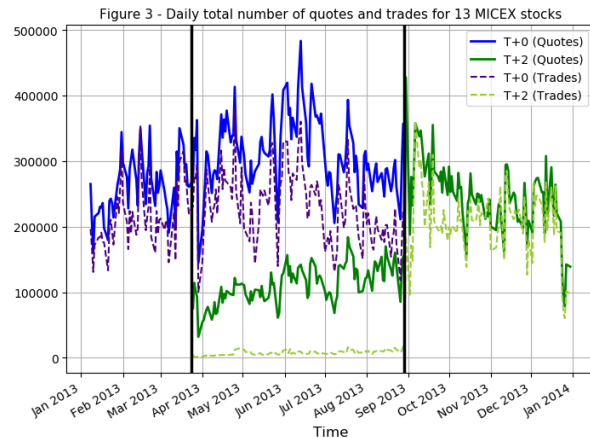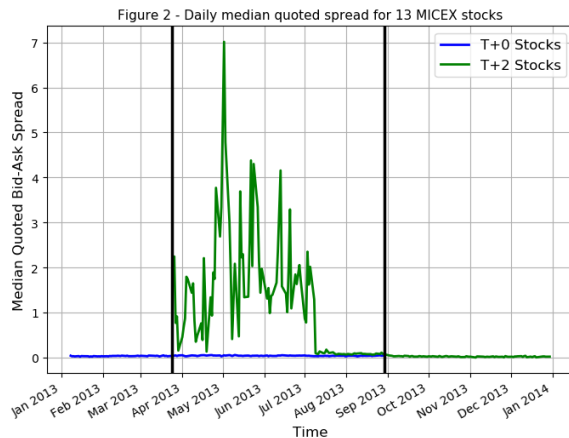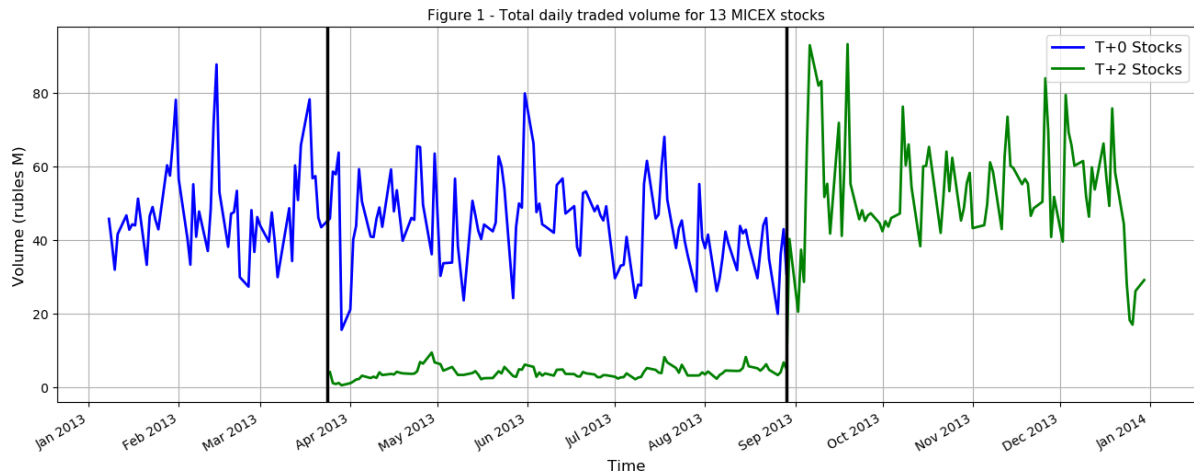## Moscow Stock Exchange Settlement Reform
Assignment Report - October 2017

On the 25th of March 2013, the Moscow Stock Exchange (MICEX) transitioned from an outdated trading system of immediate settlement (which we will denote as "T+0") to an industry-standard 2-day delay settlement ("T+2"). The settlement reform was completed in over 4 months. The purpose of this empirical market microstructure assignment is to analyse the impact of the settlement time reform on market liquidity. From a folder of 4529 zipped files, we run a Python program where we pre-process, aggregate the hourly time series into daily panel data.

We then run an exploratory data analysis on 13 key MICEX stocks (mainly gas/oil, hydroelectric, electricity transmission, mining, financials). We can clearly notice a 4-month interim from March 25th to August 30th, which helped transition some of the MICEX stocks (and the market as a whole) to the new settlement time. This is why we notice a certain continuity between the "T+0" and "T+2" after the end of the reform. The extremely poor liquidity for the "T+2" stocks (measured by the quoted spread) during the interim can be explained by the initial apprehensiveness of investors and the low level of traded volumes which would inflate the bid/ask spread.

Figure 1 - Total daily traded volume for 13 MICEX stocks

Figure 2 - Daily median quoted spread for 13 MICEX stocks

Figure 3 - Daily total number of quotes and trades for 13 MICEX stocks

To assess the impact of the settlement reform on the quoted spread $QSpread_{i,t}$, we will be using a **fixed effects panel regression model**. Suppose i is one of the 13 stocks, t the day time, thus:

$$QSpread_{i,t} = \beta d_{i,t} + \phi_1 D_{1,i} + \ldots + \phi_{13} D_{13,i} + \varepsilon_{i,t}, \qquad QSpread_{i=n,t} = \beta d_{n,t} + \phi_n + \varepsilon_{n,t}$$

$\varepsilon_{i,t}$ is the error term; $d_{i,t}$ is an indicator (dummy) variables that tells if we are in the new "T+2" time settlement system (thus equals 1) or not and we are still in "T+0" (thus 0).

ϕ_i is a stock specific intercept that captures the cross-sectional factors (unrelated to the settlement reform $d_{i,t}$) that affect the market liquidity. We can interpret ϕ_i here as the organizational/sectorial characteristics that distinguish Oil/Gas (Rosneft) from Financials (Sberbank) for example. $D_{n,i}$ is a dummy value for stock i: if we are dealing with a stock n, only ϕ_n and $\varepsilon_{n,t}$ will still be active. Thus, every time we are dealing with a different stock, the "intercept" ϕ_i changes. Therefore, the choice of running a fixed effects model stems from our desire to take into account the unique sectorial/organizational traits of each stock into our regression, and downplay the role of the 2013 settlement time reform in being the main driver of the evolution of MICEX's market liquidity that year.

We run this fixed effects model on a longitudinal dataset composed of the same 13 MICEX stocks as before, with daily series from January 1st to March 25th and from August 30th to December 31st 2013 (we do not consider the unstable transition period in-between):

Figure 4 - Summary of fixed effects panel regression

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Formula: Y ~ <T+2> + <FE_FEES> + <FE_GAZP> + <FE_GMKN> + <FE_HYDR> + <FE_LKOH>
             + <FE_MOEX> + <FE_NVTK> + <FE_ROSN> + <FE_SBER> + <FE_SNGS>
             + <FE_URKA> + <FE_VTBR> + <intercept>

Number of Observations:          1766
Number of Degrees of Freedom:    14
R-squared:          0.5155
Adj R-squared:      0.5119

---------------------Summary of Estimated Coefficients---------------------
    Variable      Coef     Std Err     t-stat    p-value    CI 2.5%    CI 97.5%
---------------------------------------------------------------------------
         T+2    -0.0184     0.0012     -15.55     0.0000    -0.0208    -0.0161
     FE_FEES    -0.0017     0.0029      -0.59     0.5552    -0.0074     0.0040
     FE_GAZP    -0.0500     0.0029     -17.28     0.0000    -0.0557    -0.0443
     FE_GMKN    -0.0241     0.0029      -8.32     0.0000    -0.0298    -0.0184
     FE_HYDR    -0.0161     0.0029      -5.56     0.0000    -0.0218    -0.0104
---------------------------------------------------------------------------
     FE_LKOH    -0.0416     0.0029     -14.39     0.0000    -0.0473    -0.0360
     FE_MOEX     0.0427     0.0031      13.86     0.0000     0.0366     0.0487
     FE_NVTK     0.0002     0.0029       0.06     0.9501    -0.0055     0.0059
     FE_ROSN    -0.0372     0.0029     -12.86     0.0000    -0.0429    -0.0315
     FE_SBER    -0.0511     0.0029     -17.66     0.0000    -0.0568    -0.0454
---------------------------------------------------------------------------
     FE_SNGS    -0.0262     0.0029      -9.06     0.0000    -0.0319    -0.0205
     FE_URKA    -0.0203     0.0029      -7.02     0.0000    -0.0260    -0.0147
     FE_VTBR    -0.0303     0.0029     -10.48     0.0000    -0.0360    -0.0247
   intercept     0.0621     0.0022      28.58     0.0000     0.0578     0.0664
```

Interpretation: for any given stock, the transition from an immediate settlement ('T+0') to an industry-standard 2-day settlement system ('T+2') decreased the daily mean quoted spread by -0.018. Thus, it seems as if the MICEX settlement time reform did improve liquidity, as it eases the collateralization of trades. But, we also notice that with the exception of 2 stocks, almost all fixed effect dummy coefficients [1] are significant (due to insignificant p-values). More importantly, among the 11 significant ones, 2 are positive (MOEX, CHMF) and 9 are negative. This could mean that the settlement reform wasn't the only positive driver for market liquidity, but also time-variant causes for each of the 9 stocks with negative signs, such as sectorial/organizational changes (e.g. concentration, improved transparency, political factors, etc.).

As a bonus, we run concurrently an OLS regression. The coefficient estimate for the settlement reform is similar (-0.016), but the R² goes from 0.52 to 0.05. Clearly, by taking into account the distinct microeconomics of each stock, we significantly improve the performance of our linear regression, as well as our understanding of the MICEX market microstructure.

[1] The <intercept> is actually the fixed effects dummy coefficient of Severstal (CHMF), which is called "intercept" but it is just one of the 13 stock-specific intercepts that change from one stock to another (we can call it equivalently FE_CHMF).