



# The Quarter-Penny Tick

Larry Harris

Fred V. Keenan Chair in Finance

USC Marshall School of Business

Q Group Research Coordinator

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# Overview of Main Points



# Why Tick Size Matters

- At exchanges, orders are ranked for matching by price, display, and time.
  - Price Priority: Highest bids and lowest offers go first.
  - Display Precedence: At a given price, displayed orders go first.
  - Time Precedence: At a given price and display type, earlier orders go first.
- The minimum price variation regulates the value of the secondary rules.
  - Traders who want to jump ahead must improve price.



# Main Points

- Clever exchange pricing conventions have created a near-complete quarter-penny grid available primarily only to proprietary (high frequency) traders.
- This grid creates special trading opportunities for HFTs and aggravates agency problems between brokers and their clients.



# The Quote-Matching Strategy



# Standing Limit Orders Are Options

- Bids are put options available to the first trader willing to trade at the buy limit price.
- Offers are calls.

The Market Microstructure understanding of options contracts:

An options contract is a limit order sold to a single holder that the writer cannot cancel until expiration.

# Quote-Matching Extracts Order Option Values

Suppose a slow trader bids buy limit 20.00: A put option.

- A fast trader steps ahead and bids 20.01 (quote-matches).
- A marketable sell order arrives and the quote-matcher buys.
- If prices subsequently rise, the quote-matcher profits.
- If prices subsequently fall, the quote-matcher sells to the 20 bid and limits his loss.
- The return distribution looks like that of a call option because the quote-matcher is extracting the value of the put option.
  - The two traders split the return distribution.



# Reg NMS



# Relevant Reg NMS Provisions

- The Reg NMS Subpenny Pricing Rule prohibits exchanges from publishing quotes on a subpenny grid for prices above \$1.
  - All exchange order-matching systems operate on a one-cent grid.
- The Access Rule prohibits access fees above 0.30¢/share.
  - Exchanges charge access fees to traders who want to trade there.
- The Order Protection Rule effectively prevents exchanges from quoting prices that lock or cross markets.
  - Bid=Ask is a locked market.
  - Bid>Ask is a crossed market.



# Exchange Transaction Fee Practices



# Traditional Pricing

- Exchanges traditionally charged the buyer and seller, or just the seller, a fee for arranging trades.
- These fees were essentially brokerage commissions.
- Exchange net transaction fee revenue per trade is small—typically about 0.05¢/share.



# Pricing Based on Makers and Takers

- Most exchanges now use pricing systems that collect fees and pay rebates based on who made the market (supplied liquidity) and who took the market.
  - Maker-taker pricing
  - Inverted pricing (taker-maker pricing)
  - Flat pricing



# Makers and Takers

- *Makers* provide liquidity by posting standing limit orders.
- *Takers* take (remove) liquidity using marketable orders.
- Makers may be on either side of the market.
  - Takers are on the opposite side from the maker, and thus also may be on either side of the market.



# Maker-Taker Pricing

- Maker-taker exchanges charge the taker an access fee and provide a liquidity rebate to the maker.
  - For US equities, the access fee is typically 0.3¢/share, and the liquidity rebate is 0.25¢, so the exchange makes 0.05¢/share.
  - Brokers doing low volumes obtain worse prices.
- Brokers benefit from maker-taker pricing when they get paid rebates when their customers' standing limit orders execute.
  - Most brokers do not pass exchange transaction fees through to their customers.



# Inverted (Taker-Maker) Pricing

- Inverted exchanges charge the maker an access fee and provide a rebate to the taker.
  - The maker fee is typically 0.25¢/share and the taker rebate is typically 0.20¢/share so the exchange nets 0.05¢/share.
  - Prices vary by broker monthly volumes and by exchange.
- Brokers benefit from inverted pricing when they get paid rebates for routing their customers' marketable orders to inverted exchanges.
  - Few brokers pass these rebates back to their customers.



# Routing Decisions



# Broker Routing Decisions

- When the best bids at maker-taker and inverted exchanges are the same, most brokers route to obtain rebates.
- They route
  - Liquidity-supplying (standing) limit buy orders to the maker-taker exchange, and
  - Marketable sell orders to the inverted exchange.
- Ditto for sell orders.



# Proprietary Trader Routing Decisions

- At a given bid price, liquidity rebates made offering liquidity more attractive at maker-taker exchanges than at inverted exchanges.
- When the total queued order size at the best bid at a maker-taker exchange is high, traders must wait long to trade.
  - They may not trade if prices rise.
- Traders impatient to trade at the best bid jump the queue by bidding the same price at the traditional exchange.
  - They pay a higher net price if they trade.



# Implications

- Standing limit orders at maker-taker exchanges tend to trade after standing orders at inverted and flat exchanges are filled.
- Proprietary traders have liquidity-supplying opportunities that other traders do not.
  - They can jump ahead of traders at maker-taker exchanges by switching to flat or inverted exchanges, at a cost of approximately a quarter- or half-penny.
  - Proprietary traders offer most liquidity at inverted exchanges.
- Investors trading through most brokers must improve prices at maker-taker exchanges by 1¢/share to get ahead.



# Exchange Transaction Fee History



# Maker-Taker Pricing

- Starting in 1997 with Island ECN, ECNs created maker-taker pricing to attract liquidity by corrupting the agency relationship between brokers and their clients.
  - Brokers profit from liquidity rebates.
  - Their standing limit order customers suffer because HFTs often jump ahead of them, which reduces their probability of trading.
- Competition for customer order flow caused almost all major exchanges to switch from traditional pricing to maker-taker pricing.



# Inverted (Taker-Maker) Pricing

- Starting in 2009 with Nasdaq BX, two exchange holding companies (or their predecessors) created subsidiary exchanges that use inverted pricing (“the inverted exchanges”).
  - Nasdaq: Nasdaq BX
  - CBOE: BYX and EDGA (Slightly different pricing schedules)
- All other trading rules are the same for their maker-taker and inverted exchanges.



# The Investors Stock Exchange (IEX)

- Until March 2021, IEX was the only remaining traditional exchange.
- IEX catered to institutional order flow with its 38-mile-long order routing cable designed to slow order and trade messages by 0.7 milliseconds roundtrip, thereby frustrating various parasitic low-latency trading strategies.
- IEX charged a relatively high transaction fee of 0.09¢/share to both sides for a net of 0.18¢/share traded.
- On April 1, 2021, IEX switched to flat pricing with a 0.00¢/share make fee and a 0.06¢/share take fee.



# Some Arithmetic



# Price Grids

- Most brokerage clients can offer liquidity only on a one-penny grid at maker-taker exchanges.
- Proprietary traders and sophisticated traders with special arrangements with their brokers route to other flat and inverted exchanges to obtain different net prices.



# The Quarter-Penny Grid

- Sophisticated traders can **bid** at net prices of approximately
  - $P - 0.25\text{¢}$  (maker-taker exchanges)
  - $P$  (flat exchanges)
  - $P + 0.25\text{¢}$  (inverted exchanges)
- The net price grid for **offers** is approximately
  - $P + 0.25\text{¢}$  (maker-taker exchanges)
  - $P$  (flat exchanges)
  - $P - 0.25\text{¢}$  (inverted exchanges)
- Approximate because rates vary by exchange and broker volumes.



# The Missing Quarter-Penny

- The only missing price on the quarter-penny grid is  $P + 0.50\text{¢}$ .
- The Reg NMS Access Rule prohibits transaction fees greater than  $0.30\text{¢}$ , which would be necessary to produce net prices at a half-penny.



# Net Price Movement in Active Markets

- When the market moves, the net transaction-fee-adjusted quoted market often will move in mostly quarter-penny increments.
- A rising best bid will move
  - from maker-taker to flat exchanges (up net 0.25¢)
  - from flat to inverted exchanges (up 0.25¢)
  - from inverted to maker-taker exchanges at the next higher nominal penny (up 0.50¢).
- The nominal quote will move in one-penny increments.



# Nominal and Net Spreads

- Suppose the nominal market is  $P$  bid, offered at  $P + 1\text{¢}$  at **all** exchanges types. The net quotes of liquidity suppliers are
  - $P - 0.25$  bid, offered at  $P + 1 + 0.25$  (maker-taker)
  - $P$  bid, offered at  $P + 1$  (flat)
  - $P + 0.25$  bid, offered at  $P + 1 - 0.25$  (inverted)
- The nominal spread is  $1\text{¢}$  at all exchanges, but the net best bid and offer (BBO) spread is  $0.50\text{¢}$  (at the inverted exchanges).
- Net spreads can be any quarter-cent at or above  $0.50\text{¢}$ .
  - Smaller net spreads would be possible if the Reg NMS Order Handling rules did not prohibit nominally locked quotes.

# Some Spread Scenarios



**Table 1:** Scenarios that give rise to some different net spreads. The maker fee is -0.25 cents/share at maker-taker exchanges, 0 cents at flat exchanges, and 0.25 cents at inverted exchanges.

Net Spreads (cents)		Ask Prices (cent part only)						
		20 at flat exchange	20 at inverted exchange	21 at maker-taker exchange	21 at flat exchange	21 at inverted exchange	22 at maker-taker exchange	
	Net price	20.00	20.25	20.75	21.00	21.25	21.75	
Bid Prices (cent part only)	20 at maker-taker exchange	19.75	Locked	Locked	1.00	1.25	1.50	2.00
	20 at flat exchange	20.00	Locked	Locked	0.75	1.00	1.25	1.75
	20 at inverted exchange	20.25	Crossed	Locked	0.50	0.75	1.00	1.50
	21 at maker-taker exchange	20.75	Crossed	Crossed	Locked	Locked	Locked	1.00
	21 at flat exchange	21.00	Crossed	Crossed	Crossed	Locked	Locked	0.75
	21 at inverted exchange	21.25	Crossed	Crossed	Crossed	Crossed	Locked	0.50



# Evidence



# Data

- All TAQ quotes for all stocks during the regular 9:30 a.m. to 4:00 p.m. trading day on 10/15/2021, 3/4/2022, and 3/7/2022.
  - Time-stamped to the microsecond.
- Used only stocks
  - With a minimum bid of \$1 or more,
  - Having 100 or more quotes, and
  - Mean spreads of 5¢ or less.
    - The spread filter eliminates some very high price stocks.
- 1.45 billion exchange quote records before applying these filters on October 15. (More on the other days.)



# Net NBBO Computation

- I adjusted all quote prices to reflect exchange transaction fees.
- Following the arrival of every exchange quote, I computed
  - the NBBO on a net basis
  - the total size at each the best net prices,
  - the second-best net prices, and
  - The total sizes at the second-best prices.
- On October 15, 718 million records reported any change in the NBBO prices, sizes, or second-best prices and sizes.



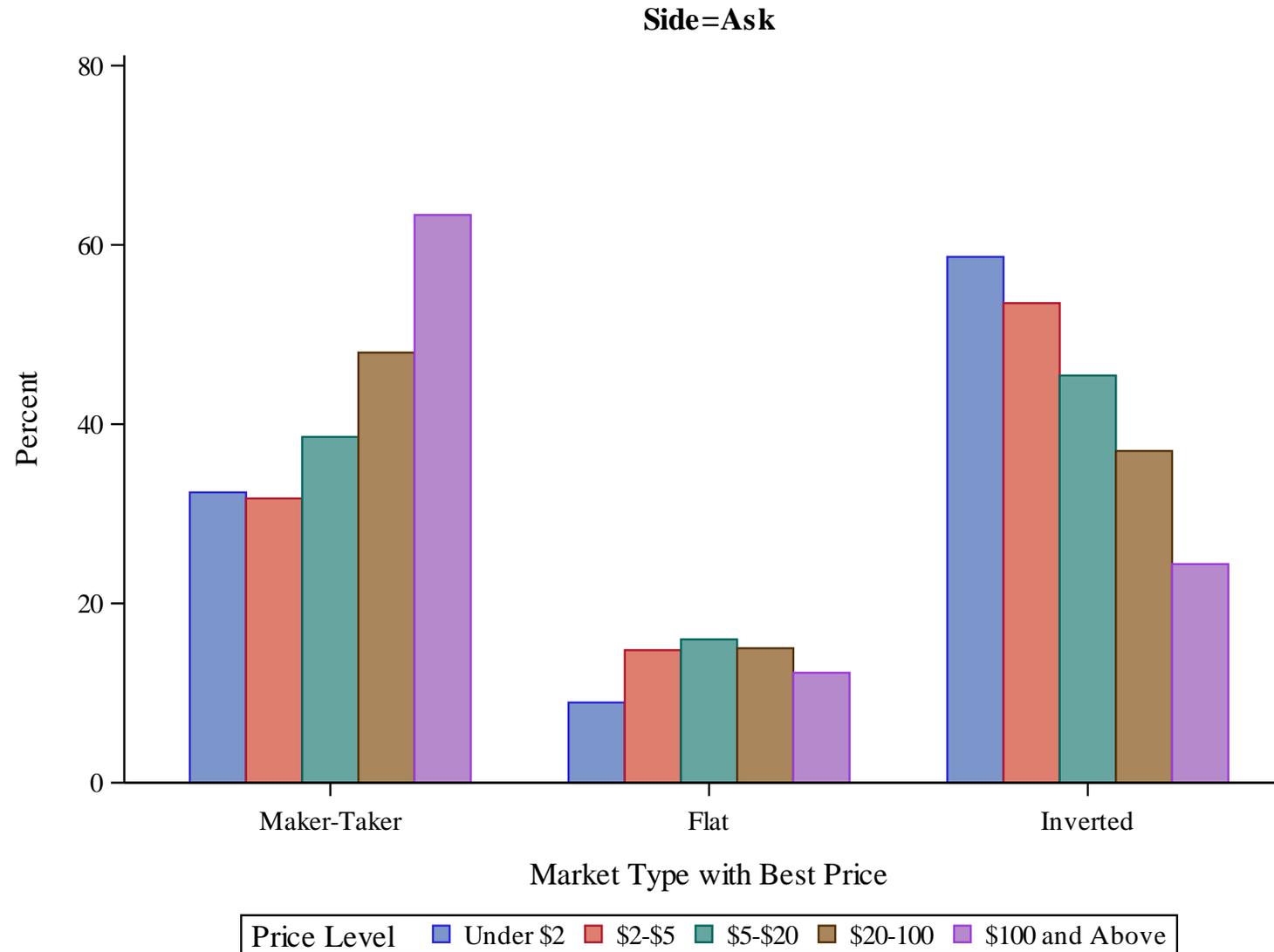
# Durations

- For every NBBO observation, I computed the period that NBBO stood in the market.
- All frequencies involving state variables, for example, spreads, are time-weighted.
- All frequencies involving events, for example, quote changes, are event-weighted.



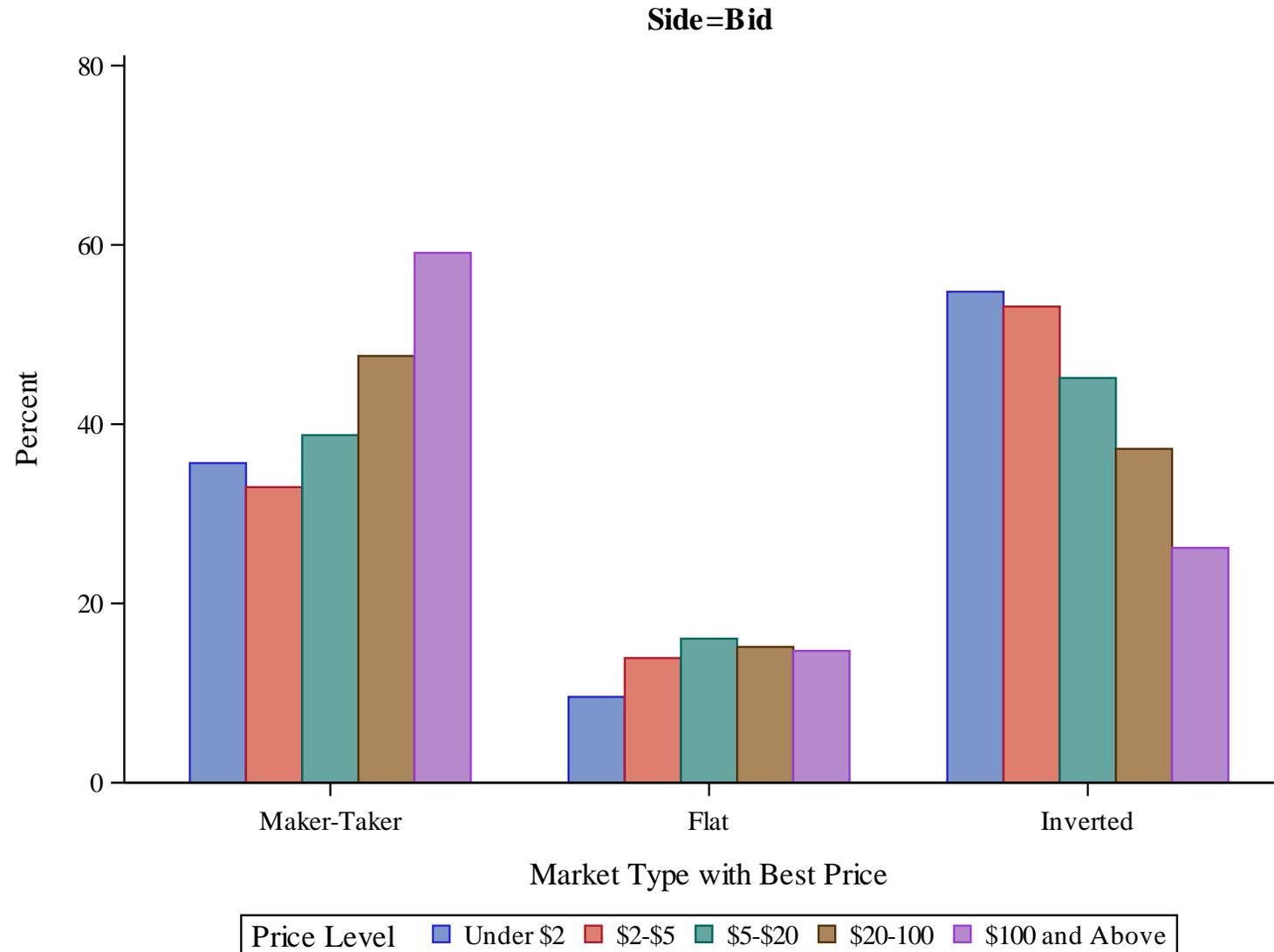
# 1A: Best Offer Mk Shares

10/15/2021 



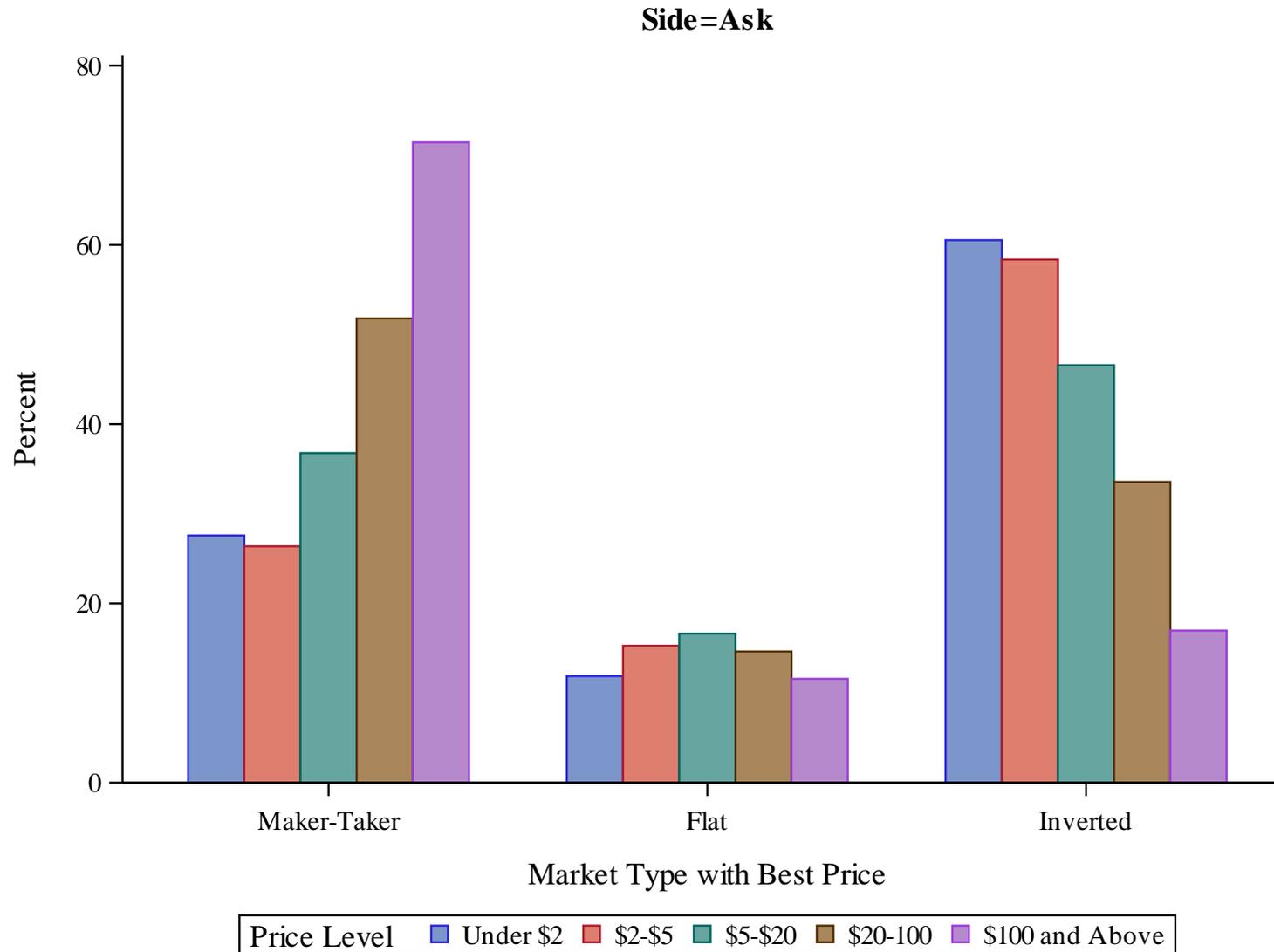
# 1A: Best Bid Mk Shares

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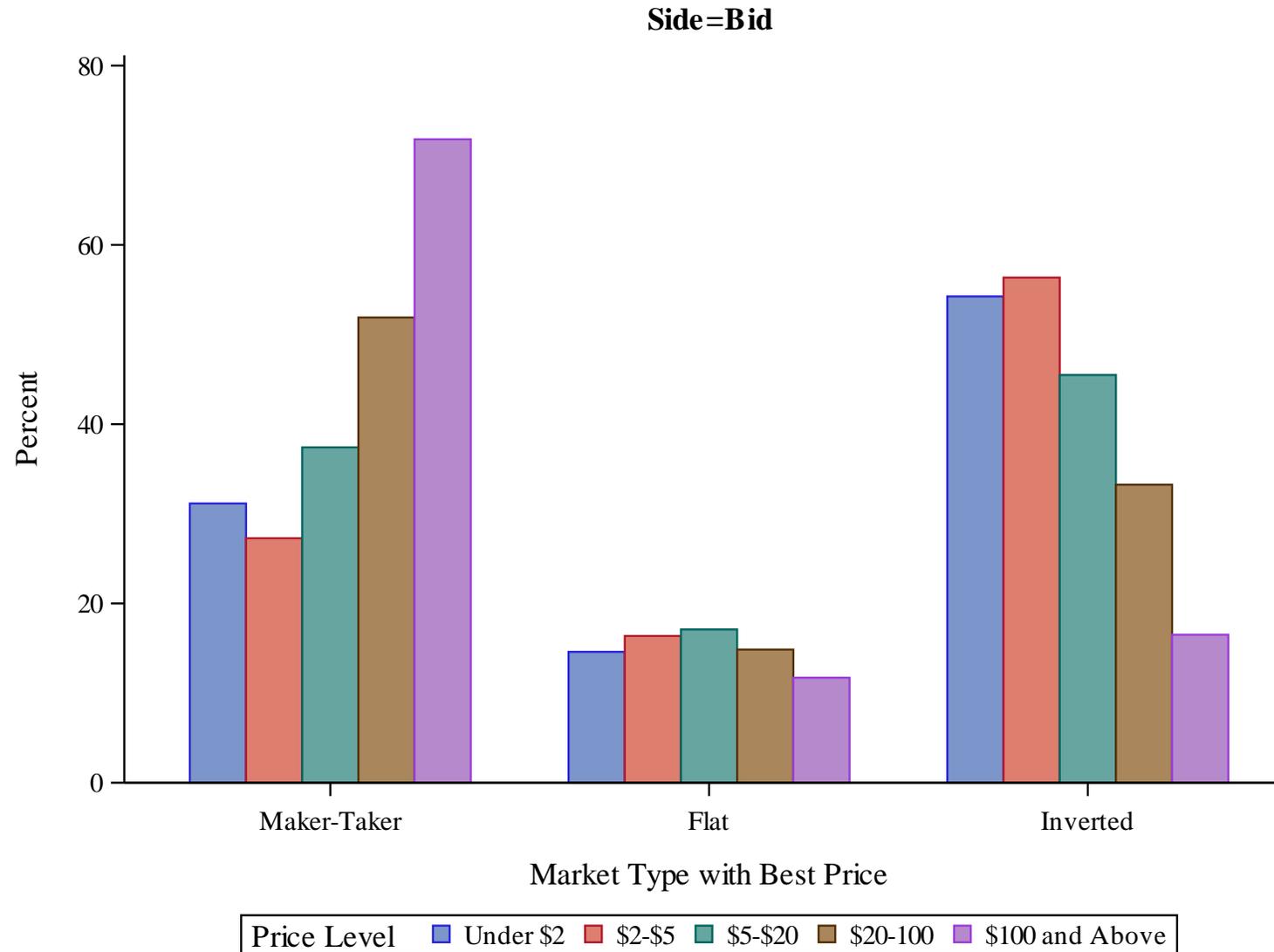
# 1C: Best Offer Mk Shares

3/4/2022 



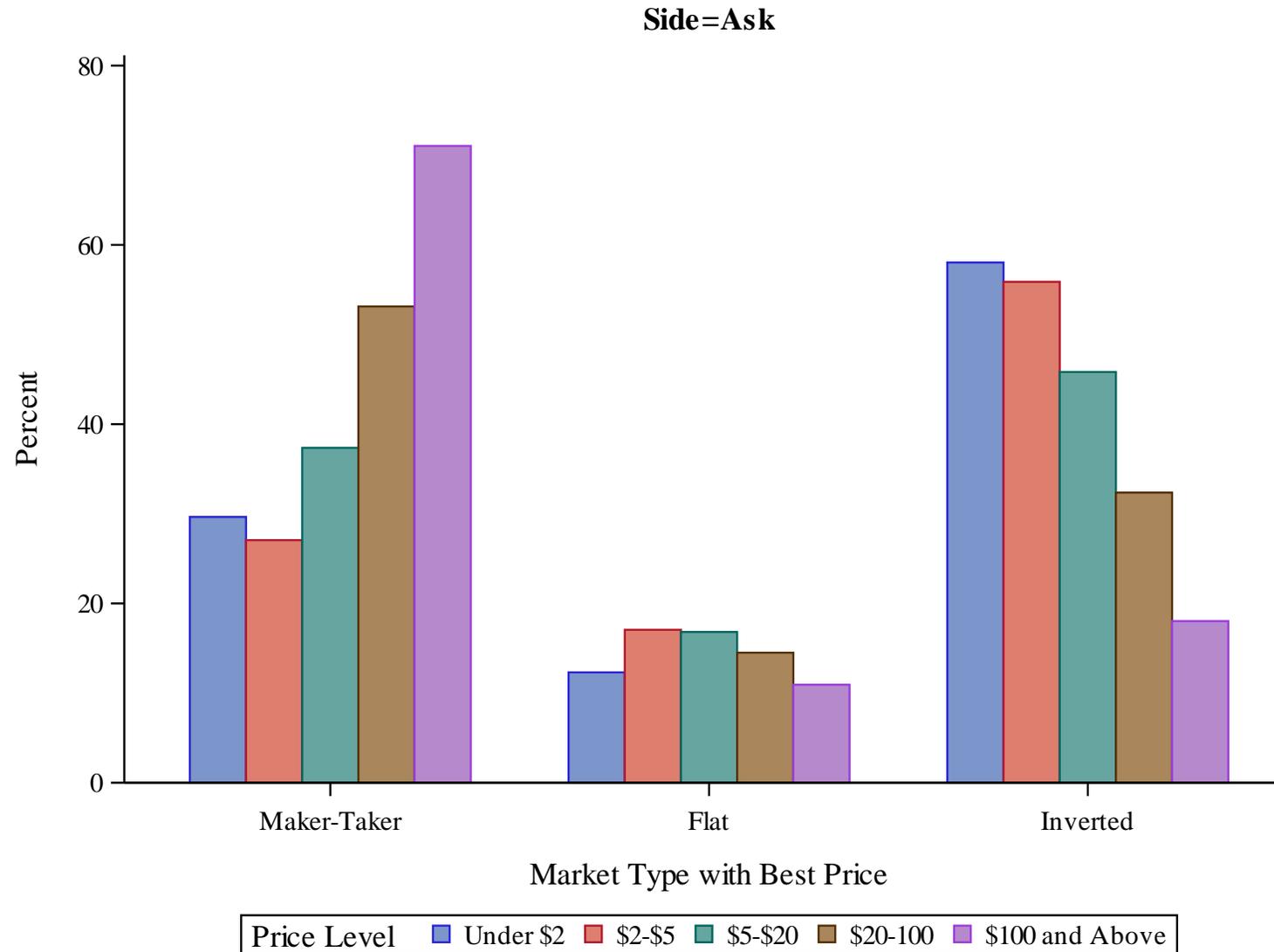
# 1D: Best Bid Mk Shares

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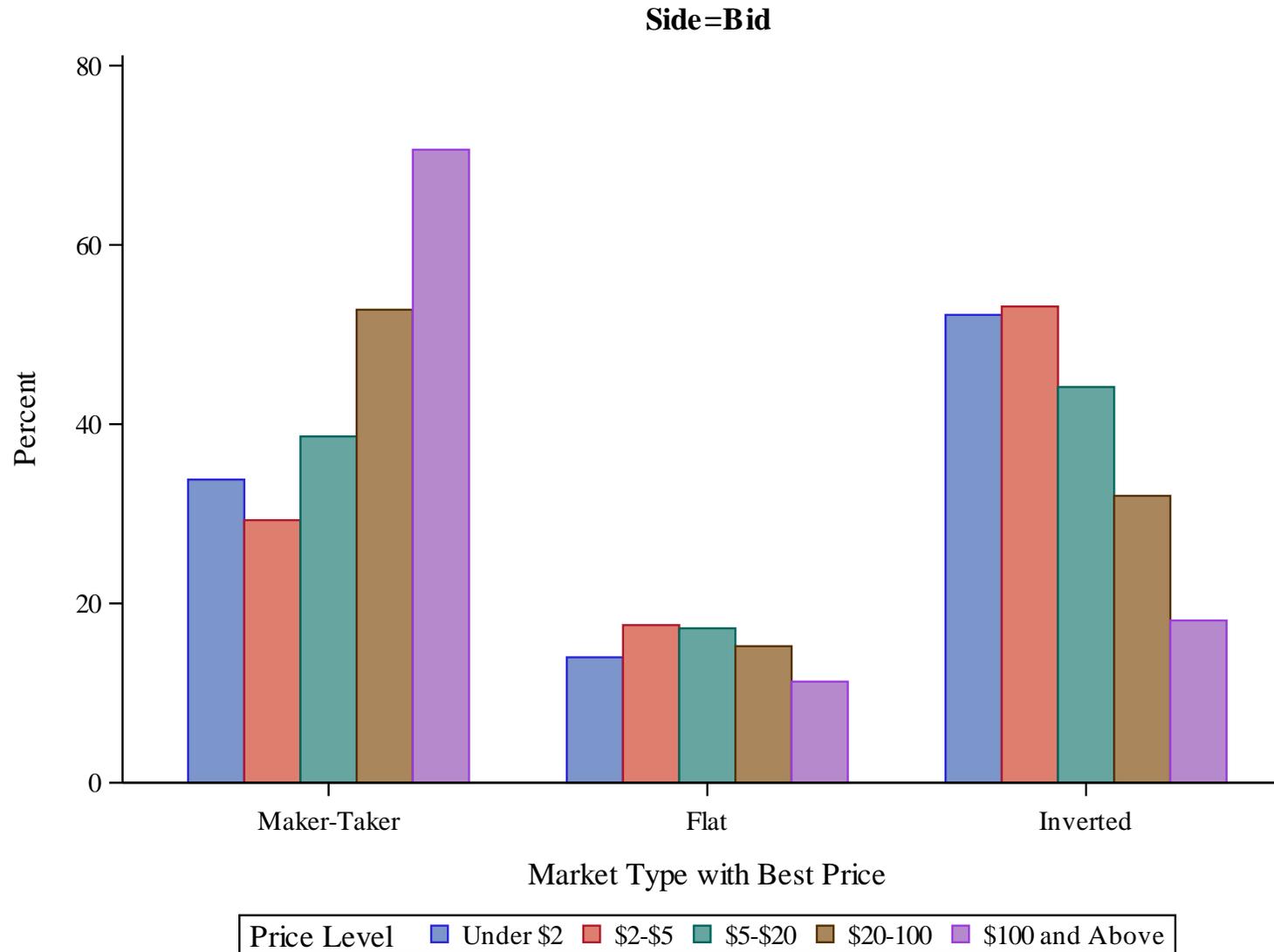
# 1E: Best Offer Mk Shares

3/7/2022 



# 1F: Best Bid Mk Shares

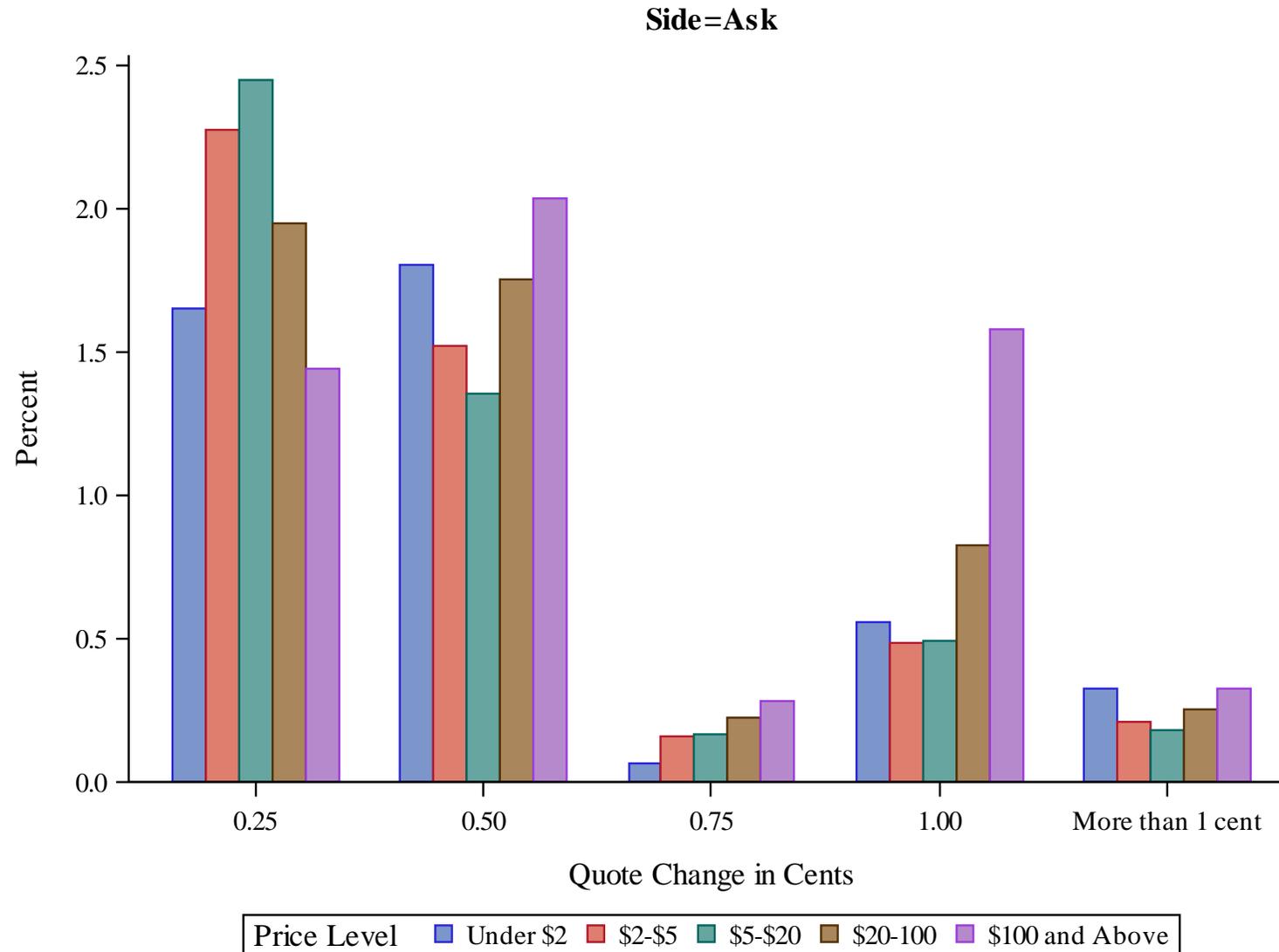
3/7/2022 





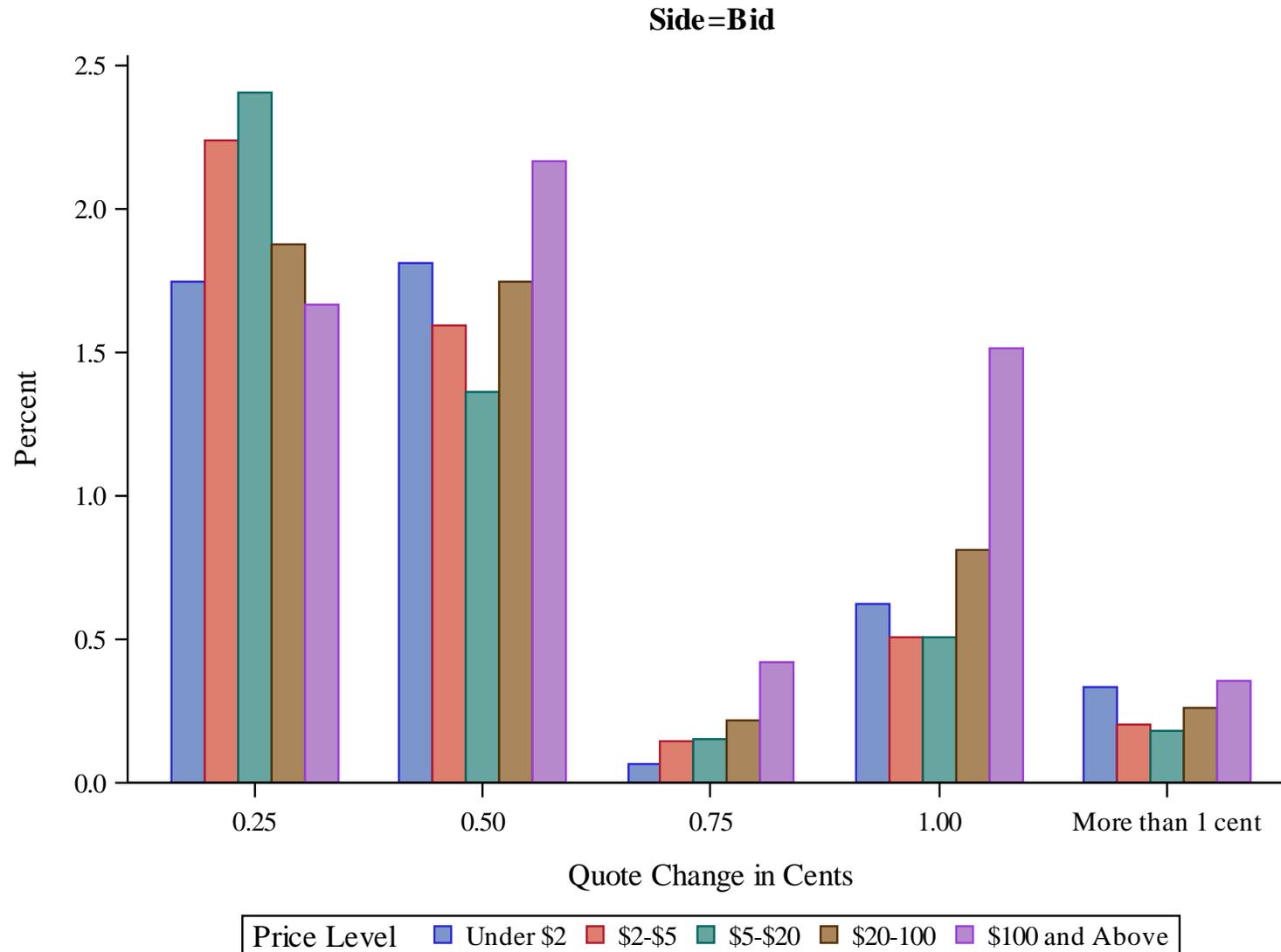
# 2A: Abs Changes in Best Offer

10/15/2021 



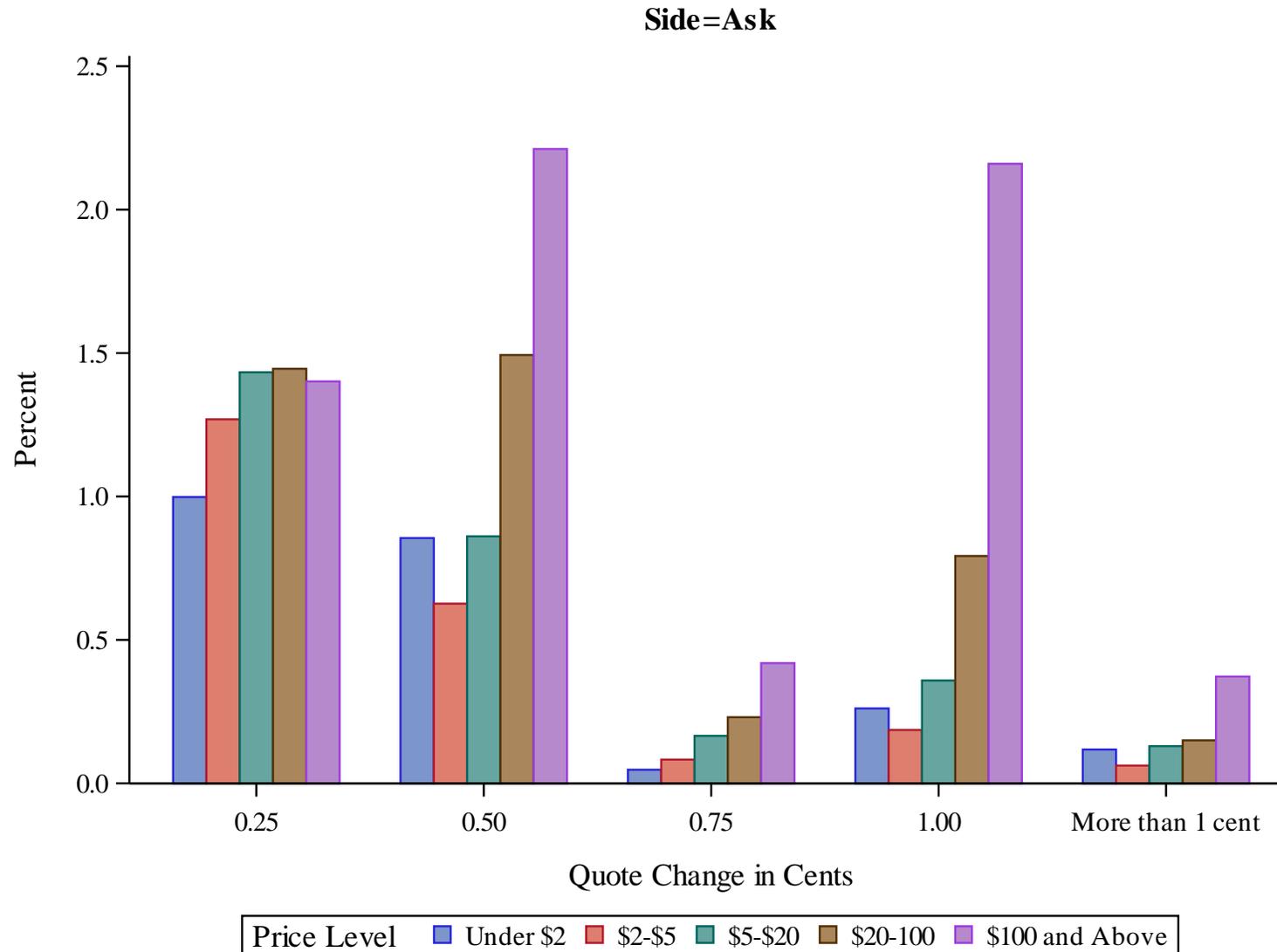
# 2B: Abs Changes in Best Bid

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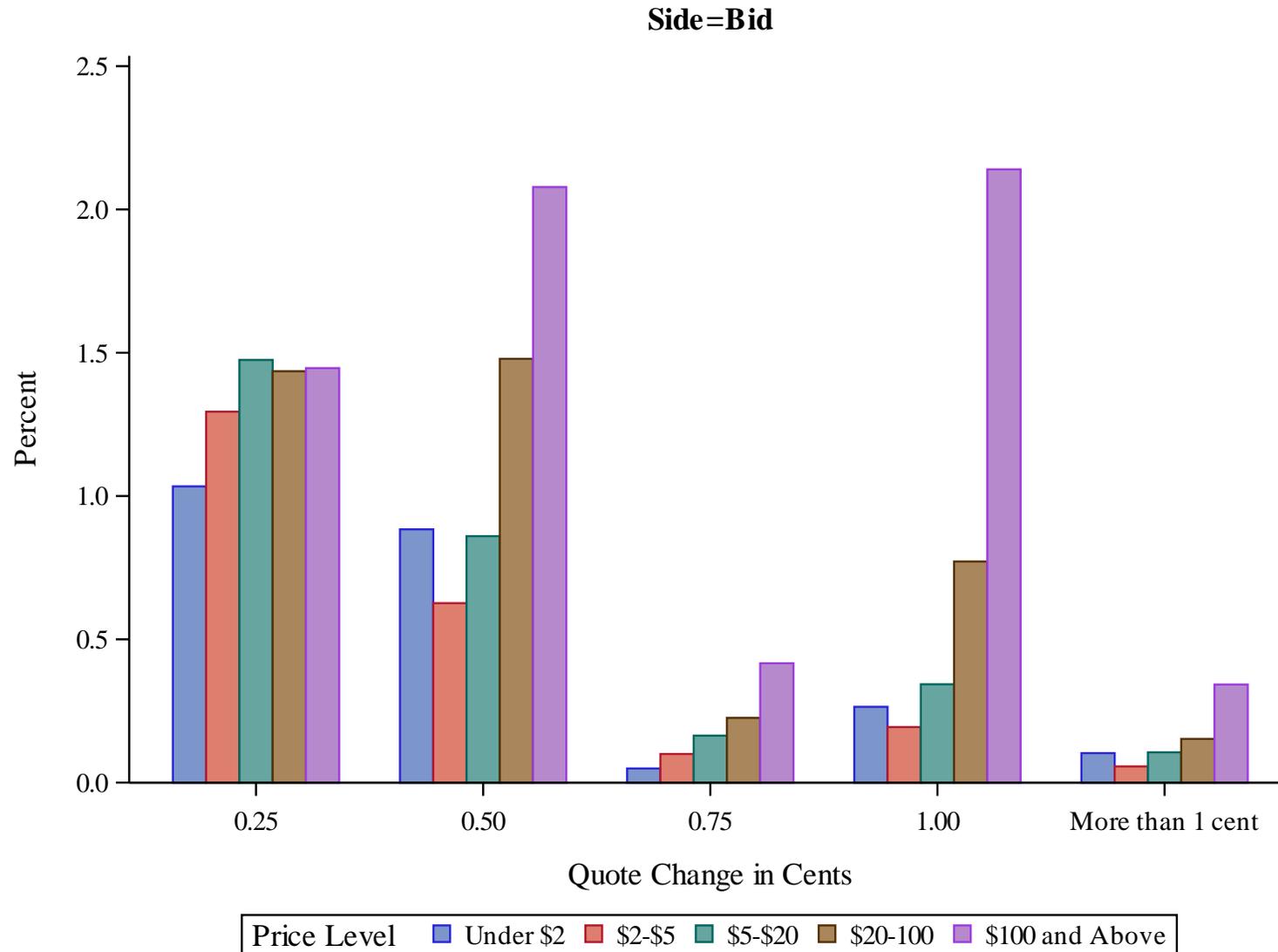
# 2C: Abs Changes in Best Offer

3/4/2022 



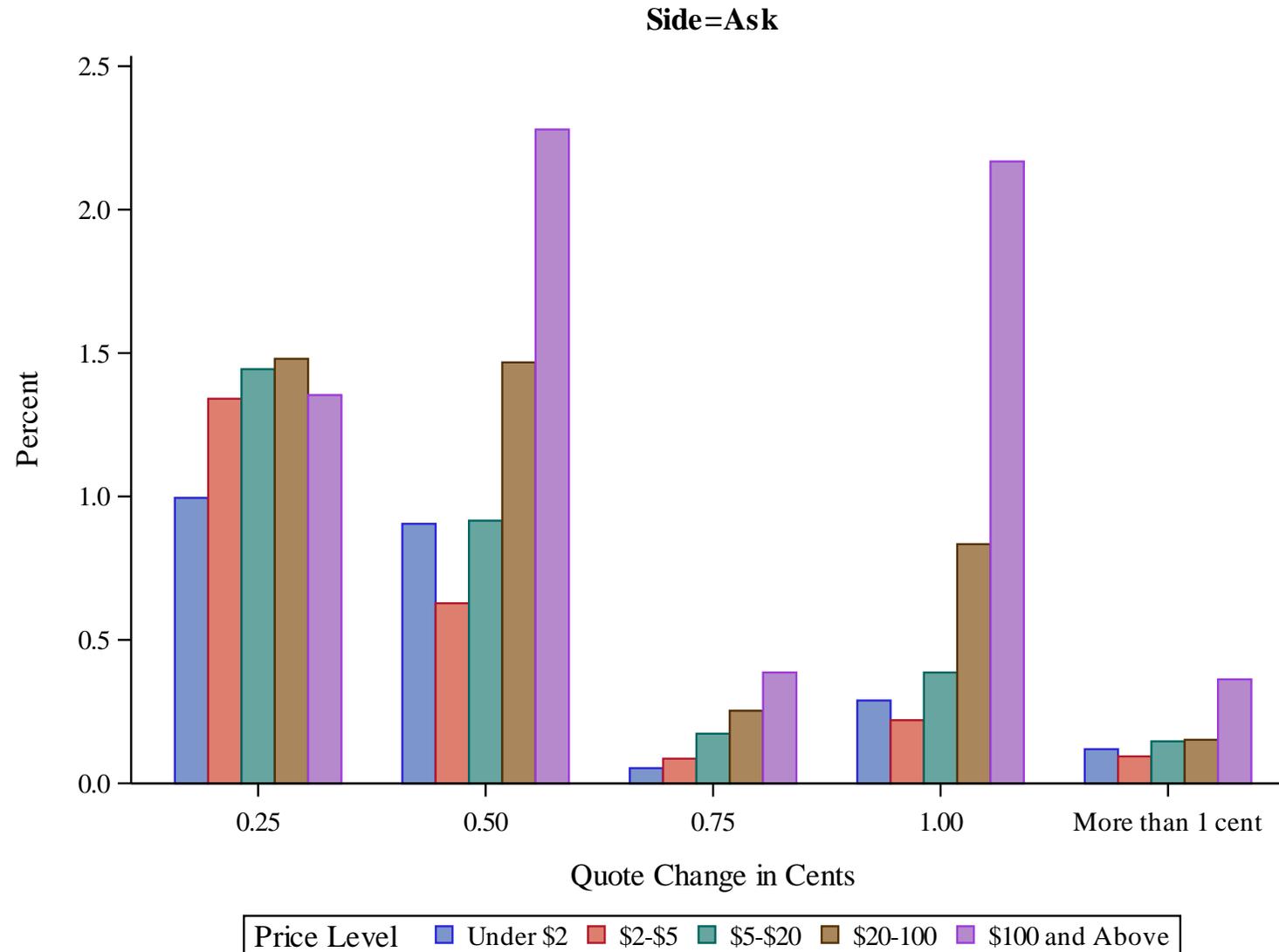
# 2D: Abs Changes in Best Bid

3/4/2022 



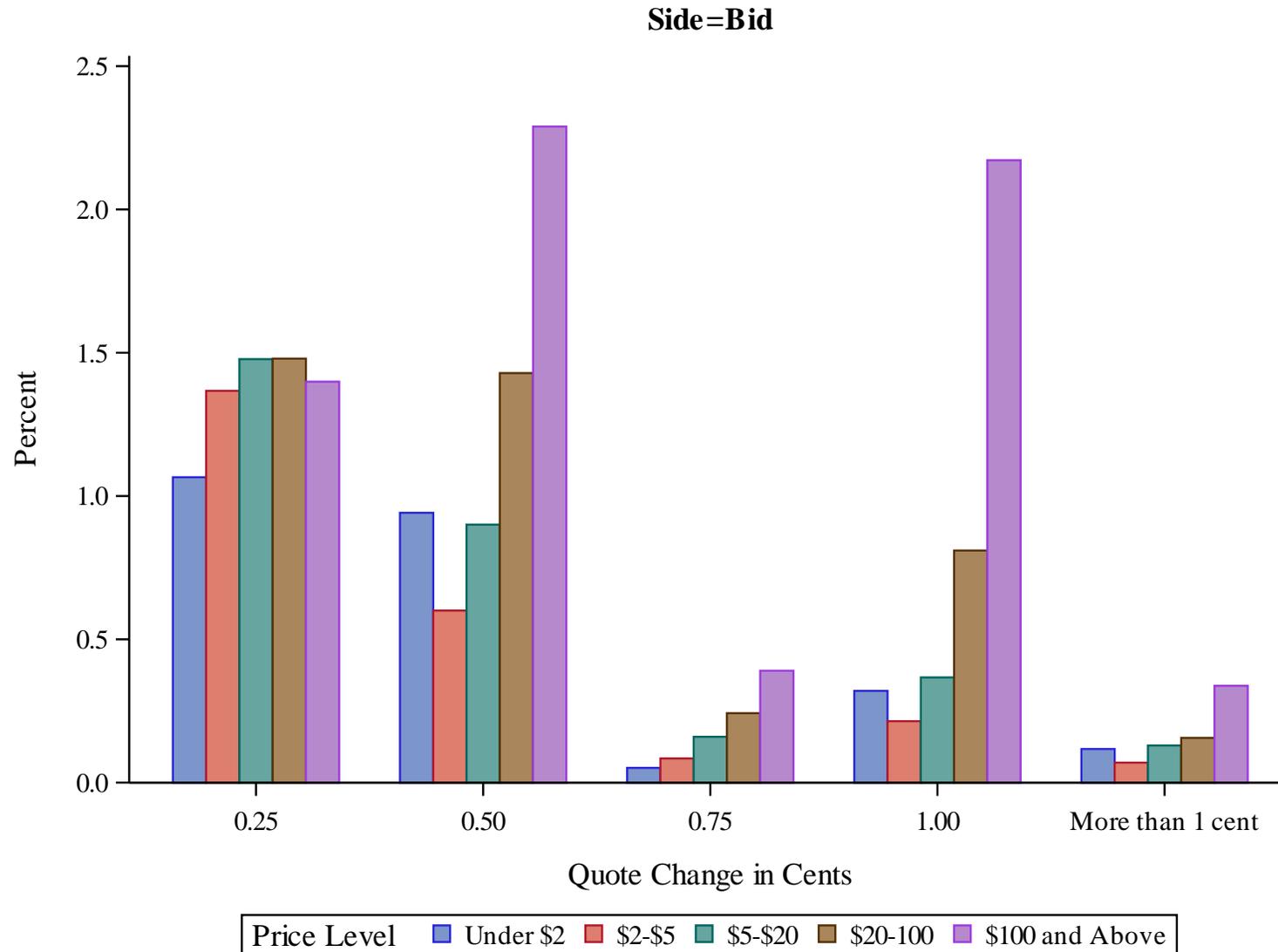
# 2E: Abs Changes in Best Offer

3/7/2022 



# 2F: Abs Changes in Best Bid

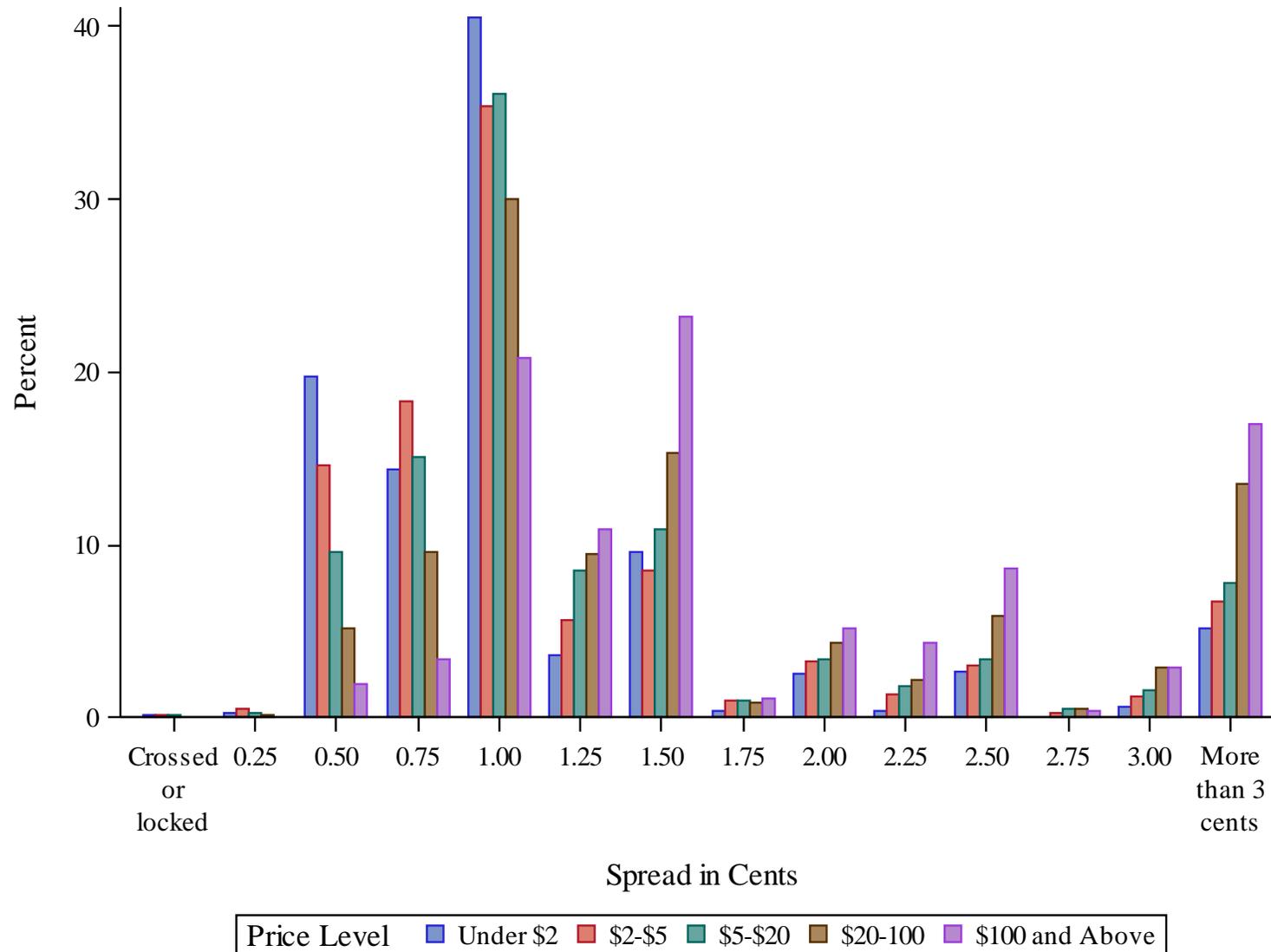
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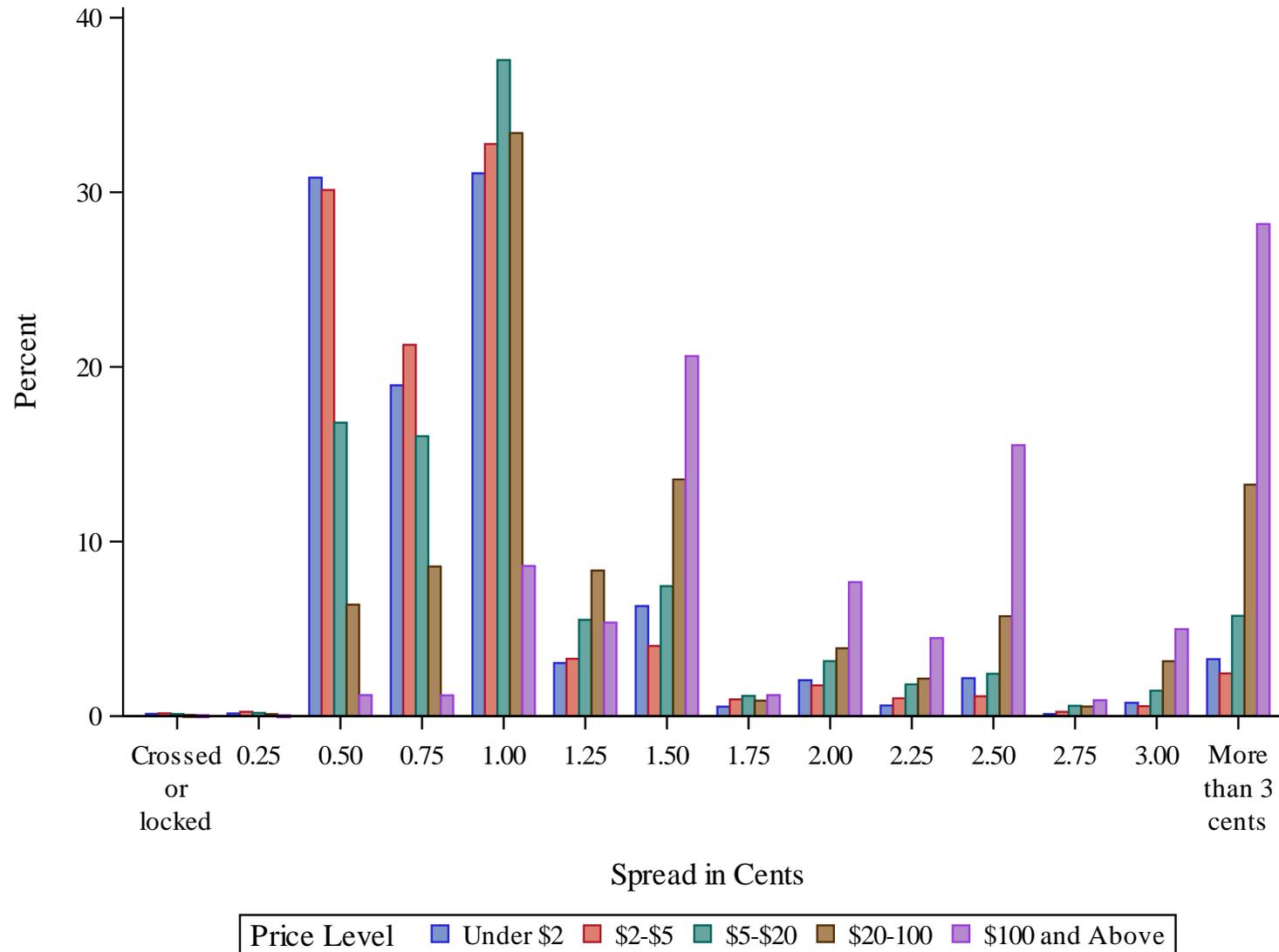
# 3A: Fee-Adjusted NBBO Spreads

10/15/2021 



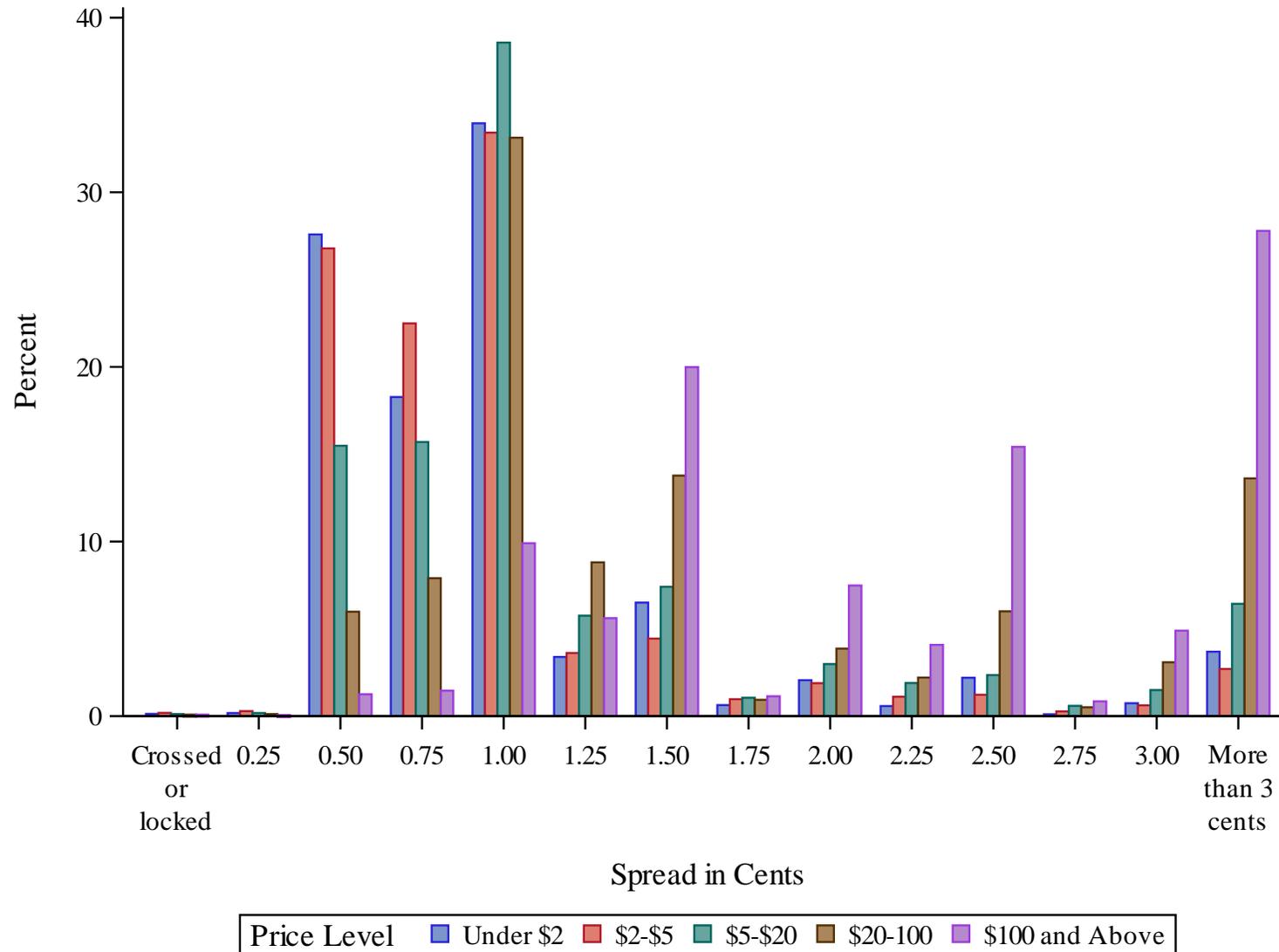
# 3B: Fee-Adjusted NBBO Spreads

3/4/2022 



# 3C: Fee-Adjusted NBBO Spreads

3/7/2022 







# Conclusion



# Summary

- Exchange pricing schemes created a convoluted system that produces a near-complete quarter-penny tick grid.
- Agency problems arise when brokers do not pass transaction fees and rebates through to their customers.
  - Brokers route standing limit orders only to maker-taker exchanges.
  - Algorithms and buy-side trade desks may seek to maximize rebate revenue to the detriment of clients.
- Proprietary traders can trade ahead, disadvantaging other traders.



# The Revenue Pipelines

Brokers, HFTs, and exchanges all benefit from the current exchange transaction fee schedules.

- Brokers get fee rebates.
- HFTs get trading profits.
- Exchanges get market data revenues from selling low-latency data to HFTs who require these data to exploit the quarter-cent tick created by the exchanges' transaction fee schedules.



# Correcting the Problem

- Eliminate exchange transaction fee pricing based on who is the maker or taker.
  - Instead, exchanges can collect fees as they traditionally have, by charging fees to the buyer or seller
- Alternatively, require brokers to pass through all fees and rebates.
  - This proposal should kill the system.
- Eliminate volume discounts.
  - They are anticompetitive.





# Political Economy



# Why is Change So Hard?

- The brokers, HFTs, and exchanges that benefit from the broker-client agency problems created by exchange transaction fees have concentrated interests in the status quo.
  - They lobby senators and provide campaign donations.
- The millions of customers hurt by the system have diffuse interests.
  - Most do not even know about the problem.
  - Only academics and a few larger buy-side institutions are concerned.
    - This paper will help.



# The SEC and Senators

- Senators recognize that current US equity markets are the most liquid in the world.
- Although academics say the markets could be better, nothing is broken, so why act?
  - Risk-averse policymakers are afraid of change.
- Even if the SEC wanted to fix these problems, senators would lobby against change.
  - The issue is not important to them, but campaign donations are.
- The SEC must respect senatorial interests.



# SEC and the Courts

- Brokers, HFTs, and exchanges can afford to effectively fight the SEC in the courts.
- In December 2018, the SEC proposed an exchange transaction fee pilot study.
- The exchanges immediately sued the SEC.
- In June 2020, the District of Columbia Circuit Court ruled that the pilot study plan violated the Administrative Procedure Act and stopped its implementation.
  - The SEC has not undertaken the study.



# Q and A