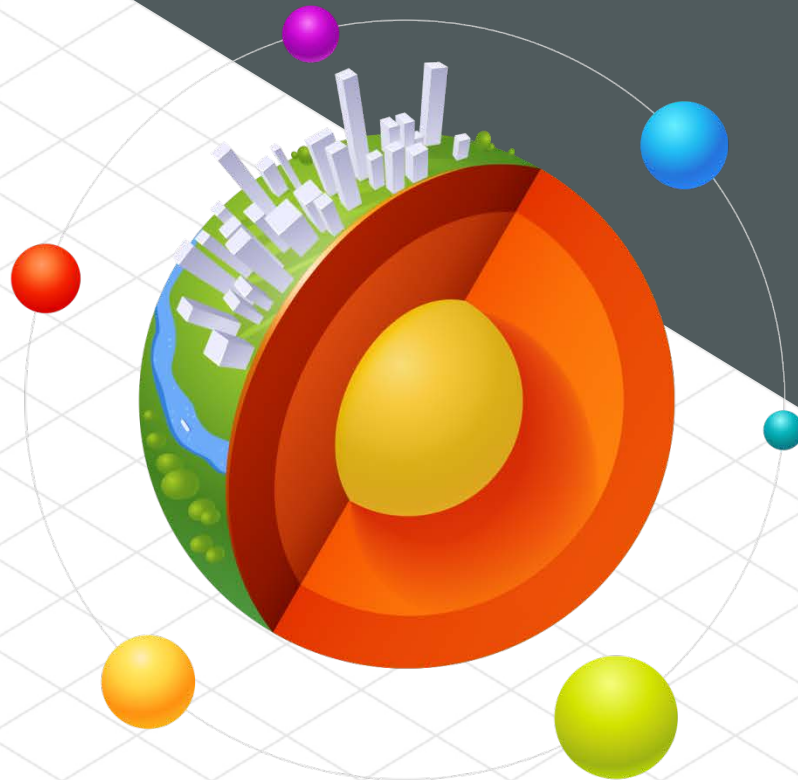


TICK SIZE and MARKET MICROSTRUCTURE

Mariya Frolova (Prognoz RiskLab)

Perm, 14.02.2015



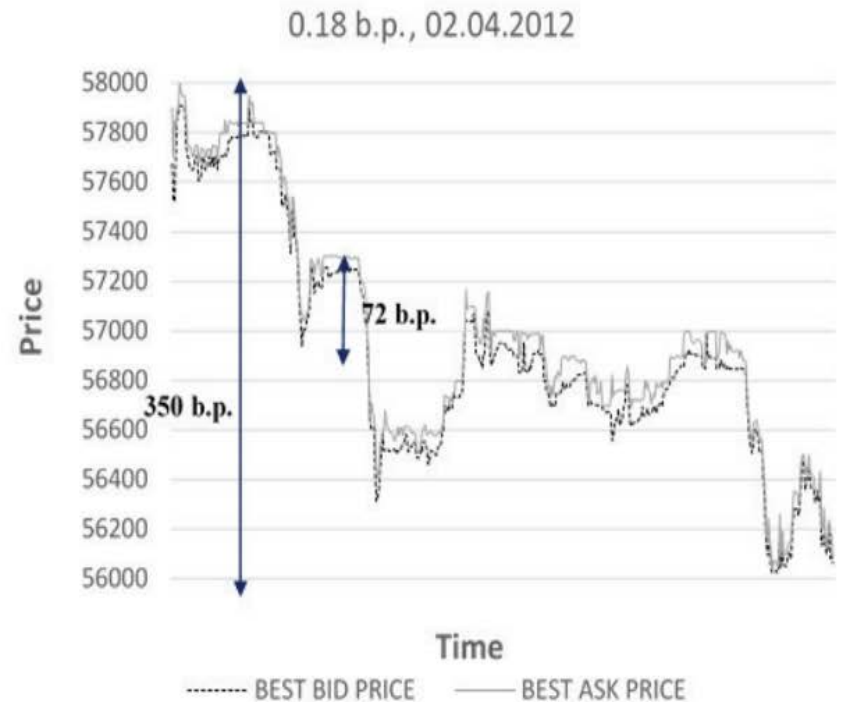
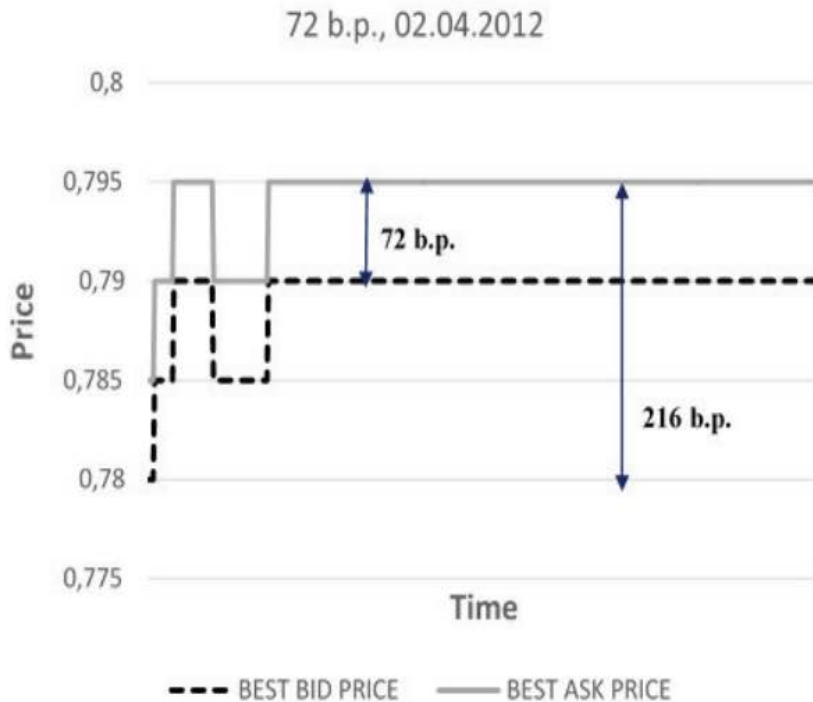
PROGNOZ

DEFINITION

Tick (*minimum price movement*):

- **influences on execution costs:** lowering trading cost, encouraging price competition, decreasing bid-ask spreads and increasing liquidity;
- **mediates power among various types of market participants** (small tick size benefits individual investors but at a higher cost for institutional investors: liquidity providers including market makers might not earn sufficient revenue to cover their operation costs when the tick size is small; large tick size serves to maintain a minimum level of profits for market makers and thus guarantees they will provide liquidity; HFT typically favors small tick assets);
- **affects the return distribution**, not only the center location and volatility, but also tail behaviors;
- **balances price priority with time priority** (small tick gives a preference to price priority, large tick – time priority).

COMPARISON OF INTRADAY PRICE PATHS FOR LARGE AND SMALL TICK ASSETS



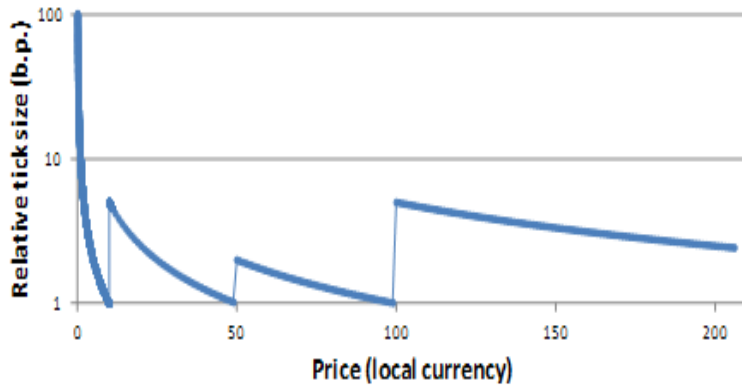
* *Arbuzov V. Modern trends in tick size regulation on Russian market (2014)*

TICK REGIMES AROUND THE WORLD

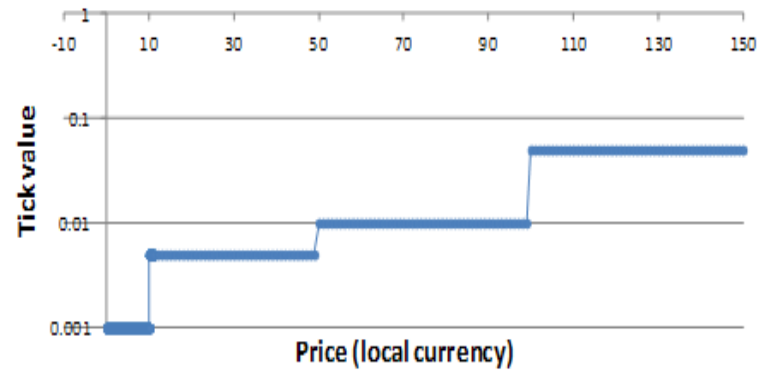
- Historically there has been a downward trend in the minimum tick size and simplification of price range structure in global markets:
 - ✓ *New York Stock Exchange (NYSE) reduced its tick size from 1/8 to 1/16 in 1997 and in 2001 the tick size changed from 1/16 to 1/100 of a dollar;*
 - ✓ *Toronto Stock Exchange (TSX) decreased tick size and adopted decimalization in 1996;*
 - ✓ *There was a general reduction of minimum tick size in Europe since 2009.*
- Tick sizes can be fixed or vary. While the majority of American equity markets tend to favor a common tick size for all stocks, most European and Asian markets adopt a stepwise tick structure depending on the price of the asset.

FOR MAJORITY OF EUROPEAN MARKETS RELATIVE TICK SIZE REMAINS SUBSTANTIALLY BELOW 10 BP

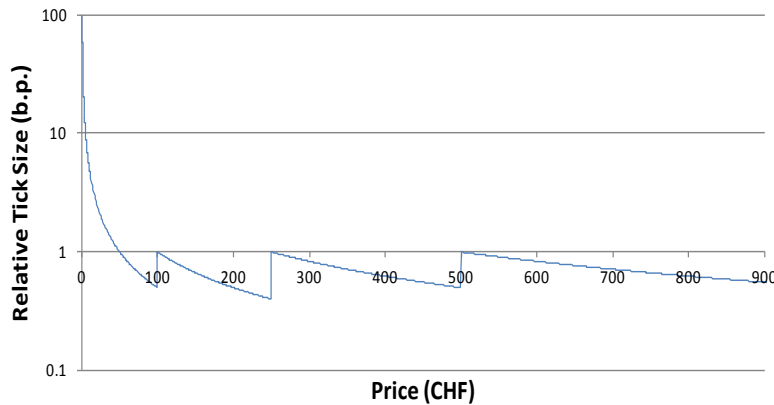
AEX, AMX, CAC 40, CAC Next20, BEL20, IBEX 35, PSI20, SBF120 stocks, and all German and Austrian stocks



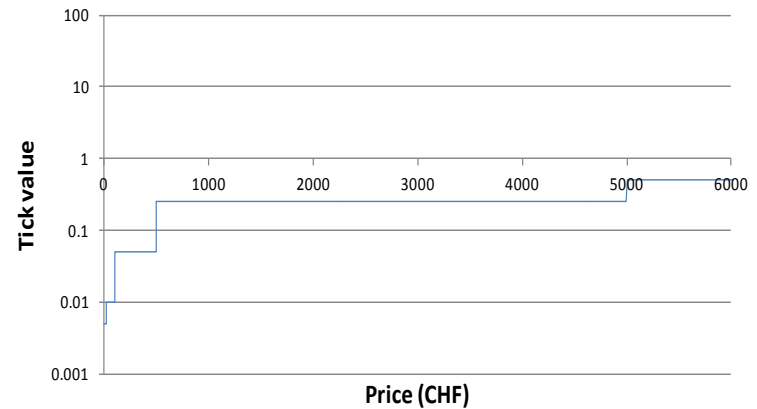
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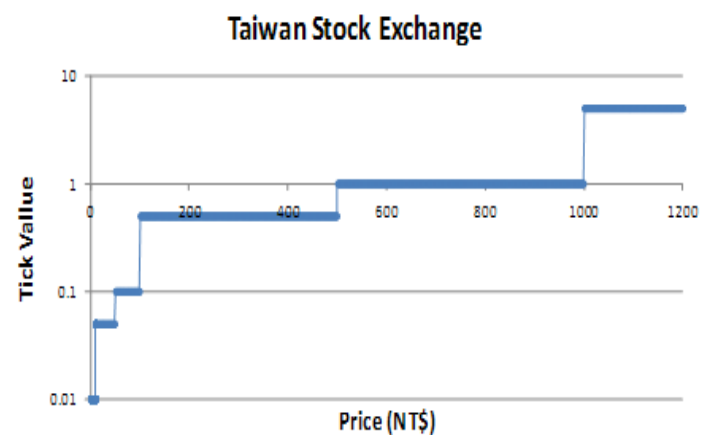
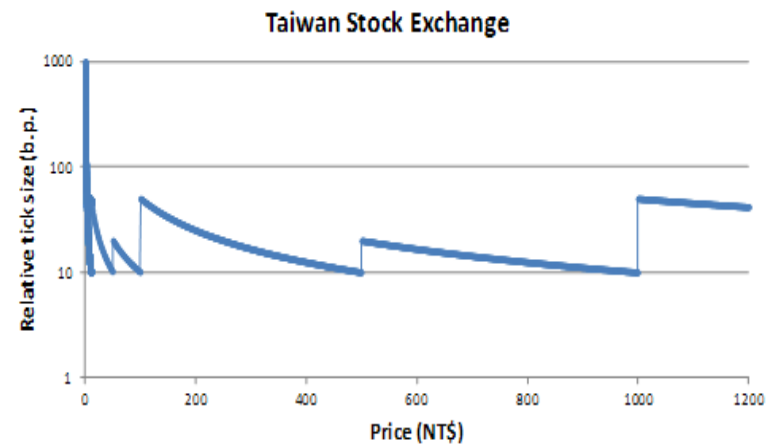
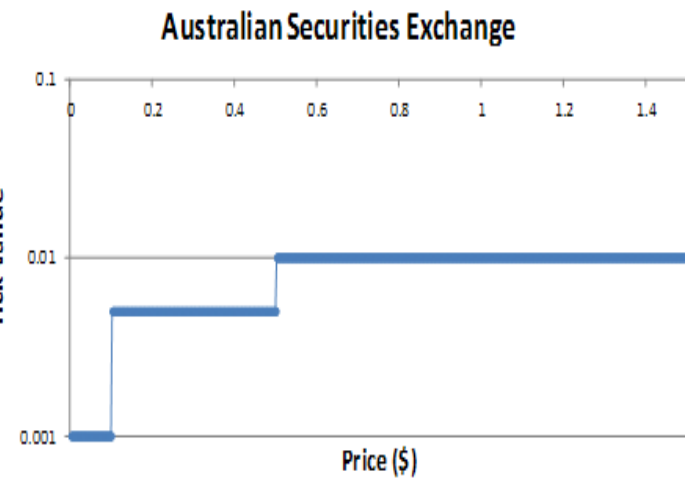
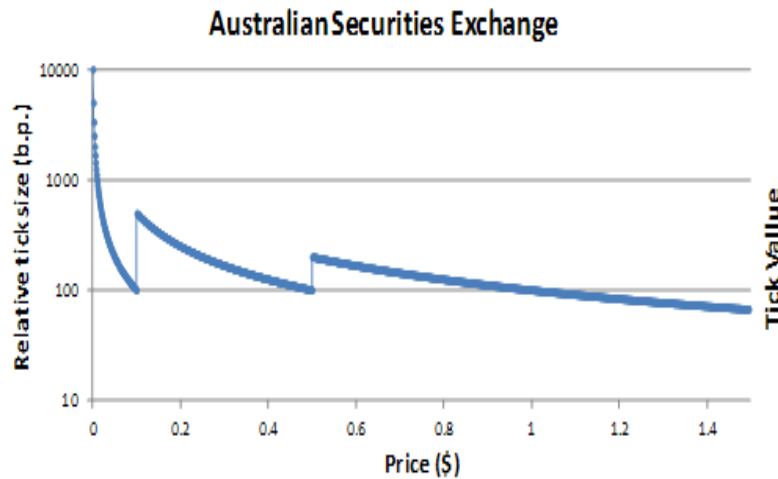
Non-Blue Chip Switzerland



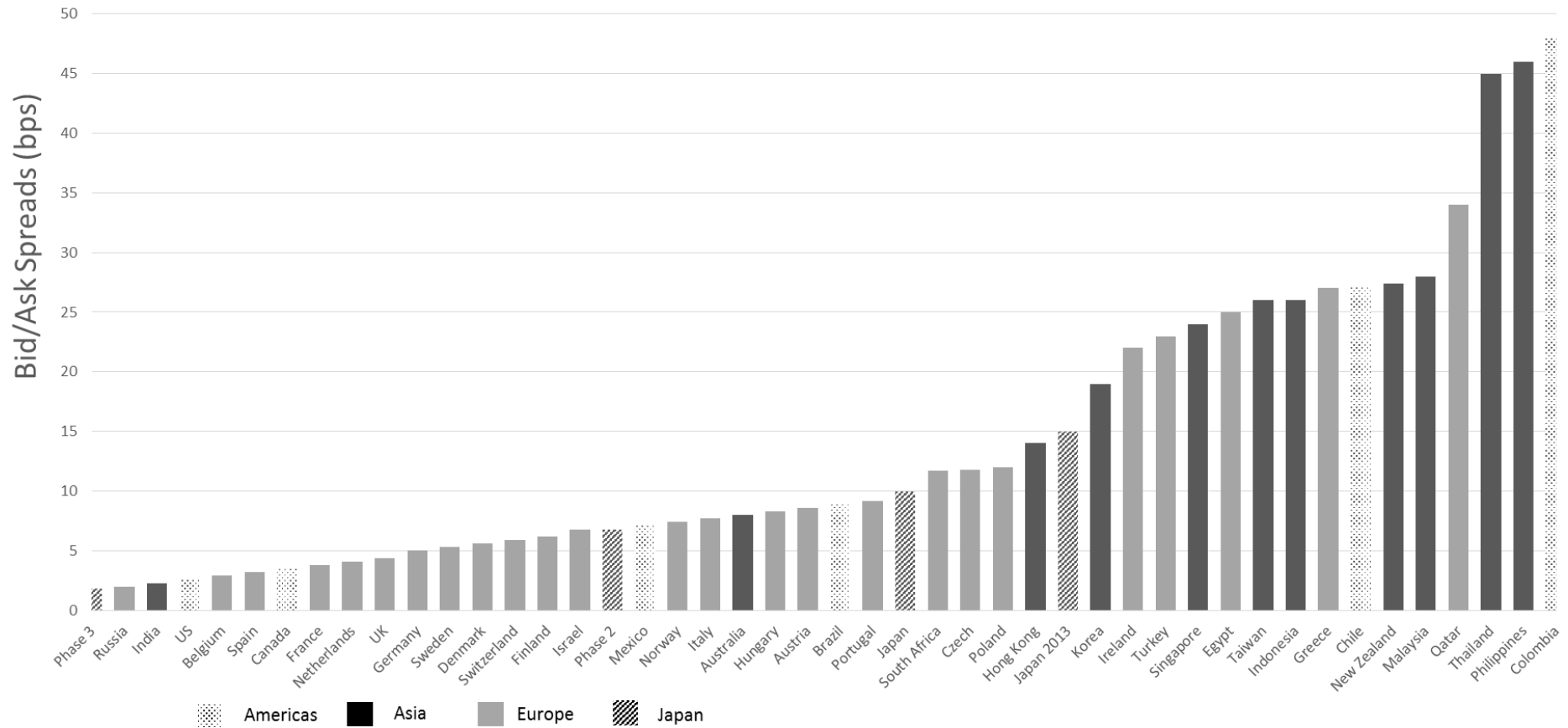
Non-Blue Chip Switzerland



COMPARED TO THE EUROPEAN MARKETS RELATIVE TICK SIZE IN ASIAN MARKETS IS SIGNIFICANTLY HIGHER



AVERAGE BID-ASK SPREAD



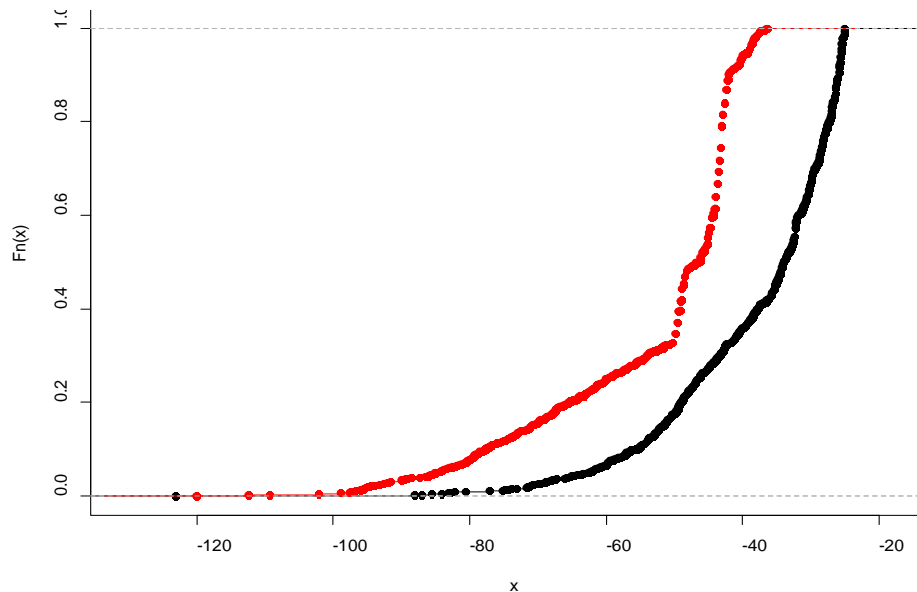
* *Arbuzov V. Modern trends in tick size regulation on Russian market (2014)*

TICK REGIME SWITCHING

Event study of 3 stocks, which switch tick size, shows that with tick size decrease from approximately 45 to 27 bp...

- transaction cost (measured by XLM) **decreases by 26%**
- volatility (measured by mean absolute 1-mins mid price returns) **decreases by 40%**
- number of order submissions **increases by 25%**
- volume on best bid and ask **decreases by 48%**
- relative spread **decreases by 62%**

Empirical distribution function of XLM (black - tick value=\$0.005 at price <\$1.995, red - tick value=\$0.01 price >\$2)



EMPIRICAL STUDY SHOWS THAT IN GENERAL WITH TICK DECREASING...

- share of HFT in trading volume **increases**;
- transaction cost (measured by 1% ADTV XLM) **decreases**, hence liquidity **improves**;
- realized volatility for both 1-min and daily returns **decreases**;
- price improvements (i.e. orders in the spread) are **more frequent**;
- time between order submission and order fulfilling **decreases**, i.e. execution times for all order types are found to have **decreased**;
- frequency of zero returns **diminishes**;
- quoted spread is **less frequent** at its minimum tick (for small-tick stocks spread is very rarely equal to one tick);
- number of order submissions per minute **increases**, agents tend to change their orders **more frequently**;
- average number of 1-minute price shocks **decreases**;
- average size of limit order **decreases**;
- **less volume** is available at the best prices.

WHAT IS THE OPTIMAL TICK SIZE WITH REGARD OF THE VOLATILITY AND LIQUIDITY?

1. **LIQUIDITY. XLM** measures the cost of a roundtrip transaction:

$$XLM_t(V) = 10000 \frac{|P_{B,t}(V) - MidQuote_t|}{MidQuote_t} + 10000 \frac{|P_{S,t}(V) - MidQuote_t|}{MidQuote_t}$$

$P_{B,t}(V)$, $P_{S,t}(V)$ – weighted average price at which an order of given size V could be executed immediately at time t ;

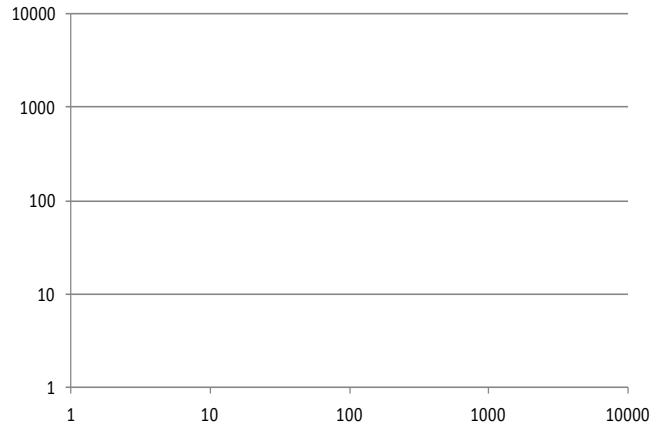
V – the order size.

2. **VOLATILITY:**

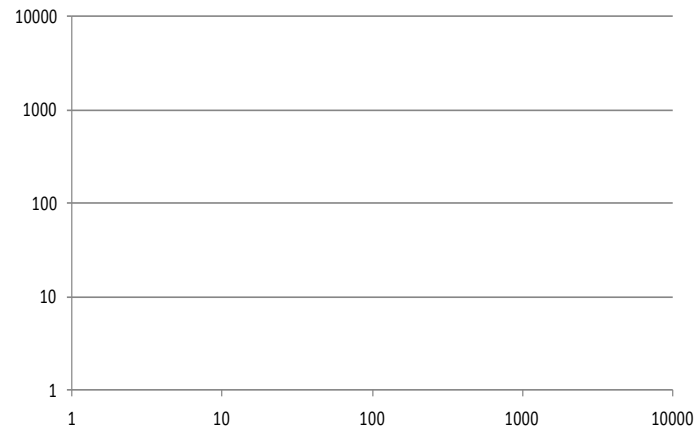
$$Volatility^d_i = StdDev\left(\ln\left(\frac{p^d_{i,t}}{p^d_{i,t-1}}\right)\right)$$

WHAT IS THE OPTIMAL TICK SIZE WITH REGARD OF THE VOLATILITY AND LIQUIDITY?

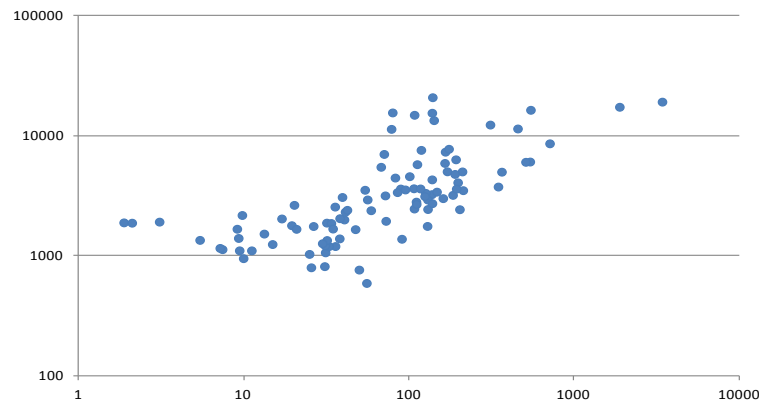
Tick-to-price vs. XLM, average values



Tick-to-price vs. volatility, average values



Tick-to-price vs. annualized volatility

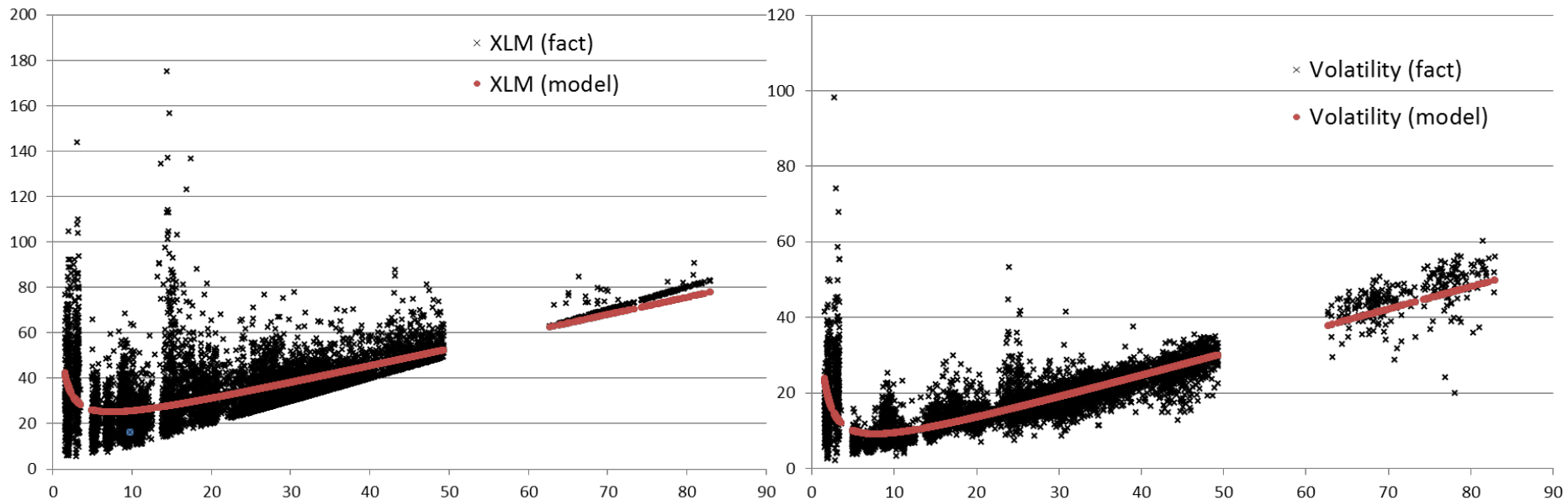


WHAT IS THE OPTIMAL TICK SIZE WITH REGARD OF THE VOLATILITY AND LIQUIDITY?

To fit the nonlinear dependency for **XLM** and **volatility** metrics we estimated the parameters of hyperbolic function:

$$y = ax + b + \frac{c}{x}$$

We then calculated the global minimum for calibrated dependencies:



CONCLUSIONS

- Tick is one of the key market parameters that:
 - influences on execution costs;
 - mediates power among various types of market participants;
 - affects the return distribution.
- Tick regimes differ across markets;
- Empirical analysis of Asian market indicates that there are nonlinear dependencies between relative tick size and volatility and liquidity. Minimum levels of volatility and liquidity corresponds to relative tick size 5-10 b. p.



THANK YOU FOR YOUR ATTENTION!
QUESTIONS?