

Best Execution, Best Possible Result

A Case Study on Trading on Institutional and Retail Exchanges
From the Perspective of a Retail Investor

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Executive summary

With this case study we would like to contribute empirical evidence to the discussion on whether trading on retail exchanges provides retail clients with best execution. The best execution is determined by the price of a financial instrument and all costs relating to the execution.¹ We show that prices of financial instruments on retail exchanges are fully competitive to institutional exchanges, costs relating to the execution are significantly lower and, most importantly, the best execution for retail investors is predominantly achieved by trading on a retail exchange. This is not in contradiction to the well-regarded fact that institutional exchanges provide deep liquidity, advanced order types and other features institutional investors value and require. It just shows that the endorsed competition between trading venues has led to the creation of different exchange models that serve different needs, while access and transparency ensure an efficient price formation mechanism across all markets.

¹ See Article 27, 2014/65/EU

Motivation

Corresponding to the goals of the capital markets union (CMU), in particular offering new opportunities for savers and investors, helping Europe deliver its new green deal and digital agenda, reinforcing the EU's global competitiveness and autonomy and making the financial system more resilient, policymakers and market participants are also discussing to evolve the market structure for trading financial instruments in the European Union. European citizens and businesses should fully benefit from the deep, competitive, efficient and reliable sources of funding and investment that capital markets can offer.

The available research on execution costs focuses primarily on execution prices.² Rigorous empirical evidence on the total costs borne by retail investors is scarce. This analysis fills this gap by providing insights into best execution for retail investors by looking at both, the prices of financial instruments and charges related to the execution.

Study design

Venues

We base our analysis on data from four execution venues. The first venue, Xetra, is the reference market for German shares, European market leader in ETFs and predominantly used by institutional investors³ ("institutional exchange 1"), whereas Börse Frankfurt is a leading trading venue for German and international securities offering a specialist trading model⁴ ("institutional exchange 2" and, together with institutional exchange 1, the "institutional exchanges"). Both institutional exchanges are operated by Deutsche Börse AG.

Further, we examine two venues ("retail exchanges") that offer features and characteristics specifically valued by retail investors, such as a broad range of shares, ETFs and funds available for trading in Euro, low fees as well as extended trading hours: gettex, a trading model at the Munich Stock Exchange, known for fast and cost-effective trading⁵ ("retail exchange 1") and Tradegate Exchange, a regulated market specialising on executing orders for private investors⁶ in which Deutsche Börse AG is also a majority shareholder ("retail exchange 2"). Other (regional) exchanges and trading models such as L&S Exchange, Quotrix or Börse Stuttgart share comparable characteristics but were not included due to data availability. The retail exchanges chosen are, however, a good proxy for the overall landscape of innovative retail-focussed exchanges.

As a leading order-flow provider on both institutional (Xetra) and retail (gettex) exchanges, we believe Scalable Capital can share meaningful insights on the impact on total cost of execution when comparing institutional and retail venues from the perspective of a retail investor.

² A recent example is: AFM, Autoriteit Financiële Markten (2022), "Assessing the quality of executions on trading venues". This study ignores that the alleged price advantage on non-PFOF venues over selected PFOF venues is much smaller than the typical fee advantage retail investors benefit from in a PFOF setup.

³ <https://www.xetra.com/xetra-en/trading>; accessed on 17.02.2022.

⁴ <https://www.xetra.com/xetra-en/trading/trading-venue-boerse-frankfurt>; accessed on 21.02.2022.

⁵ <https://www.gettex.de/en/about-us/>; accessed on 21.02.2022.

⁶ https://www.tradegate.de/docs/211230_PM_Jahresschluss_2021_e.pdf; accessed on 21.02.2022.

Time frame and instruments

The goal of this empirical analysis is to provide an in-depth insight into the market microstructure of the venues in scope. To do so, we obtained quote data sampled at ten-minute⁷ intervals (using the last observation of each interval) during the overlapping trading hours of all venues (excluding the end-of-day auction). The data cover a period of six months (August 16, 2021 - February 15, 2022) and amount to approximately 3.7 million quote pairs altogether.

Our analysis focussed on the 150 most traded financial instruments (86 shares and 64 ETFs, see Annex 1) by our clients and representing altogether approximately 70 % of the traded volume during this six-month period.

Order characteristics

To provide a representative picture of best execution for a retail investor, we derive implicit and explicit costs as well as total consideration paid for order sizes ranging from 500 € to 5,000 €.

Ex-ante and ex-post data

Both ex-ante (quotes) and ex-post (executions) data provide valuable insights into the pricing and implicit cost of trading financial instruments. In this study we focus on ex-ante (quote) data as it allows a synchronised analysis of price data across multiple venues, irrespective of the occurrence and timing of actually executed trades. While advantageous, the use of quote data to estimate trading costs is only meaningful if actual execution prices do not materially deviate from arrival quotes (i.e. the last quote available prior to the execution of a trade). To validate this, we have calculated the difference between quoted and actual spreads of actual client trades on Xetra and gettex over the six months. The executed spreads were calculated as the absolute differences between the mid points of the arrival quotes and the executed prices multiplied by two and divided by the traded volume.

As shown in Table 1, the differences are less than 0.5 basis points (bps) and have no material impact on any of the conclusions in this study. The residual differences can be explained by factors such as time delays and market moves between order submission and order execution (e.g. due to placement of an order outside of trading hours or during an auction) or by order volumes which are above the quoted volumes.

Table 1: Weighted average quoted and executed spreads

Period	Quoted (bps)	Executed (bps)	Quoted - Executed (bps)
16.08.2021 - 15.02.2022	11.34	11.78	-0.45

Implicit costs

The spread is an implicit cost component and represents one of the two important factors for total best execution/consideration paid. The spread is determined by the difference between the bid and the offer price. The fair value of a financial instrument is assumed to be in between the bid and the offer price. Hence, on average, investors “pay” half the spread on each buy or sell order. A comparison of spreads as

⁷ We have also obtained and analysed data sampled in 1-minute intervals for a subset of the time period and venues. The results at higher frequency did not materially differ. We, therefore, report results that are based on 10-minute intervals and cover a longer period, more venues and more instruments.

an indicator for implicit costs across venues is only meaningful if the mid prices do not materially deviate between the venues. To examine this, we have calculated the actual difference in mid prices between the group of institutional and the group of retail exchanges over all instruments and the complete time period (Table 2). We find that the prices are virtually identical within a ± 0.5 bps range almost half of the time (46.9%) and 90.4 % of the time within the narrow range of ± 5 bps. In case of ETFs, the deviations are particularly small; 78.3 % of the time within ± 0.5 bps and 99.2 % of the time within ± 5 bps.

Table 2: Range of relative deviations of mid prices between the institutional and the retail exchanges

Range (bps)	ETFs	Shares	Overall
± 0.5	78.3 %	23.3 %	46.9 %
± 1.0	89.1 %	41.6 %	61.9 %
± 2.5	97.2 %	68.9 %	81.0 %
± 5.0	99.2 %	83.8 %	90.4 %

Cost and charges

As the other important factor for best execution/total consideration paid by retail clients we consider costs and charges. Recent studies⁸ have shown that prices at incumbent brokers for a typical retail order volume of 2,000 € range between 2.20 € to 55 €, with the majority of brokers charging above 10 €. ⁹ Our own prices, which can be seen as representative for some of the neo brokers in the market, 0.00 € / 0.99 € for a retail exchange order and 5.49 € for an institutional exchange order, are among the most competitive offers for the respective venues available on the market. To err on the side of caution, we use the upper bound of our pricing (0.99 € retail exchanges, 5.49 € institutional exchanges) for calculating total consideration paid to verify best execution. The typically higher prices incurred by most incumbents, in particular for orders at the institutional exchanges, further reinforce the already strong conclusions in favour of trading at retail exchanges for retail order volumes.

Prices of financial instruments

Relative spreads are derived by normalising the quoted spreads by their corresponding mid prices and expressing them in terms of basis points. An analysis of the spread sizes for the same set of instruments at the same point in time over the whole sample period (summarised below in Table 3) shows that the average spread on the institutional exchanges (12.13 bps) is wider by almost one basis point (+0.99 bps) than the average spread on the retail exchanges (11.14 bps). The picture does not change when looking at individual types of financial instruments. On average, ETFs are being quoted marginally tighter (-0.41 bps) on the institutional exchanges, whereas shares trade considerably wider (+2.04 bps). The results are confirmed by the more robust and less outlier prone medians with an overall difference of just 0.04 bps, slightly tighter ETF spreads (-0.09 bps) at the institutional exchanges and slightly wider spreads (+0.33 bps) for shares. The hypothesis that retail exchanges provide inferior pricing of financial instruments is clearly rejected by this evidence.

⁸ Oliver Wyman compiled an overview of German online brokers' order fees. Fischer, R., Hübner, M. and Bulis, P. (2021): "Online-Wertpapier-Brokerage" (p. 19);

<https://www.oliverwyman.de/our-expertise/insights/2020/aug/online-wertpapier-brokerage.html>

⁹<https://www.boerse-online.de/nachrichten/geld-und-vorsorge/onlinebroker-im-test-die-basics-fuer-ihr-depot-14-an-bieter-im-check-1031182743>; accessed 21.02.2022.

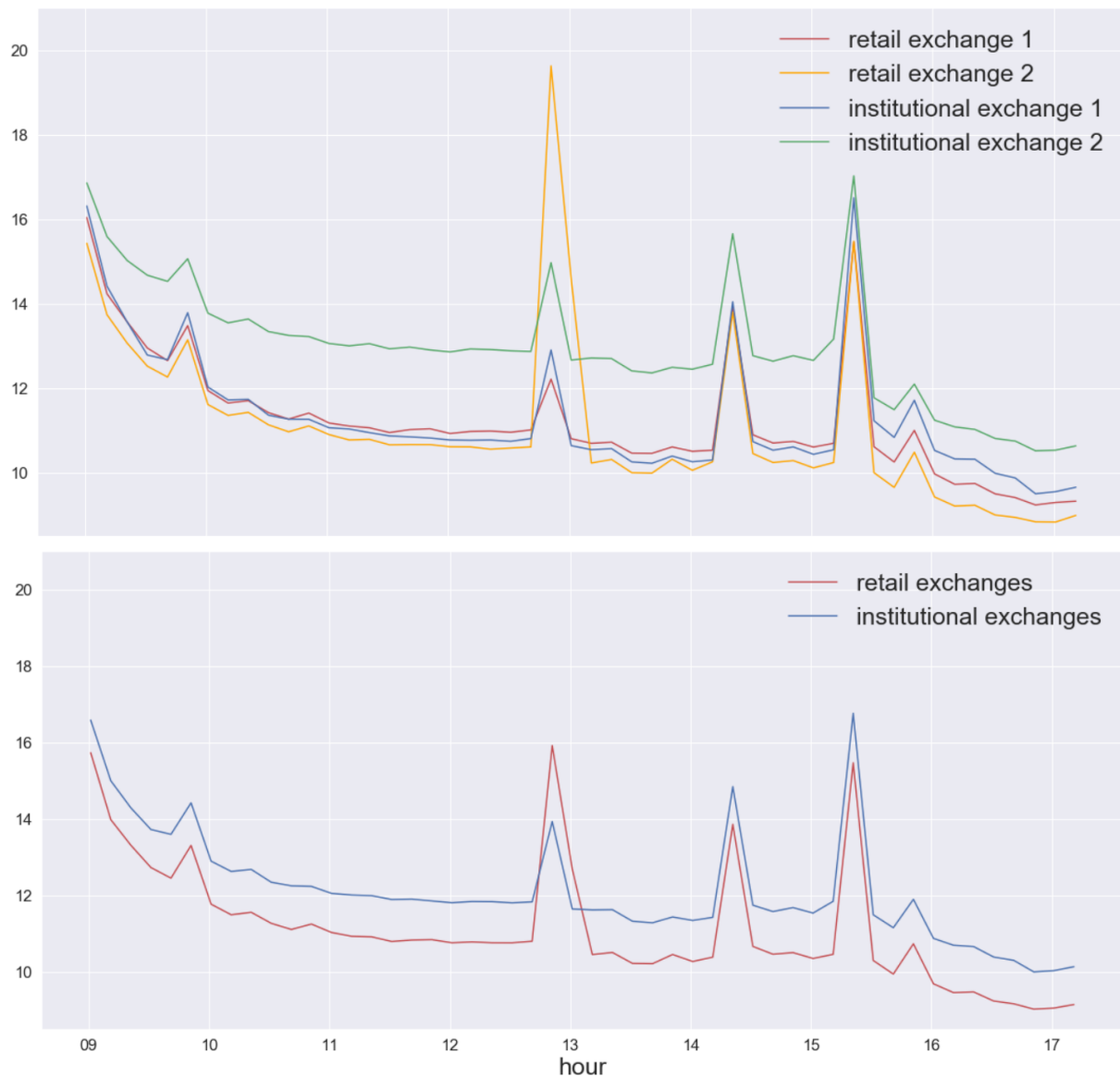
Table 3: Comparison of normalised quoted spreads (bps) on the institutional and the retail exchanges

	ETFs	Shares	Overall
Average retail exchanges	8.63	13.03	11.14
retail exchange 1	8.56	13.22	11.22
retail exchange 2	8.71	12.83	11.07
Average institutional exchanges	8.22	15.06	12.13
institutional exchange 1	8.30	13.56	11.31
institutional exchange 2	8.14	16.56	12.95
Difference of average institutional - retail	-0.41	2.04	0.99
Median retail exchanges	6.45	7.03	6.69
retail exchange 1	6.50	7.01	6.75
retail exchange 2	6.20	6.62	6.38
Median institutional exchanges	6.36	7.36	6.73
institutional exchange 1	6.34	8.53	7.24
institutional exchange 2	6.31	6.18	6.27
Difference of median institutional - retail	-0.09	0.33	0.04

For investors, in particular less experienced retail investors, it is important that best execution is not only ensured on the aggregate but at any point in time. Spread differences might not be constant throughout the day. Especially around open and closing auctions, the publication of news or the opening of US markets, there is more price uncertainty causing spreads to increase. The length and magnitude of such spread increases might differ across venues. To further validate the aggregate results, we have analysed average spreads and spread differences by time of day.

Figure 1 shows the mean spreads (top) on all observed exchanges individually and grouped by type of exchange (bottom). The slight spread advantage of retail exchanges over institutional exchanges is pretty constant throughout the day. The timing and magnitude of spread spikes around the European and the US markets open as well as around auctions is similar across all exchanges.

Figure 1: Average spreads (bps) for all exchanges (top) and aggregated by retail and institutional exchanges (bottom).



Best Execution: total consideration paid

The empirical analysis clearly shows that there are no structural differences between spreads quoted on the institutional and the retail exchanges. Investors can expect to get executed at the best available market prices across all venues, both institutional and retail. Competition and arbitrage ensures a coupling of quotes across multiple exchanges and an efficient price formation mechanism across all markets. Any differences are short lived and virtually random rather than structural.

The principle of Best Execution requires to include not only the price of a financial instrument - but also the costs of the execution - in the context of retail client order execution (see (93) and Article 27 Directive 2014/65/EU). These costs include execution-venue fees, clearing and settlement fees and any other fees paid to third parties involved in the order execution. For retail clients at neo brokers this is usually a simple exercise. Costs for trading, clearing and settlement as well as other downstream costs are borne by the broker. Clients either pay no commission or are charged an all-in commission which can

consist of a fixed Euro amount and a variable amount based on the order volume, usually accounting for variable costs such as those incurred by some exchanges.

Table 4 shows the total trading costs in Euro for different order sizes for the 50 most traded instruments in the sample (see Annex 2 and Annex 3 for the full results on all instruments observed). Implicit costs (left) are solely determined by the difference between mid prices and executable prices. In line with our findings above, there is no material difference between the average spread costs on institutional versus retail exchanges - with the exception of slightly higher costs on the institutional exchanges for some of the most popular US stocks. Further, after taking commissions into account to validate best execution (right), it becomes clear that retail investors greatly benefit from significant cost advantages when trading on retail exchanges. This holds across all instruments and across the range of typical retail order sizes.

Table 4: Implicit and total trading costs (in Euro) for the 50 most traded instruments grouped by order size and type of exchange

Exchanges	Costs & charges		only spread costs						spread costs and all other costs							
	Order size	500 €	1,000 €		3,000 €		5,000 €		500 €	1,000 €		3,000 €		5,000 €		
		Retail	Institutional	Retail	Institutional	Retail	Institutional	Retail	Institutional	Retail	Institutional	Retail	Institutional	Retail	Institutional	
BioNTech SE	0.47	1.11	0.95	2.21	2.85	6.63	4.74	11.05	1.46	6.60	1.94	7.70	3.84	12.12	5.73	16.54
Tesla Inc.	0.21	0.24	0.41	0.48	1.23	1.45	2.05	2.42	1.20	5.73	1.40	5.97	2.22	6.94	3.04	7.91
iShares Core MSCI World ETF	0.06	0.06	0.12	0.12	0.37	0.37	0.61	0.62	1.05	5.55	1.11	5.61	1.36	5.86	1.60	6.11
Amazon.com Inc.	0.15	0.20	0.30	0.40	0.89	1.19	1.48	1.98	1.14	5.69	1.29	5.89	1.88	6.68	2.47	7.47
Vanguard FTSE All World (Dist.) ETF	0.11	0.10	0.22	0.21	0.67	0.62	1.11	1.04	1.10	5.59	1.21	5.70	1.66	6.11	2.10	6.53
Vanguard FTSE All World (Acc.) ETF	0.20	0.15	0.40	0.29	1.20	0.88	2.01	1.47	1.19	5.64	1.39	5.78	2.19	6.37	3.00	6.96
Nvidia Corp.	0.27	0.23	0.54	0.45	1.63	1.36	2.72	2.26	1.26	5.72	1.53	5.94	2.62	6.85	3.71	7.75
Apple Inc.	0.11	0.11	0.22	0.23	0.67	0.69	1.11	1.14	1.10	5.60	1.21	5.72	1.66	6.18	2.10	6.63
BASF SE	0.06	0.04	0.11	0.08	0.34	0.25	0.56	0.41	1.05	5.53	1.10	5.57	1.33	5.74	1.55	5.90
Moderna INC.	0.52	0.66	1.04	1.33	3.11	3.98	5.18	6.63	1.51	6.15	2.03	6.82	4.10	9.47	6.17	12.12
Xtrackers MSCI World UCITS ETF	0.13	0.12	0.26	0.24	0.78	0.72	1.30	1.21	1.12	5.61	1.25	5.73	1.77	6.21	2.29	6.70
Microsoft Corp.	0.17	0.17	0.34	0.34	1.03	1.02	1.72	1.69	1.16	5.66	1.33	5.83	2.02	6.51	2.71	7.18
Deutsche Lufthansa AG	0.11	0.07	0.23	0.13	0.68	0.40	1.13	0.67	1.10	5.56	1.22	5.62	1.67	5.89	2.12	6.16
iShares Core S&P 500 ETF	0.07	0.07	0.15	0.15	0.44	0.44	0.73	0.74	1.06	5.56	1.14	5.64	1.43	5.93	1.72	6.23
Lyxor Core MSCI World ETF	0.18	0.16	0.36	0.32	1.08	0.96	1.80	1.60	1.17	5.65	1.35	5.81	2.07	6.45	2.79	7.09
Alphabet Inc. Class A	0.27	0.28	0.54	0.56	1.63	1.67	2.72	2.79	1.26	5.77	1.53	6.05	2.62	7.16	3.71	8.28
HSBC MSCI World ETF	0.14	0.14	0.28	0.29	0.84	0.86	1.40	1.43	1.13	5.63	1.27	5.78	1.83	6.35	2.39	6.92
Mercedes Benz Group AG	0.05	0.07	0.10	0.14	0.30	0.41	0.50	0.69	1.04	5.56	1.09	5.63	1.29	5.90	1.49	6.18
iShares Core MSCI EM IMI ETF	0.14	0.14	0.29	0.27	0.86	0.82	1.44	1.37	1.13	5.63	1.28	5.76	1.85	6.31	2.43	6.86
AMC Entertainment Holdings Inc.	0.99	1.05	1.98	2.11	5.95	6.32	9.92	10.54	1.98	6.54	2.97	7.60	6.94	11.81	10.91	16.03
iShares MSCI ACWI (Acc) ETF	0.13	0.12	0.26	0.24	0.78	0.73	1.31	1.22	1.12	5.61	1.25	5.73	1.77	6.22	2.30	6.71
Volkswagen AG	0.07	0.05	0.14	0.10	0.43	0.30	0.72	0.50	1.06	5.54	1.13	5.59	1.42	5.79	1.71	5.99
iShares MSCI World SRI ETF	0.17	0.16	0.33	0.31	0.99	0.94	1.65	1.57	1.16	5.65	1.32	5.80	1.98	6.43	2.64	7.06
Invesco MSCI World ETF	0.15	0.14	0.29	0.29	0.88	0.87	1.46	1.45	1.14	5.63	1.28	5.78	1.87	6.36	2.45	6.94
PayPal Holdings Inc.	0.33	0.34	0.66	0.68	1.99	2.03	3.32	3.38	1.32	5.83	1.65	6.17	2.98	7.52	4.31	8.87
Allianz SE	0.05	0.03	0.11	0.07	0.32	0.20	0.54	0.33	1.04	5.52	1.10	5.56	1.31	5.69	1.53	5.82
Alibaba Group (ADR)	0.36	0.38	0.73	0.77	2.18	2.30	3.63	3.84	1.35	5.87	1.72	6.26	3.17	7.79	4.62	9.33
Plug Power Inc.	0.64	0.78	1.28	1.56	3.85	4.67	6.41	7.79	1.63	6.27	2.27	7.05	4.84	10.16	7.40	13.28
Bayer AG	0.05	0.03	0.10	0.06	0.31	0.17	0.51	0.29	1.04	5.52	1.09	5.55	1.30	5.66	1.50	5.78
Varta AG	0.30	0.29	0.60	0.59	1.79	1.77	2.98	2.95	1.29	5.78	1.59	6.08	2.78	7.26	3.97	8.44
Meta Platforms Inc. Class A	0.25	0.29	0.50	0.58	1.49	1.73	2.48	2.88	1.24	5.78	1.49	6.07	2.48	7.22	3.47	8.37
Infineon Technologies AG	0.06	0.06	0.11	0.12	0.33	0.37	0.56	0.62	1.05	5.55	1.10	5.61	1.32	5.86	1.55	6.11
iShares Nasdaq 100 ETF	0.06	0.08	0.13	0.15	0.38	0.46	0.63	0.76	1.05	5.57	1.12	5.64	1.37	5.95	1.62	6.25
iShares Global Clean Energy ETF	0.21	0.22	0.43	0.44	1.28	1.32	2.14	2.21	1.20	5.71	1.42	5.93	2.27	6.81	3.13	7.70
SAP SE	0.06	0.04	0.11	0.09	0.34	0.27	0.57	0.44	1.05	5.53	1.10	5.58	1.33	5.76	1.56	5.93
Xtrackers DAX ETF	0.06	0.06	0.12	0.12	0.37	0.35	0.62	0.58	1.05	5.55	1.11	5.61	1.36	5.84	1.61	6.07
Advanced Micro Devices Inc.	0.35	0.35	0.69	0.70	2.08	2.09	3.46	3.48	1.34	5.84	1.68	6.19	3.07	7.58	4.45	8.97
iShares Core DAX ETF	0.08	0.05	0.17	0.11	0.50	0.32	0.84	0.53	1.07	5.54	1.16	5.60	1.49	5.81	1.83	6.02
Curevac N.V.	0.96	1.02	1.91	2.04	5.74	6.13	9.57	10.22	1.95	6.51	2.90	7.53	6.73	11.62	10.56	15.71
ASML Holding N.V.	0.07	0.18	0.15	0.37	0.44	1.10	0.73	1.83	1.06	5.67	1.14	5.86	1.43	6.59	1.72	7.32
iShares Nasdaq-100 ETF	0.10	0.11	0.20	0.21	0.59	0.64	0.98	1.07	1.09	5.60	1.19	5.70	1.58	6.13	1.97	6.56
iShares MSCI World Small Cap ETF	0.39	0.30	0.79	0.60	2.37	1.81	3.95	3.01	1.38	5.79	1.78	6.09	3.36	7.30	4.94	8.50
Palantir Technologies Inc.	0.54	0.83	1.09	1.67	3.26	5.00	5.43	8.34	1.53	6.32	2.08	7.16	4.25	10.49	6.42	13.83
Deutsche Telekom AG	0.05	0.03	0.10	0.05	0.30	0.15	0.50	0.26	1.04	5.52	1.09	5.54	1.29	5.64	1.49	5.75
SPDR MSCI World ETF	0.18	0.19	0.37	0.37	1.10	1.12	1.83	1.87	1.17	5.68	1.36	5.86	2.09	6.61	2.82	7.36
iShares MSCI WORLD ETF	0.13	0.13	0.26	0.25	0.78	0.76	1.31	1.26	1.12	5.62	1.25	5.74	1.77	6.25	2.30	6.75
Fresenius SE & CO. KGaA	0.06	0.04	0.12	0.08	0.37	0.23	0.62	0.39	1.05	5.53	1.11	5.57	1.36	5.72	1.61	5.88
Teamviewer AG	0.25	0.26	0.49	0.53	1.48	1.58	2.46	2.63	1.24	5.75	1.48	6.02	2.47	7.07	3.45	8.12
Xtrackers MSCI Emerging Markets ETF	0.13	0.13	0.27	0.26	0.81	0.78	1.34	1.31	1.12	5.62	1.26	5.75	1.80	6.27	2.33	6.80
Pfizer Inc.	0.32	0.26	0.63	0.52	1.89	1.57	3.15	2.62	1.31	5.75	1.62	6.01	2.88	7.06	4.14	8.11
Average	0.22	0.24	0.44	0.49	1.32	1.46	2.20	2.43	1.21	5.73	1.43	5.98	2.31	6.95	3.19	7.92

Foreign shares

European retail investors can trade foreign shares on both retail and institutional exchanges in Euro. As an alternative, some brokers offer trading on the respective non-EU venues in foreign currencies. In this case, FX charges, typically 0.25 % or more, quickly outweigh any benefits resulting from potentially tighter spreads on the reference market. Table 5 illustrates this for popular foreign shares. It can be seen that Europe-based retail exchanges are on-par or better for almost all shares and order sizes in terms of best execution for retail investors.

Table 5: Total trading costs (in Euro) for different order sizes and types of venues plus FX costs

Exchanges	500 €			1,000 €			3,000 €			5,000 €		
	Institutional			Institutional			Institutional			Institutional		
	Retail	Institutional	FX	Retail	Institutional	FX	Retail	Institutional	FX	Retail	Institutional	FX
BioNTech SE	1.46	6.60	1.25	1.94	7.70	2.50	3.84	12.12	7.50	5.73	16.54	12.50
Tesla Inc.	1.20	5.73	1.25	1.40	5.97	2.50	2.22	6.94	7.50	3.04	7.91	12.50
Amazon.com Inc.	1.14	5.69	1.25	1.29	5.89	2.50	1.88	6.68	7.50	2.47	7.47	12.50
Nvidia Corp.	1.26	5.72	1.25	1.53	5.94	2.50	2.62	6.85	7.50	3.71	7.75	12.50
Apple Inc.	1.10	5.60	1.25	1.21	5.72	2.50	1.66	6.18	7.50	2.10	6.63	12.50
Moderna INC.	1.51	6.15	1.25	2.03	6.82	2.50	4.10	9.47	7.50	6.17	12.12	12.50
Microsoft Corp	1.16	5.66	1.25	1.33	5.83	2.50	2.02	6.51	7.50	2.71	7.18	12.50
Alphabet Inc. Class A	1.26	5.77	1.25	1.53	6.05	2.50	2.62	7.16	7.50	3.71	8.28	12.50
AMC Entertainment Holdings Inc.	1.98	6.54	1.25	2.97	7.60	2.50	6.94	11.81	7.50	10.91	16.03	12.50
PayPal Holdings Inc.	1.32	5.83	1.25	1.65	6.17	2.50	2.98	7.52	7.50	4.31	8.87	12.50
Alibaba Group (ADR)	1.35	5.87	1.25	1.72	6.26	2.50	3.17	7.79	7.50	4.62	9.33	12.50
Plug Power Inc.	1.63	6.27	1.25	2.27	7.05	2.50	4.84	10.16	7.50	7.40	13.28	12.50
Meta Platforms Inc. Class A	1.24	5.78	1.25	1.49	6.07	2.50	2.48	7.22	7.50	3.47	8.37	12.50
Advanced Micro Devices Inc.	1.34	5.84	1.25	1.68	6.19	2.50	3.07	7.58	7.50	4.45	8.97	12.50
Palantir Technologies Inc.	1.53	6.32	1.25	2.08	7.16	2.50	4.25	10.49	7.50	6.42	13.83	12.50
Pfizer Inc.	1.31	5.75	1.25	1.62	6.01	2.50	2.88	7.06	7.50	4.14	8.11	12.50
Block Inc.	1.54	6.17	1.25	2.09	6.85	2.50	4.30	9.56	7.50	6.51	12.28	12.50
Alphabet Inc. Class C	1.31	5.81	1.25	1.62	6.13	2.50	2.89	7.40	7.50	4.15	8.68	12.50
Gamestop Corp.	2.34	7.30	1.25	3.69	9.12	2.50	9.10	16.38	7.50	14.50	23.64	12.50
Gazprom (ADR)	1.23	5.78	1.25	1.48	6.07	2.50	2.46	7.24	7.50	3.43	8.40	12.50
Berkshire Hathaway Inc. Class B	1.32	5.96	1.25	1.65	6.42	2.50	2.98	8.28	7.50	4.31	10.14	12.50
Coinbase Global Inc.	1.93	6.53	1.25	2.87	7.57	2.50	6.64	11.72	7.50	10.40	15.87	12.50
Netflix Inc.	1.42	5.95	1.25	1.85	6.40	2.50	3.57	8.23	7.50	5.29	10.05	12.50
Intel Corp.	1.34	5.82	1.25	1.69	6.14	2.50	3.08	7.44	7.50	4.47	8.74	12.50
Visa Inc.	1.38	5.89	1.25	1.77	6.29	2.50	3.32	7.90	7.50	4.87	9.50	12.50
Amgen Inc.	1.97	6.17	1.25	2.95	6.84	2.50	6.88	9.55	7.50	10.81	12.26	12.50
Adobe Inc.	1.80	6.12	1.25	2.60	6.74	2.50	5.83	9.25	7.50	9.05	11.75	12.50
Airbnb Inc.	2.13	6.85	1.25	3.27	8.20	2.50	7.84	13.63	7.50	12.41	19.05	12.50
Salesforce.Com Inc.	1.45	6.03	1.25	1.91	6.57	2.50	3.76	8.72	7.50	5.60	10.87	12.50
Coca-Cola Co., The	1.24	5.74	1.25	1.50	5.99	2.50	2.52	7.00	7.50	3.54	8.00	12.50
Walt Disney Co., The	1.44	5.87	1.25	1.90	6.25	2.50	3.71	7.78	7.50	5.53	9.31	12.50
Tilray Brands Inc.	2.54	7.06	1.25	4.08	8.64	2.50	10.27	14.94	7.50	16.45	21.24	12.50
BlackRock Inc.	2.01	6.62	1.25	3.02	7.74	2.50	7.09	12.25	7.50	11.16	16.75	12.50
AT&T Inc.	1.41	5.85	1.25	1.84	6.20	2.50	3.54	7.63	7.50	5.24	9.06	12.50
Boeing Co./The	1.42	6.19	1.25	1.86	6.88	2.50	3.60	9.67	7.50	5.33	12.46	12.50
BP Plc.	1.19	5.71	1.25	1.38	5.93	2.50	2.16	6.81	7.50	2.94	7.70	12.50
Unilever Plc	1.31	5.92	1.25	1.62	6.36	2.50	2.88	8.09	7.50	4.14	9.82	12.50
Rio Tinto Plc	1.53	6.03	1.25	2.06	6.57	2.50	4.20	8.72	7.50	6.34	10.88	12.50
Average	1.50	6.07	1.25	2.01	6.64	2.50	4.06	8.94	7.50	6.10	11.24	12.50

Conclusion

The empirical analysis presented here provides clear and strong evidence that competitive and arbitrage mechanisms work across institutional and retail exchanges, ensuring price formation evolves in an efficient and synchronous fashion across exchanges. Commissions aside, for the venues under investigation, investors can expect that their orders get executed at the best available market prices.

This study found no evidence that executable prices at retail exchanges are inferior to those at institutional exchanges. To the contrary, we found that trading is most of the time and in most instruments and across order sizes more favourable at retail exchanges. Those also include many of the instruments most popular with retail investors, especially foreign shares.

Accounting for both execution prices and charges, the picture is clear: retail investors benefit from significant cost advantages across all instruments and across a range of relevant order sizes. Retail investors should always scrutinise execution prices but - following the principle of Best Execution - be aware that commissions are the predominating determining factor for the best execution.

The results of this study by no means contradict the well-regarded fact that institutional exchanges provide high execution quality, deep liquidity, advanced order types, and other features institutional investors - and also some retail investors - value and require. What they do show is that the endorsed competition between trading venues has led to different exchange models that serve the different needs different groups of investors have.

Recommendation for further analysis

We believe that this research provides a meaningful contribution to the current discussion on the CMU. The exchanges, instruments and time period studies can be considered representative of institutional and retail trading in a large European market with a competitive landscape of exchanges. Nevertheless, a more thorough analysis including even more exchanges and instruments in scope and across an even longer time frame may reveal more insights.

About Scalable Capital

Scalable Capital was founded in 2014 with the *raison d'être* to increase access to capital market investments for retail investors. We service over half a million retail accounts in the EU as part of a competitive and growing EU fintech sector. Scalable Capital offers digital wealth management and brokerage services that enable retail investors to invest for their future. At the centre of Scalable Capital's business model is providing our clients with the best possible result. Hence, providing our clients the most favourable terms and our own business growth are interdependent.

Annex

Annex 1: 150 most traded shares and ETFs by volume

Rank	Shares	ETFs
1	BioNTech SE	iShares Core MSCI World ETF
2	Tesla Inc.	Vanguard FTSE All World (Dist.) ETF
3	Amazon.com Inc.	Vanguard FTSE All World (Acc.) ETF
4	Nvidia Corp.	Xtrackers MSCI World UCITS ETF
5	Apple Inc.	iShares Core S&P 500 ETF
6	BASF SE	Lyxor Core MSCI World ETF
7	Moderna INC.	HSBC MSCI World ETF
8	Microsoft Corp	iShares Core MSCI EM IMI ETF
9	Deutsche Lufthansa AG	iShares MSCI ACWI (Acc) ETF
10	Alphabet Inc. Class A	iShares MSCI World SRI ETF
11	Mercedes Benz Group AG	Invesco MSCI World ETF
12	AMC Entertainment Holdings Inc.	iShares Nasdaq 100 ETF
13	Volkswagen AG	iShares Global Clean Energy ETF
14	PayPal Holdings Inc.	Xtrackers DAX ETF
15	Allianz SE	iShares Core DAX ETF
16	Alibaba Group (ADR)	iShares Nasdaq-100 ETF
17	Plug Power Inc.	iShares MSCI World Small Cap ETF
18	Bayer AG	SPDR MSCI World ETF
19	Varta AG	iShares MSCI WORLD ETF
20	Meta Platforms Inc. Class A	Xtrackers MSCI Emerging Markets ETF
21	Infineon Technologies AG	iShares MSCI World ESG Screen. ETF
22	SAP SE	Lyxor Nasdaq 100 Daily (2x) Lev. ETF
23	Advanced Micro Devices Inc.	iShares Edge MSCI World Momentum Factor ETF
24	Curevac N.V.	iShares MSCI EM (Acc) ETF
25	ASML Holding N.V.	Xtrackers MSCI AC World ESG Screened ETF
26	Palantir Technologies Inc.	Amundi Leveraged MSCI USA Daily ETF
27	Deutsche Telekom AG	iShares S&P 500 IT Sector ETF
28	Fresenius SE & CO. KGaA	iShares STOXX Global Select Dividend 100
29	Teamviewer AG	UBS MSCI World Soc. Resp. ETF (Dis)
30	Pfizer Inc.	Lyxor Stoxx Europe 600 ETF
31	Deutsche Post AG	UBS MSCI World Soc. Resp. ETF (Acc)
32	Siemens Energy AG	Vanguard FTSE All-World High Div. Yield ETF
33	RWE AG	Invesco Nasdaq-100 ETF
34	TUI AG	Xtrackers MSCI World Inf. Tech. ETF
35	Siemens AG	Invesco Coinshares Global Blockchain ETF
36	Block Inc.	Vanguard S&P 500 ETF
37	Alphabet Inc. Class C	iShares MSCI World ESG Enhanced ETF
38	Airbus SE	Lyxor Daily ShortDAX x2 ETF
39	Nordex SE	iShares Stoxx Europe 600 ETF
40	Adidas AG	Vaneck Semiconductor ETF
41	Gamestop Corp.	Lyxor Nasdaq 100 ETF
42	Porsche Automobil Holding SE	Xtrackers Nasdaq-100 ETF
43	Gazprom (ADR)	iShares Dow Jow Global Sust. ETF
44	Deutsche Bank AG	Lyxor Daily LevDAX ETF
45	Berkshire Hathaway Inc. Class B	iShares MSCI EM IMI ETF
46	Vonovia SE	iShares Automation & Robotics ETF
47	Zalando SE	Vanguard FTSE Developed World (Dis) ETF
48	Hellofresh SE	Xtrackers MSCI World ETF
49	Coinbase Global Inc.	Xtrackers Art. Intelligence ETF
50	Thyssenkrupp AG	Lyxor MSCI World ETF
51	Bayerische Motoren Werke AG St	iShares Core S&P 500 ETF
52	Covestro AG	Vanguard S&P 500 ETF
53	Aixtron SE	Xtrackers MSCI World ESG ETF
54	Netflix Inc.	iShares Global Water ETF
55	BP Plc.	Vanguard FTSE Developed World (Acc) ETF
56	Intel Corp.	iShares MSCI EM SRI ETF
57	Visa Inc.	iShares MSCI Europe SRI ETF
58	Shop Apotheke Europe N.V.	Amundi MSCI World SRI ETF
59	Amgen Inc.	iShares E. Vehicles and Driving Tech. ETF
60	E.On SE	iShares Digital Security ETF

61	Morphosys AG	Deka DAX ETF
62	Adobe Inc.	BlackRock ESG Multi-Asset Growth Portfolio ETF
63	Henkel Ag & Co. KGaA	Xtrackers MSCI World Momentum ETF
64	LVMH S.A.	Vanguard ESG Global All Cap ETF
65	Linde Plc	-
66	Verbio Vereinigt.Bioenergie AG	-
67	Münchener Rückvers.-Ges. AG	-
68	Sartorius AG	-
69	Steinhoff International Holdings N.V.	-
70	Airbnb Inc.	-
71	Unilever Plc	-
72	Salesforce.Com Inc.	-
73	Delivery Hero SE	-
74	Coca-Cola Co., The	-
75	Rio Tinto Plc	-
76	Fresenius Medical Care KGaA	-
77	Walt Disney Co., The	-
78	Heidelbergcement AG	-
79	Carl Zeiss Meditec AG	-
80	Commerzbank AG	-
81	Tilray Brands Inc.	-
82	Merck KGaA	-
83	BlackRock Inc.	-
84	AT&T Inc.	-
85	Continental AG	-
86	Boeing Co/The	-
