**1 Problem outline and background information**

One of the most notable trends of the past couple of years in the equity trading is the growth of the closing auction volumes. This is largely driven by the increase in passive investing. In the course of past 3 years, the closing auction has grown from accounting for roughly 15% of the total daily volume to contributing to as much as 25% of the daily trading activity.

The end-of-day auction is operated by primary exchanges with LSE running its auction for the UK listed stocks, Xetra for the stocks listed on their exchange and SIX for the stocks that IPOed on their platform, mainly large Swiss issuers. In contrast to continuous trading where there is competition and fragmentation, the closing auction is a single price forming event, operated by primary exchanges, often at a premium trading fee.

With the growth of the auction, there has been additional pressures in the industry to find alternatives. The biggest challenge is how to compete in the closing auction when it works best as a centralized process, meaning when all the buyers and sellers participate in one single auction for a specific stock to ensure the best price discovery. That closing price serves as an official benchmark to many fund managers tracking indices, for ETF NAV calculations and for portfolio valuations. Therefore, it is very challenging for competitors to offer an alternative closing auction in parallel to the existing end-of-day auction because that alternative would result in a different price which is not an official benchmark.

Therefore, instead of creating competing auction events, Aquis, CBOE, Turquoise some banks focused on offering matching of closing auction orders away from the closing auction but at the closing price. For example, Aquis offers participants ability to cross market orders. Participants can submit buy and sell market orders, once there is a match between buy and sell market orders for the closing auction, Aquis locks these orders and after the closing auction on the primary exchange concludes, Aquis matches the locked orders at that primary closing auction price. Other venues and banks offer similar services with varying levels of sophistication.

One thing that these offerings have in common – they take liquidity away from the closing auction of the primary market. With more and more trades happening through alternative closing auction matching mechanisms, a higher portion of closing auction orders will be drained from the primary markets. It is clear that these competitive services can save trading fees to participants (for SIX that can be approximately 1bps). Question is, what are the costs associated with draining liquidity from the closing auction? We are interested in analysing the costs for market participants if alternative closing mechanisms were to attract 5%, 10%, 25%, etc. of the end-of-day liquidity.

**2 Proposed research design and methods**

This section gives some first ideas how we could design our research agenda around closing auctions and serves as a motivation and basis for discussion. The researchers are encouraged to deviate from the proposed methodology if appropriate and develop their own empirical strategies. We are curious about any insights on the price discovery around the close.

**2.1 Data**

The data sample focus on Swiss equities, namely Blue Chips and Mid/Small Caps, traded on SIX (XVTX and XSWX) from 01.01.2019 to 31.08.2019.

**2.2 Methodology**

The research methodology comprises three approaches to highlight the importance of the closing auction as an important price forming event. The first approach shows how orders directly contribute to price formation in the closing auction. The second approach shows how orders contribute to price discovery. The third approach gives insights how orders interact in the closing auction phase on a centralized market suggesting that all order submissions, modifications and cancellations help to discover the closing auction price.

**2.2.1 Closing auction price sensitivity at the uncross**

What happens if liquidity migrates away from the closing auction? In our simulation, we compute the theoretical uncross price if some liquidity does not participate in the closing auction.

Methodically, we take a snapshot of the order book just before the auction uncross and compute the theoretical uncross price under the following scenarios

1. Remove x% of the buy volume from price formation for
2. Remove x% of the sell volume from price formation for
3. Remove x% of the buy and sell volume from the price formation for
4. Remove all market orders from price formation
5. Remove all market orders resting during the complete auction phase in the limit order book from price formation, i.e. market orders submitted with validity at-the-close during the trading day and activated at the start of the auction phase

This theoretical uncross price and corresponding auction turnover gets compared against the actual closing price and auction turnover. Statistics of interest are the following

1. How often is the theoretical uncross price different to the closing price for each scenario?
2. How much turnover would have been traded at a different price for each scenario?
3. What is the difference between the turnover executed at the official closing price and the theoretical uncross price for each scenario? Does the price impact outweigh the costs incurred by the auction trading fees? Specifically what is the average price impact in basis points of each scenario?

**2.2.2 Price discovery around close**

We first compute summary statistics of the auction price dislocation, defined as the change between the closing price and the midpoint price recorded just before the end of continuous trading aka start of the closing auction phase. We standardize this measure by (a) the midpoint price and (b) the spread computed both just before the end of continuous trading, respectively.

Mathematically, we compute the auction price dislocation as

(1a)

(1b)

where corresponds to the official closing price of the exchange and corresponds to the midpoint price observed just before the start of the auction phase, which starts with the activation of at-the-close orders. Stated differently, at-the-close orders do not contribute to the formation of the .

The auction price dislocation measures the price change during the closing auction phase.

What drives price discovery in the auction phase? To estimate the extent of price discovery, we estimate a panel regression of auction price dislocation on the following explanatory variables

(2) Volume order imbalance at the midpoint price just after the start of the closing auction, where imbalance is computed as

(3) Closing auction turnover share computed as the ratio of closing auction turnover divided by total turnover at SIX.

(4) Return during the last 15 minutes of continuous trading constructed from midpoint prices

(5) Stock-fixed effect

(6) Day-fixed effect

In a first robustness check, we replace the auction dislocation measure by the weighted price contribution (WPC) as originally proposed by Barclay and Warner (1993) and defined as

(1c)

where is the return during the closing auction phase, as defined by the auction dislocation measure (1a), and is the intraday open-to-close return constructed from midpoint prices.

In a second robustness check, we include an event-dummy for the period of non-equivalence (trading days after 01.07.2019) or run separate panel regressions for the two subsamples before and after 01.08.2019.

We encourage the researchers to visualize results, e.g. plot auction dislocations (y-axis) against the order imbalance (x-axis), if instructive.

**2.2.3 Bonus: Zooming into price discovery during auction phase**

How does order imbalance and the theoretical uncross price evolve during the closing auction? Does order imbalance reverts to zero during the course of the auction? To investigate this question, we split the auction phase into 30 seconds intervals and compute the following measures at the start of each interval and at the closing auction

1. Theoretical uncross price
2. Theoretical uncross volume (in CHF)
3. Imbalance at the theoretical uncross price for each interval as
4. WPDC measure, see Bellia et al (2017) as a reference

Visual representations show whether price discovery takes place at the start or towards the end of the auction phase.

**References**

Barclay, Michael J. and Jerold B. Warner (1993) Stealth trading and volatility: Which trades move prices? Journal of Financial Economics, volume 34, issue 3, pages 281-305.

Bellia, Mario, Loriana Pellizzon, Marti G. Subrahmanyam, Jun Uno and Darya Yuferova (2017) Coming Early to the Party. Working paper.