

Payment for Order Flow and the Retail Trading Experience

Thomas Ernst and Chester Spatt

Abstract

U.S. retail brokers have shifted to a business model with zero-commission trades, earning much of their revenue through payment for order flow (PFOF), under which wholesalers pay brokers to route the orders of their retail clients. The presence of PFOF has led to potential concerns about whether it leads to distortions in routing decisions by brokers, a reduction in market quality due to its effect in segmenting retail orders, or changes in the brokers' incentives to encourage excess trading. While the recent SEC regulatory focus has been on equity markets, two-thirds of all PFOF comes from option markets. PFOF rates in option markets are much larger, creating a system where broker revenue is much higher when retail clients trade options compared to equities, leading to potential incentives to encourage option trading. We consider the current SEC proposal for order-by-order auctions in retail equity trading and its implications for retail investor welfare. We address three alternatives. First, we propose an expansion of equity Retail Liquidity Programs rather than mandated retail auctions. Second, we consider changes to option markets to reduce frictions, which could include fee caps, competitive designated-market-maker assignments, and a more competitive auction process. Finally, we suggest a PFOF-fee cap, which would preserve PFOF, while addressing the large cross-asset PFOF fee differences.



Thomas Ernst is Assistant Professor of Finance at the Smith School of Business at the University of Maryland.



Chester Spatt is the Pamela R. and Kenneth B. Dunn Professor of Finance at the Tepper School of Business at Carnegie Mellon University.

The **Wharton Initiative on Financial Policy and Regulation** is directed by **Itay Goldstein**, the Joel S. Ehrenkranz Family Professor and Professor of Finance at The Wharton School of the University of Pennsylvania. It commissions white papers from leading and emerging experts on a range of topics on financial policy and regulation. For more, see <https://wifpr.wharton.upenn.edu/>

Payment for Order Flow and the Retail Trading Experience

Thomas Ernst (University of Maryland) and Chester Spatt (Carnegie Mellon University)

U.S. retail brokers have shifted to a business model with zero-commission trades, earning much of their revenue through payment for order flow (PFOF), under which wholesalers pay brokers to route the orders of their retail clients. The presence of PFOF has led to potential concerns about whether it leads to distortions in routing decisions by brokers, a reduction in market quality due to its effect in segmenting retail orders, or changes in the brokers' incentives to encourage excess trading. While the recent SEC regulatory focus has been on equity markets, two-thirds of all PFOF comes from option markets. PFOF rates in option markets are much larger, creating a system where broker revenue is much higher when retail clients trade options compared to equities, leading to potential incentives to encourage option trading. We consider the current SEC proposal for order-by-order auctions in retail equity trading and its implications for retail investor welfare. We address three alternatives. First, we propose an expansion of equity Retail Liquidity Programs rather than mandated retail auctions. Second, we consider changes to option markets to reduce frictions, which could include fee caps, competitive designated-market-maker assignments, and a more competitive auction process. Finally, we suggest a PFOF-fee cap, which would preserve PFOF, while addressing the large cross-asset PFOF fee differences.

1. Introduction
2. History and Definitions
 - a. Payment for Order Flow and Price Improvement
 - b. Zero-commission trading
3. Concerns
 - a. Execution Quality
 - i. Split of market maker revenue to PFOF vs. Price Improvement
 - ii. Difficulty competing on execution quality
 - b. Market Quality
 - i. Concentration among wholesalers
 - ii. Specific DMM and auction rules in options that protect profits
 - c. Broker incentives
 - i. Significant differences in PFOF revenue across assets
4. Solutions
 - a. SEC Proposal: Order-by-Order Auctions
 - i. Auctions trade competition for allocative efficiency
 - ii. Auctions and information leakage
 - b. Technical Alternatives:
 - i. Retail Liquidity Program expansion in Equity Markets
 - ii. Option Changes: Competitive DMM assignments, level playing field for auction bidding, reduced access fees
 - c. PFOF Fee Cap: A cap on PFOF could equalize broker revenue across assets
5. Conclusion

I. INTRODUCTION

The automation of trading has been a decades-long process, with brokerage commissions substantially reduced from the fixed-commission era to the discount broker era, and now to the zero-commission era. All five of the largest U.S. retail brokers no longer charge commissions on equity trades, with several of the firms earning substantial revenue from payment-for-order-flow (PFOF), whereby wholesalers pay brokers for the right to fulfill their clients' orders. Concomitantly, retail trading volume has surged, in both equity and option markets, and PFOF has gained renewed interest from regulators.

This white paper investigates various concerns about PFOF and considers several potential improvements for the retail trading experience. While PFOF enabled zero-commission equity trading and remains a critical source of revenue for several discount retail brokers, PFOF highlights a number of concerns about the health of markets.

One concern about PFOF is that it can influence and distort a broker's routing decision, "akin to commercial bribery" (Roberts 1993). However, we highlight that brokers who require PFOF payments charge the same rate on a given order type across all wholesalers (providing a level playing field), which prevents routing to a venue offering worse price improvement, but better PFOF. On the other hand, dollars committed to PFOF are dollars which flow directly to the broker rather than the consumer, so at best can only indirectly benefit the consumer.

A second concern about PFOF is the impact on market quality from the segmentation of retail orders. Retail market making is a concentrated business: in both equity and option markets, the top two firms respectively hold a 60% market share. While some of this concentration may be due to scale economies in market making and intermediation, we believe that some of it is a result of particular rules for U.S. option markets. All option trades must be executed on exchanges, but some exchanges have adopted rules which facilitate internalization (whereby the market maker who purchased and routed the order is the one who executes against it) with little competition. These exchange rules sometimes restrict who can internalize trades or compete for retail order flow and create a barrier to entry for buying order flow from brokers. Chief among these rules is the unique ability of Designated Market Makers (DMMs) to internalize option trades.

A final concern over PFOF is the effect that it has on broker incentives. PFOF rates vary across assets. Options PFOF rates are higher than equity rates, and two-thirds of all PFOF arises

from option markets rather than equity markets. Additionally, option portfolios lead to skewed portfolio returns. This creates a potentially powerful incentive misalignment with a broker's fiduciary duty to act in its clients' interests, as brokers earn substantially different PFOF depending on what their clients choose to trade. In fact, the current SEC market structure proposal addresses equity market structure, but not options market structure or the interaction between equity and options markets.

Given these concerns over PFOF, we explore several possible improvements to retail trading. The first is the proposed SEC Rule 615 (Order Competition Rule), which would mandate equity auctions for retail trades. These auctions offer potentially increased efficiency in allocations for retail orders, but at the cost of decreased competition, as the auctions would suffer from a winner's curse, where heterogeneously informed market makers bid against each other (Ernst, Spatt, and Sun, 2023). The winning bidder tends to overpay in a common-value auction as well as from information leakage (Battalio and Jennings, 2023). These concerns would be especially severe for illiquid securities.

Instead of order-by-order auctions, we will consider three alternative improvements to markets. The first is an expansion of Retail Liquidity Programs (RLPs), which are exchange programs that enable market participants to post limit (price-contingent) orders, which are only accessible by retail market orders (orders by retail investors willing to trade at the market-clearing price). This allows market participants to offer price improvement to retail investors, while reducing the information leakage problem of mandated auctions (institutions are reluctant to post orders for lesser amounts that potentially reveal their interest in larger trades). Existing RLPs cannot display prices, and allowing more latitude for them to do so, combined with oversight to ensure that retail investors always receive prices at least as good as RLP quotes, may help RLPs gain market share.

Our second proposal is a series of improvements to option markets. Both competitive DMM assignments and limiting the self-routing ability of DMMs would help reduce barriers to entry in option market wholesaling. Changing option auctions to reduce the advantages of auction initiators would encourage competitors to bid more aggressively. Lastly, reducing access fees, and in particular asymmetric access fees, would reduce some of the profits from internalizing trades.

Our final proposal is a fee cap on PFOF itself. A fee cap would allow PFOF to continue

as a source of broker revenue, possibly with a cap high enough to preserve zero-commission trading. Execution quality is difficult to measure, even for sophisticated institutions; to the extent that charging higher PFOF (at the cost of lower price improvement) allows brokers not only to eliminate commissions but to earn large profits, a cap on PFOF can curb any excesses.

Furthermore, a cap on PFOF would reduce revenues for what are currently the highest-paying assets, and reducing this disparity in PFOF across assets would reduce any broker incentive misalignment that encourages recommending higher-PFOF assets.

II. History and Definitions

A. Payment-For-Order-Flow and Price Improvement

While PFOF has been discussed by regulators for more than 30 years, the recent uptick in retail trading in a zero-commission environment has brought PFOF to the forefront of regulatory interest. Retail brokers receive PFOF to encourage routing their client orders to particular market makers. Market makers with a large business fulfilling retail customer orders are called wholesalers. These wholesalers may “internalize” trades by trading directly with the retail customers, or they may “externalize” trades by routing them to other market makers, alternative trading systems like dark pools, or to traditional exchanges. Whether or not PFOF is involved, most retail brokers route orders directly to wholesalers, rather than to exchanges.

Market makers prefer orders from retail investors to those of anonymous market participants. Battalio and Holden (2001) argue retail investors have lower adverse selection, while Baldauf, Mollner, and Yueshen (2022) model retail investors as less correlated in their trading. When market makers trade with retail investors, they know each trade is likely a one-off trade, and not the first child order of a large parent order or a trade from a highly informed professional counterparty. To obtain retail orders, wholesalers are willing to give both PFOF to the broker, and price improvement to the retail investors. Retail brokers have a best execution duty to route their client orders optimally, so wholesalers who offer superior price improvement can expect to receive a larger share of retail investor orders. The uniformity of the PFOF rates charged by a particular broker should limit the distortion in routing created by PFOF.

Routing directly to wholesalers offers a variety of advantages for retail brokers, and Battalio and Jennings (2022) note that even brokers which do not accept PFOF route almost all their orders to wholesalers rather than exchanges. Wholesalers can offer both PFOF and price improvement to segregated retail orders, but they also can offer a series of practical advantages,

including investing in low latency trading technology, subscribing to all exchange direct data feeds, trade reporting infrastructure, and qualifying for volume tiers for exchange pricing.

When retail brokers do accept PFOF, they are required to disclose any payments they receive for routing customer orders under SEC Rule 606. Under FINRA Rule 5310, brokers must conduct a regular review of market centers to ensure their customers obtain best execution and must “justify why [factors including PFOF] is not modifying its routing arrangements” in a way that would be disadvantageous to customers. In practice, each broker sets a single PFOF rate, and all wholesalers pay the broker that single PFOF rate.¹ This eliminates the ability to route orders to a wholesaler who offers less price improvement, but more PFOF, and ensures compliance with FINRA Rule 5310. When a broker sets a single PFOF rate or formula that applies to all market centers, the broker is left free to determine routing solely on the execution quality of each wholesaler rather than any differences in PFOF payment. Furthermore, the regulations prevent payment for order flow and other inducements from interfering with the broker’s fiduciary duty to obtain best execution on behalf of his customers.² Brokers who do not accept PFOF also route their equity trades to wholesalers (despite the absence of payments) rather than to exchanges (Battalio and Jennings 2022), as wholesalers receiving segmented retail order flow can offer more price improvement than exchanges.

B. Zero-Commission Trading

Robinhood introduced zero-commission trading in March 2015, earning revenue largely from PFOF, rather than a combination of commissions and PFOF. Table One presents the six largest PFOF recipients in 2021, and the percentage of revenue for each firm. TD Ameritrade earns more total PFOF than Robinhood, but Robinhood obtains a larger share of its revenue from PFOF than most brokerages, with 54% of Robinhood’s revenue coming from equity and options PFOF in 2021.³

¹ Two brokers set a PFOF rate as a formula defined on the bid-ask spread (Subcommittee on Oversight and Investigations, 2022). For these firms, the formula is applied to all market centers equally. If these brokers route more orders with narrow spreads to one market maker, and more orders with wide spreads to another market maker, PFOF rates reported by the broker will differ across market makers, though the formula applied to each market maker is the same.

² For example, Securities and Exchange Commission, December 2000, “Special Study: Payment for Order Flow and Internalization in the Options Markets.”

³ SEC 606 reports must be filed for equity and option trades. There is no reporting requirement for cryptocurrencies, but they can generate transaction-based revenue in a similar fashion as equity and options. In 2021, 13% of Robinhood revenues came from cryptocurrency transaction-based revenue.

Table One: PFOF By Broker (SEC Rule 606 filings). For the top six brokers receiving PFOF, we summarize their total PFOF revenue, as well as the percentage of their total revenue coming from PFOF in 2021. Note that for E-trade, we use 2020 revenue numbers due to its acquisition by Morgan Stanley, and Weibull revenue not being public.

Broker	PFOF (Millions)	Percentage of Revenue From PFOF
TD Ameritrade	1,421	24%
Robinhood	974	54%
Etrade	454	15%
Charles Schwab	320	2.9%
Weibull	208	-
Fidelity	162	1%

Robinhood grew quickly, from under two million accounts with \$4.5 billion in assets in 2017 to over 22 million accounts with \$100 billion in assets in 2021. Similarly, overall option trading increased 35% from 2020 to 2021, to an average of 39 million contracts.⁴ Analogously, BNY Mellon Wealth Management reported in November 2021 that “Retail investors’ share of total equities trading volume is now approaching 25%, up from 20% in 2020 and 10-15% the preceding decade.” Competition among brokerage firms led TD Ameritrade, Fidelity, Charles Schwab, and E-Trade to all reduce commissions from \$5 to \$0 in October 2019. Vanguard eliminated commissions for ETFs in October 2018, and for all stocks in January 2020. With all major brokerages offering zero-commission trading, brokers must operate using other sources of non-commission revenue. For several brokerage firms, PFOF is a significant source of revenue, and substantial reduction or elimination of PFOF would require fundamental changes to the funding model for retail trading. Robinhood’s focus on PFOF allowed the brokerage start-up to enter the industry with zero-commission trading. On average, wholesalers pay brokers twenty cents for every 100 shares they route, which means that to generate \$5 in PFOF at this rate, would require the broker to route 2,500 shares. Switching from \$5 commissions to zero-

⁴ Yun Li, December 22, 2021, “Options Trading Activity Hits Records Powered by Retail Investors, But Most are Playing a Losing Game,” CNBC.

commission trading has therefore reduced broker revenue, even considering PFOF, on all but the largest retail orders.

III. Concerns Over PFOF

A. Concerns over Execution Quality

Wholesalers improve exchange prices both by paying for order flow and by offering price improvement. If wholesaler revenue is the bid-ask spread, then the total of PFOF and price improvement is bounded by the bid-ask spread. Allocating a dollar toward PFOF or a dollar toward price improvement has the exact same impact on wholesaler revenue, thus dollars directed toward PFOF for brokers are dollars that cannot be directed toward price improvement for retail investors. This creates a direct tradeoff between PFOF and price improvement (Securities and Exchange Commission, 2020).

Dollars received by brokers as PFOF may be passed through to retail clients through services or reduced fees or kept as profit. Robinhood's zero-commission trading was an explicit by-product of their PFOF-focused model, as the revenue from PFOF obviated the need to charge commissions. If PFOF revenue were eliminated, this revenue source would need to be replaced.

If PFOF revenues are kept as profits and not passed to the ultimate retail investor through better services, market competition may fail to discipline brokers if retail investors do not fully understand and act upon differences in execution quality. Even for sophisticated investors, execution quality is difficult to measure, despite the availability of data. All market centers or wholesalers must file monthly reports on execution quality for equity markets. These reports, required by SEC Rule 605, give statistics on the effective, quoted, and realized spreads⁵ of orders executed by each broker, broken down by size categories. Surprisingly, there is no analogy to Rule 605 reports for options trading, which is reflective of more limited attention to the market structure for option trading and the greater complexity of the options market and its trading opportunities.

SEC 606 reports require each broker to report where they route orders. Ostensibly, one could evaluate where brokers route orders against the 605 reports produced by those market

⁵ Quoted spreads are defined as the difference between the best ask and the best bid and present a standard transaction-cost measure for trading. Investors sometimes pay less than the full spread, and effective spreads are defined as twice the difference between the price paid and the mid-quote. Realized spreads are defined as twice the distance between the price paid and the mid-quote sometime after the trade (often five minutes). Prices often move against market makers following trade (termed adverse selection), and realized spreads account for this price movement.

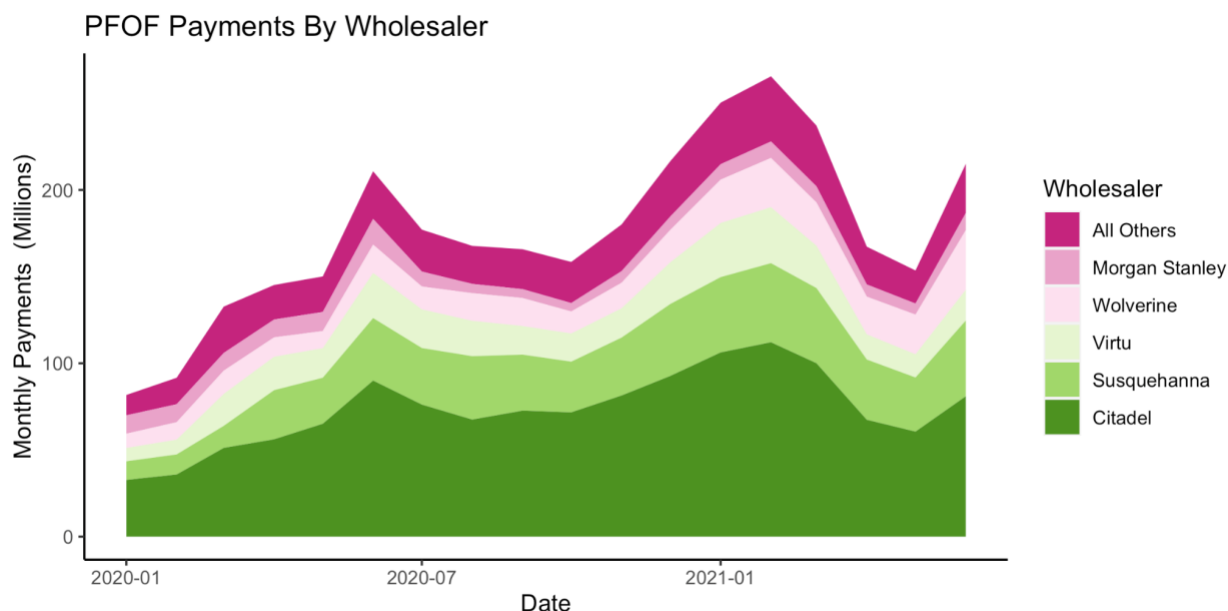
centers, but market centers may offer different prices to different brokers. Schwarz et. al. (2022) document significant differences in execution quality among retail brokerage firms, for example, which are likely driven by differences in broker clienteles. Brokers with sophisticated—or unsophisticated but correlated—clients will obtain less improvement, as market makers trading against sophisticated clients will be willing to give less price improvement.

B. Concerns over Market Quality

Over 90% of all retail orders are routed to wholesalers. This degree of segmentation has raised some concerns among regulators. Current SEC Chair Gary Gensler, speaking before the Investor Advisory Committee in September 2021, summarizes the concern: “nearly half of trading along with a significant portion of retail market orders happens away from the lit markets [which display bid and ask prices and trading volume]. I believe this may affect the width of the bid-ask spread.” The concern is that if retail investors are removed from exchanges, traders left on the exchange will have a higher level of information, leading to wider spreads. This is a widely recognized feature of segmentation, as retail investors receive better prices due to the adverse selection or correlation in their trades. As noted above, the extent of improvement will vary across retail brokers.

Retail wholesaling also is a very concentrated business, which is reflective of the extent of the underlying scale economies in market making. Figure 1 plots monthly payments made by wholesalers reported on SEC 606 reports. Citadel, the top firm, made 41% of all payments. Susquehanna and Virtu, the second and third-ranked wholesalers, respectively made 18% and 11% of all payments.

Figure 1: PFOF Payments By Wholesaler (SEC Rule 606 filings). We plot total monthly payments across combined equity and option markets by wholesaler.



C. Concerns Over Internalization Rules in Option Markets

Clearing requirements imply that all option trades occur on exchanges.⁶ Unlike equities, there is no off-exchange trading for options, including off-exchange internalization. Option exchanges, however, have several rules that facilitate internalization of trades. One set of rules pertains to designated market makers, another set of rules pertains to price improvement auctions, and a third set of rules pertains to trading fees.

When a broker routes an order to a wholesaler, the wholesaler in turn has a choice of which exchange to route the order. If the order is routed to the exchange as a standard trade, the order would go to the best bid or ask. If there are multiple orders at the best bid or ask, the order will be allocated according to the price-time or pro-rata rules at that exchange. For wholesalers seeking to internalize a trade, this creates a challenge compared to equity, as they would need apparently to be at both the NBBO and the front of the queue to internalize a trade.

Exchanges who appoint DMMs designate a single firm for each security, such that these firms gain a combination of special responsibilities to offer liquidity (such as quoting obligations) and unique privileges, including the ability to route retail trades to their own quotes.

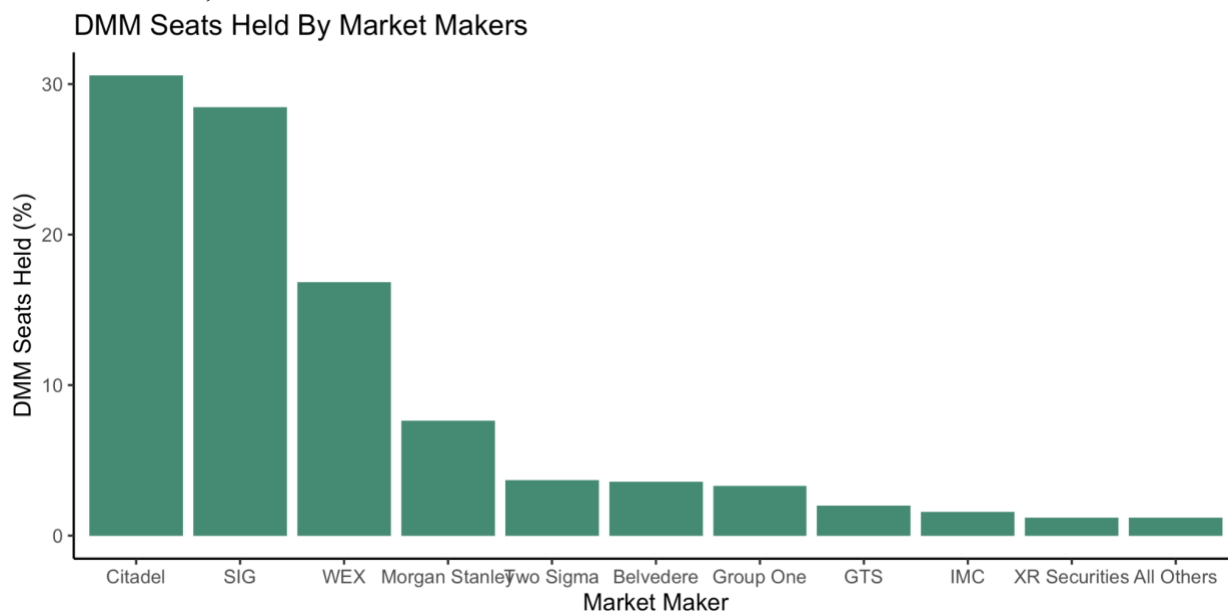
⁶ The options purchased and sold on various exchanges are interchangeable through the unified clearing mechanism.

The top two firms control 59% of all DMM seats, and those same two firms capture a similar proportion of retail option order flow. DMM seats are rarely reassigned, limiting competition for buying retail order flow. While not all trades can be internalized via the DMM route, exchanges offer other alternatives to internalize trades, like auctions, which offer additional advantages to the firm managing the order. In auctions, the market maker who initiates the auction can auto-match competing bids and receive an outsized allocation of the order in the event of a tie. Option markets also have large access fees, and often have an asymmetric fee schedule, whereby an internalizer is charged a lower fee than any competitors, offering another advantage to the initiator.

Designated Market Maker assignments, vastly improve the ability of a wholesaler to internalize trades. DMM assignments allow the DMM to internalize the first five contracts (500 shares) of any order they route to the exchange, provided they are quoting at the NBBO. In other words, the queue position for a DMM does not matter for internalizing. As long as they are quoting at the NBBO, they will obtain 100% of the order for up to five contracts for any orders they route to the exchange.

The ability to internalize the first five contracts of any trades changes the incentives of option DMMs who internalize orders. For example, if a DMM is at the back of the queue on a time-priority exchange, posting a new quote which improves upon the NBBO would allow it first access to incoming market orders, but any orders they internalize would occur at the new, narrower NBBO. Ernst and Spatt (2023) exploit exchange-symbol level variation in DMM assignments to compare PFOF-paying DMMs with non-PFOF paying DMMs. Quoted, effective, and realized spreads are higher when the exchange's DMM pays for PFOF, consistent with PFOF-paying DMMs using their advantage to profitably internalize trades. Exchanges almost never re-assign DMM seats, creating a barrier to entry for new entrants. Figure 2 highlights the concentration in designated-market maker seats, with the top two firms holding 579% of all stock-exchange level DMM assignments.

Figure 2: DMM Seats Held by Each Market Maker. We plot the total percentage of Designated Market Maker (DMM), or Specialist seats held by each market maker, across all exchanges and symbols. Citadel holds 30% of all seats, Susquehanna International Group holds 26% of all seats, and Wolverine Execution Services holds 15% of all seats.



Wholesalers also can internalize trades in auctions. These auctions, which go by the names "Price Improvement Mechanism", "Customer Best Execution (CUBE)," or an "Automated Improvement Mechanism," all create an auction for an individual order. While any market maker can bid through this auction, the wholesaler who initiates the auction obtains several advantages. The initiator has a right to auto-match any competing bids in the auction, obtain an outsized allocation in the event of a tie and obtain reduced trading fees compared to other bidders.

Option exchanges also have asymmetric fee schedules which reduce competition, as the initiator pays a lower fee to trade with an order than any competing bidders. Some exchanges charge high trading fees but rebate a substantial portion of these fees to designated market makers. This creates a further barrier to competition between designated market makers and other market participants. Option auctions can have asymmetric fee schedules, where the initiating market maker pays a lower fee to trade than any competing bidders, which further reduces incentives of competing market participants to bid in auctions.

Each of the initiator advantages has the potential to make bidding less competitive, particularly for small orders. As an example, consider an order for either one or two contracts, where the initiator decides to auto-match. For a two-contract order, a competitor who bids will obtain one contract, while the initiator will obtain the other. For a one-contract order, the

competitor obtains nothing, as a single contract cannot be split. Ernst and Spatt (2023) show that one-contract orders receive less price improvement, and earn larger realized spreads, than two-contract orders. Bryzgalova, Pavlova, and Sikorskaya (2022), Hendershott, Khan, and Riordan (2022), and Ernst and Spatt (2023) all examine option auctions, and the ability of retail wholesalers to internalize retail trades via auctions. Bryzgalova, Pavlova, and Sikorskaya (2022) focus on tracking retail investor activity via auctions, while Hendershott, Khan, and Riordan (2022) examine price improvement auctions theoretically and empirically and argue option auctions are consistent with cream-skimming, with auction trades having lower price impact than limit order book trades. They estimate that without the cream-skimming that they observe, auction average bid-ask spreads would narrow from 10 cents to 9 cents. Ernst and Spatt (2023) point out that auctions are just one method of internalizing trades, with the DMM seats providing a second method, and one which is inaccessible to firms without DMM seats. Retail brokers who route order flow to market making firms will evaluate execution quality on the entire bundle of orders executed by that firm. A market making firm interested in having the auction initiator advantage could obtain order flow directly from a retail broker, but if the market making firm has no DMM seats and can only internalize orders through auctions, they may struggle to compete on the combination of PFOF and price improvement offered by a market making firm which holds DMM seats and can use both DMM seats and auctions to internalize trades.

D. Concerns over Broker Incentives

While brokers are paid the same rate by all wholesalers, the PFOF paid to brokers will vary depending on what assets their clients trade. Figure 3 plots total PFOF by asset class. Despite the focus of the current SEC proposals on stocks, over two-thirds of all PFOF are paid on retail option trades. This pattern is consistent across months, and across brokers, with all major brokers earning more from option PFOF than equity PFOF.

Figure 4 plots the average payment rate per 100 shares traded for different assets. For every 100 shares traded, options pay almost double what equity orders pay. In an era of \$5 commissions, an option trade would give a market maker 4% more revenue than an equity trade. With \$0 commissions, an option trade would give a market maker 100% more revenue than an equity trade. Differences in prices between stocks and options provide further amplification. The average retail stock trade is in a \$25 stock, while the average retail option trade is in a \$5 option. A nominal investment of \$1,000 in a \$25 stock would generate a 40-share equity order worth 8

cents in equity PFOF, while a nominal investment of \$1,000 in a \$5 option would generate a 200-share option order worth 80 cents in option PFOF. In other words, the same nominal investment in options will generate 10 times as much PFOF as an investment in equity.

Figure 3: Total PFOF by Asset. We plot total PFOF payments recorded by the top five U.S. retail brokers, calculated from SEC Rule 606 Reports.

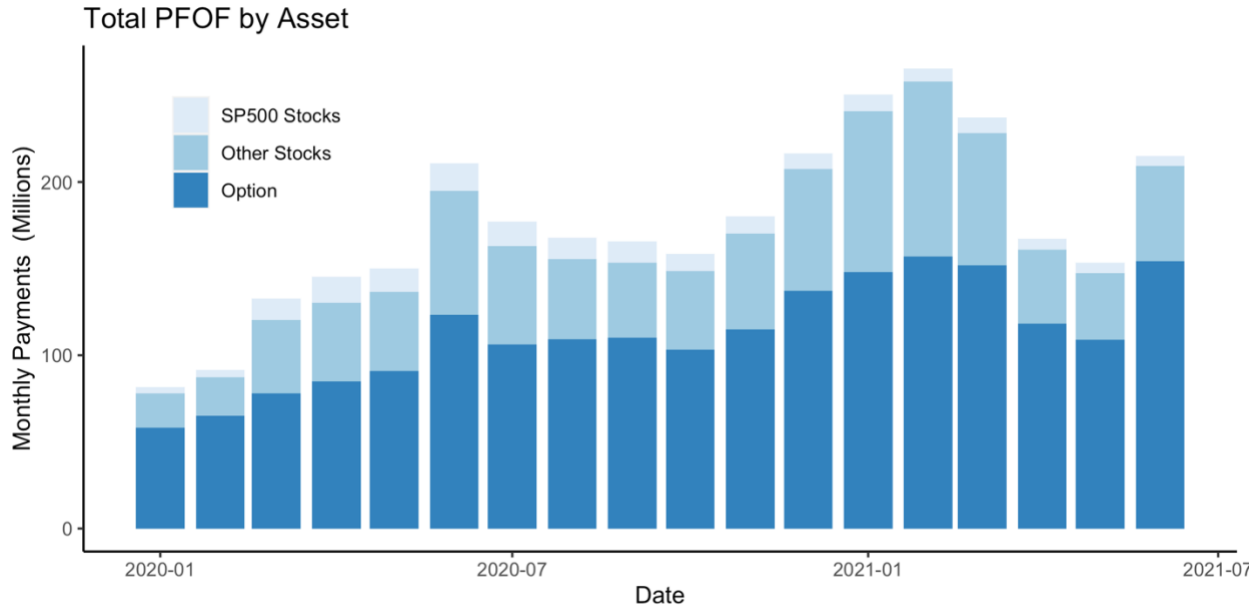
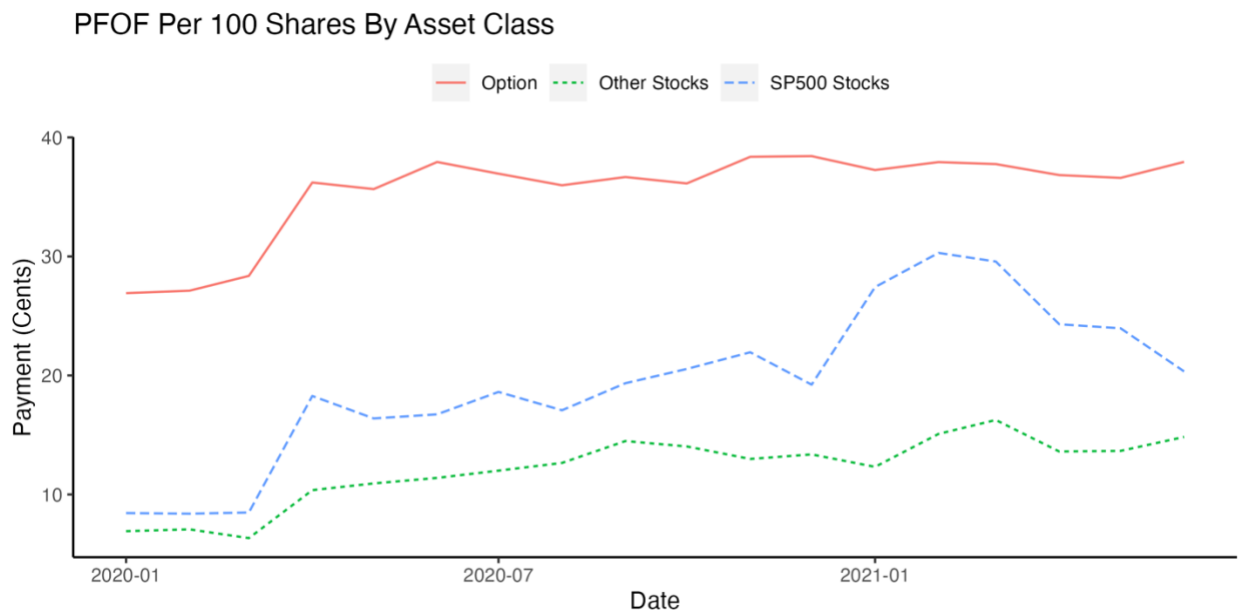


Figure 4: PFOF Rate by Asset. We plot the PFOF rate per 100 shares, averaged across the top five U.S. retail brokers, calculated from SEC Rule 606 Reports.



This discrepancy between stock and option PFOF also exists within stocks. Two firms have PFOF rates proportional to the bid-ask spread (SEC Proposed Rule 615, page 246). When clients of these two firms trade stocks with wide spreads, the firms earn more PFOF than they do when their clients trade stocks with narrow spreads.

SEC Regulation Best Interest (BI) requires brokers to “act in the best interest of the retail customer ... without placing the financial or other interest of the broker-dealer ahead of the interests of the retail customer.” Brokers can obtain higher revenues when their clients trade options or stocks with large spreads, as they will obtain larger PFOF on these orders.⁷ The ability of a retail broker to influence their client investments can be varied and subtle. For example, a broker could highlight that many clients are buying a particular stock, or that a particular stock has gone up or down in price, without explicitly suggesting that a client buy that stock.

Many retail brokerages offer option trading as well as stock trading and can shape investor behavior through subtle choices. One brokerage which allows trading options reminds users that call options profit when prices rise; while this may be a helpful reminder for some traders, it also begs the question of whether options are suitable for investors who are unfamiliar with the terminology of calls or puts. Bryzgalova, Pavlova, and Sikorskaya (2023) highlight that many retail traders fail to exercise call options optimally around dividend payments, providing additional evidence that many retail investors may lack the sophistication to understand products they are trading. Many aspects of app or website can exert a suggestive influence on investors, and the SEC has recently released a proposal to hold algorithms to similar standards as investment advice.⁸ The proposal covers a wide range broker of messaging which could optimize for, guide, forecast, or direct investment-related behaviors and outcomes, including AI chatbots and push notifications on mobile trading applications.

IV. PROPOSED SOLUTIONS

A. SEC Proposed Rule 615

The SEC has proposed Rule 615, the “Order Competition Rule” which would create a new system for executing retail trades. Under this system, retail orders could be internalized by

⁷ Focusing on revenues does not address differences in cost associated with brokerage services for options vs. equity.

⁸ Kiernan, P., July 26, 2023, “Apps Like Robinhood Make Trading Fun, but SEC Fears It is Costing Investors,” *Wall Street Journal*.

wholesalers at mid-quote, but any retail orders which wholesalers do not wish to internalize at mid-quote would have to go to an auction. In these auctions, retail market orders would be up for bidding from all market participants in a public sealed-bid first-price auction. The auctions would be operated by exchanges, conducted over 100 to 300 milliseconds, and identify the submitting retail broker.

SEC Rule 615 does not directly address PFOF, but instead indirectly seeks to limit wholesaler profits from internalizing retail trades. Wholesalers would only be able to directly internalize trades at mid-quote. For trades that enter an auction, any participant could bid on the order. Unlike the auction market, the wholesaler who initiates the auction would have no advantage through a favorable trading fee, outsized allocation, or ability to price match competing bids. That is, each market participant would be competing on a level playing field, with no advantage accruing to the initiating wholesaler beyond the right to fill the order at mid-quote prior to initiating an auction.

The question of how segmented retail orders should be executed is a relatively new one. Ernst, Spatt, and Sun (2023) model the proposed order-by-order auctions and the current system of broker's routing jointly, identifying a trade-off between allocative efficiency and competition. The current system of broker's routing is highly competitive, where retail brokers allocate orders based on past wholesaler performance. While retail brokers use recent past competing market maker performance to inform routing decisions, they do not communicate with the market maker prior to routing each individual order, which gives rise to a small allocative inefficiency. Order-by-order auctions would address this allocative inefficiency, as the order-by-order nature of auctions would ensure that each individual order is allocated efficiently, and this welfare gain is shared between retail investors and wholesalers. In the presence of common values, however, market participants in the auction bid cautiously and earn positive rents, which is a welfare transfer from retail investors to wholesalers. Retail investor welfare is lower whenever the losses from reduced competition outweigh the gains from more efficient order allocation.

Allison Bishop, co-founder of Proof Trading, draws a connection between the proposed order-by-order auctions and existing exchange retail liquidity programs:

Exchanges already have ways for retail orders to be identified and treated specially by market makers, called retail liquidity programs (RLPs). The details differ across exchanges, but they typically allow market participants (including market makers and institutional investors) to submit orders that will interact

solely or distinctly with retail-identified orders. Such orders operate on the continuous books of the exchanges, rather than executing via auctions. It seems that such existing mechanisms can deliver a similar benefit to retail investors through order-by-order competition among market makers and institutional investors. – Bishop (2023)

While predictions about the function of proposed auctions is inherently speculative, the closely analogous and presently operating Retail Liquidity Programs offer potential insight into the functioning of the proposed auctions. Ernst, Spatt, and Sun (2023) highlight that current RLPs have relatively high quoting interest, but low trading volume. Part of this low volume is that wholesalers internalize most trades, and often do not route to RLPs. When wholesalers do route to RLPs, retail investors obtain an average price improvement of just 10 cents per hundred shares. Dyhrberg, Shkilko, and Werner (2022) use SEC 605 Reports to estimate that wholesalers give 27% of the quoted half-spread as price improvement, which is substantially more price improvement than RLPs. This creates a two-sided (“chicken and egg”) problem: wholesalers do not route to RLPs because the price improvement obtained is low, but market participants may not post substantial price improvement because wholesalers do not route to RLPs.

The execution quality of RLPs has the potential to be self-perpetuating if wholesalers only use RLPs for orders they do not wish to internalize. Ernst, Spatt, and Sun (2023) show that RLPs usage increases in times of high volatility, consistent with these venues being treated by wholesalers as high-cost, high-immediacy venues. Conversely, there is a negative correlation between RLP interest and order imbalances. When order imbalances are high, RLP interest is more likely to be absent than when order imbalances are low.

In the cross-section, RLP volumes, measured as a share of total trade volume, are much higher for larger stocks than smaller stocks. Retail investors, however, do not just trade liquid stocks, but also trade stocks not favored by institutions. For the least liquid tercile of stocks, Dyhrberg, Shkilko, and Werner (2022) estimate that retail trading volume is three to seven times larger than institutional volume. To the extent that auctions improve welfare only if they attract sufficient bidders, order-by-order auctions may particularly struggle to find bidders in less liquid securities.

The SEC economic analysis in support of the proposed order competition rule examines the potential for institutions to trade with retail. In the current system, the SEC notes that 50% of the time, retail investors obtain mid-quote executions. For orders where retail investors do not

obtain mid-quote, 75% of the time there is non-displayed liquidity resting at the mid-quote on at least one venue. This SEC estimate relies on CAT data to suggest that there are participants who could give retail investors better prices in order-by-order auctions, but they currently lack the ability to trade with retail investors. The SEC suggests that wholesalers may be unaware of this liquidity, and that “Currently, if wholesalers wanted to detect this hidden liquidity, they would have to ping each individual exchange or NMS Stock ATS to see if midpoint liquidity was available on that venue.” Ernst, Spatt, and Sun (2023) highlight, however, that the IEX RLP operates on a different structure than other RLPs in that it only allows mid-quote liquidity. Consequently, any investor seeking to trade with retail investors at mid-quote can post interest at the IEX, and IEX will disseminate a flag whenever there are at least 100 shares of interest. The IEX is able to disseminate this flag thanks to an exemption from SEC Rule 602, as the RLP quote is only accessible to retail market orders. The IEX RLP, however, has two-sided interest for less than 2% of the trading day, calling into question whether the traders submitting the resting midpoint liquidity that the SEC identifies truly desire trading with retail counterparties.

Several practical details of the proposed auctions are unresolved and potentially highly problematic. The auction would compete alongside the traditional limit order book as well as all off-exchange alternative trading systems and dark pools. The auctions would last for 100 to 300 milliseconds.⁹ While this is less than the blink of a human eye, an algorithmic trading platform could make a trading decision and route orders to any of the major equity venues in less than one millisecond. Consequently, there is a major concern over information leakage in these auctions. When an auction order is announced, the NBBO on all exchanges may change during the course of the auction, through either revision of quotes or execution of trades placed on information gleaned from the auction announcement.

Battalio and Jennings (2023) examine the potential for information leakage around the proposed order-by-order auctions. They estimate that the mid-quote would move against retail investors in 20% of proposed auctions. Auction bidding is entirely at-will; when the mid-quote moves against a retail investor, it increases the probability that no participants bid in the auction,

⁹ Budish’s (2023) comment letter suggests that the auction length should be substantially shorter than 100 milliseconds and potentially even one millisecond in light of the relevant decision-making responses being algorithmic rather than human decision-making.

and the auction fails. Battalio and Jennings (2023) estimate that the total costs to retail investors from these failed auctions would be approximately \$2 billion per year.

B. RLP Improvements

Exchange Retail Liquidity Programs have quotes that are only accessible to retail market orders. SEC Rule 602 requires visible quotes to be accessible to all market participants. RLP programs disseminate a flag of interest, which indicates whenever there are at least 100 shares available to retail market orders, and therefore requires exemptive relief from Rule 602. None of the RLPs disseminate exact price information, so wholesalers or routing brokers cannot see the exact level of price improvement or quantity of improvement available, only whether there are at least 100 shares.

While four RLPs allow quotes with prices with as little as one-tenth of a penny improvement, the IEX RLP is distinct in that it only allows RLP quotes to be priced at the NBBO mid-quote. Consequently, the IEX RLP price is known, though IEX does not disseminate the price, because the NBBO is publicly observable. While wholesalers will still not observe the quantity of shares available, if there is a flag of at least 100 shares of interest at the IEX RLP, wholesalers know that there will be 100 shares available at the specific price of the mid-quote.

The exemptive relief provided to the IEX program is therefore considerably stronger than that granted to the other exchange RLPs. Using a proprietary sample of retail trades from a large retail broker, Ernst, Spatt, and Sun (2023) show that when the IEX RLP flag is active, investors obtain mid-quote 75% of the time, compared to 60% when the IEX RLP flag is not active. This suggests that either the IEX RLP facilitates wholesalers providing mid-quote liquidity, or that competition among wholesalers implies that they give retail investors mid-quote under the same conditions that lead to IEX RLP interest.

Retail investors do not obtain mid-quote 100% of the time that the IEX RLP is active, even for orders of 100 shares or less, suggesting a potential improvement in retail execution quality. Brokers evaluate orders against the NBBO and seek to ensure their clients execute at or better than the NBBO, but the IEX RLP offers an additional benchmark for evaluation. If wholesalers are internalizing orders for 100 shares or less at prices worse than the mid-quote when the IEX RLP is active, customers would obtain better prices if their orders were instead directed to the IEX RLP.

Retail Liquidity Programs have had comparatively more success in Europe. Aramin and Comerton-Forde (2023) highlight that RLPs comprise 3.3% of total trading volume in Europe. Like the U.S. platforms, they allow competing participants to post limit orders only accessible to retail market orders, but many of the European platforms have full transparency, with prices and quantities visible to market participants. U.S. RLPs, which cannot display price or size available, suffer from the problem that the average price improvement is low. Consequently, wholesalers treat RLPs as high-cost in the pecking order of venues, yet RLP quotes must then be priced considering that wholesalers have not found lower-cost liquidity available. Enabling RLPs more flexibility in displaying price or size would give market participants further incentives to quote better prices in U.S. RLPs and requiring wholesalers to meet or exceed RLP prices would ensure that RLP liquidity results in better execution quality for retail investors.

C. Option Market Changes

Option markets have several technical barriers to competition. Designated Market Maker assignments are rarely changed and come with a powerful ability to internalize trades and collect a share of the revenue from trading fees. The ability to internalize trades at the quote regardless of queue position reduces DMM incentives to narrow the bid-ask spread, while decoupling this specific benefit from the broader set of benefits and obligations which DMMs possess would realign DMM incentives. DMM seats, once assigned, are also almost never reassigned. While it is possible that the threat, never exercised, of removing a DMM position is a strong competitive pressure, a more dynamic assignment of DMM seats would likely produce stronger competitive pressures on DMMs. At present, there is little transparency into how DMM positions are assigned and evaluated.

Auctions in options have several features which reduce competition. The auction initiator, often a wholesaler that has paid for order flow, has several advantages relative to competing bidders. Eliminating the initiator's ability to auto-match competing bids, the initiator's outsized allocation relative to competing bids, and the initiator's reduced trading fees relative to competing bids all would help encourage more competing bidding in auctions.

Option exchanges have very high trading access fees. The revenue from these high trading fees often goes to pay high rebates to other traders. Maker-taker pricing is one common method of this redistribution. In this pricing scheme, exchanges charge liquidity-taking fees for marketable orders, but pay market-making rebates to limit orders. The SEC has capped access

fees in equity markets, and proposed,¹⁰ but never adopted, a similar cap in option markets to “prevent fees from being charged that interfere with fair and efficient access to an option exchange’s displayed prices.” SEC Commissioner Crenshaw, in a 2023 speech, has raised the possibility of a renewed focus into the benefits of access fees in option markets, extending to option markets similar protections to that experienced by equity investors. The SEC has focused much more on reforms to the equity markets rather than the option and bond markets.

D. PFOF Rate Caps

While PFOF has enabled zero-commission trading, market competition may fail to produce the optimal division of wholesaler payments between PFOF and price improvement. A regulatory cap on PFOF is a simple solution that the SEC could use to limit harm from the practice without an outright ban. A sufficiently high cap would avoid the concern of how brokers should obtain revenue, as the cap can be set to align with observed costs for routing customer orders. In the event that brokers do obtain large revenues from PFOF that are not passed on to consumers, lowering the cap on rebates would directly limit excess broker revenues.

As a cap on PFOF would restrict only the largest of payments while leaving smaller payments unchanged, it would, by its very nature, reduce discrepancies in broker income across assets. The Order Protection Rule of Reg NMS ensures that orders are never filled at prices worse than displayed quotes. As a result, the maximum potential revenue available to wholesalers is limited by the bid-ask spread, and this in turn limits the amount wholesalers are able to pay as PFOF. Routing trades in liquid, large-cap stocks can support little PFOF due to narrow bid-ask spreads, while routing trades in either very illiquid stocks or options can support much larger PFOF due to the much larger bid-ask spread, giving brokers a problematic incentive structure to recommend illiquid stocks or options. Introducing a cap on PFOF would reduce the incentive distortions of brokers by reducing disparities in PFOF between liquid stocks, and less liquid stocks or options.

Fee caps allow a gradual, phased approach to changes. Setting a very high initial cap would lead to slight changes in broker revenue. Across the top two brokers accepting PFOF in January 2023¹¹, for example, a cap of 60 cents per hundred shares traded would impact 2% of

¹⁰ SEC Proposed Amendments to Rule 610 of Regulation NMS, 2010.

¹¹ We use SEC Rule 606 Reports for Quarter 1 of 2023 from Robinhood and Schwab. We note that 606 reports do not include odd lots. As option PFOF rates are higher than equity rates, and options do not

orders and reduce total PFOF by less than 5%. A cap of 50 cents per hundred shares traded would impact 20% of orders and reduce total PFOF by less than 8%. An initial cap at a very high rate, followed by a gradual reduction in the cap would allow the SEC to monitor the impact of the fee cap, and adjust future potential reduction accordingly. A phased, gradual approach would also allow offer brokers more opportunity to adjust their business model than a radical redesign of markets.

Unlike the order-by-order proposal, which would require a radical and potentially expensive redesign of securities markets, fee caps are a simple regulatory tool which have been applied to regulate exchange trading fees. Wholesalers are not unique in paying for orders. Most major equity exchanges use maker-taker pricing, where the exchange charges market orders a fee but pays limit orders a market-making rebate. This market-making rebate is analogous to PFOF, as it is a transaction-based payment to the supplier of the order. The exchange rebates for limit orders closely match what many brokers earn in PFOF from routing limit orders. Regulation NMS caps trading fees at 30 cents per one hundred shares traded, and most major equity exchanges charge market orders a fee of around thirty cents (while simultaneously paying limit orders a rebate of around 30 cents per 100 shares traded). For PFOF payments for limit orders, Fidelity Brokerage Services, for example, reports net payments of 31 to 34 cents per hundred shares from CBOE, NASDAQ, and the Members Exchange. Most brokers who accept PFOF and route to off-exchange wholesalers record similar payments. E-Trade and Schwab, for example, both report receiving around thirty cents per 100 shares for every non-marketable limit order they route to off-exchange wholesalers.

For exchange access fees, the SEC has recently proposed¹² tiered caps based on price, with smaller caps for low-priced stocks, and higher caps for high-priced stocks. A potential cap on PFOF payments would benefit from a similar tiered structure, with a lower cap on lower-priced stocks or options. Capping fees solely on a per-share or per-order basis delivers an incentive structure such that if an investor places a single order in a high-priced stock or invests the same dollar value in multiple small orders in a low-priced option, broker revenue is substantially higher in the latter case. Capping PFOF as a percentage of value traded eliminates

have odd lots, our results may slightly overstate the effects of the explanatory caps by missing equity PFOF paid on odd lots.

¹² Regulation NMS: Minimum Pricing Increments, Access Fees, and Transparency of Better Priced Orders, File No. S7-30-22, Release No. 34-96494.

this broker incentive structure but may fail to provide revenue which matches any fixed per-order costs, which may differ for stocks and options. A tiered fee cap, similar to the proposed access fee tiering, offers one method of striking a balance between the two approaches.

The solution of capping rebates therefore parallels the approach regulators have used to limit make-take pricing on exchanges, another long-standing practice that would be complicated to alter. As previously noted, average equity PFOF is twenty cents per 100 shares, so the switch from \$5 commissions to zero-commission trading had reduced broker revenue on all but the largest retail orders. Setting a PFOF cap would preserve the benefits of zero-commission trading, while limiting any excess rents, and reduce broker incentives to encourage trading high-PFOF assets.

V. Conclusion

PFOF has enabled zero-commission trading, and retail investor trading volume has surged in both equity and option markets in the last few years. With this growth, investors have developed concerns over the impact of PFOF on market quality.

We highlight four specific concerns over PFOF: execution quality, concentration and broader market quality, options market rules which favor internalization, and broker incentives. We view the latter two concerns as more severe. While internalization in both equity and option markets is concentrated, option markets have specific rules, including DMM assignments, that make entry into the business difficult. Options PFOF rates are much higher than equity PFOF rates, implying that brokers earn substantially more money when their clients trade options, even if such trades are not in their client's best interests.

SEC has proposed mandating all retail equity orders be executed in order-by-order auctions, but switching to auctions would involve both a tradeoff between competition and allocative efficiency, and concerns about information leakage. Instead, we propose three alternative changes to markets. The first is greater flexibility for Retail Liquidity Programs, which already allow competition for retail market orders. The second is a series of changes to option markets, such as competitive DMM assignments and reduced access fees, which would enhance competition in option markets. The third and final change is a fee cap for PFOF. A fee cap would enable PFOF to continue as a revenue source for brokers, while curbing potential excesses. Imposing a PFOF cap would also reduce broker incentives to encourage trading of any particular asset, avoiding misalignment in the current system. While one should view our

proposals as preliminary, they do suggest a potential basis for both broadening the current regulatory debate involving equity market structure and extending the dialogue to potential reforms of option markets.

References

1. Aramin, Fatemeh, and Carole Comerton-Forde. "Retail Trading in European Equity Markets." University of Melbourne Working Paper. 2023.
2. Baldauf, M, J Mollner, and B Yueshen. "Siphoned Apart: A Portfolio Perspective on Order Flow Fragmentation." Working Paper. 2022. Available at SSRN 4173362.
3. Battalio, R. and C Holden. "A Simple Model of Payment for Order Flow, Internalization, and Total Trading Cost." 2001 *Journal of Financial Markets*.
4. Battalio, R., and R. H. Jennings. "On the Potential Cost of Mandating Qualified Auctions for Marketable Retail Orders." March 28, 2023. Available at SSRN: 4403047.
5. Battalio, R. H., and R. H. Jennings. "Why do Brokers who do not Charge Payment for Order Flow Route Marketable Orders to Wholesalers?" *Available at SSRN 4304124* (2022).
6. Bishop, Allison. "The SEC Isn't Mad at PFOF. They're Just Disappointed." January 6, 2023. Available at: <https://medium.com/prooftrading/the-sec-isnt-mad-at-pfof-they-re-just-disappointed-f5252fbbf6df>
7. Bryzgalova, Svetlana, Anna Pavlova, and Taisiya Sikorskaya. "Retail Trading in Options and the Rise of the Big Three Wholesalers." *Journal of Finance, Forthcoming* (2022).
8. Bryzgalova, Svetlana, Anna Pavlova, and Taisiya Sikorskaya. "Profiting from Investor Mistakes: Evidence from Suboptimal Option Exercise." Working Paper (2023).
9. Budish, Eric. Comment Letter on SEC Order Competition Rule Proposal (Release No. 34-96495, File No. S7-31-22), March 31, 2023 <https://www.sec.gov/comments/s7-31-22/s73122-20163081-333049.pdf>
10. Crenshaw, Caroline. "Fixed Income and Options: The Other Market Structures Remarks at the Fixed Income Forum Spring Roundtable." March 30, 2023. Available at: https://www.sec.gov/news/speech/crenshaw-remarks-fixed-income-forum-spring-roundtable-033023#_ftnref51
11. Dyberg, A, A Shkilko, and I Werner. "The Retail Execution Quality Landscape." Fisher College of Business Working Paper: 2022.
12. Ernst, Thomas, and Chester S. Spatt. "Payment for Order Flow and Option Internalization." 2022.
13. Ernst, Thomas, Chester S. Spatt, and Jian Sun. "Would Order-by-Order Auctions Be Competitive?" *Available at SSRN* (2022).
14. Hendershott, Terrence, Saad Khan, and Ryan Riordan. "Option Auctions." *Available at SSRN 4110516* (2022).
15. Parlour, C., and U Rajan. "Payment for Order Flow." *Journal of Financial Economics*, 2001.
16. Roberts, Richard. "Payment For Order Flow." *Ray Garrett Institute*, April 29, 1993.
17. Schwarz, Christopher, Brad M. Barber, Xing Huang, Philippe Jorion, and Terrance Odean. "The 'Actual Retail Price' of Equity Trades." *Available at SSRN 4189239* (2022).

18. Securities and Exchange Commission. Proposed Rule 615. Securities and Exchange Commission. “Proposed Amendments to Rule 610 of Regulation NMS, Release No. 34-61902”. April 14, 2010. Available at: <https://www.sec.gov/rules/proposed/2010/34-61902.pdf>

19. Securities and Exchange Commission. Release No. 33-10906. “In the Matter of Robinhood Financial, LLC Admin. Proc. File No. 3.20171.” December 17, 2020.

20. Spatt, C. “Is Equity Market Exchange Structure Anticompetitive?” Working Paper, 2020.

21. Subcommittee on Oversight and Investigations. “Game Stopped: How the Meme Stock Market Event Exposed Troubling Business Practices, Inadequate Risk Management, and the Need for Regulatory and Legislative Reform.” June 24, 2022. Maxine Waters, Chairwoman.