

## Auction Volume Report: Americas

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Tethys Auction Volume Report is an independent analysis of auctions in global equity markets. This report includes current and historical auction data. It also includes factor cross-section analysis. The report features a subset of the data and analysis that contributes to the success of our award-winning settlement price benchmark **ECLOS** algorithm.

For the purpose of this report, the phrase 'auction' refers to both auction and cross based market open and close mechanisms. The term "auction volume %" is the auction volume as a percentage of total daily volume.

Auction Volume % = Auction volume on the primary exchange / Total traded volume across all venues

This report utilizes both the straight median and the notional weighted average in measuring auction volume. The difference provides an insight into the auction participation divergence in the liquidity spectrum. To manage the noise of the data, we filter the equities by putting the minimum median auction volume of 500 shares and 1,000 shares for opening and closing auction, respectively.

This report covers major listing exchanges in the Americas. Table 1 below presents the current six-month straight median and notional weighted auction data.

	Daily Median Closing Auction Volume % (Changes)*	Daily Notional Weighted Closing Auction Volume % (Changes)	Daily Median Opening Auction Volume % (Changes)	Daily Notional Weighted Opening Auction Volume % (Changes)
BSP (BRAZIL)	8.70% -0.59%	12.52% -0.91%	0.32% -0.02%	1.02% +0.25%
TOR 1 (CANADA)	6.59% +0.29%	29.42% +1.56%	0.54% +0.04%	1.61% -0.20%
TOR 2 (CANADA)	4.62% +0.10%	21.03% -0.94%	0.77% +0.12%	1.19% +0.01%
TSX (CANADA)	0.51% +0.38%	2.34% +0.25%	1.26% +0.45%	1.69% +0.45%
SGO (CHILE)	9.10% +0.56%	13.52% +0.63%	0.12% -0.00%	0.28% -0.06%
MEX (MEXICO)	11.04% -1.31%	28.37% +4.09%	0.05% +0.01%	0.06% +0.01%
ARCA (US)	0.63% +0.15%	2.24% +0.31%	1.19% +0.14%	0.54% +0.06%
AMEX (US)	1.90% -0.17%	6.99% -1.88%	1.19% +0.19%	1.05% +0.35%
BATS (US)	0.77% +0.04%	1.74% +0.49%	1.21% +0.11%	0.95% +0.24%
NYSE (US)	11.03% -0.06%	12.73% -0.29%	0.86% +0.07%	1.23% -0.00%
NSDQ (US)	9.51% -0.32%	8.00% -0.11%	0.77% +0.10%	0.88% +0.07%

\* The term "Daily Auction Volume %" denotes the 4 auction volume % metrics presented in Table 1.

\* Change in Daily Auction Volume % = Daily Auction Volume % of the past month – Daily Auction Volume % of the 6 months before the past month.

\* TOR 1 includes Interlisted stocks with TOR (Toronto Stock Exchange) as the primary exchange and TOR 2 includes Non-Interlisted stocks with TOR as the primary exchange.

## Closing Auction Volume % Trend by Country

We use two metrics to demonstrate the evolution of auction volume over time: weekly notional weighted average closing auction volume % and weekly median closing auction volume %. The first metric measures the average auction volume % of the entire country or exchange symbol universe on weekly basis with the value being weighted by each security's daily notional traded value (definition is on page 6). The latter calculates the median auction volume % of entire country or exchange symbol universe on weekly basis

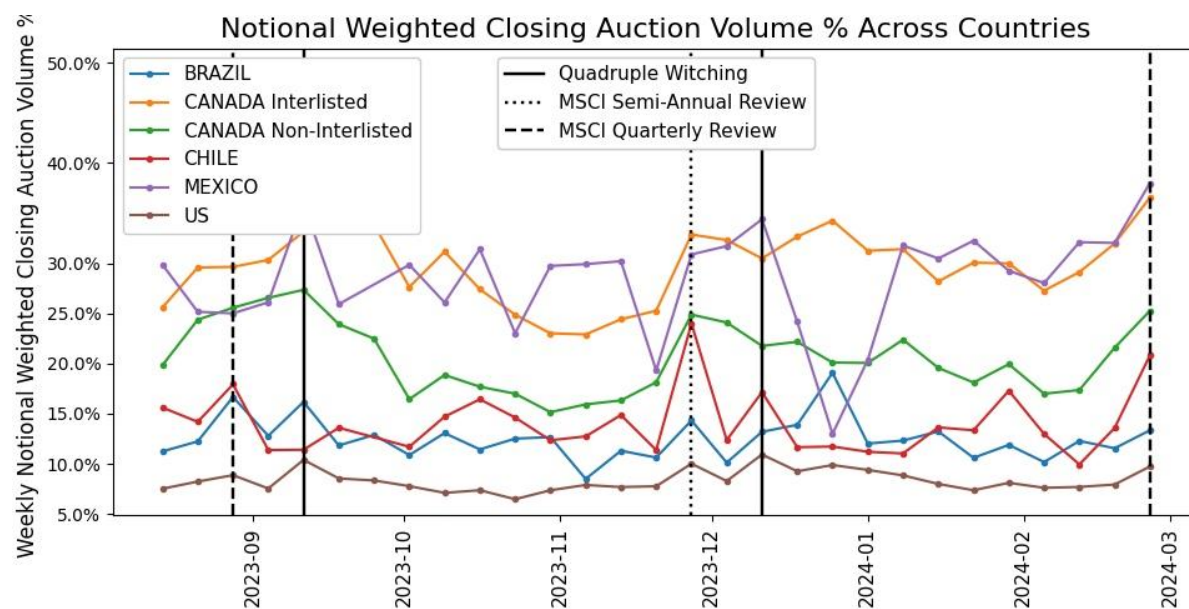


Figure 1

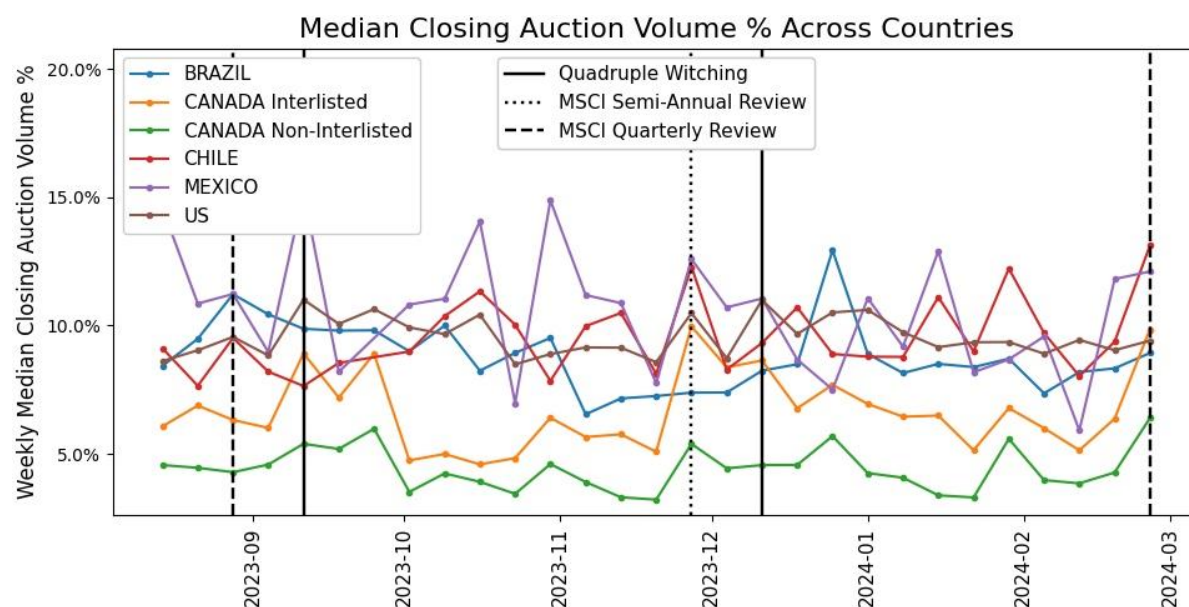


Figure 2

Closing Auction Volume % Trend by Exchange

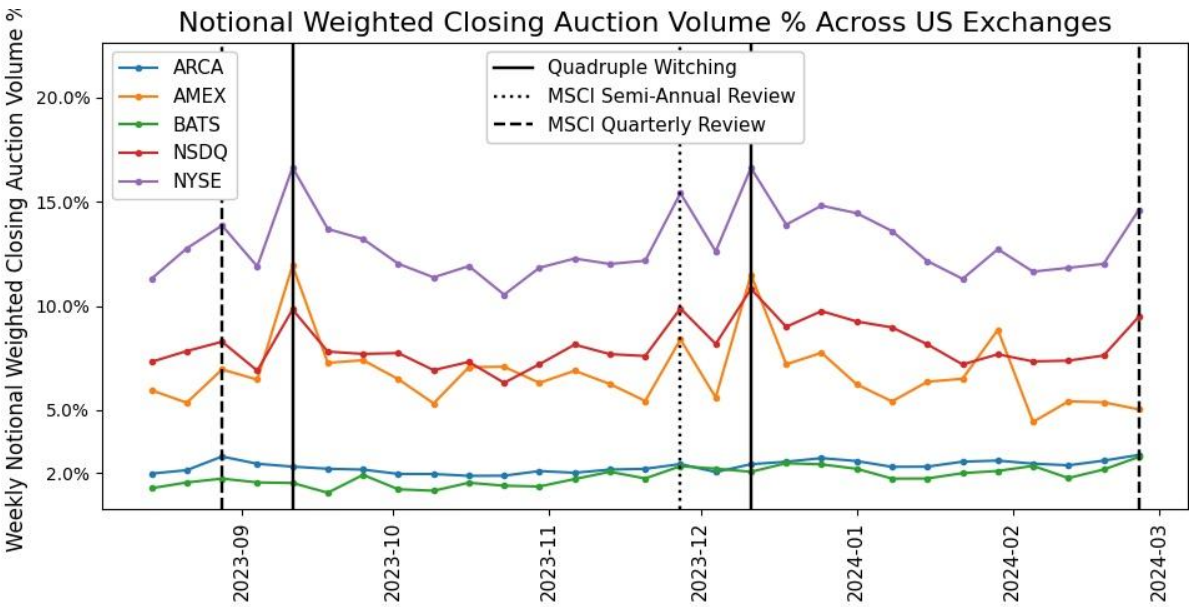


Figure 3

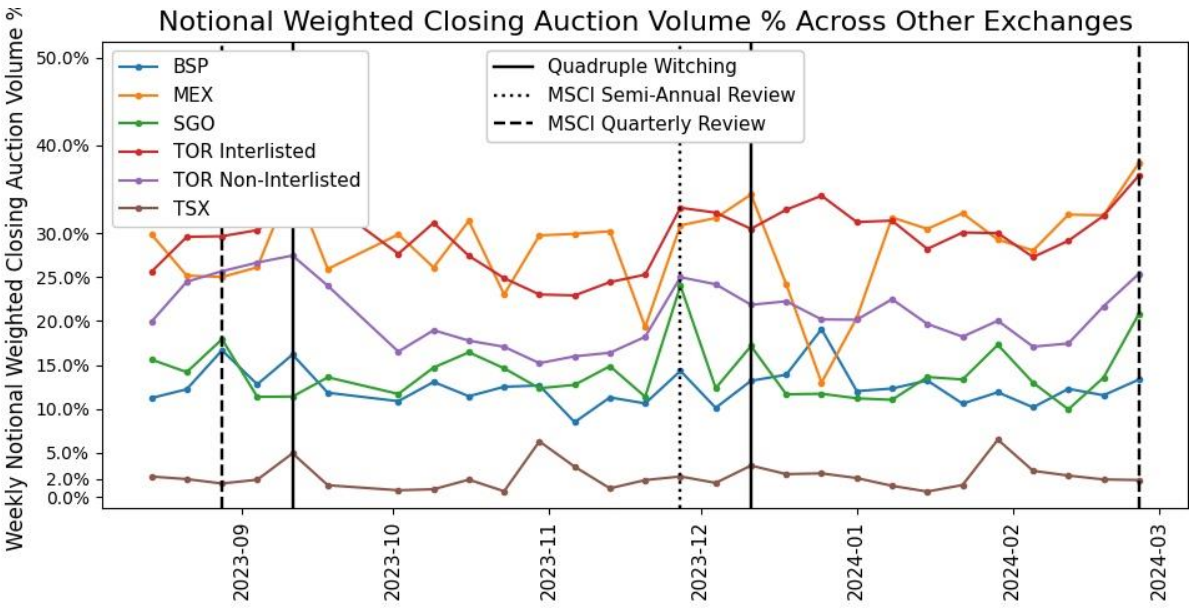


Figure 4



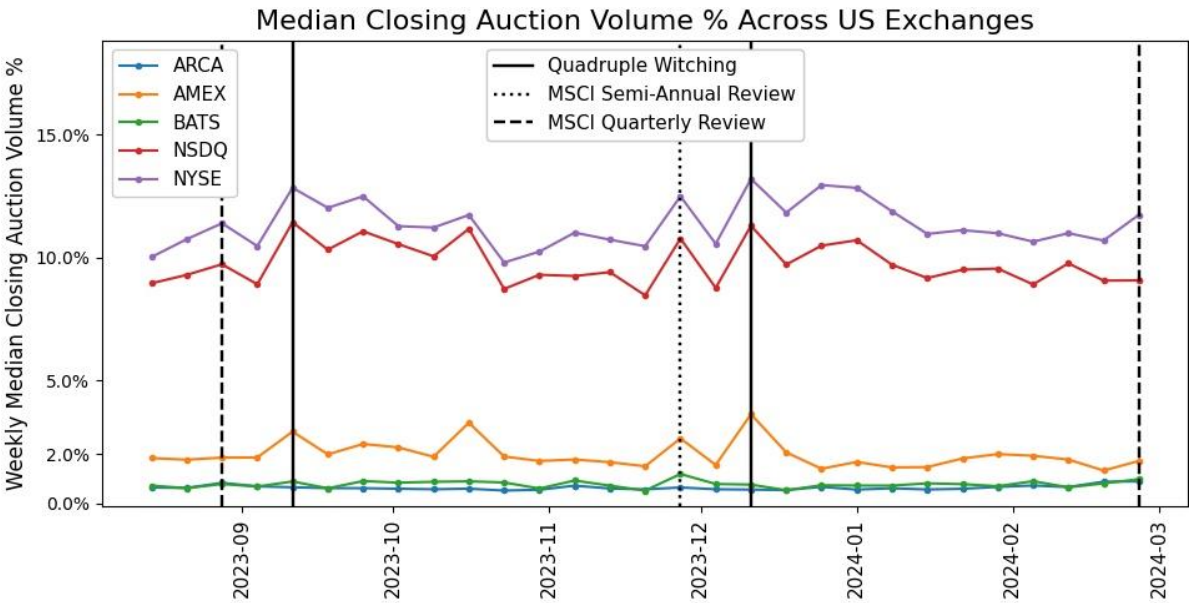


Figure 5

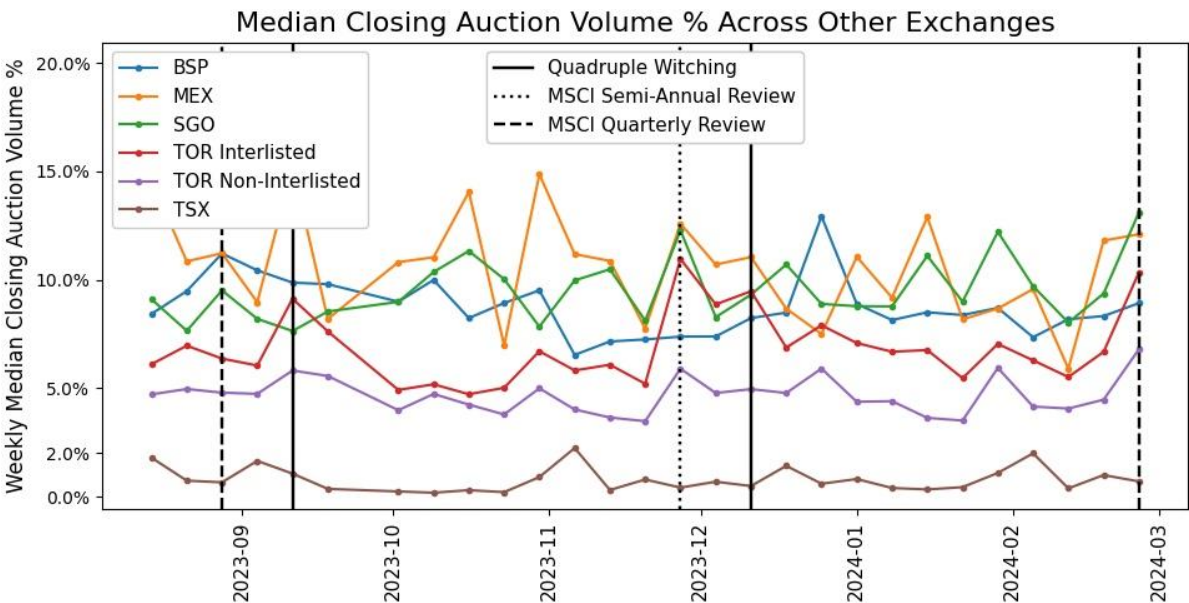


Figure 6

## Summary

- Closing Auction: On notional-traded basis, the Brazilian Bovespa, the Mexican BMV, the Santiago Stock Exchange, the Nasdaq Stock Exchange, the New York Stock Exchange and the Toronto Stock Exchange stand out for the high level of closing auction participation. BATS and ARCA have the lowest level of closing auction participation on notional-traded basis among American Exchanges, since they are dominated by ETF listings, and ETFs usually have low auction volume % participation, except for low liquidity ETFs and certain US-listed Asian and European focused funds.

As expected, the median Auction Volume % data is significantly more stable than the notional weighted data.

It is notable that quadruple witching, shown on our time series graphs, plays an important role across major exchanges in closing auctions. We will publish a separate report studying the influence of quadruple witching on the opening auctions.

- Price Level is the factor with highest explanatory power in the list of factors we presented in this report.
- Since Notional Value Traded factor is directly proportional to the Price Level, we see its positive correlation with Auction Volume% for several exchanges as well.
- Daily Price Range has a negative correlation with Auction Volume %. This is explicable, as spreads tend to be higher for these securities and imbalances will have proportionately higher impact.
- Daily Trading Volume also exhibits negative correlation with Auction Volume %, since it is positively correlated to Daily Price Range.
- Trade size fragmentation has an interestingly negative correlation with Auction Volume %, which we will offer reasons for in a future report. There is an intriguing angle to be explored.

It is also interesting to note that:

- The Nasdaq and the NYSE stand out for the widespread use of closing auctions through the liquidity spectrum. As seen in the Table 1 and Figures 13, 14 together with Figures 37, 38, the overall level of closing participation is high at these exchanges and the spread between auction participation of the low liquidity and the high liquidity securities is narrow.
- There is a significant closing auction participation difference between the highest liquidity securities and the remainder of the listings on the Toronto Stock Exchange. This may be because the TOR liquid universe is dominated by inter-listed (US-Canada cross listing) securities. US auction levels strongly influence these securities.
- The Brazilian Bovespa has a distinct and efficient closing auction mechanism. There is a separate closing auction session unlike the U.S. and Canadian exchanges where the auction period overlaps continuous trading. The exchange provides real time dissemination of the imbalance and the expected clearing price. The provision of auction extension and the randomization of the closing time reduce gaming.

The Mexican BMV market offers a closing cross instead of an auction, which is complicated to navigate for investors. There is selective information dissemination and non-transparent lockups. We are hopeful that launch of competitor BIVA exchange will serve as a catalyst for the BMV to improve its closing auction mechanism.

## Exchange and Factor Description

The primary listing exchanges covered in our report are listed below. These exchanges encompass a majority of the auction volume in North America and LATAM. Tethys offers execution algorithms for all the countries below as well as Colombia, which will be included in upcoming reports.

### Brazil

- BSP: Brazilian Stock Exchange (BOVESPA)

### Canada

- TOR: Toronto Stock Exchange
- TSX: Toronto Stock Exchange Venture

### Chile

- SGO: Santiago Stock Exchange

### Mexico

- MEX: Mexican Stock Exchange (BMV)

### United States

- ARCA: NYSE ARCA
- AMEX: NYSE American
- BATS: BATS Exchange
- NYSE: New York Stock Exchange
- NSDQ: NASDAQ

For brevity we only include commonly known trading related factors to analyze closing auction volumes. Fundamental factors like market capitalization are not included in this report. Tethys maintains an extensive list of factors in context of auctions. Please note that the factors are not mutually orthogonal (i.e. not completely independent of each other). The factors presented are:

- Daily Trading Volume
- Price Level =  $0.5 * (\text{Open Price} + \text{Closing Auction Price})$
- Daily Price Range =  $\ln(\text{High/Low})$ , where  $\ln$  is the natural logarithm
- Notional Value Traded = Daily Trading Volume \* Price Level

Average Trade Size = Daily Trading Volume / Number of Trades

## Closing Auction Volume in Multi-Dimensional Factor Space

Closing Auction Volume is affected by various factors. Analyzing Closing Auction Volume % with respect to each factor conveys an understanding of the closing auction microstructure behavior for each exchange. Please note that the factors are not mutually independent.

We divided the respective security universe into 5 bins with respect to each factor.

For example, we sort the securities into 5 bins by daily trading volume, where Bin 1 contains the 20% of the securities with the lowest daily trading volume, and Bin 5 keeps the 20% with the highest daily trading volume. Straight median and notional weighted average closing auction volume % are then calculated on a weekly basis. Note that we only include securities that have median close auction volume > 1000 shares.

The chart below summarizes the overall correlation between closing auction volume % and each factor by exchange. The plus “+” indicates positive correlation and minus “-” negative correlation. A blank cell indicates that we can’t validate that there is a correlation by using the binning method.

**Table 2**

Exchanges	Factors	Daily Trading Volume	Price Level	Daily Price Range	Notional Value Traded	Average Trade Size
BSP (Brazil)					+	
TOR (Canada)			+	-	+	
MEX (Mexico)						
ARCA (US)			+			
AMEX (US)						
BATS (US)		-				
NYSE (US)		-	+			-
NSDQ (US)		-				-

## Correlation between Closing Auction Volume % and Factors

### I. Weekly Median Closing Auction Volume % Binned by Daily Trading Volume

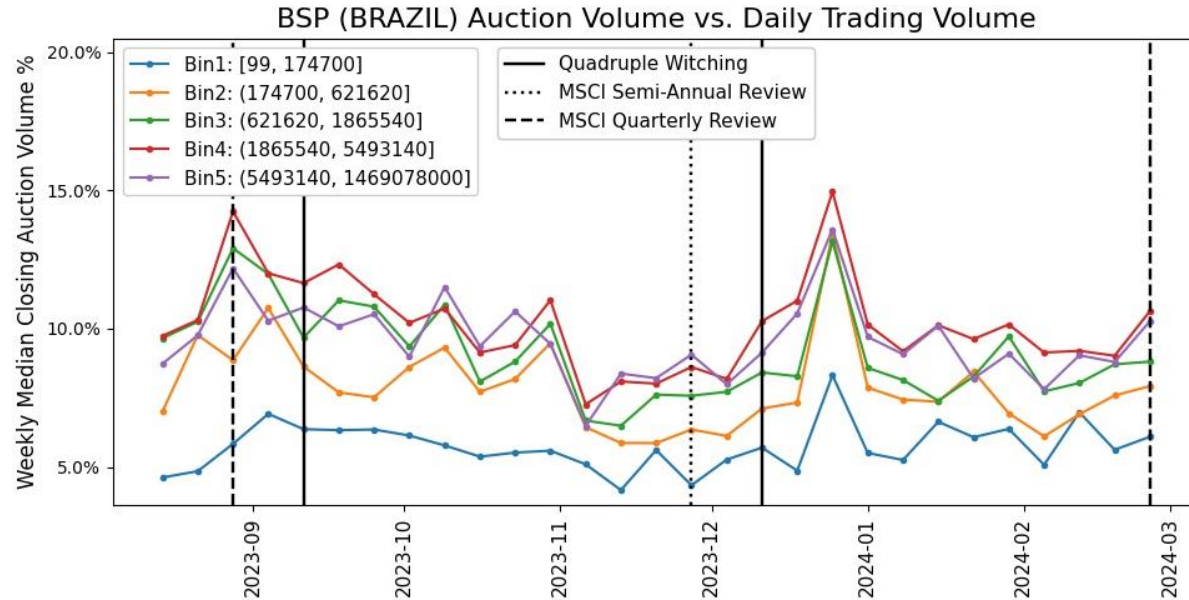


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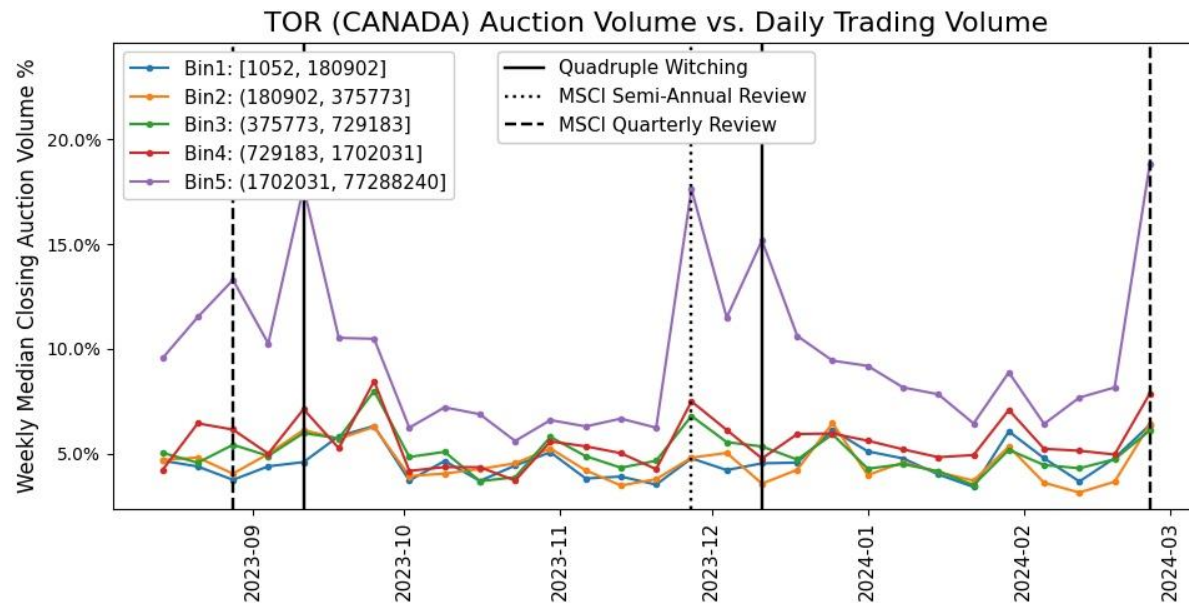


Figure 8



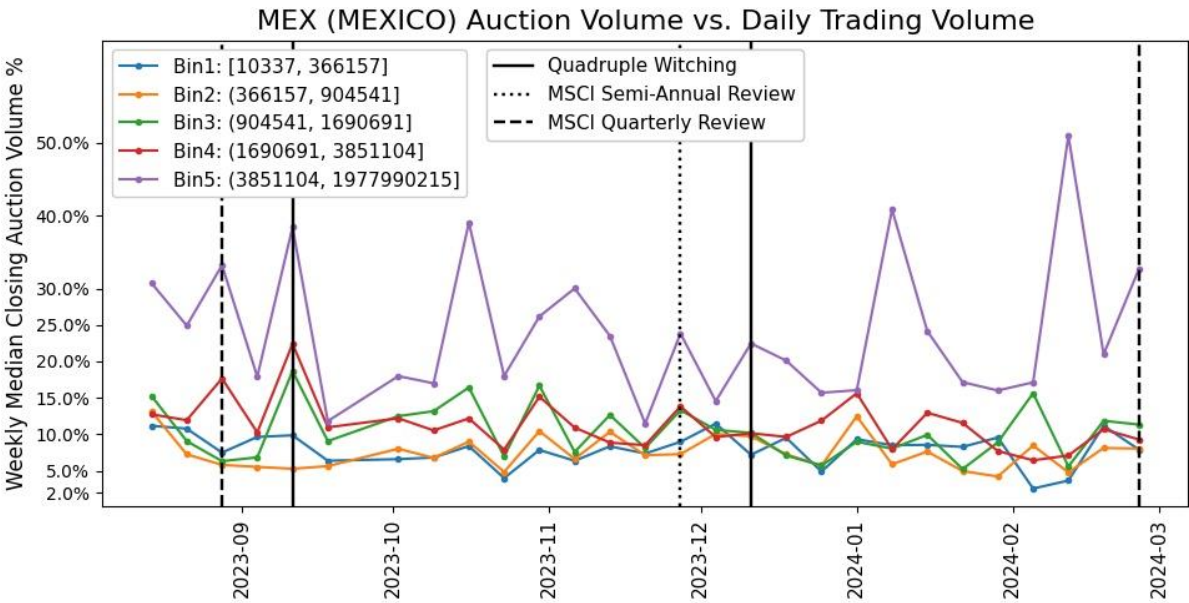


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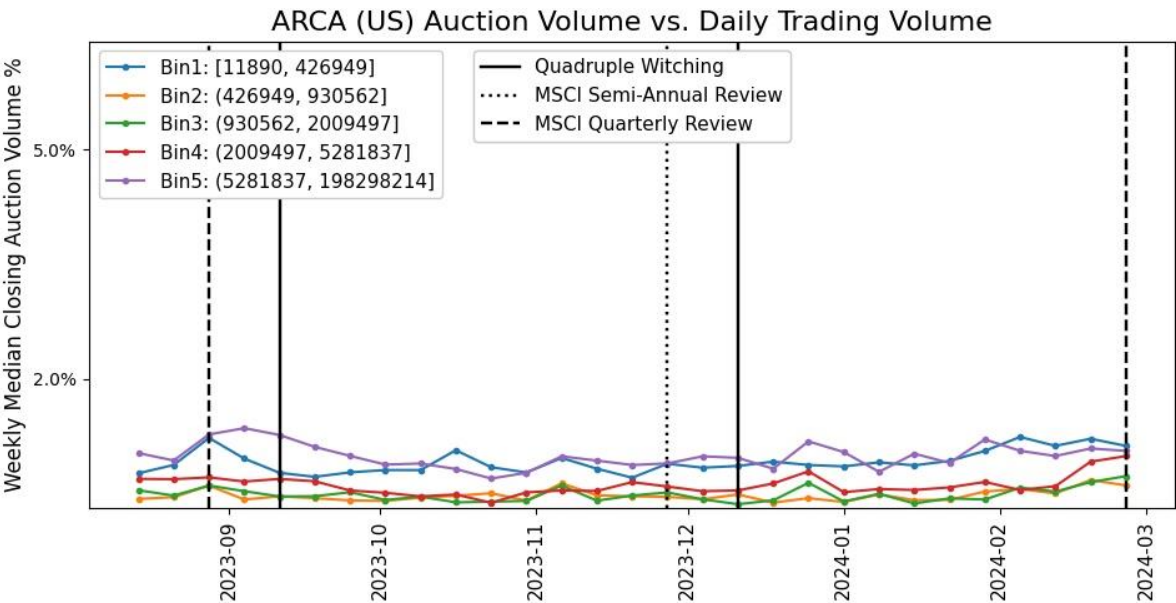


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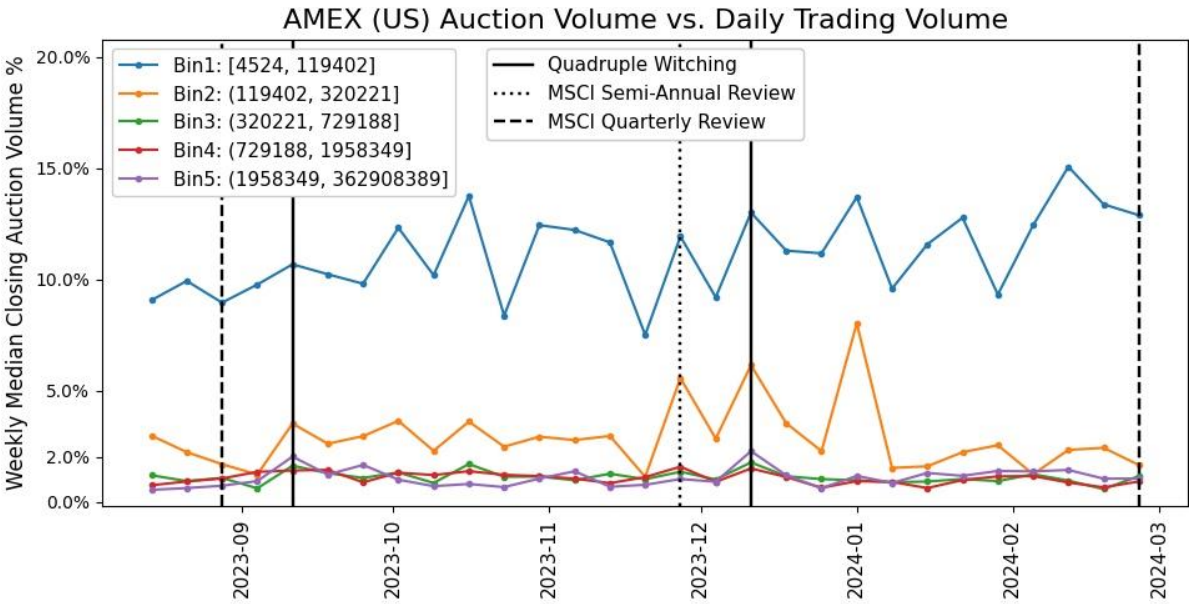


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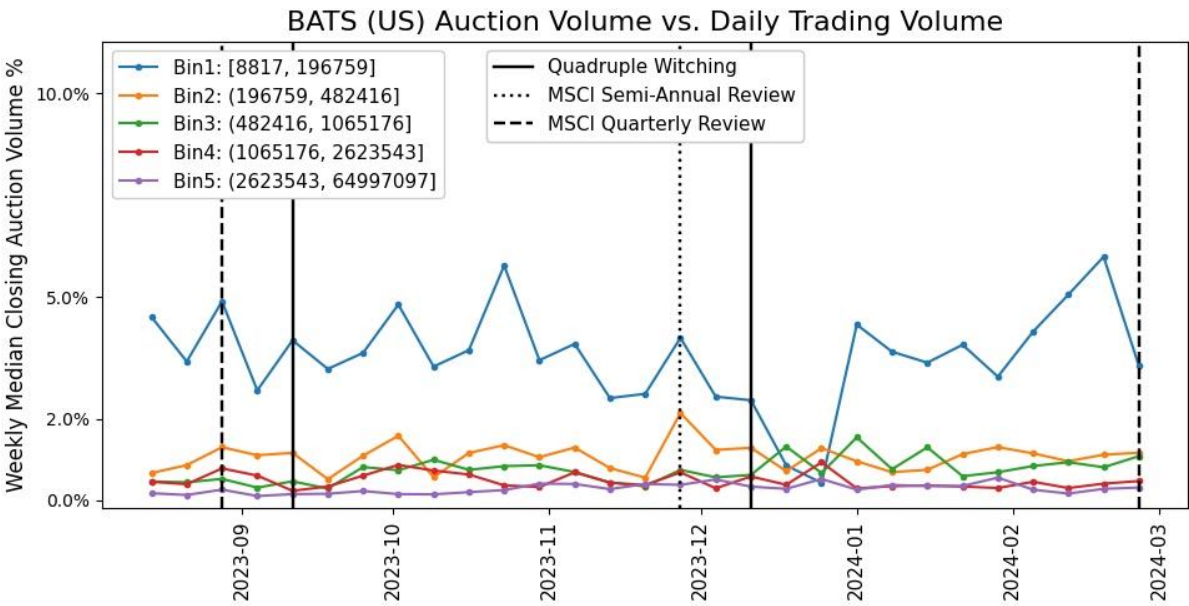


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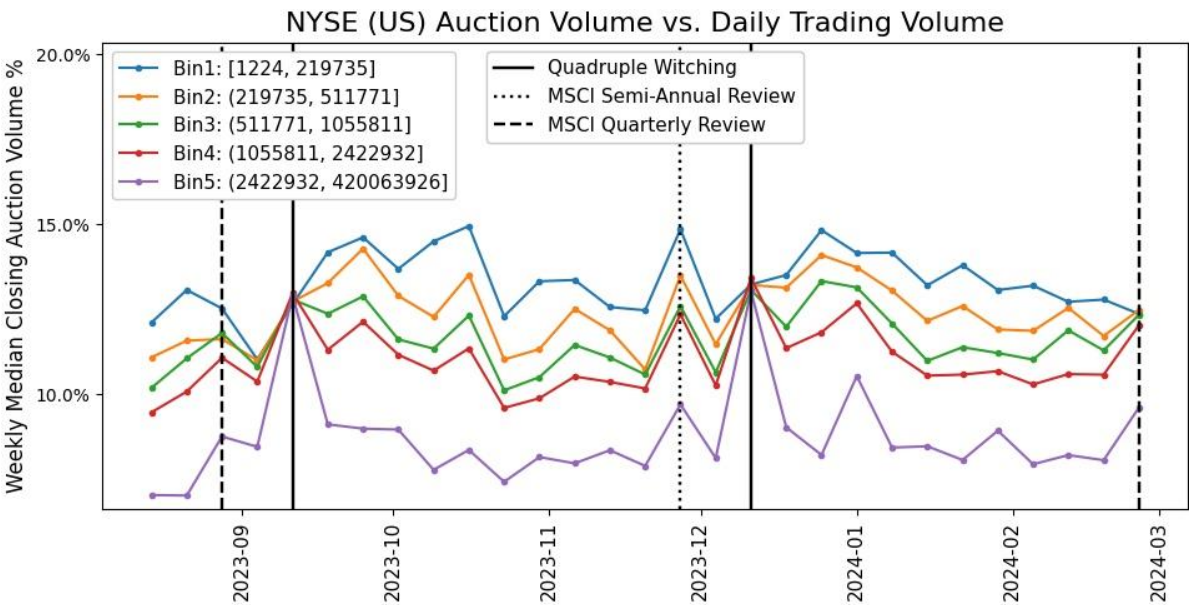


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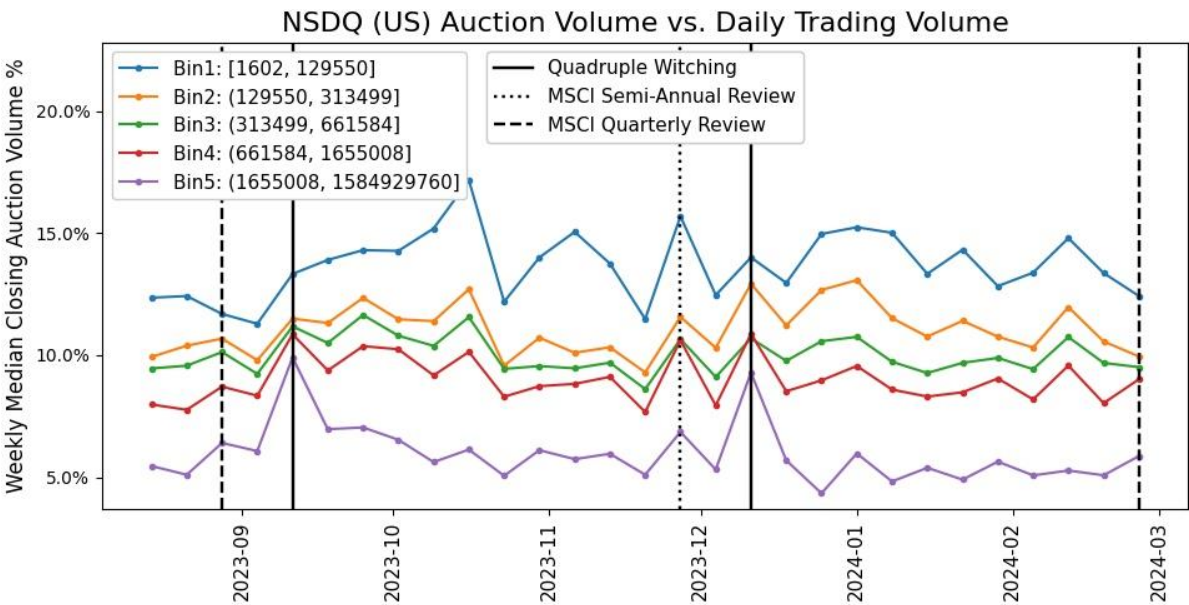


Figure 14



## II. Weekly Median Closing Auction Volume % Binned by Price Level

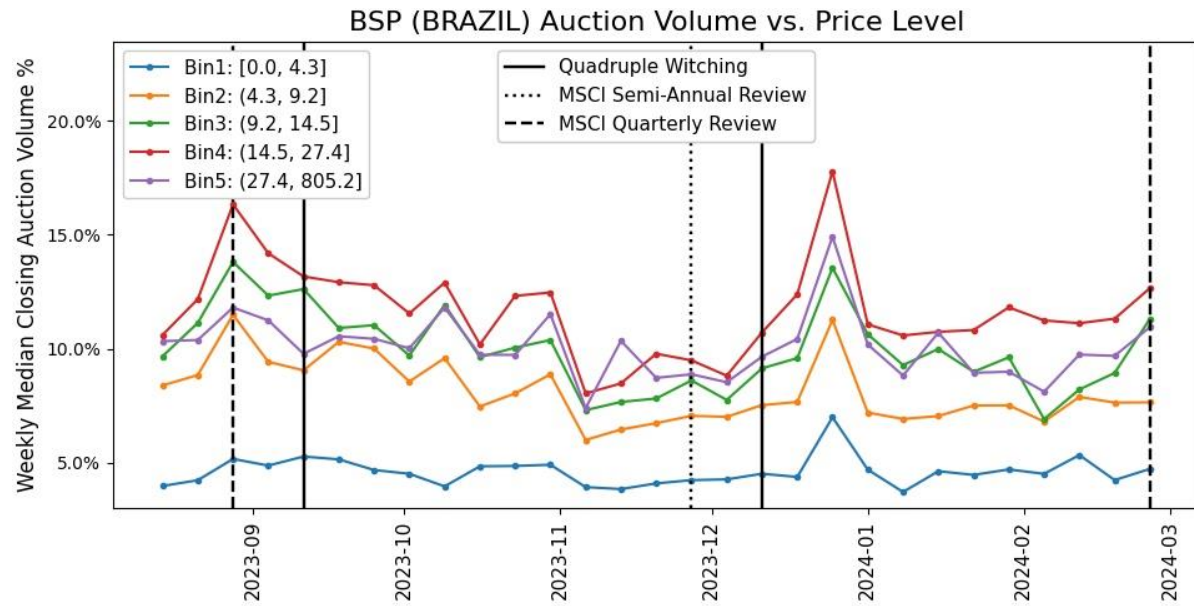


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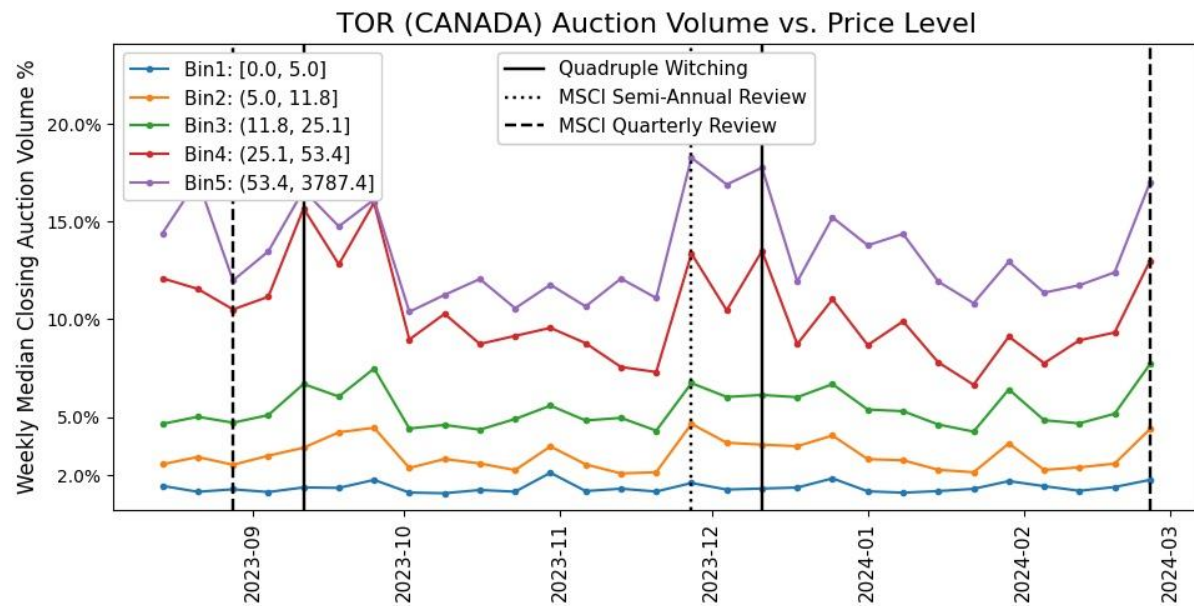


Figure 16



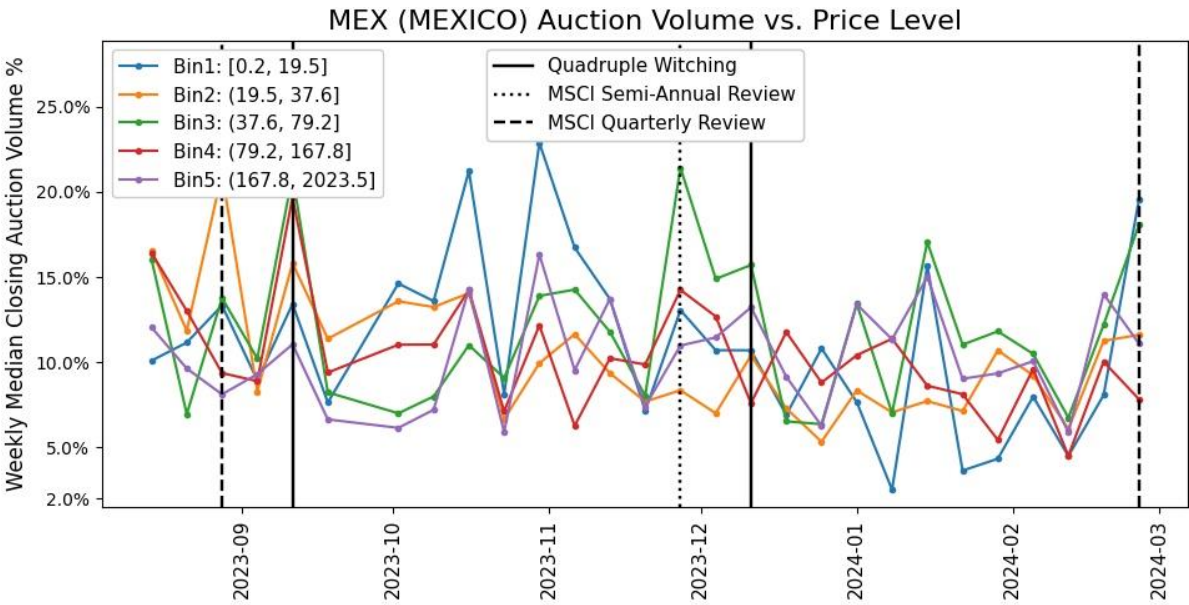


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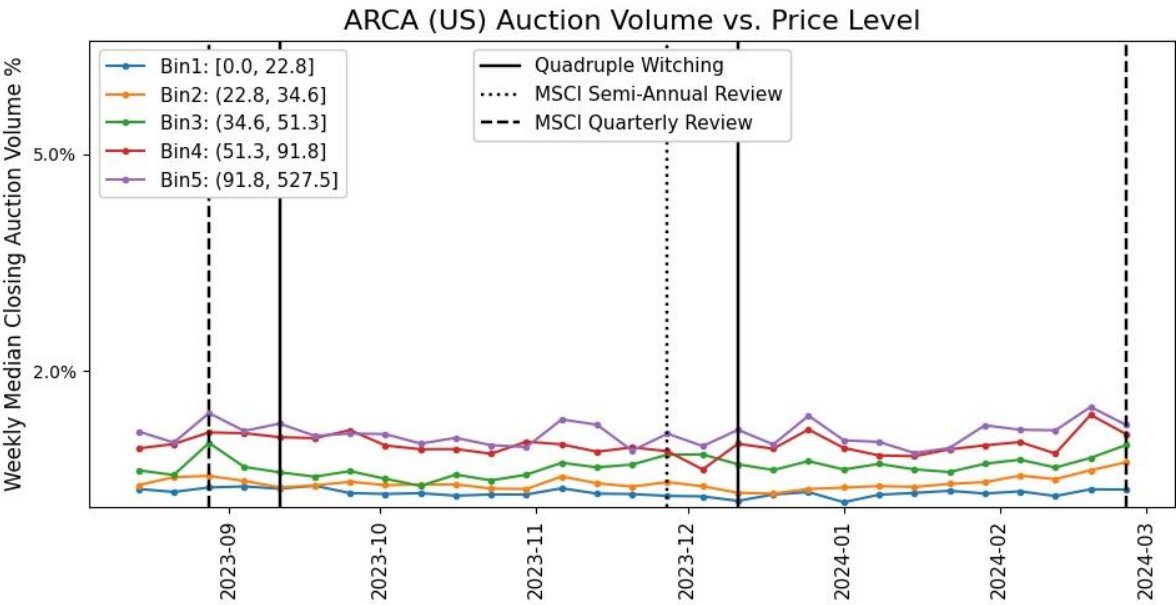


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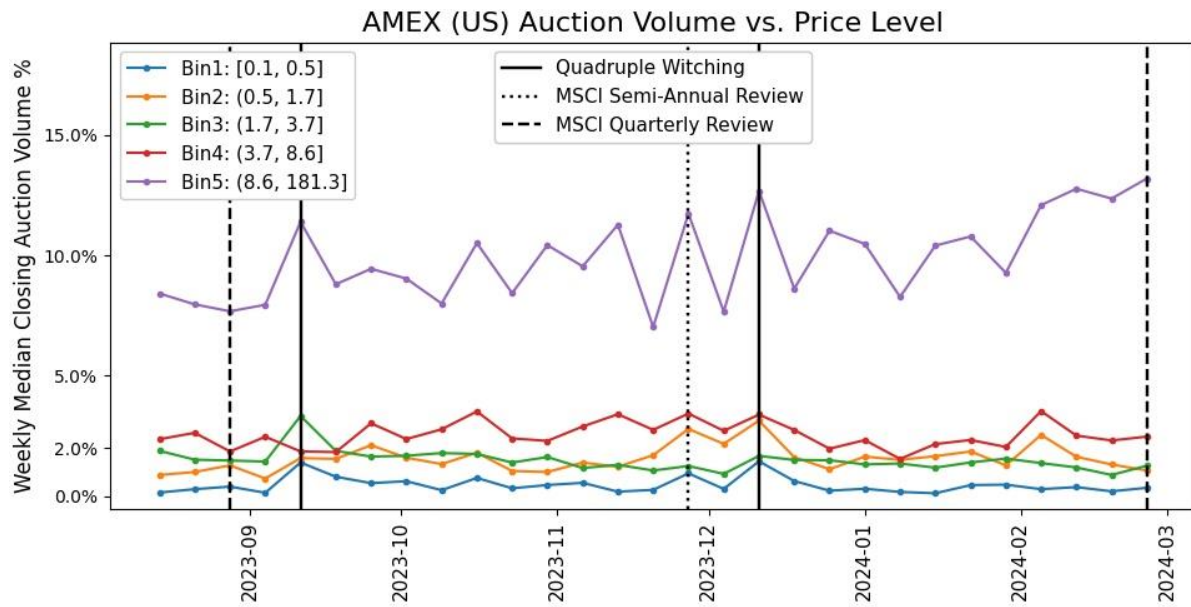


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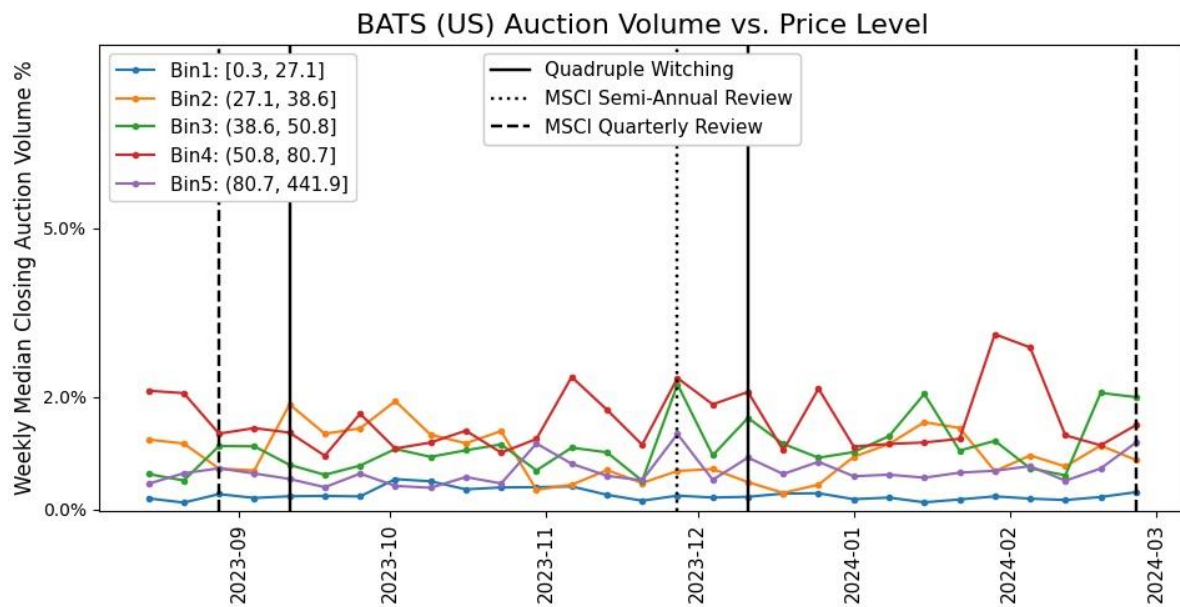


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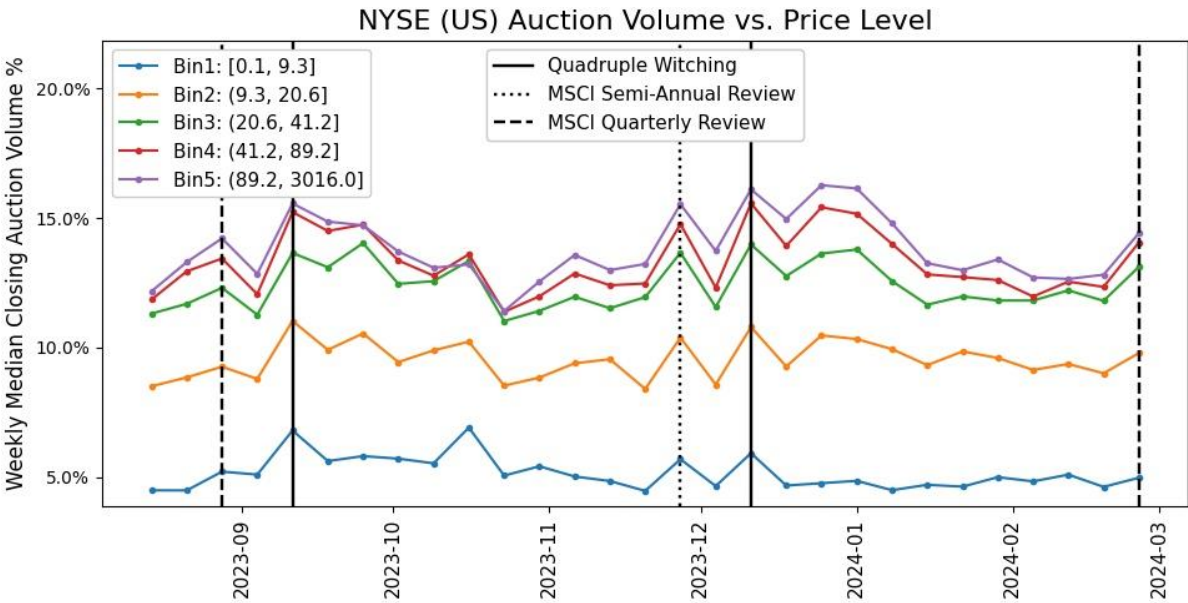


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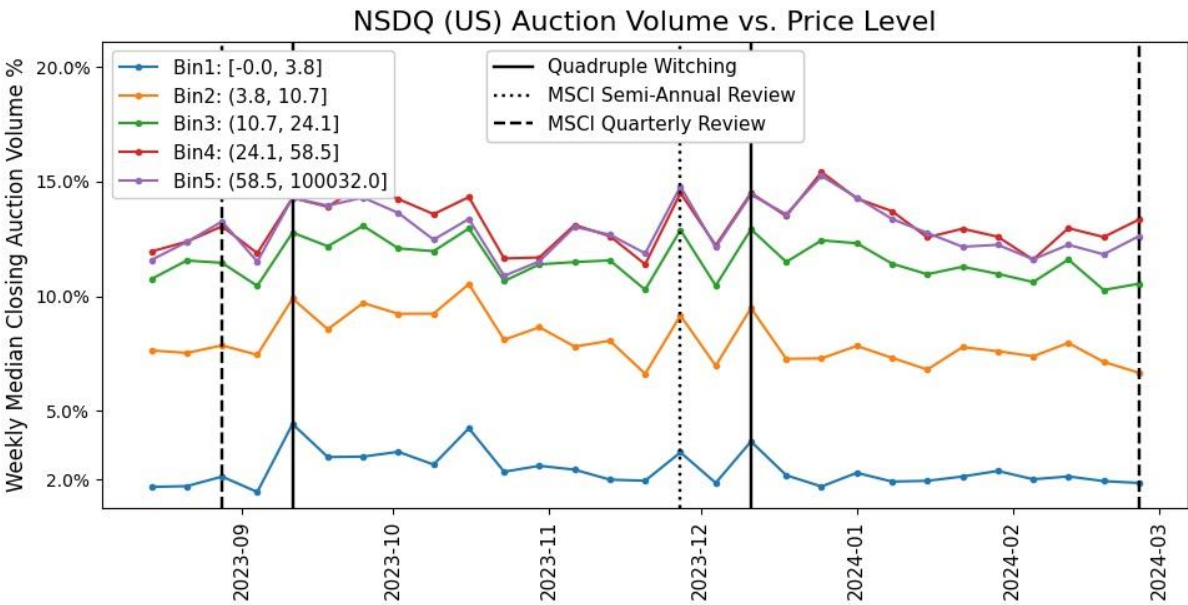


Figure 22



### III. Weekly Median Closing Auction Volume % Binned by Daily Price Range

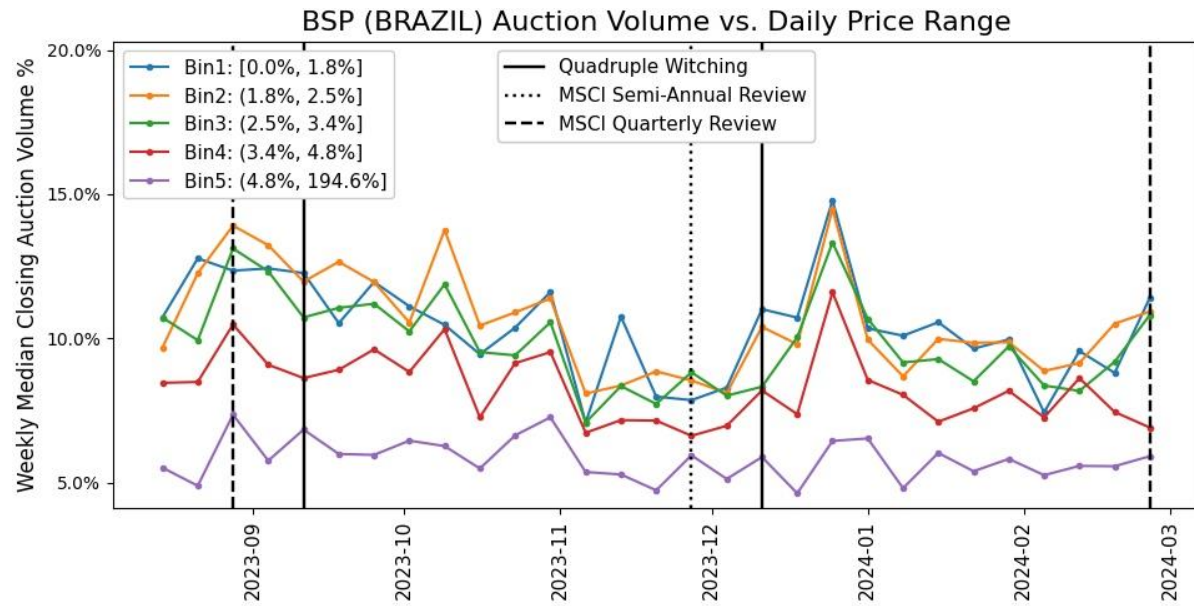


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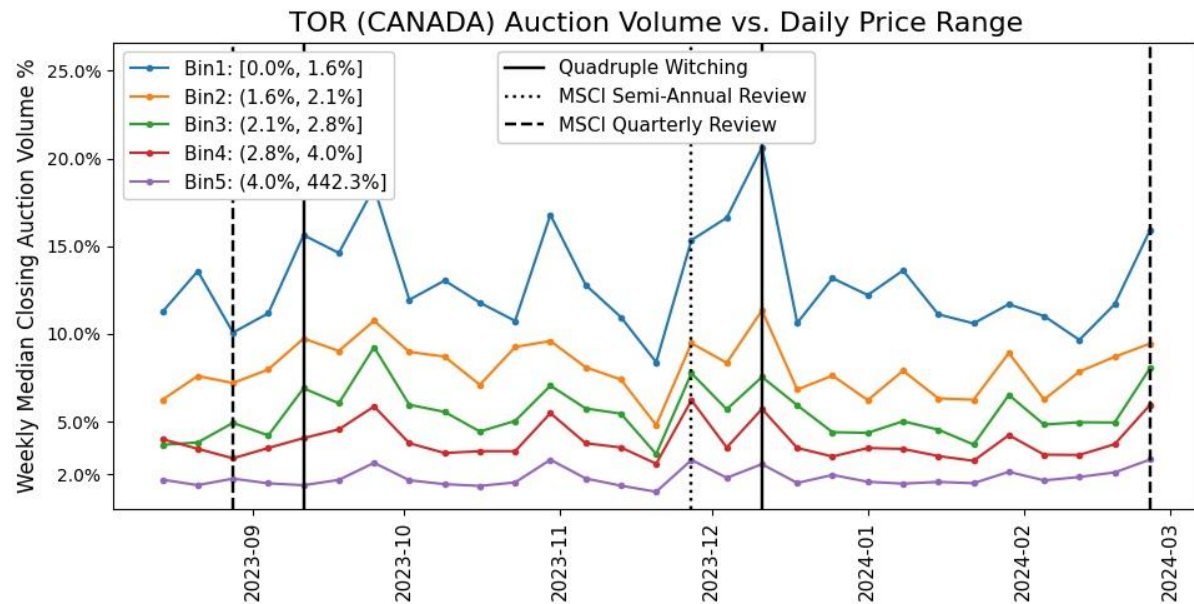


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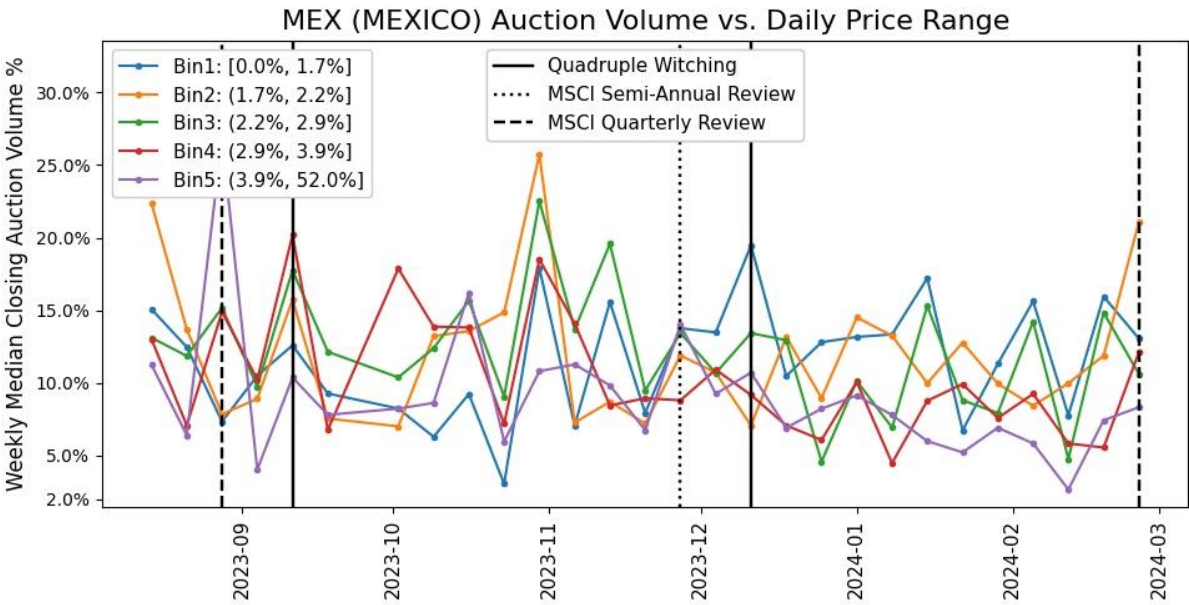


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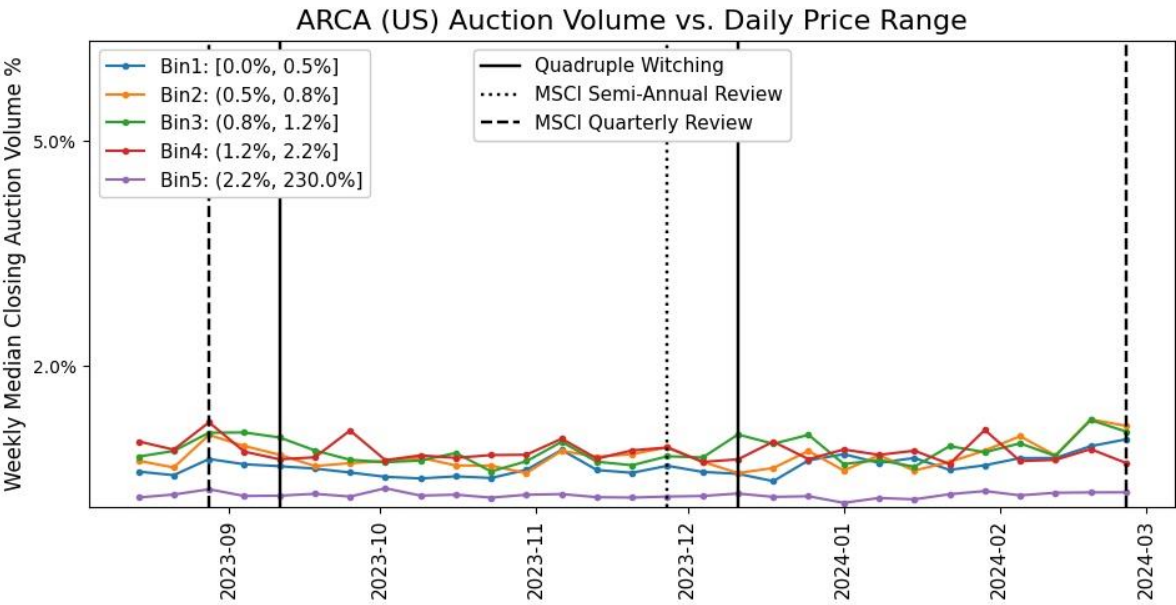


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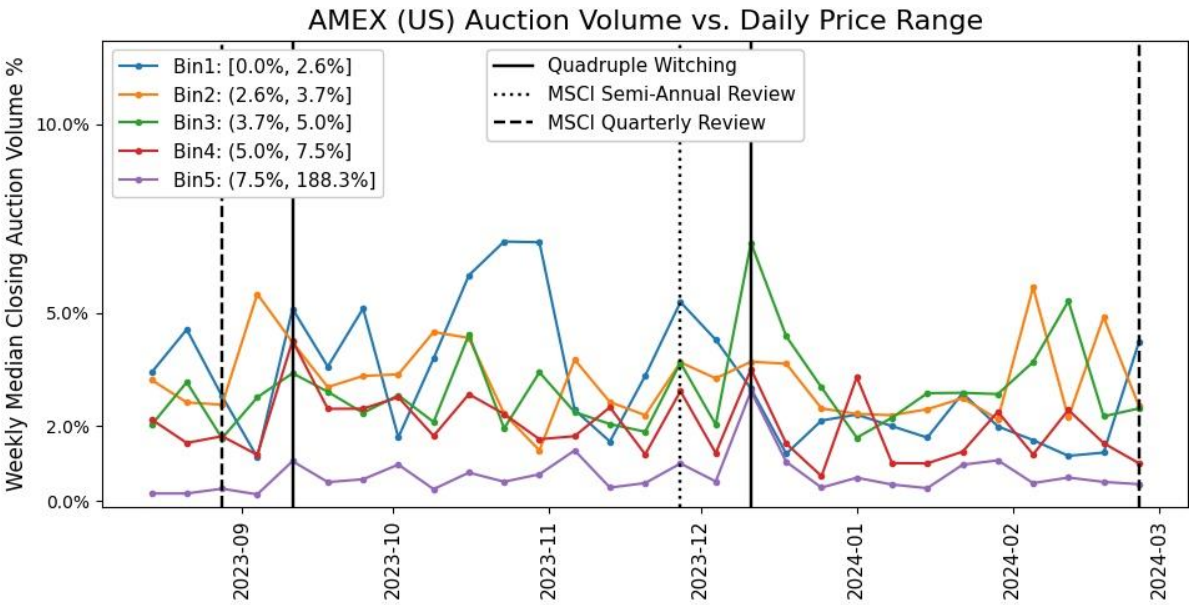


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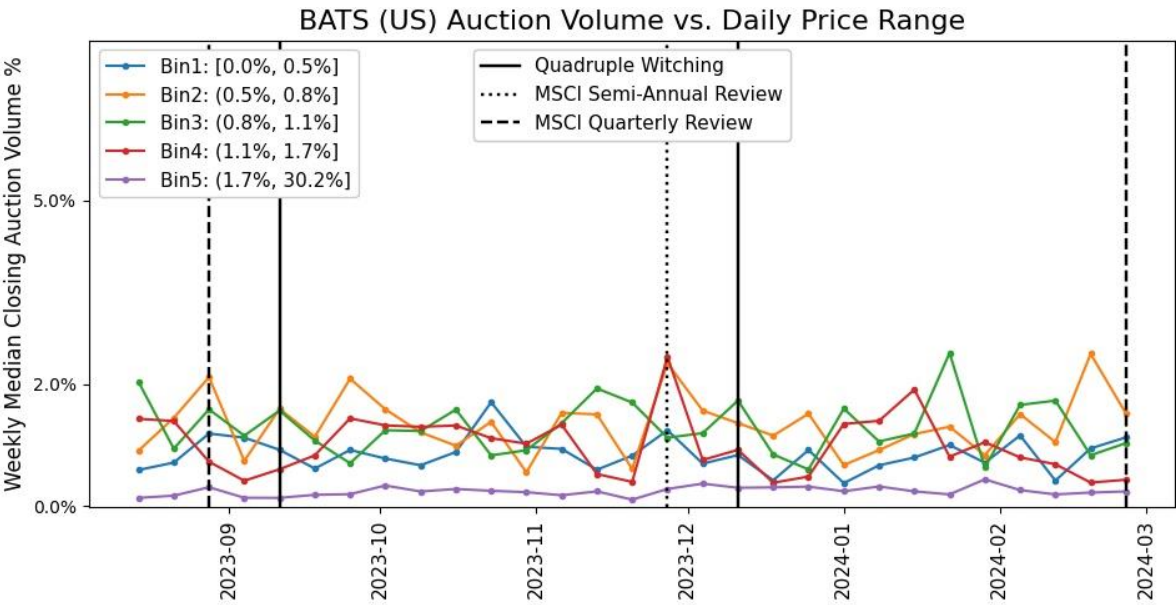


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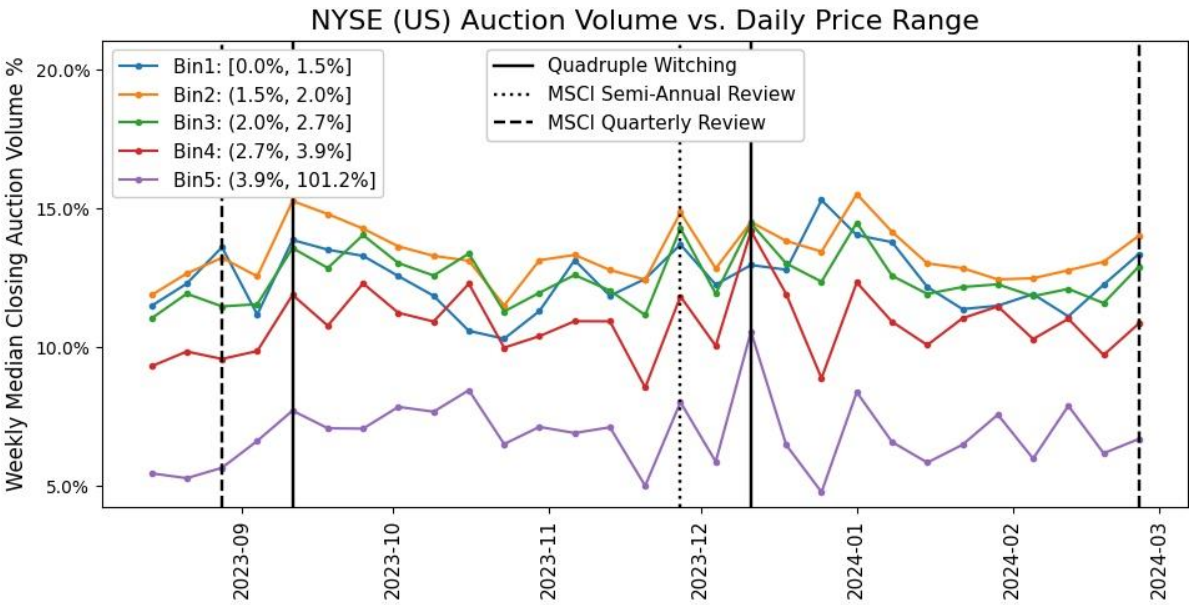


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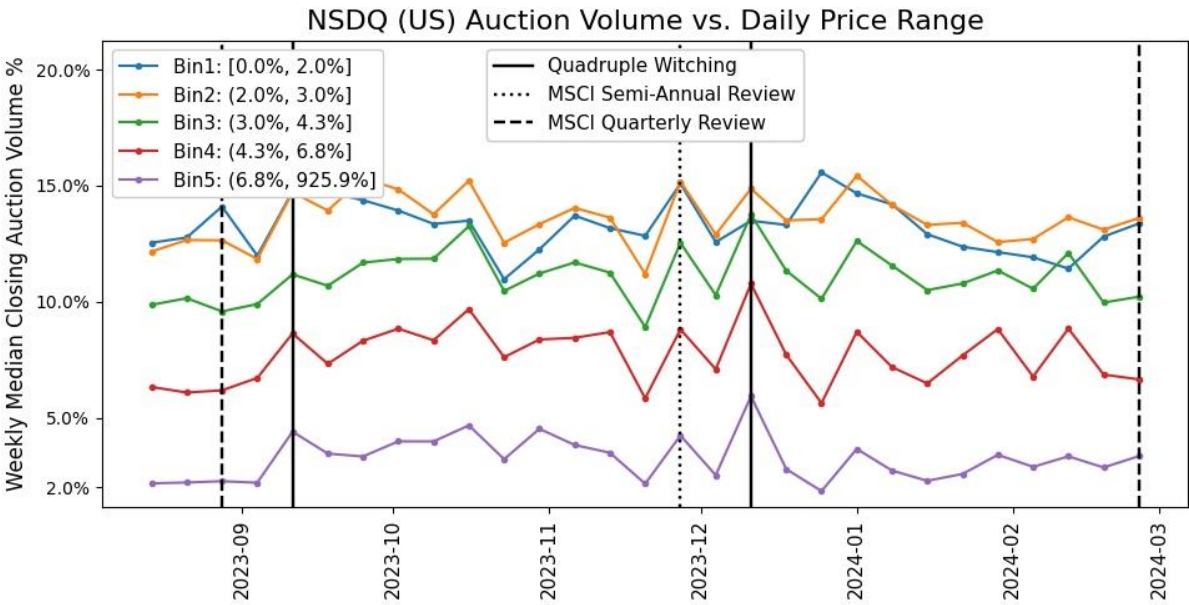


Figure 30



IV. Weekly Median Closing Auction Volume % Binned by Notional Value Traded

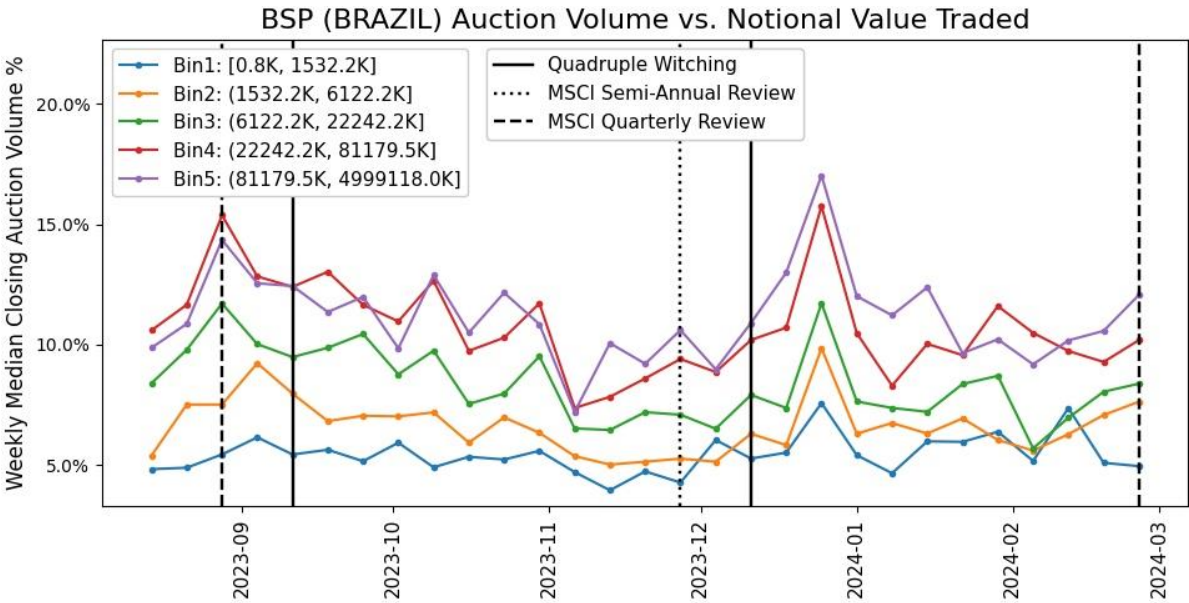


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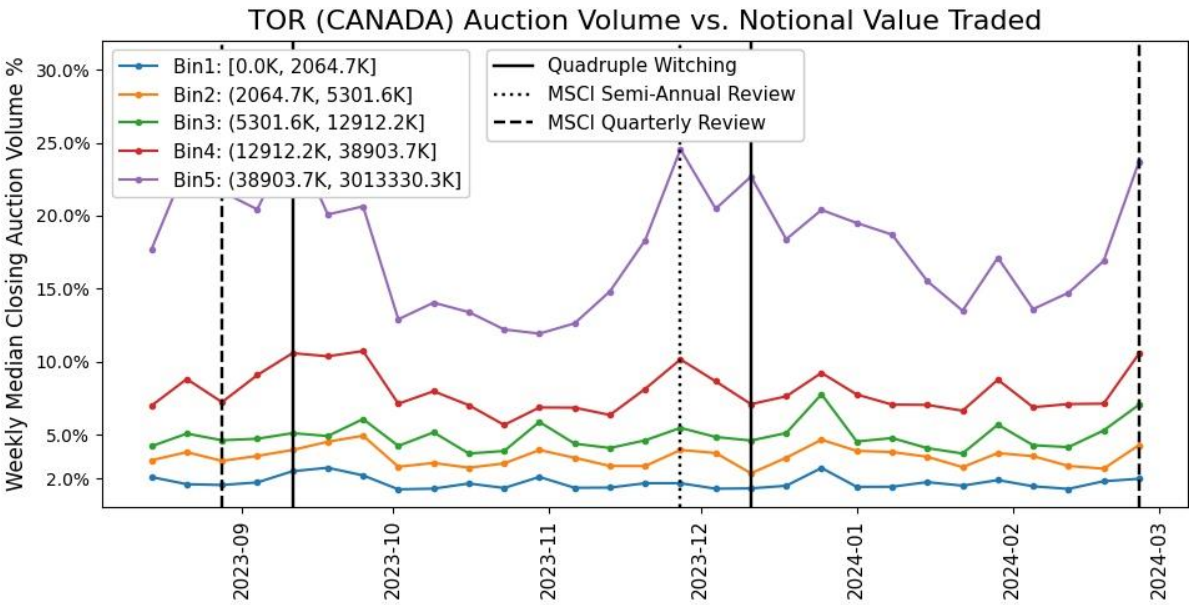


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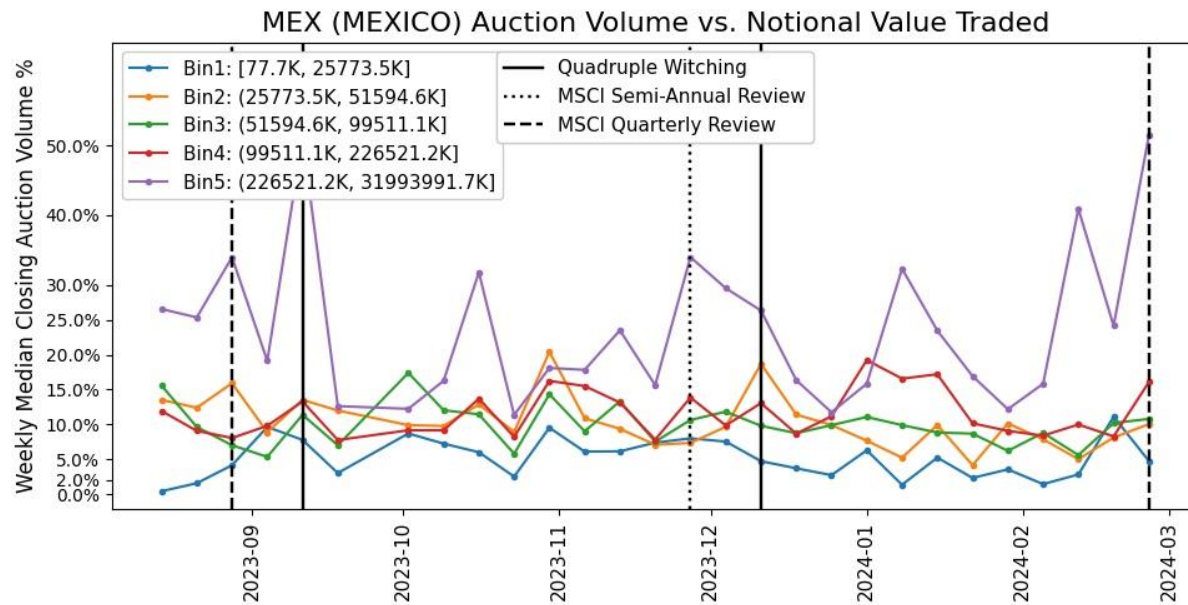


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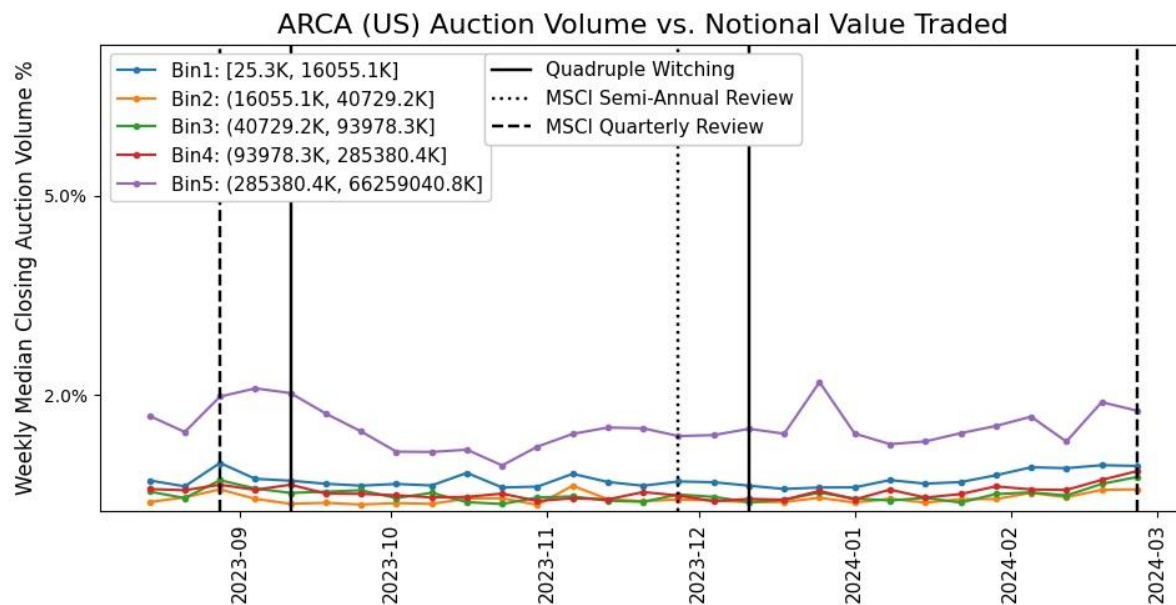


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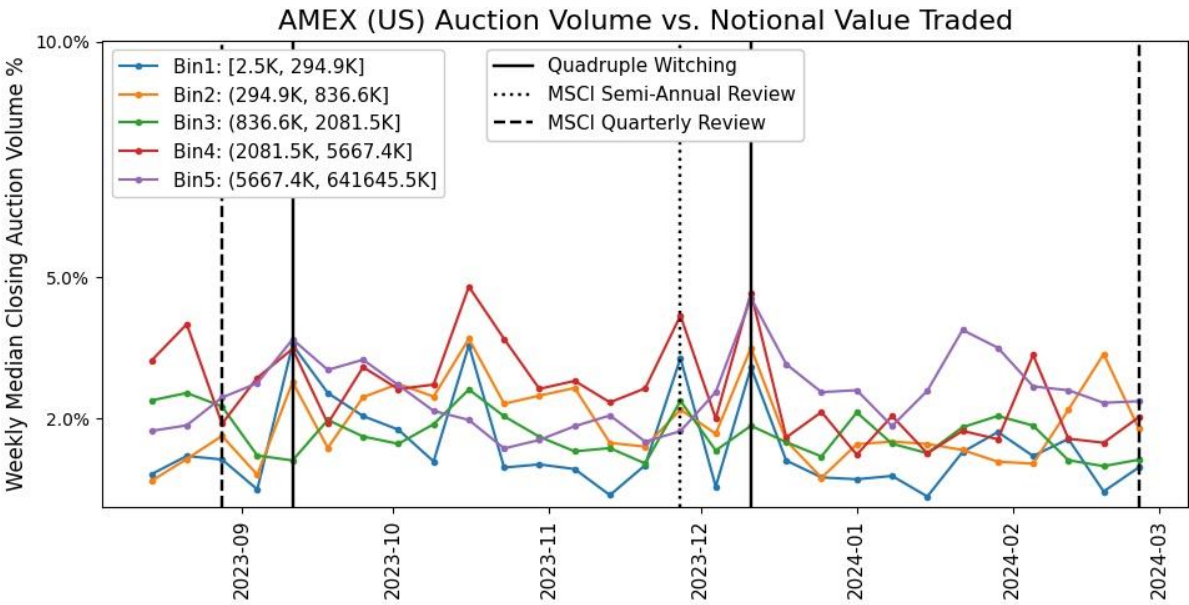


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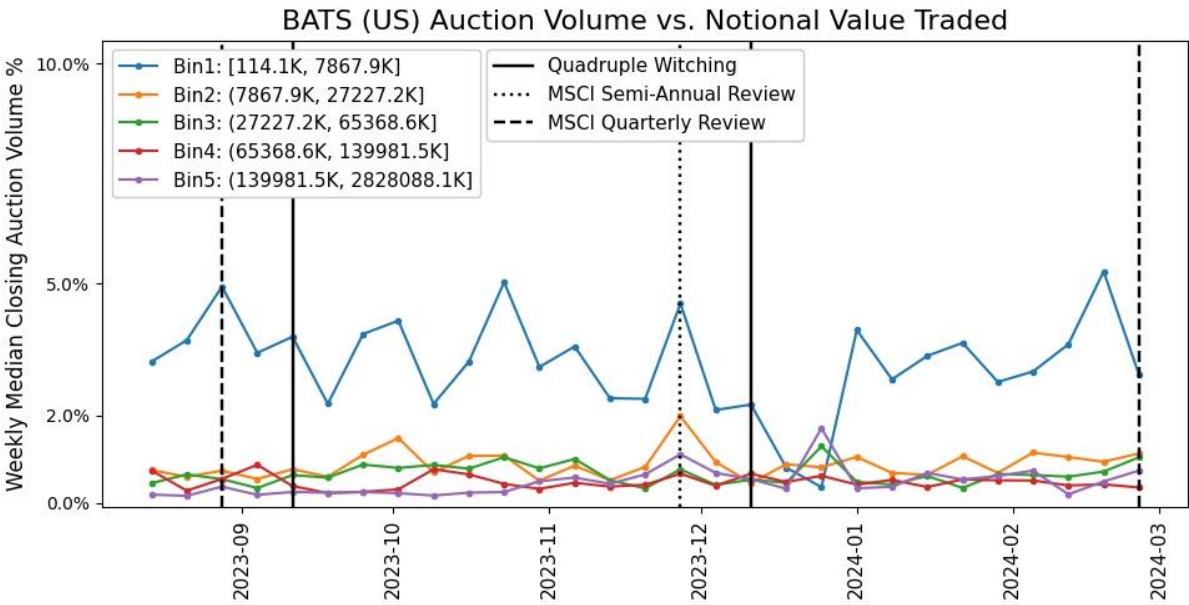


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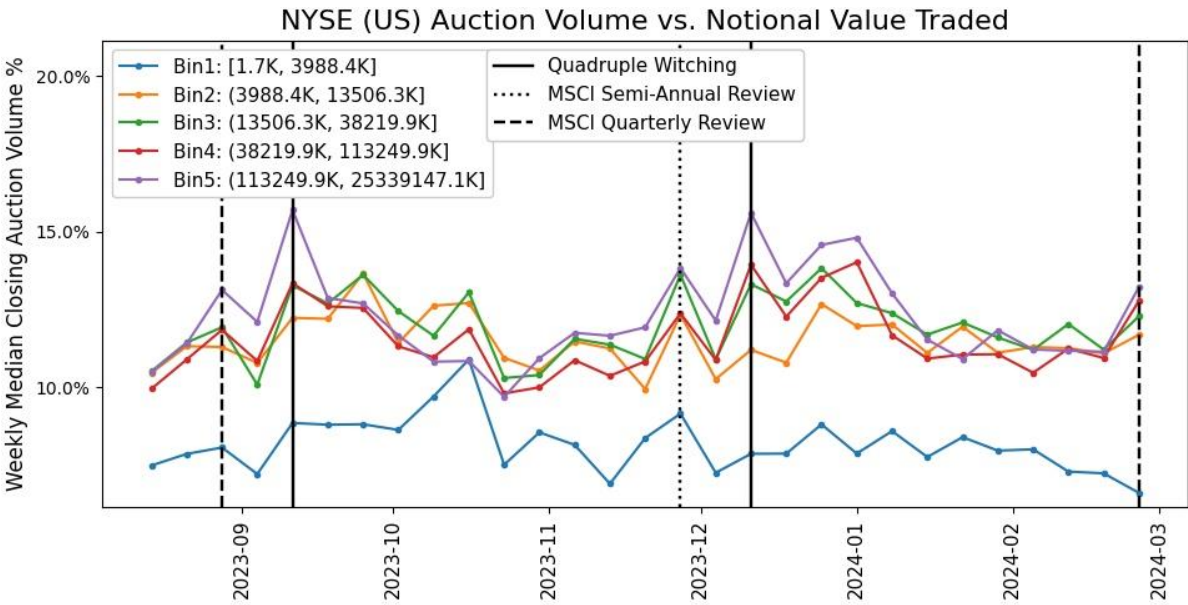


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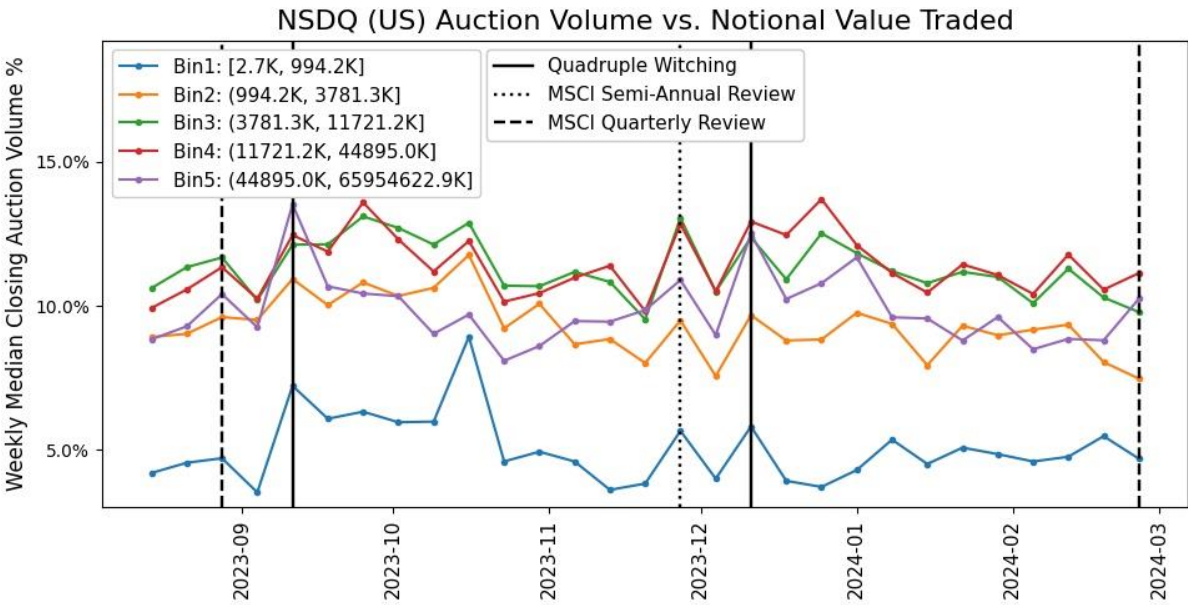


Figure 38



V. Weekly Median Closing Auction Volume % Binned by Average Trade Size

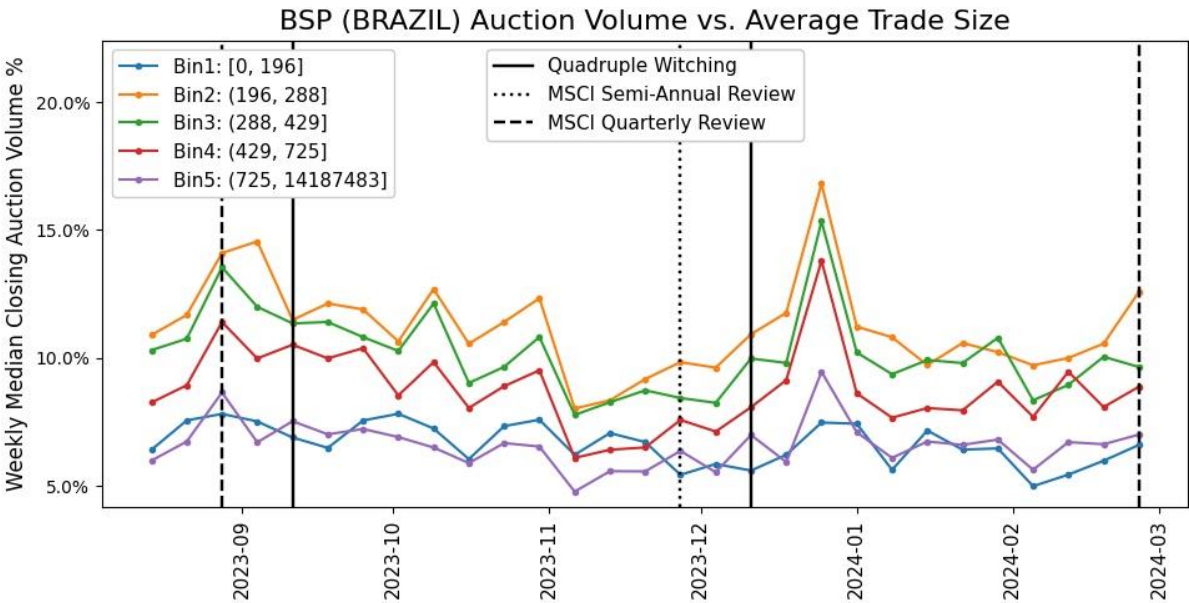


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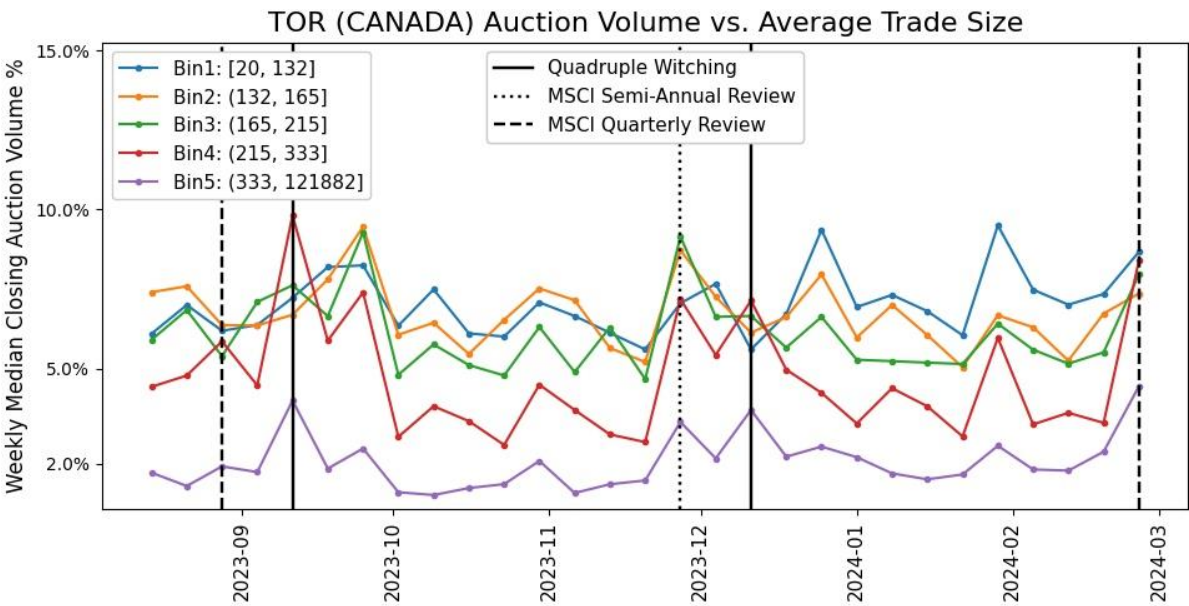


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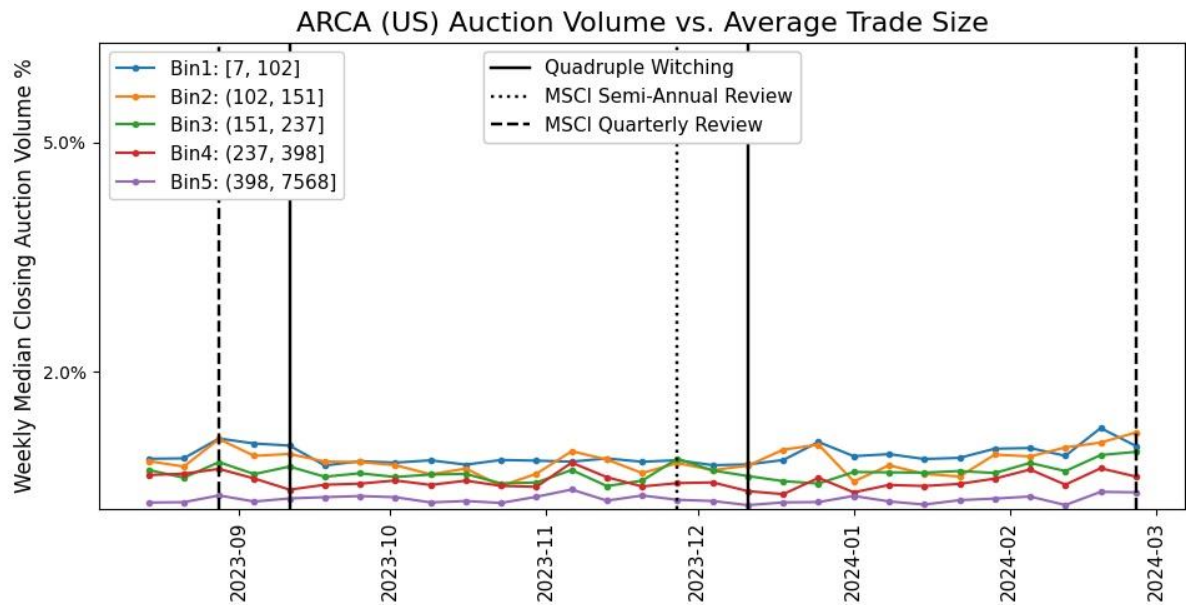


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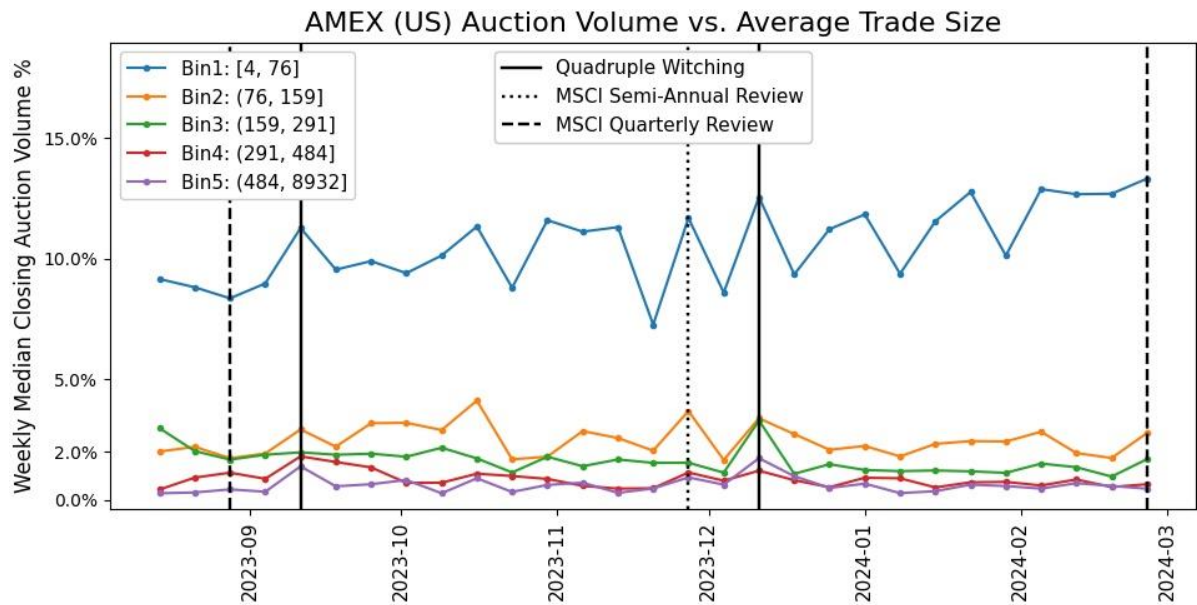


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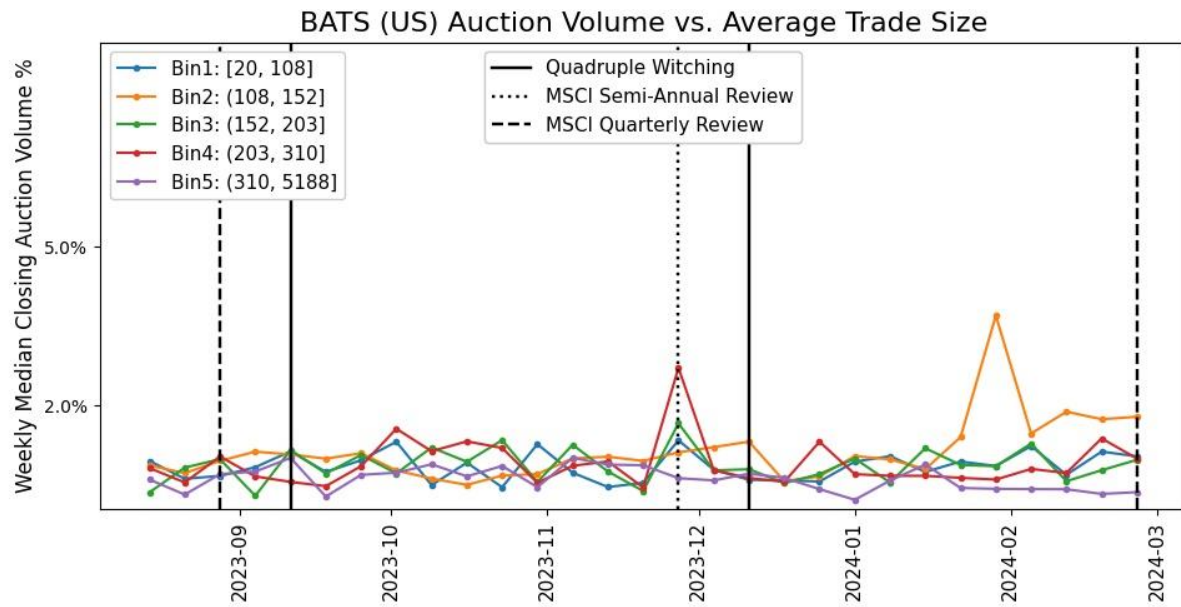


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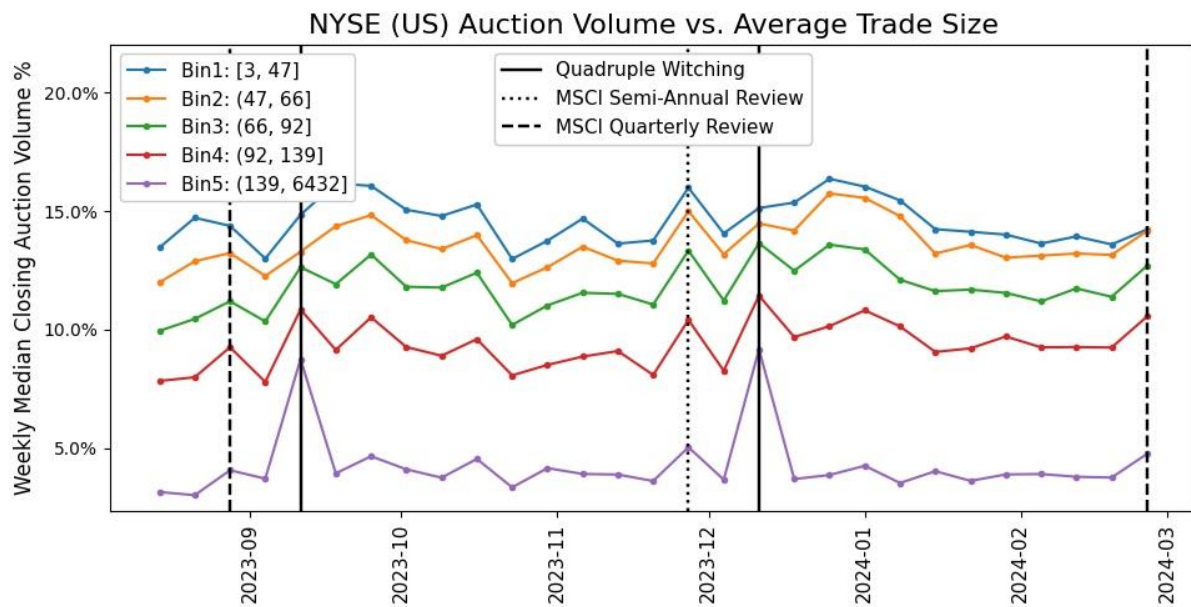


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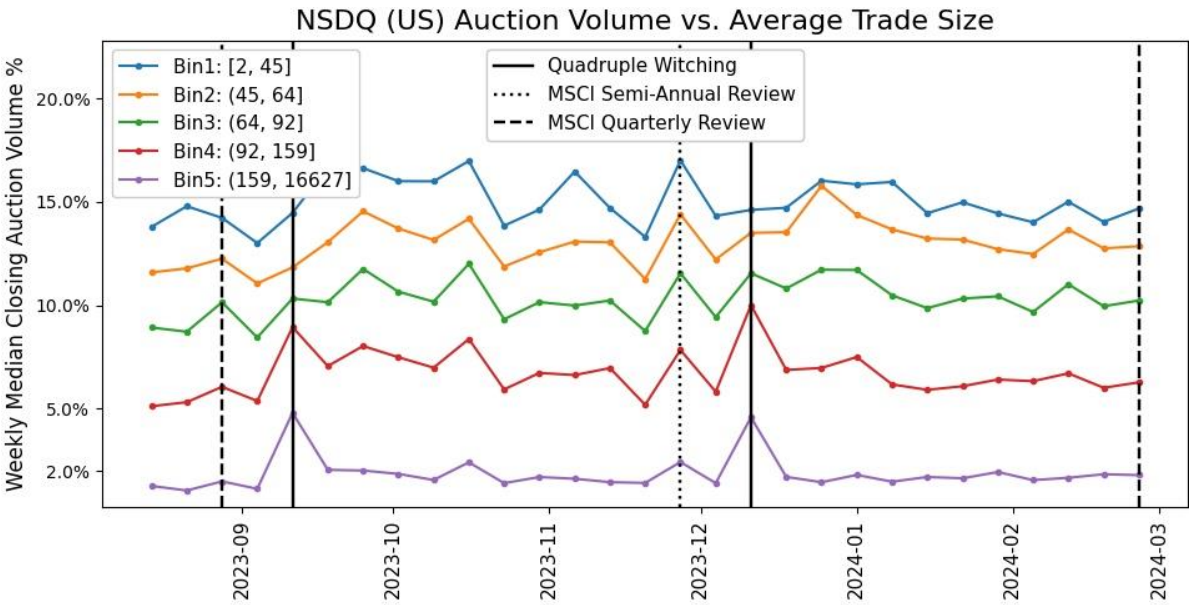


Figure 45