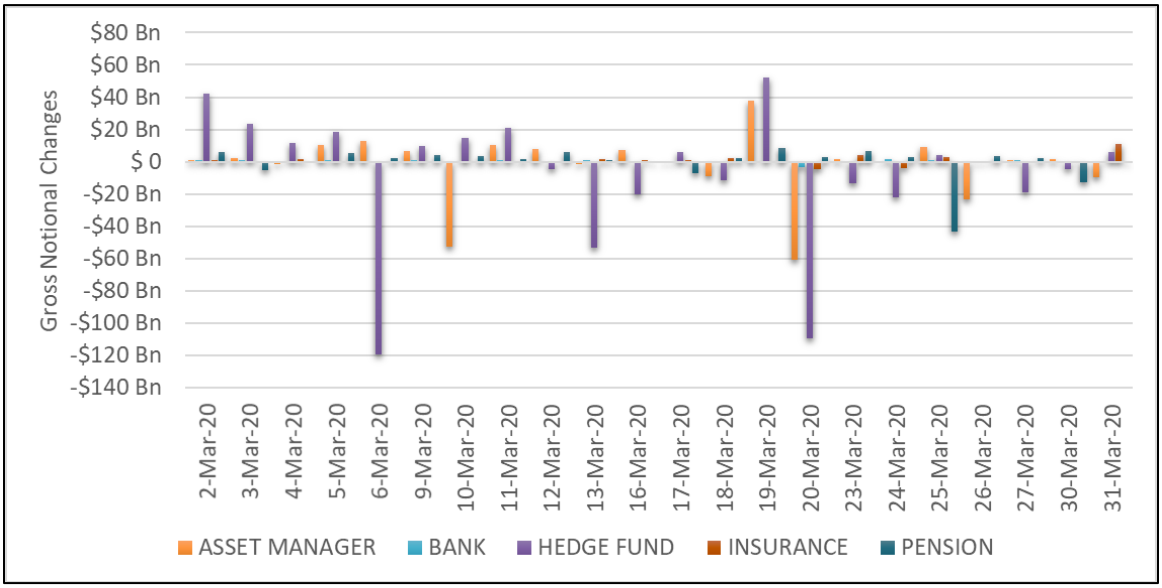
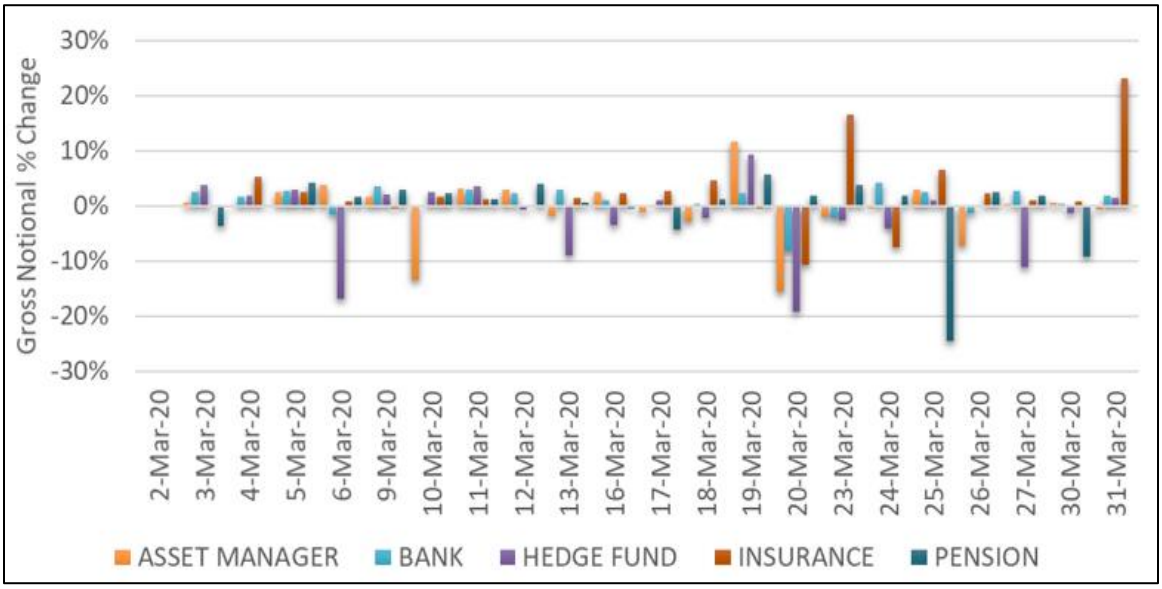


Figure 60: Cleared CDS Gross Notional % Changes by Client Account Type



The increase in gross notional values for March 19, 2020, as should be noted, was followed by a similarly large decrease a day later. This may reflect rapid trading and re-positioning by asset managers and hedge funds to protect their broader credit exposures amid the rapid volatility in the markets – this timing coincides with credit rolls, too.

Figure 61: Cleared CDS Net Notional Changes by Client Account Type

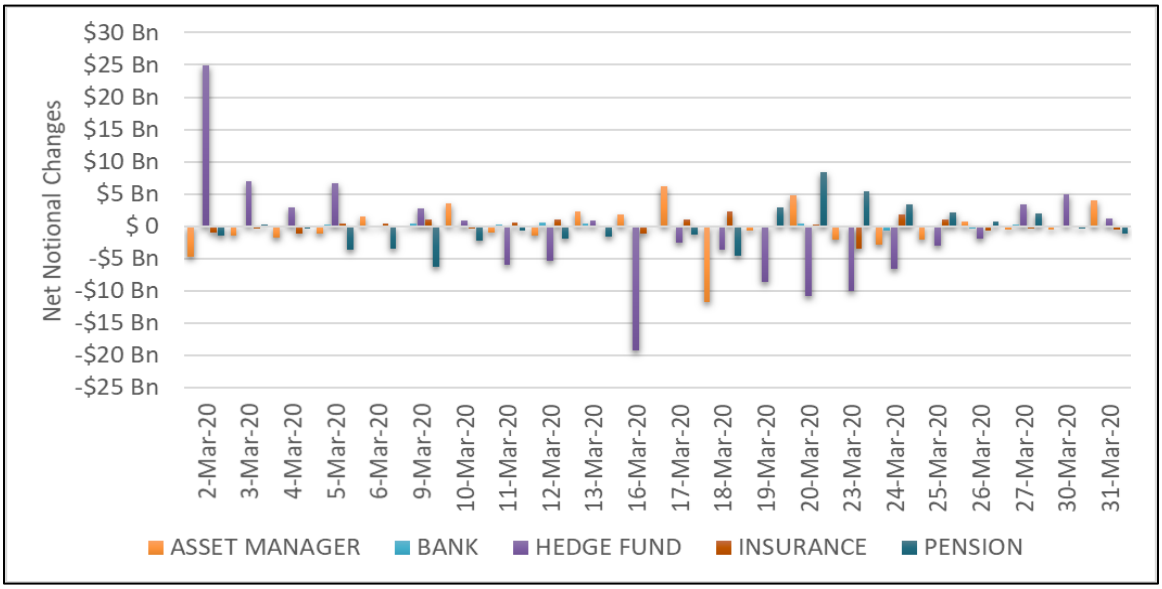
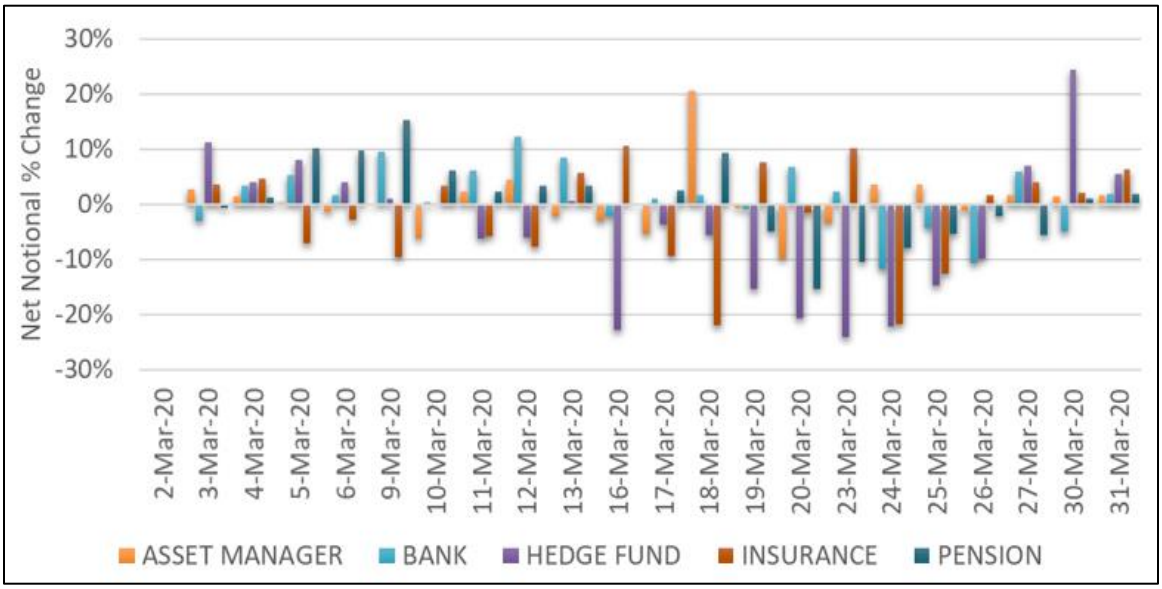


Figure 62: Cleared CDS Net Notional % Changes by Client Account Type



When looking at net notional, hedge funds can be seen to increase their net notional at the beginning of the month only to rapidly bring down the exposures during the latter half of the month, which could be related to their slight decrease in IM (down roughly 5%) for the month compared to others (up 30-50%). This observation may moreover suggest the possibility of changes in market volatility being drivers for the immense changes in IM for all but hedge funds. Further to this point, when considering HHIs for notional change concentration risks as done previously, net notional and gross notional values are seen to be relatively low for asset

managers (0.05 and 0.11) and hedge funds (0.08 and 0.12). This may imply that there were not a select few driving large notional changes during March for asset managers or hedge funds, and that hedge funds, in unison, traded actively to manage credit risk exposures.

IMPACT AND BEHAVIORAL DIVERSITY: FUTURES & OPTIONS

Figure 63: Cleared F&O IM Changes by Client Account Type

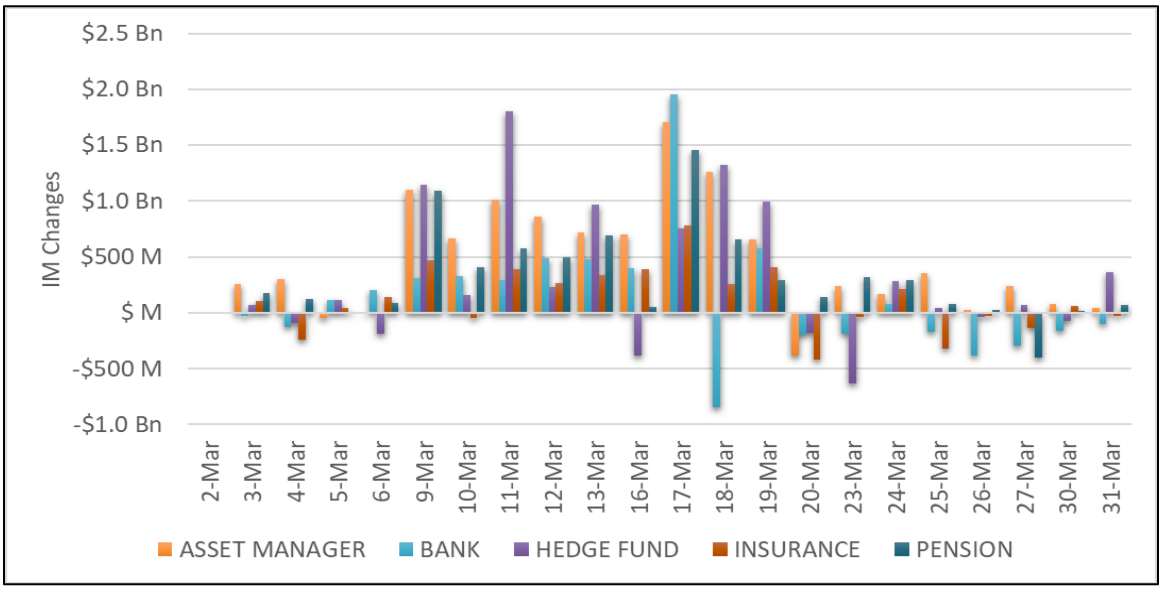


Figure 64: Cleared F&O IM % Changes by Client Account Type

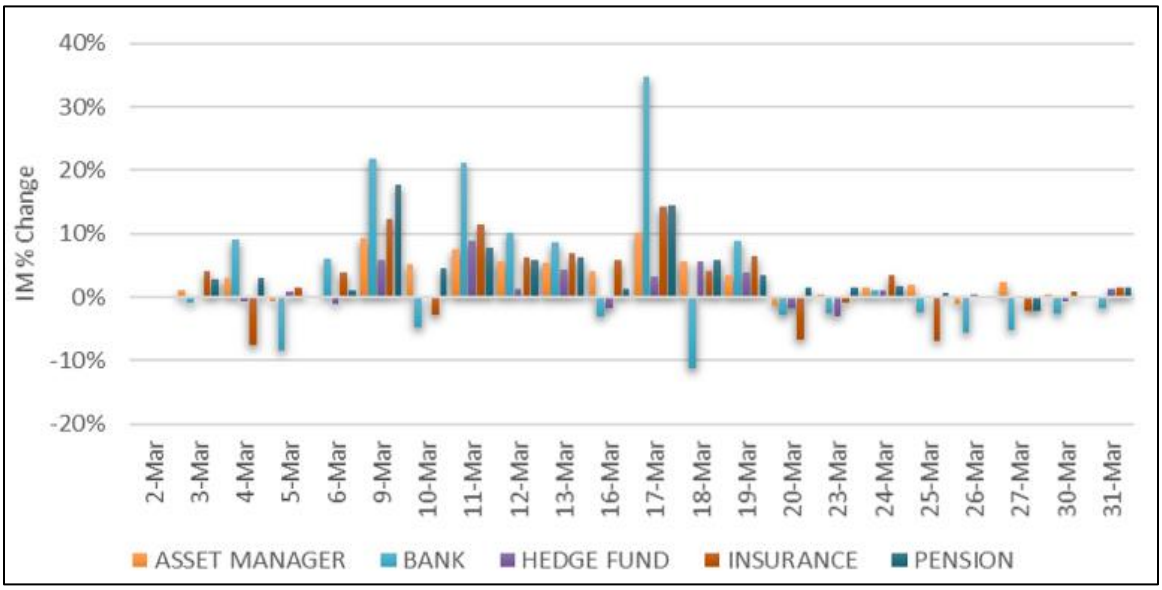
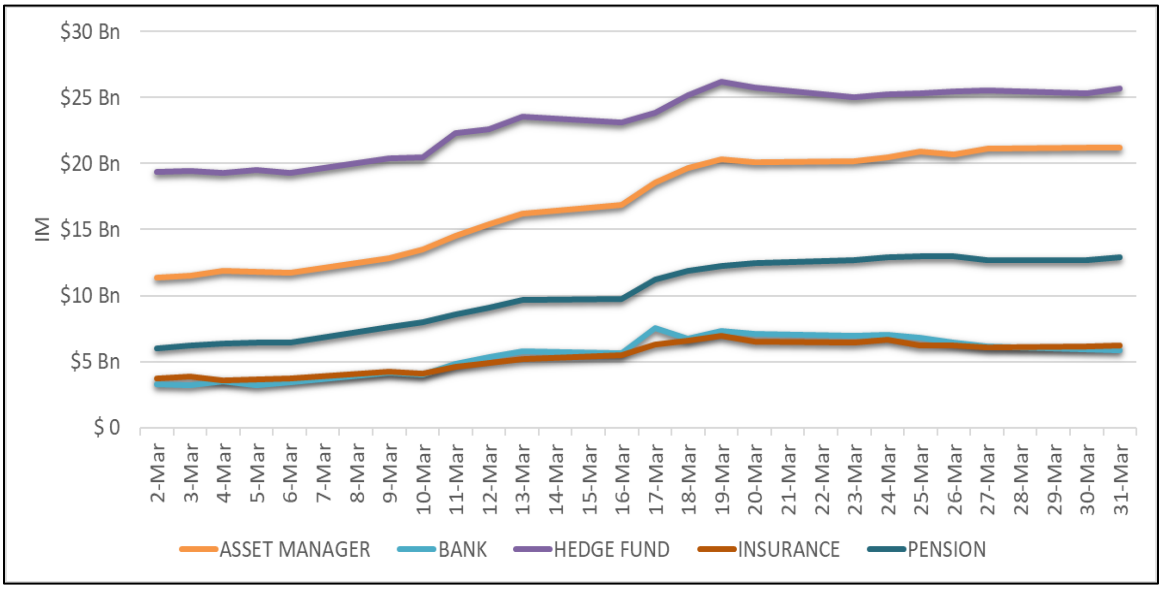


Figure 65: Cleared F&O IM Totals by Client Account Type



Cleared futures and options may be exposed to similar risk factors as the credit and rates markets. Figure 63 shows daily IM changes in futures and options throughout the middle of March when both credit and rates markets experienced significant effects but on different days (pronounced IM move on March 9th for IRS and March 19th for CDS). And with respect to overall changes in IM for the month, staff saw increases across for asset managers (+$9.9 billion), banks (+$2.6 billion – roughly doubling of bank IM), hedge funds (+$6.3 billion), insurance companies (+$2.5 billion), and pension funds (+$6.8 billion).

Figure 66: Cleared F&O Delta-Adjusted Gross Notional Changes by Client Account Type

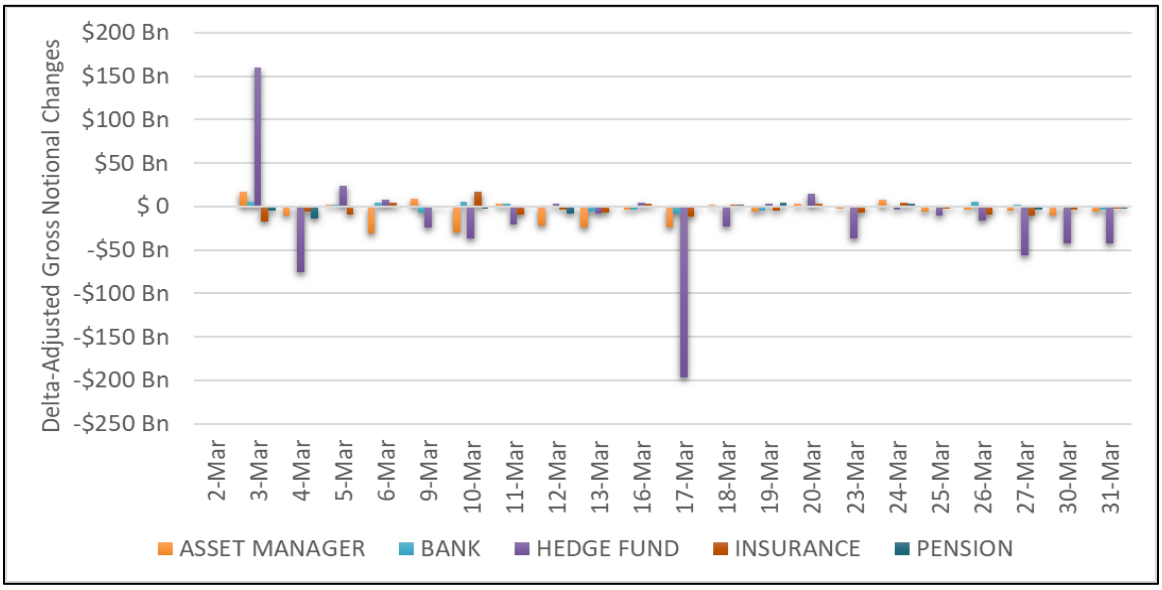


Figure 67: Cleared F&O Delta-Adjusted Gross Notional % Changes by Client Account Type

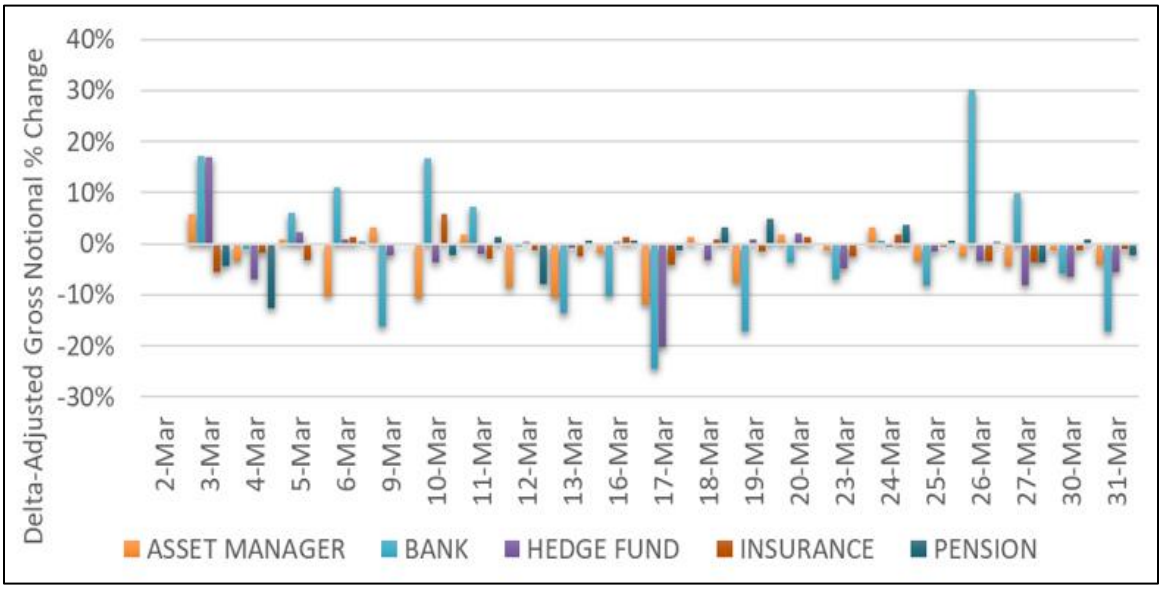


Figure 68: Cleared F&O Delta-Adjusted Net Notional Changes by Client Account Type

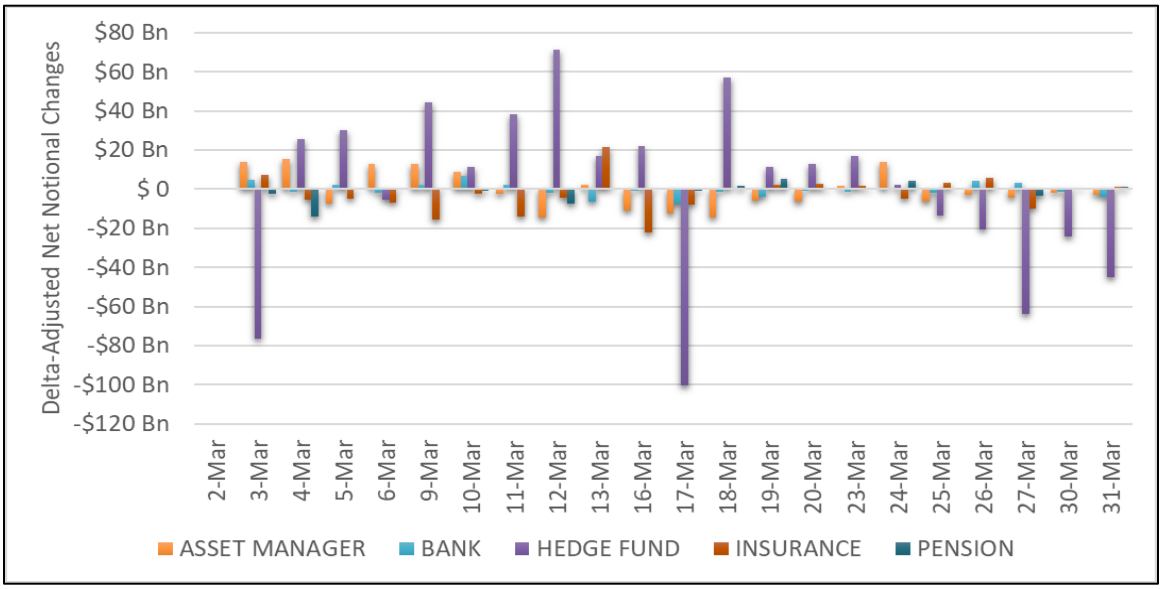
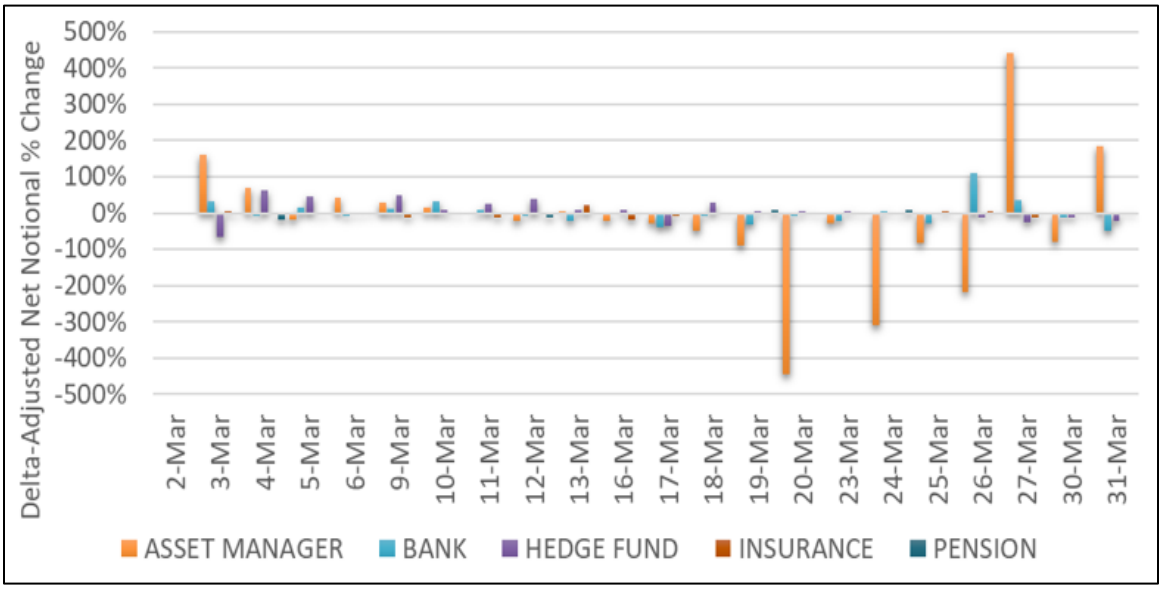


Figure 69: Cleared F&O Delta-Adjusted Net Notional % Changes by Client Account Type



As was the case with swaps, hedge fund gross (Figure 66) and net (Figure 68) notional volatility is evident without noticeable impacts to IM percentage changes (Figure 64) and relative to the participant types as a whole. Overall, hedge fund gross notional change and net notional HHIs are 0.25 and 0.26 indicating high concentration; however, IM change HHI is 0.03. This observation seems to suggest that, while the same does not appear true for swaps, there were much more active, directional position changes from a smaller number of entities in the futures and options markets but with little noticeable impact to IM from the suspected trading activity. Compared to swaps, it should be noted that banks, however, showed notable changes in IM and gross notional. Asset managers showed significant net notional changes over the month that were less pronounced from a gross notional perspective – but it is unclear from this analysis if the focus was in underlying rates or credit markets or something else.

CONCLUDING REMARKS AND FUTURE ANALYSIS

As an interim report, this presents analysis and findings by CFTC staff related to the cleared derivatives markets during a period of extreme volatility. Analytical work on this period continues, both the CFTC as well as a number of regulatory bodies around the world. In addition, there have been numerous white papers and conferences describing how COVID-19 affected financial markets as a whole and, in particular, the cleared derivatives markets. There is broad consensus that, after acknowledging the extremity of the volatility driven by the social and economic impact of the pandemic shock, the clearing ecosystem functioned generally as designed.

The ability to analyze cleared derivatives markets is in part due to the level of transparency of risk management at CCPs. In addition to the quarterly PQD published on their websites, CCPs provide highly detailed data about liquidity flows to regulatory agencies around the world; the combination of these data sets has allowed for the granular analysis found in this report and others that have been published over the last year.

In this interim report, starting from aggregated daily IM and VM flow information, CFTC staff have attempted to systematically understand the margin dynamics that prevailed in these markets during March and April of 2020. Where possible, this analysis seeks to inform in areas where aggregate data can be helpful in tracking activity at a macro level; these aggregate data, however, are less reliable in answering probing questions about, for example, specific aspects of a CCP's margin model or the behavior of individual groups of market participants.

More specifically, taking one example, though a large number of product-level breaches occurred during the period, given the historic moves, some of the largest breaches were in contracts where open interest was relatively small, such as those close to expiration. In addition, breaches appeared somewhat less prevalent at the level of individual portfolios, where hedging activity by a number of market participants meant that they were not fully exposed to directional moves. In addition, there is a rich diversity of behavior across different participant classes, such as banks, hedge funds, pension funds, asset managers, and insurance companies. The observations presented tend to be consistent with conventional wisdom – for example, hedge funds might, on average, have more flexibility to reduce or add to their exposures depending on market conditions; in contrast, given their use of derivatives markets, the portfolios of pension funds and insurance companies may remain more stable even when volatility shifts significantly.

A careful study of the risk management framework of CCPs reveals an interesting, and often complicated, blend between contract or instrument, or more generally product-level IM requirements and various portfolio-level risk considerations. One could view the product-level

analytics as a core set of building blocks; as portfolios grow in size (i.e. the absolute amount of risk exposure due to a specific instrument) and complexity (the number of instruments and the presence or lack of correlation among them), the divergence between product and portfolio-level metrics can have a greater bearing on the calculation of IM requirements.

With the analysis in this interim report showing a diverse set of reactions to market volatility, often depending on participant type or market, this motivates further, future analysis to examine questions and hypotheses about specific aspects of CCPs' risk frameworks. One such set of questions relates to the procyclicality of CCPs' IM requirements – often identified as the 'anti-procyclicality' or 'APC' factor. Staff is continuing to study this topic; one contribution in this report is some analysis that looks at the difference in IM changes due to position changes versus model changes.

As we have alluded to earlier in this report, procyclicality (anti- or otherwise) of CCP margin models is a complex topic. At a high-level, regulators and the market have a strong interest in ensuring that IM increases do not cause or strongly exacerbate funding liquidity strains on market participants, especially during stressed market conditions. One way of potentially mitigating these increases is, on average, raising IM requirements during periods of relative calm, so the gap between low and high volatility periods is smaller. This adjustment, of course, balances the benefit of smaller or slower IM demands during stressed periods with the higher costs of clearing during "normal" times. Another means of mitigating liquidity demand is to implement IM rate changes gradually, over a number of days, rather than all at once – which in turn is evidenced in the analysis presented in this report.

Most large global CCPs already implement one or more APC policies, such as incorporating an IM buffer during low volatility periods or deriving IM levels from a mix of current and stressed market conditions. Even with these policies in place, conversations continue regarding whether more needs to be done. This report does not come to a definitive conclusion on the "ideal" APC requirements, or whether changes should be made. However, the analysis in this report does reiterate the point that because liquidity demands (just as defaults) come from firms rather than products, APC analysis is helpful at not just the product level, but also the more complex portfolio and firm level. CFTC staff continues to study these issues and will look to share the findings from their analyses in updated versions of this interim report and other work.

One other set of questions being studied by CFTC staff and various other authorities relates to the transmission of potential strains from increases in IM requirements to the trading and funding markets. This requires information on the funding liquidity dynamics of clearing members and their clients – more generally the full set of liquidity resources available to cleared market participants and how this interacts with cleared liquidity demands. This report focuses primarily on the demand side of this balance – how much individual firms needed to

have on hand to post to CCPs (whether due to IM or VM requirements). CFTC staff has less access to data on the factors outside of the clearing space, such as the underlying business lines of an entity, the interactions between the economic and financial markets on a given business, and the size of collateral demands from other financial contracts like uncleared OTC derivatives or various securities and loan transactions. Without the ability to assess the proportionality of IM/VM calls relative to broader funding demands and available supply, it is difficult to assess the systemic impact of CCPs' margin calls on the broader financial system. Further work by CFTC staff as well as other regulators, on these broader questions will provide a better view not just into cleared market dynamics but also how this segment of the financial market interacted with the financial system as a whole during the COVID-19 period. Hopefully the analysis found in this interim report will aid in this ongoing work.

APPENDIX 1: BREACH ANALYSIS OF SELECT BENCHMARK FUTURES CONTRACTS

Figure 70: Eurodollar Futures (CME)

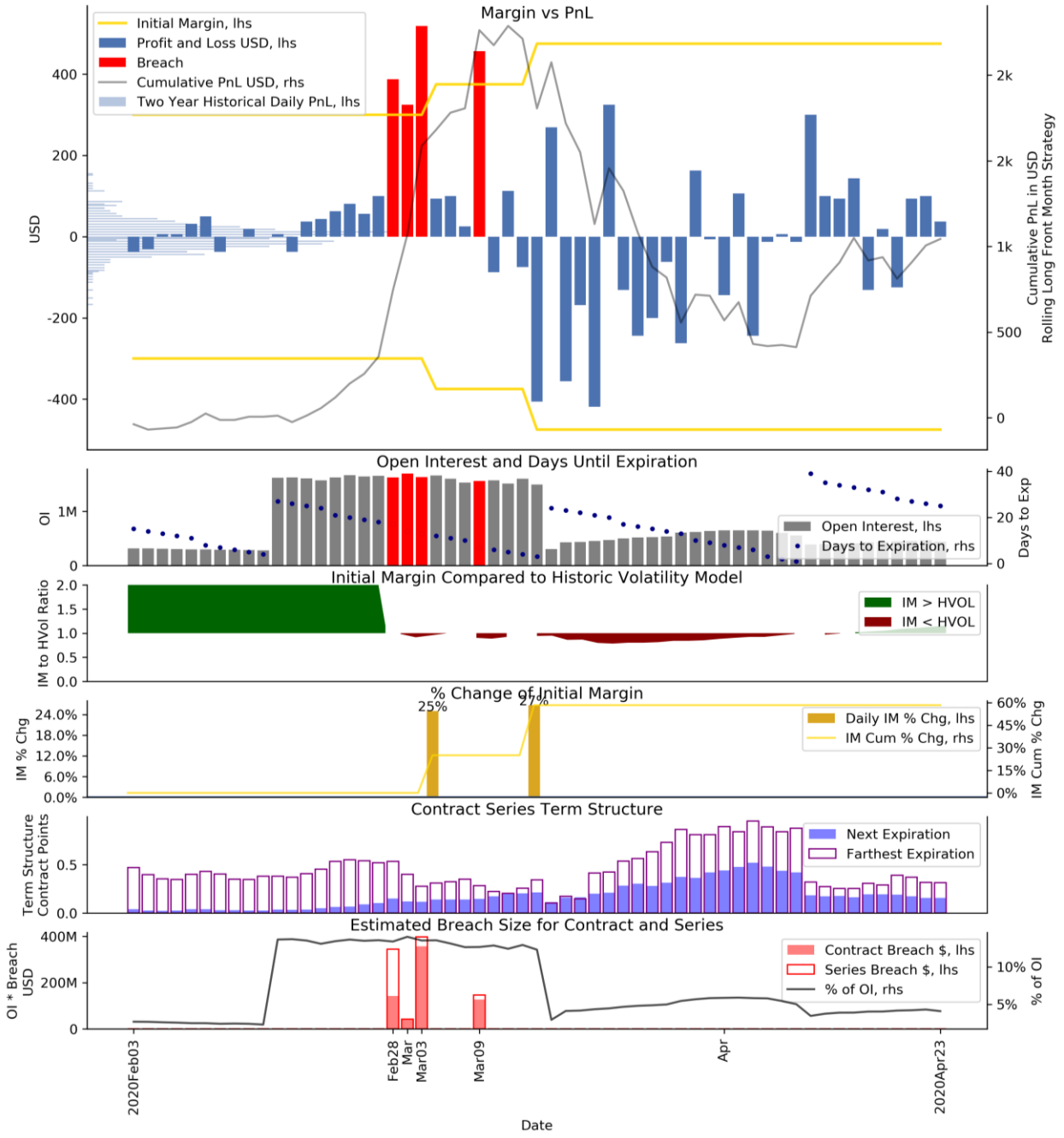


Figure 71: 30-Year US Treasury Bond Futures (CME)

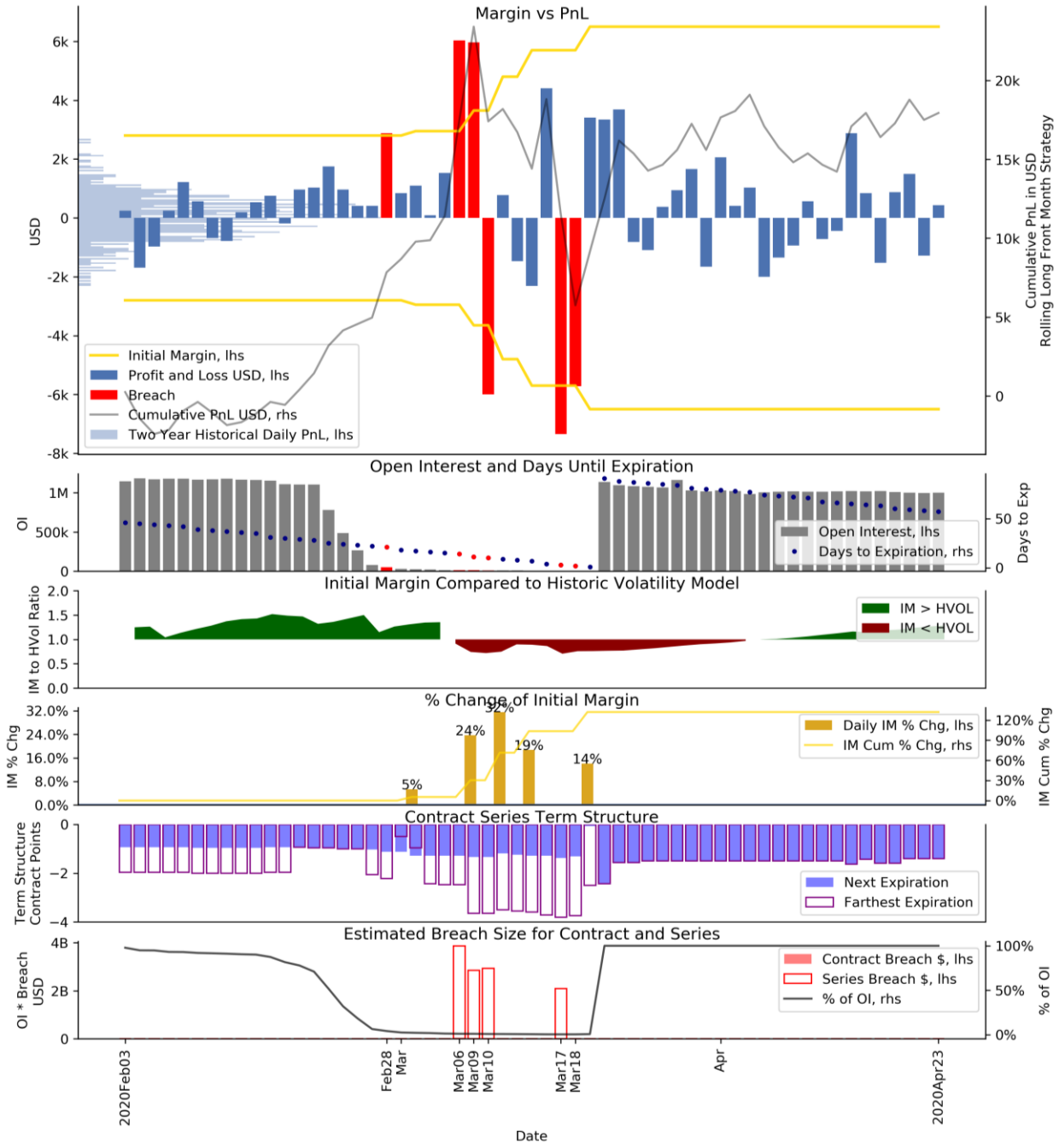


Figure 72: Henry Hub Natural Gas Futures (CME)

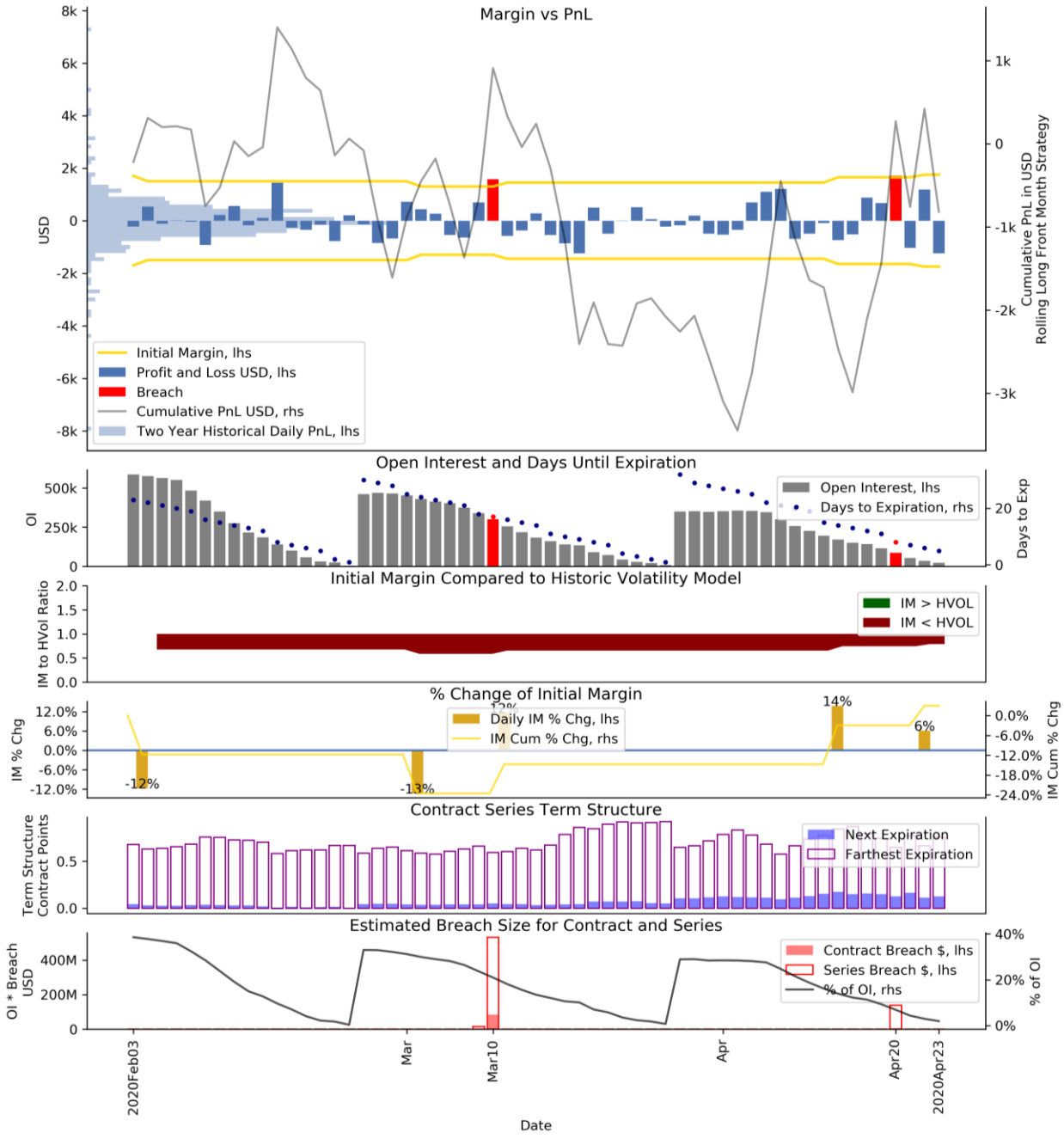


Figure 73: Henry Hub Natural Gas Futures (ICEU)

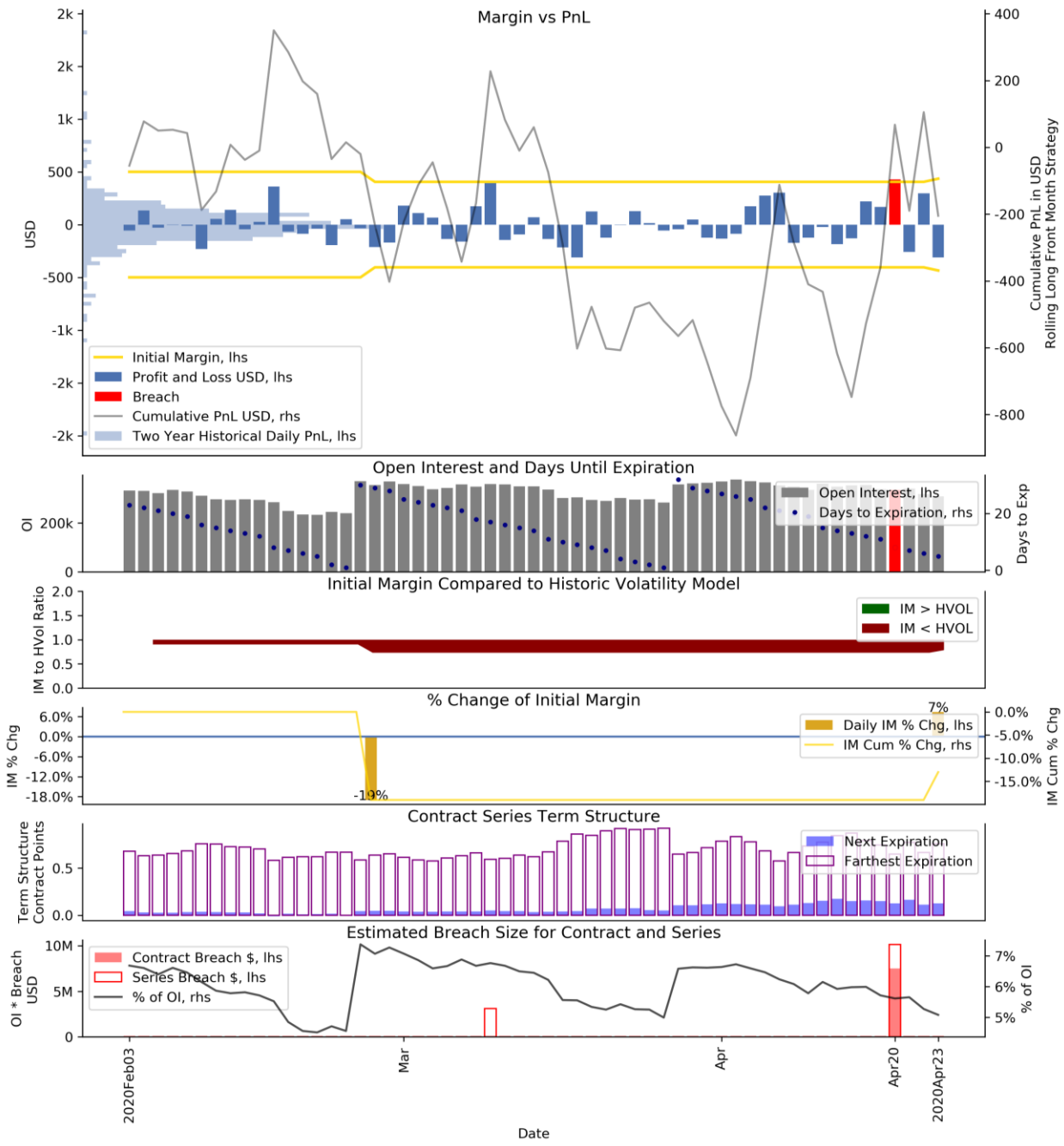


Figure 74: Gold Futures (CME)

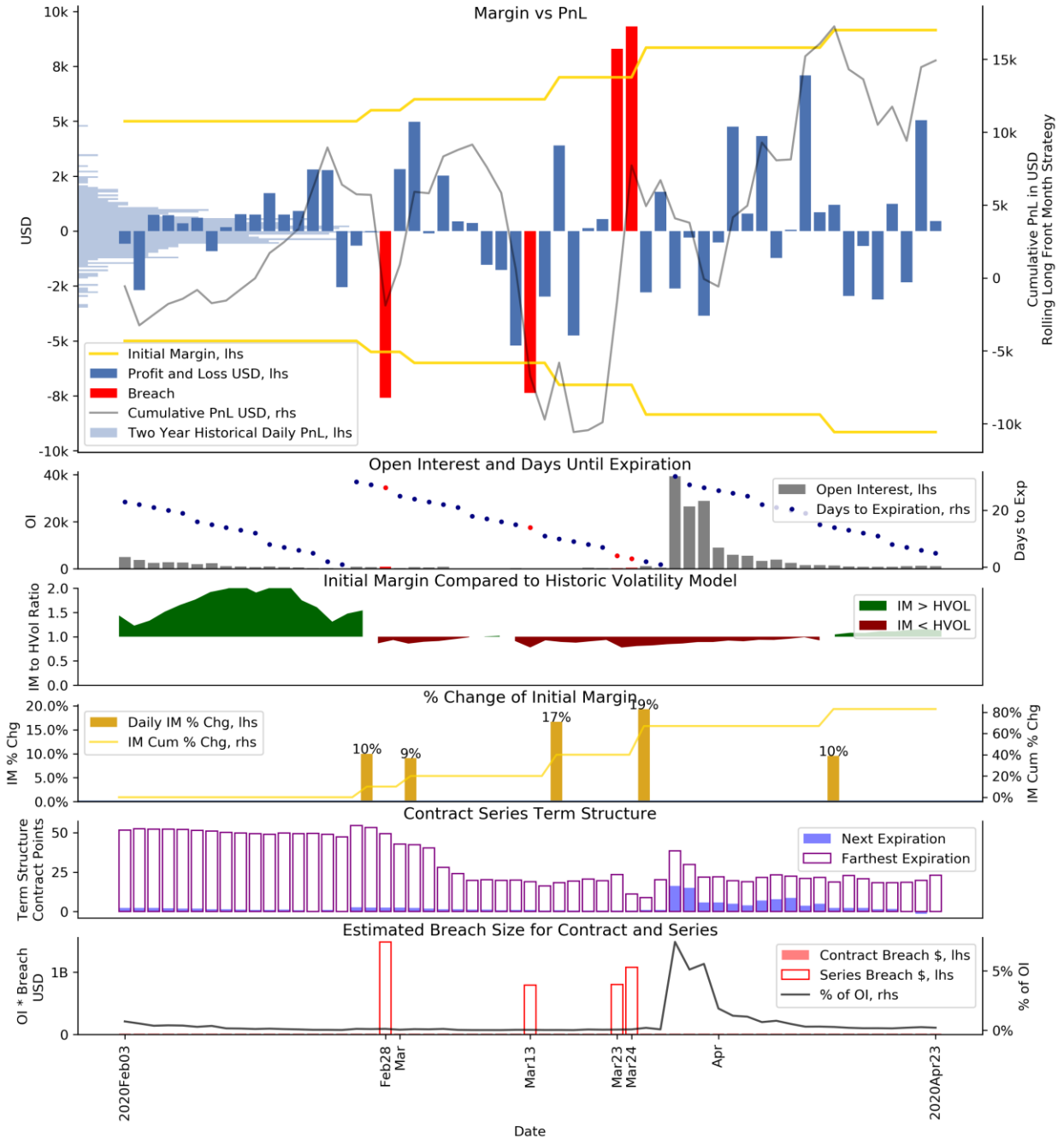


Figure 75: Copper Futures (CME)

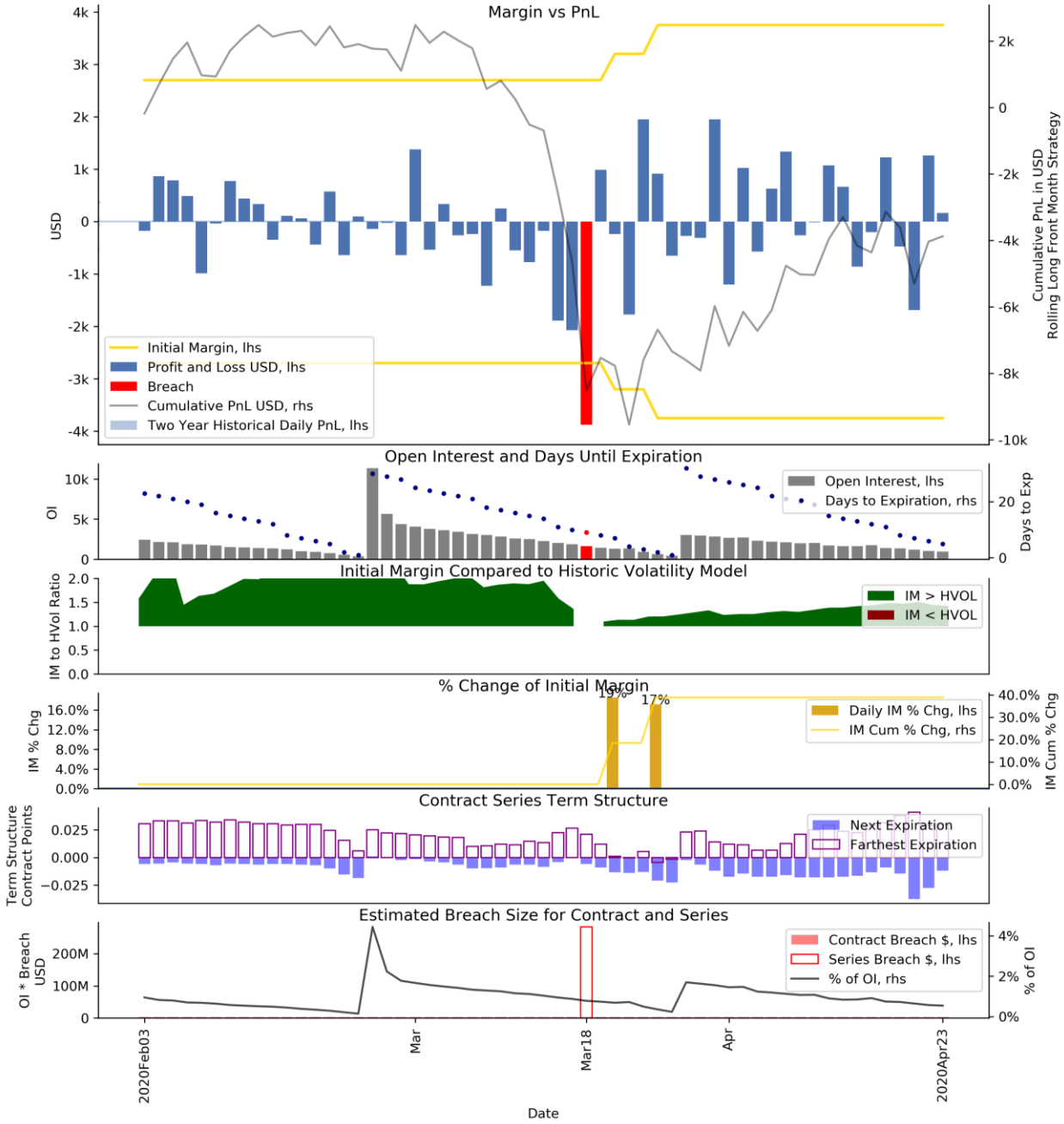


Figure 76: Soybean Futures (CME)

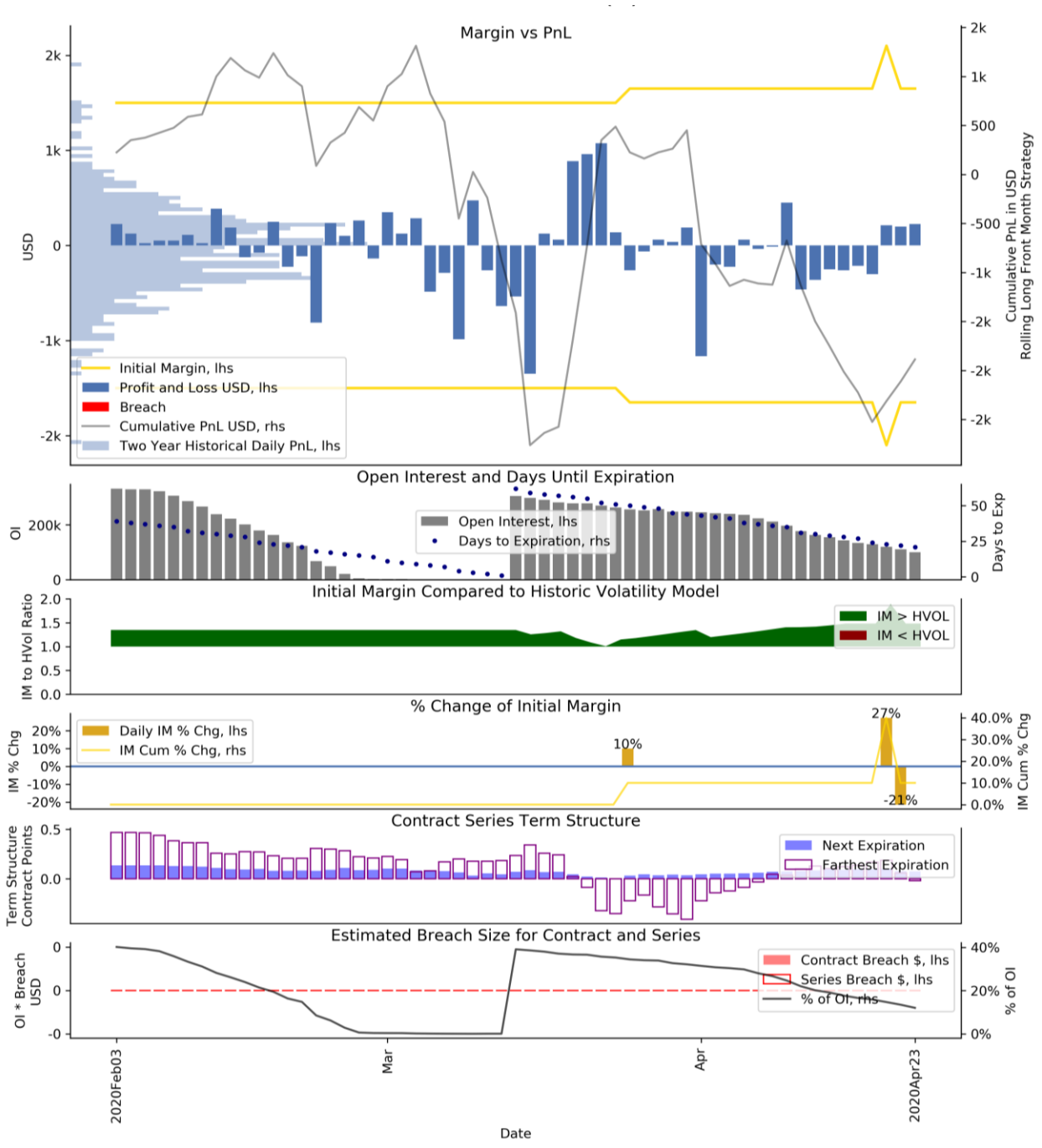
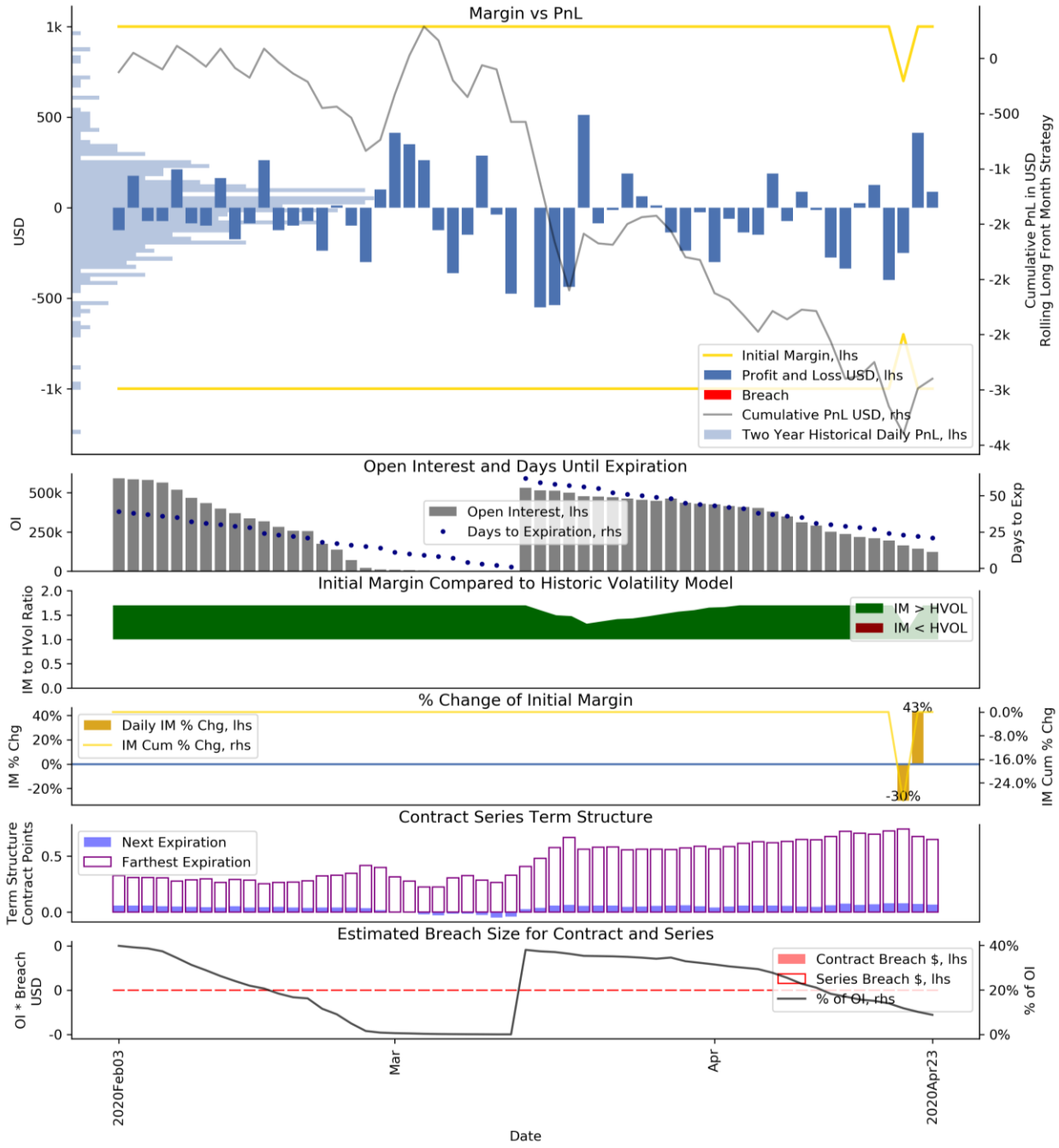


Figure 77: Corn Futures (CME)



APPENDIX 2: 2020 PERCENTILE RANKS OF INDEX GAINS AND LOSSES

Table 4: 2020 Percentile Ranks of Index Gains and Losses

Date	Index	Percentile Rank	Percent Return
9-Mar-20	10Y U.S. Gov Rate	100.00%	(29%)
20-Apr-20	Front Month WTI	100.00%	(306%)
16-Mar-20	S&P 500 Index	100.00%	(12%)
20-Mar-20	10Y U.S. Gov Rate	99.99%	(26%)
12-Mar-20	S&P 500 Index	99.99%	(10%)
16-Mar-20	10Y U.S. Gov Rate	99.99%	(25%)
16-Mar-20	Federal Funds Rate	99.99%	(77%)
27-Mar-20	10Y U.S. Gov Rate	99.98%	(20%)
6-Mar-20	10Y U.S. Gov Rate	99.97%	(16%)
15-Apr-20	10Y U.S. Gov Rate	99.97%	(16%)
9-Mar-20	Front Month WTI	99.97%	(25%)
9-Mar-20	S&P 500 Index	99.96%	(8%)
27-Apr-20	Front Month WTI	99.96%	(25%)
4-Nov-20	10Y U.S. Gov Rate	99.95%	(15%)
3-Mar-20	10Y U.S. Gov Rate	99.95%	(14%)
18-Mar-20	Front Month WTI	99.95%	(24%)
5-Mar-20	10Y U.S. Gov Rate	99.94%	(13%)
1-Apr-20	10Y U.S. Gov Rate	99.94%	(13%)
10-Jun-20	10Y U.S. Gov Rate	99.93%	(12%)
13-Mar-20	VIX Index	99.93%	(23%)
12-Nov-20	10Y U.S. Gov Rate	99.91%	(10%)
11-Jun-20	S&P 500 Index	99.90%	(6%)
28-Feb-20	10Y U.S. Gov Rate	99.88%	(9%)
7-May-20	10Y U.S. Gov Rate	99.88%	(9%)
4-Aug-20	10Y U.S. Gov Rate	99.86%	(9%)
18-Mar-20	S&P 500 Index	99.86%	(5%)
11-Jun-20	10Y U.S. Gov Rate	99.84%	(8%)
20-Mar-20	Front Month WTI	99.84%	(11%)
11-Mar-20	S&P 500 Index	99.83%	(5%)
31-Mar-20	10Y U.S. Gov Rate	99.82%	(8%)
9-Jul-20	10Y U.S. Gov Rate	99.82%	(8%)
12-Mar-20	10Y U.S. Gov Rate	99.80%	(8%)

Date	Index	Percentile Rank	Percent Return
17-Mar-20	10Y U.S. Gov Rate	100.00%	50%
30-Apr-20	Front Month WTI	100.00%	25%
10-Mar-20	10Y U.S. Gov Rate	99.99%	49%
2-Apr-20	Front Month WTI	99.99%	25%
24-Mar-20	S&P 500 Index	99.99%	9%
13-Mar-20	10Y U.S. Gov Rate	99.99%	19%
13-Mar-20	S&P 500 Index	99.98%	9%
4-Sep-20	10Y U.S. Gov Rate	99.98%	13%
19-Mar-20	Front Month WTI	99.98%	24%
18-May-20	10Y U.S. Gov Rate	99.97%	13%
29-Apr-20	Front Month WTI	99.97%	22%
6-Apr-20	S&P 500 Index	99.97%	7%
9-Nov-20	10Y U.S. Gov Rate	99.97%	13%
6-Apr-20	10Y U.S. Gov Rate	99.96%	13%
5-May-20	Front Month WTI	99.96%	20%
5-Oct-20	10Y U.S. Gov Rate	99.95%	12%
23-Apr-20	Front Month WTI	99.95%	20%
11-Aug-20	10Y U.S. Gov Rate	99.95%	11%
26-Mar-20	S&P 500 Index	99.94%	6%
22-Apr-20	Front Month WTI	99.94%	19%
17-Mar-20	S&P 500 Index	99.94%	6%
18-Mar-20	10Y U.S. Gov Rate	99.93%	10%
11-Jun-20	VIX Index	99.93%	48%
4-Jun-20	10Y U.S. Gov Rate	99.92%	10%
1-Dec-20	10Y U.S. Gov Rate	99.92%	10%
24-Feb-20	VIX Index	99.91%	47%
27-Apr-20	10Y U.S. Gov Rate	99.91%	10%
27-Aug-20	10Y U.S. Gov Rate	99.90%	9%
3-Jun-20	10Y U.S. Gov Rate	99.89%	9%
22-Apr-20	10Y U.S. Gov Rate	99.88%	9%
10-Mar-20	S&P 500 Index	99.88%	5%
5-Jun-20	10Y U.S. Gov Rate	99.87%	9%

Cleared Derivatives Markets: March-April 2020

Date	Index	Percentile Rank	Percent Return
27-Feb-20	S&P 500 Index	99.78%	(4%)
28-Apr-20	10Y U.S. Gov Rate	99.78%	(7%)
1-Apr-20	S&P 500 Index	99.77%	(4%)
14-Apr-20	Front Month WTI	99.78%	(10%)
20-Mar-20	S&P 500 Index	99.76%	(4%)
23-Mar-20	10Y U.S. Gov Rate	99.76%	(7%)
9-Apr-20	10Y U.S. Gov Rate	99.75%	(7%)
24-Feb-20	10Y U.S. Gov Rate	99.75%	(7%)
6-Mar-20	Front Month WTI	99.75%	(10%)
26-Jun-20	10Y U.S. Gov Rate	99.71%	(6%)

Date	Index	Percentile Rank	Percent Return
8-Apr-20	10Y U.S. Gov Rate	99.86%	8%
11-Mar-20	10Y U.S. Gov Rate	99.85%	8%
5-Aug-20	10Y U.S. Gov Rate	99.84%	8%
2-Mar-20	S&P 500 Index	99.83%	5%
16-Mar-20	VIX Index	99.83%	43%
30-Mar-20	10Y U.S. Gov Rate	99.82%	8%
24-Mar-20	10Y U.S. Gov Rate	99.82%	8%
27-Feb-20	VIX Index	99.81%	42%
3-Apr-20	Front Month WTI	99.81%	12%
6-Nov-20	10Y U.S. Gov Rate	99.78%	7%
12-Mar-20	VIX Index	99.78%	40%

Note: Front Month WTI relative returns for 21-Apr-2020 were excluded from the Gains table. The price change from -$37.63 to $10.01 produces nonsensical results.

Index	Start Date
Front Month WTI	1983
10Y U.S. Gov Rate	1962
Federal Funds Rate	1954
VIX Index	1990
S&P 500 Index	1950

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