**Motivation and Research Question**

**Research Question:** How dark (M-ELO) activity impacts the number of mini-flash crashes and market liquidity?

**Data**

**Data Sources:**
1. NASDAQ historical ITCH
2. M-ELO Transparency Statistics
3. MIDAS Market Structure Metrics

**Mini-Flash Crashes:**
- Intervals of 50 trades (durations of 0 – 169 seconds)
- Extreme return’s Z-score ≥ 7
- 30-minutes price reversal is, on average, 88%

**Crash Characteristics:**
1. Return Z-score
2. Crash Duration, s
3. Price reversal, 30 min

**Midpoint Extended Life Order (M-ELO):**
- Hidden order
- Linked to Mid-price: \( m_t = (a_t + b_t)/2 \)
- Interacts only with M-ELO type orders
- Non-Executable before an end of “Holding Period” (0.5 s)
- Available since March 12, 2018

**Liquidity Measures:**
1. Quoted, Realized Spreads
2. Price Impact
3. LOB Depth around the midquote
4. Depth Imbalance

**Empirical Analysis**

**Methodology:**
- Linear panel model with fixed effects
- M-ELO trading is endogenous ⇒ Instrumental approach (M-ELO trading in other stocks of the same turnover group)

\[
\text{M-ELO}_{i,t} = \beta_1 X_{i,t} + \beta_2 W_{i,t} + C_t + \epsilon_{i,t},
\]

\[
y_{i,t} = \beta_3 \text{M-ELO}_{i,t} + \beta_4 X_{i,t} + C_t + u_{i,t},
\]

where \( y_{i,t} \) is the main dependent variable (number of mini-flash crashes, crash characteristic, liquidity measure), \( \text{M-ELO}_{i,t} \) is a fraction of M-ELO shares among all shares matched by NASDAQ, \( X_{i,t} \) is a vector of control variables, \( W_{i,t} \) is a vector of excluded instruments, \( C_t \) is time invariant unobserved individual effect, \( \epsilon_{i,t} \) and \( u_{i,t} \) are error terms.

- Assume strict exogeneity: \( E[u_{i,t} | X_{i,t}, C_t] = 0, \forall i, t \)

**Robustness Tests**

- Alternative specifications of M-ELO activity
- Alternative mini-flash crash identification
- Estimation of the model on separate sub-periods
- Separate estimation for small and big stocks
- Independent first-stage regression for each stock
- Different instruments for M-ELO
- Different control variables
- Outliers removal

**Conclusions**

- M-ELO is able to deemphasize HFT firms speed advantages, while leaving the possibility to manage the risk of open positions
- Dark trading can make markets more stable
- Liquidity provision improves in line with M-ELO trading activity

**References**