

Original Article

The Impact of the Volatility Index (VIX) on Swaps: A Quantitative Analysis

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Abstract: This paper aimed to analyze if there exists any relationship between open interest in the swap market and the CBOE (Chicago Board Options Exchange) Volatility Index after conducting a literature review of the existing work on swaps/swaptions. The paper found a moderate positive correlation between the open interest (which is derived in different cases utilizing the gross notional value, the dollar volume, and the ticket volume) in the swaps market involving entities and repositories registered with the CFTC (Commodities Future Trading Commission) and the volatility index over a period of past two years by utilizing the Karl Pearson's correlation coefficient. Furthermore, the paper explored various reasons for the findings, such as the utilization of swaps as a hedge against market and credit uncertainty and the cointegration of market risk with credit risk.

Keywords: Swaps, VIX, CFTC, Correlation.

I. INTRODUCTION

Swaps are, in essence, a financial derivative instrument in which two parties exchange the returns they derive from two different underlying financial instruments. Each return or cash flow comprises one-half of the swap. One cash flow is either fixed while the other cash flow is floating and usually depends on an underlying benchmark index or variable interest rate. Swaps are not traded directly on exchanges. They are either traded over the counter or in a registered swap execution facility^[1].

The three types of swaps that are reported by the Commodities and Futures Trading Commission (CFTC) Weekly Swaps Report are Interest Rate Swaps, Credit Default Swaps, and FX (Cross-Currency) Swaps^[2].

An interest rate swap is the most common type of swap and occupies the bulk of the swap market. Such a swap usually comprises a notional value exchanged between two counterparties, with one leg exchanged at a fixed rate, such as 5.00% p.a. In contrast, the other leg is exchanged at a floating rate, such as LIBOR or the Federal Funds Rate. According to the data published by the CFTC, the gross notional outstanding value of Interest rate swaps is more than \$288 trillion, accounting for most of the gross notional value of all swaps by cleared status^[3]. A credit default swap is a type of derivative instrument created to transfer the credit risk of one entity with that of another entity. To transfer this risk, the lender buys a CDS from an investor who agrees to repay the lender in case the borrower defaults in exchange for premium payments made to the investor. However, these swaps create a substantial systemic risk; (Dickinson, 2012) argues that these derivatives concentrate power in the financial industry and can create the potential for a few individuals or firms to destabilize entire markets^[4]. A currency swap is a swap which involves the exchange of interest as well as the principal, i.e., the notional value of one currency for another currency. This brings forth the main difference between a currency swap and an interest rate swap; an interest rate swap only involves the exchange of the difference in interest payments, unlike currency swaps, which involve the exchange of the principal along with the interest.^[5]

The CBOE Volatility Index is a volatility index published by the CBOE, commonly known as the VIX. It represents the 30-day forecast volatility of the S&P 500. When the VIX index increases, the stock market tends to adjust downward because of the high turbulence in the US stock market (Whaley, 2000)^[6].

II. LITERATURE REVIEW

The usage of credit default swaps exacerbated the financial crisis of 2007-08 and led to the Global Recession by causing billions of dollars in losses not only for private companies but for public companies such as the Metropolitan Transportation Commission, and threatened to bring down the economy [7]. Additionally, considerable changes and dislocations occurred in the forex swaps market during the financial crisis, aggravated by the collapse of Lehman Brothers and the subsequent bear run, as shown in (Baba and Packer, 2009)[8]. Empirical analysis from their paper shows that FX swap deviations for EUR/USD, CHF/USD, and GBP/USD rose steadily in the initial stages of the crisis and skyrocketed after Lehman Brothers' bankruptcy. This situation prompted the United States Federal Reserve to increase their swap limits with other central banks to infinity to counter the dollar crunch in the market.



The impact of credit default swaps was further evident during the European Debt Crisis of 2011-12, which was clearly demonstrated in (Noeth and Sengupta, 2021). It is noted that a higher CDS spread is indicative of a greater risk of default by the underlying entity. The onset of the financial crisis in 2008 raised the CDS spreads for all sampled groups of countries, especially those in Eastern Europe. As the financial crisis deepened, investor sentiment towards financially hit eurozone countries grew increasingly bearish, leading to a continued rise in CDS spreads throughout 2011 and 2012.

Moreover, the ability to use CDS for speculative purposes, allowing market participants to take on exposure far exceeding the actual debt covered, significantly heightened systemic risk, according to (Partnoy and Skeel). Hedge funds, in particular, engaged heavily in purchasing and selling "naked" CDS contracts, where they held no underlying debt. This speculative behavior had the potential to lead to a liquidity crisis if multiple defaults occurred, necessitating the rapid unwinding of numerous positions. Such a scenario could trigger widespread financial contagion, potentially freezing interbank lending and causing market panic. This paper proved to be correct in this matter, with the financial crisis and the subsequent Global Recession beginning the next year itself, 2007[9].

Interest rate swaps also posed significant risks during the financial crisis. The inherent risks of interest rate swaps were highlighted through various losses made by municipalities while engaging in such swaps. For example, the Alabama Public School and College Authority had to pay a \$13 million settlement to JP Morgan as it had failed to make payments on a swaption it had sold to the bank. Similarly, the city of Oakland, California, had to pay nearly \$19 million to terminate an interest swap with Goldman Sachs, even after rate cuts in light of the crisis, due to the downgrades to the credit companies insuring the debt[10].

Contrasting these perspectives, some scholars such as R.M. Stulz argue that while CDS and other derivatives played a role in the financial crisis, they did not directly cause it[11]; he believes that credit default swaps did not cause the dramatic events of the credit crisis and notes that the OTC market for CDS had functioned effectively during much of the crisis's first year. Instead, excessive risk-taking by financial institutions, failures in risk management, and regulatory shortcomings are highlighted as primary drivers. While CDS and the broader OTC derivatives market played a role in terms of counterparty risk and speculation, they were part of a larger set of issues rather than the sole cause of the crisis.

Numerous studies such as (Dickinson, 2012), (Baba & Packer, 2009), (Partnoy and Skeel), (Noeth and Sengupta, 2021), and even (Stulz, 2009) have acknowledged and emphasized the risks associated with all major types of swaps, such as interest rate swaps, FX swaps, and credit default swaps. While these studies may have varying perspectives on the extent of swaps' involvement in the financial crisis of 2007-08, the empirical data consistently indicates heightened activity and increased investor interest in swaps during that time period. The financial crisis was also marked by significant volatility in the equity markets. For instance, the CBOE Volatility Index (VIX) rose from levels around 10 to the mid-20s in mid-2007, during the early stages of the crisis. It then skyrocketed, reaching an all-time high of 85.93 on October 24, 2008. Although the VIX decreased afterwards, it remained significantly above average levels during the recovery phase in 2009-10. A similar pattern was observed again before and during the 2011-12 European Debt Crisis, when open interest in swaps, especially credit default swaps, increased, and the CBOE VIX soared above 40.

These observations lead to an intriguing question: Is there a relationship between the interest and volume in the swaps market and the CBOE VIX? This paper aimed to explore this potential relationship by analyzing data from the past eight years. To do this, we accessed publicly available data on transaction ticket volume, gross notional value, and transaction dollar value for swaps from the Commodities Futures Trading Commission, as well as the corresponding CBOE VIX values. The nature of the relationship will be determined mathematically using Karl Pearson's Correlation Coefficient. By examining this data, we hoped to uncover any significant correlations and provide insights into how swaps activity may influence or be influenced by market volatility, as measured by the CBOE VIX.

III. EMPIRICAL ANALYSIS

The Dodd-Frank Wall Street Reform and Consumer Protection Act was a federal law enacted by the United States Government in the light of the Financial Crisis of 2007-08. Under 17 CFR Part 45, every swap clearing organization, designated market, and major swap market dealers are required to compile and report data to the Swaps Data Repositories about all active swaps and new swap agreements undertaken. These repositories then report to the Commodities Future Trading Commission on a weekly basis. The CFTC then collates the data into the CFTC Weekly Swaps Report[12, [13].

The CFTC divides Swaps by Asset Class into Gross Notional Outstanding, Dollar Volume, and Ticket Volume.

The Gross Notional Outstanding tables provide details of all market-facing or all plain-vanilla swaps' notional value outstanding in the Swaps Data Repositories on a gross basis, in millions of dollars. Transaction Dollar Volume refers to the

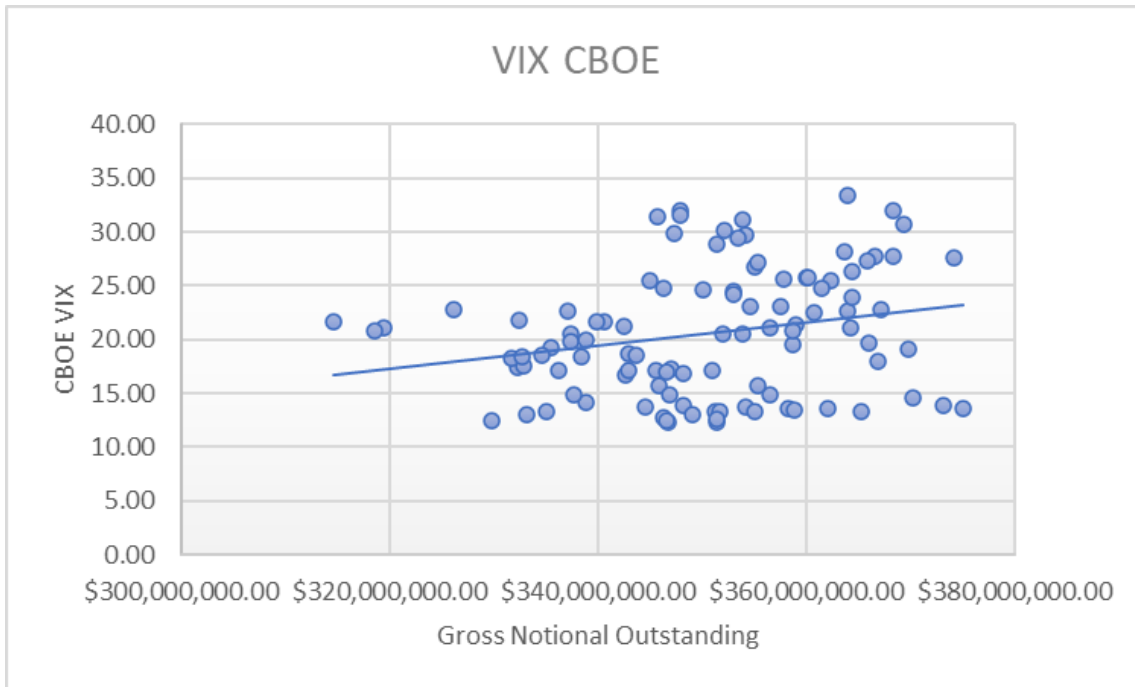
aggregate of all the notional values, in US Dollars, of all of the new trade events reported to a Swap Data Repository during a week.

The transaction ticket volume indicates the number of new trade events reported to a Swap Data Repository (SDR) within a one-week span between the notional outstanding snapshots found in the Swaps Report. These transactions are tracked using Unique Swap Identifiers (USIs) as mandated by the Commission's Swap Data Recordkeeping and Reporting Rule (17 CFR Part 45) for all market-facing swap transactions reported to an SDR.[13]

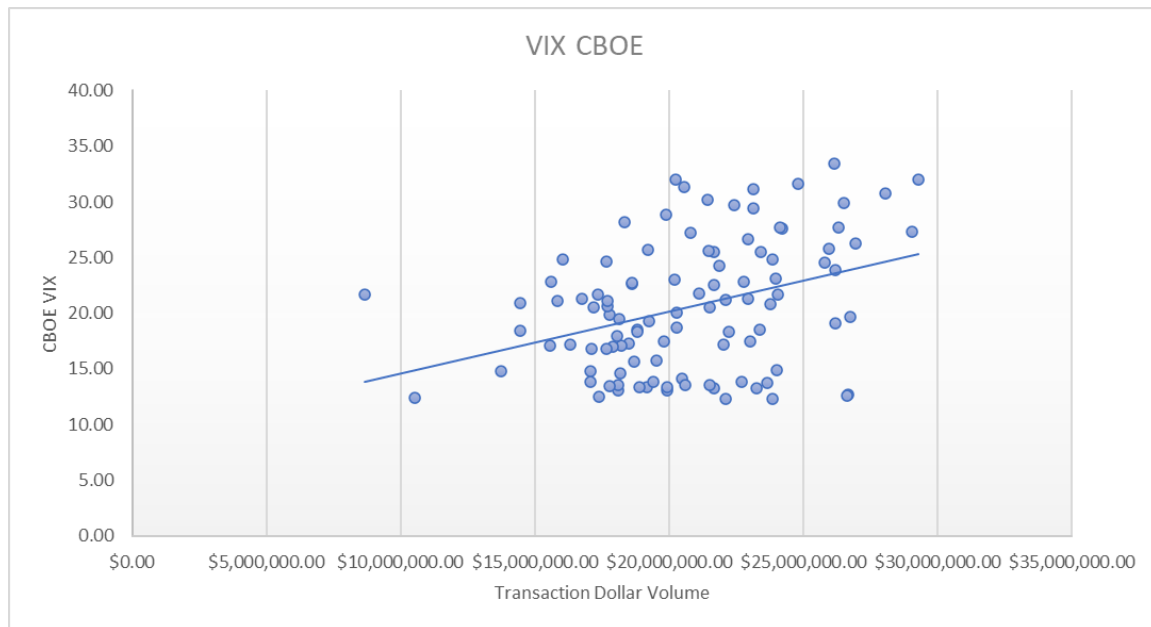
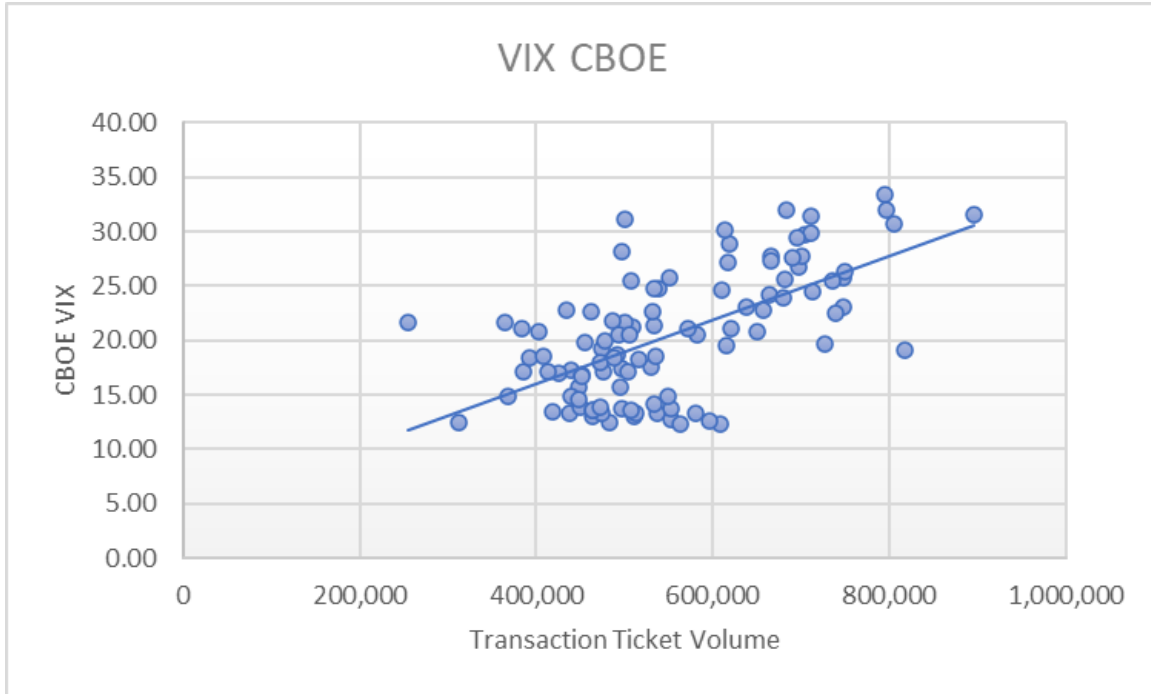
The data range for the research was a period of approximately two years, or 104 weeks, from February 5, 2022, to January 26, 2024. The closing value of the INDEXCBOE: VIX was utilized as the CBOE VIX value for each day corresponding to the swap report release date. The following values of Karl Pearson's Coefficient were calculated for different measures of open interest in the Swap Market against the VIX.

Correlation: GNO vs VIX	0.231377
Correlation: TV vs VIX	0.621622
Correlation: DV vs VIX	0.364009
Correlation: GNO vs VIX	0.231377
Correlation: TV vs VIX	0.621622
Correlation: DV vs VIX	0.364009

Given below are the graphs for Gross Notional Value, Transaction Ticket Volume, and Transaction Dollar Volume against the VIX.



It can be clearly inferred from Karl



Pearson's Correlation Coefficient, as well as the lines of best fit for the scatterplots, that there exists a moderate positive correlation between the value and volume of swaps and the CBOE VIX. The reasons for this positive correlation can be:

A) Risk Management and Hedging:

Swaps are often used by market players and interested parties to hedge their bets, apart from speculation. Credit Default Swaps serve as effective hedges against the risk of default or restructuring in various bonds. (Ratner and Chiu, 2013), the authors used GARCH dynamic conditional correlation analysis to conclude that CDS serve as a hedge against risk in not only fixed-income but also equity markets^[14]. Similarly, interest rate swaps are also utilized as hedges against interest rate risks by investment firms^[15]. Firms usually ramp up hedging during times of high risk and uncertainty, which are also accompanied by increases in the CBOE VIX. This explains the positive correlation between the datasets.

B) VIX and Interest Rates:

According to (Cotton, 2022), there exists a strong negative correlation between stock prices and interest rates[16]. There is an uptrend in VIX when there is a downtrend in stock prices. Moreover, many investment firms and borrowers use interest rate swaps to hedge against higher interest rates. As a result, open interest in interest rate swaps is directly proportional to the market volatility as measured by the CBOE VIX. Since Interest Rate Swaps account for the bulk of swaps activity, there exists a positive correlation between the open interest and value of swaps and the VIX.

C) VIX and Credit Risk Perception:

In (Figuerola-Ferretti & Paraskevopoulos, 2010), the authors have established that the market volatility or the VIX is cointegrated with credit risk. Therefore, since periods of high market volatility are accompanied by periods of high credit risk, there is a sharp uptick in the use of credit default swaps by lenders as well as interest rate swaps by the borrower, resulting in an increase in Gross Notional Volume, Transaction Ticket Volume, and Transaction Dollar Volume.

IV. REFERENCES

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V. APPENDIX

Date	Gross Notional Outstanding (\$ million)	Ticket Volume	Dollar Volume (\$ million)	VIX CBOE
1/26/2024	\$351,352,219.00	536,236	\$21,680,634.00	13.26
1/19/2024	\$351,796,661.00	580,694	\$23,274,433.00	13.30
1/12/2024	\$346,332,516.00	551,922	\$26,666,336.00	12.70
1/5/2024	\$335,065,507.00	438,110	\$19,182,561.00	13.35
12/29/2023	\$329,819,073.00	312,692	\$10,521,058.00	12.45
12/22/2023	\$333,196,017.00	510,143	\$18,098,009.00	13.03
12/15/2023	\$351,458,520.00	608,672	\$23,847,165.00	12.28
12/8/2023	\$346,820,654.00	563,074	\$22,103,706.00	12.35
12/1/2023	\$351,409,662.00	596,994	\$26,647,067.00	12.63
11/24/2023	\$346,600,997.00	482,635	\$17,402,962.00	12.46
11/17/2023	\$344,513,848.00	553,382	\$22,707,612.00	13.80
11/10/2023	\$338,916,555.00	534,324	\$20,479,421.00	14.17
11/3/2023	\$337,645,368.00	549,181	\$24,005,560.00	14.91
10/27/2023	\$342,603,339.00	508,590	\$22,959,240.00	21.27
10/20/2023	\$340,641,916.00	501,036	\$24,069,658.00	21.71

10/13/2023	\$335,496,997.00	475,003	\$19,234,428.00	19.32
10/6/2023	\$332,278,171.00	497,009	\$19,808,616.00	17.45
9/29/2023	\$332,866,226.00	529,723	\$23,038,537.00	17.52
9/22/2023	\$336,245,406.00	476,399	\$22,043,939.00	17.20
9/15/2023	\$354,282,029.00	496,725	\$23,656,396.00	13.79
9/8/2023	\$348,199,314.00	450,354	\$17,069,156.00	13.84
9/1/2023	\$349,034,606.00	464,318	\$19,921,925.00	13.09
8/25/2023	\$345,896,673.00	448,143	\$18,680,012.00	15.68
8/18/2023	\$347,005,392.00	439,921	\$18,484,250.00	17.30
8/11/2023	\$346,930,140.00	439,108	\$17,052,565.00	14.84
8/4/2023	\$345,630,599.00	503,775	\$18,214,893.00	17.10
7/28/2023	\$355,143,178.00	474,498	\$19,931,685.00	13.33
7/21/2023	\$362,080,634.00	464,391	\$18,097,028.00	13.60
7/14/2023	\$365,341,467.00	512,772	\$18,906,697.00	13.34
7/7/2023	\$356,566,625.00	367,598	\$13,741,281.00	14.83
6/30/2023	\$358,297,299.00	463,472	\$20,592,021.00	13.59
6/23/2023	\$358,848,278.00	418,027	\$17,805,516.00	13.44
6/16/2023	\$375,149,991.00	507,858	\$21,525,005.00	13.54
6/9/2023	\$373,154,369.00	473,098	\$19,426,645.00	13.83
6/2/2023	\$370,304,786.00	448,398	\$18,172,666.00	14.60
5/26/2023	\$366,914,201.00	472,215	\$18,080,636.00	17.95
5/19/2023	\$348,293,686.00	451,161	\$17,131,045.00	16.81
5/12/2023	\$346,685,103.00	426,389	\$17,922,169.00	17.03
5/5/2023	\$350,951,556.00	385,005	\$16,303,790.00	17.19
4/28/2023	\$355,329,572.00	495,950	\$19,545,916.00	15.78
4/21/2023	\$342,610,805.00	451,756	\$17,651,707.00	16.77
4/14/2023	\$342,927,606.00	413,093	\$15,570,998.00	17.07
4/7/2023	\$338,424,203.00	391,675	\$14,450,566.00	18.40
3/31/2023	\$343,022,364.00	490,979	\$20,303,062.00	18.70
3/24/2023	\$332,478,773.00	485,939	\$21,119,518.00	21.74
3/17/2023	\$345,060,618.00	507,713	\$23,436,608.00	25.51
3/10/2023	\$346,338,394.00	539,586	\$23,860,248.00	24.80
3/3/2023	\$343,763,143.00	534,798	\$23,365,240.00	18.49
2/24/2023	\$339,912,997.00	364,042	\$17,333,991.00	21.67
2/17/2023	\$338,934,352.00	477,853	\$20,269,039.00	20.02
2/10/2023	\$337,435,424.00	492,782	\$21,513,876.00	20.53
2/3/2023	\$331,744,592.00	516,126	\$22,227,790.00	18.33
1/27/2023	\$334,690,435.00	407,828	\$18,798,528.00	18.51
1/20/2023	\$337,349,117.00	454,920	\$17,803,848.00	19.85
1/13/2023	\$332,726,791.00	488,176	\$18,834,047.00	18.35
1/6/2023	\$319,397,971.00	383,315	\$15,855,847.00	21.13
12/30/2022	\$314,653,634.00	254,889	\$8,667,652.00	21.67
12/23/2022	\$318,604,009.00	402,728	\$14,452,892.00	20.87
12/16/2022	\$337,176,016.00	462,121	\$18,611,231.00	22.62
12/9/2022	\$326,176,265.00	434,797	\$15,617,508.00	22.83
12/2/2022	\$369,814,607.00	816,879	\$26,209,046.00	19.06
11/25/2022	\$352,012,377.00	583,120	\$17,175,287.00	20.50
11/18/2022	\$354,655,346.00	747,373	\$23,956,800.00	23.12
11/11/2022	\$360,830,081.00	738,582	\$21,686,120.00	22.52
11/4/2022	\$353,081,661.00	713,801	\$25,800,021.00	24.55
10/28/2022	\$360,113,121.00	748,521	\$25,946,375.00	25.75
10/21/2022	\$354,156,907.00	704,850	\$22,444,602.00	29.69
10/14/2022	\$347,919,196.00	683,729	\$20,252,180.00	32.02
10/7/2022	\$345,739,224.00	711,371	\$20,548,770.00	31.36
9/30/2022	\$347,997,235.00	896,887	\$24,810,311.00	31.62
9/23/2022	\$347,323,866.00	711,029	\$26,514,750.00	29.92
9/16/2022	\$364,454,161.00	750,509	\$26,937,751.00	26.30
9/9/2022	\$367,202,389.00	657,116	\$22,769,291.00	22.79
9/2/2022	\$362,424,912.00	735,962	\$21,673,239.00	25.47

8/26/2022	\$357,889,101.00	681,646	\$21,483,225.00	25.56
8/19/2022	\$353,880,648.00	506,027	\$17,703,016.00	20.60
8/12/2022	\$358,764,888.00	615,698	\$18,140,318.00	19.53
8/5/2022	\$356,492,140.00	571,241	\$17,692,444.00	21.15
7/29/2022	\$359,102,633.00	534,131	\$16,750,452.00	21.33
7/22/2022	\$357,541,538.00	637,721	\$20,188,099.00	23.03
7/15/2022	\$353,021,382.00	665,070	\$21,889,731.00	24.23
7/8/2022	\$350,083,130.00	610,236	\$17,682,229.00	24.64
7/1/2022	\$355,088,125.00	698,021	\$22,922,942.00	26.70
6/24/2022	\$355,371,259.00	617,382	\$20,789,102.00	27.23
6/17/2022	\$353,934,796.00	500,559	\$23,126,707.00	31.13
6/10/2022	\$366,658,457.00	701,009	\$26,328,760.00	27.75
6/3/2022	\$361,495,028.00	533,095	\$16,044,780.00	24.79
5/27/2022	\$360,142,252.00	550,517	\$19,205,702.00	25.72
5/20/2022	\$353,503,284.00	694,962	\$23,143,824.00	29.43
5/13/2022	\$351,449,443.00	619,373	\$19,870,818.00	28.87
5/6/2022	\$352,205,239.00	613,761	\$21,439,232.00	30.19
4/29/2022	\$364,006,580.00	795,354	\$26,167,413.00	33.40
4/22/2022	\$363,781,735.00	496,980	\$18,323,852.00	28.21
4/15/2022	\$364,024,361.00	532,085	\$18,601,334.00	22.70
4/8/2022	\$364,258,669.00	619,898	\$22,122,747.00	21.16
4/1/2022	\$366,016,985.00	726,222	\$26,759,096.00	19.63
3/25/2022	\$358,717,002.00	649,869	\$23,781,574.00	20.81
3/18/2022	\$364,399,710.00	680,681	\$26,190,255.00	23.87
3/11/2022	\$369,347,834.00	805,279	\$28,064,521.00	30.75
3/4/2022	\$368,421,396.00	796,948	\$29,289,298.00	31.98
2/25/2022	\$374,279,167.00	689,619	\$24,198,307.00	27.59
2/18/2022	\$368,330,407.00	666,189	\$24,112,594.00	27.75
2/11/2022	\$365,949,977.00	665,634	\$29,064,186.00	27.36