# Implementation of Stock Market Arbitrage

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***Abstract*—Arbitrage is one of the most popular strategies in the spectrum of low-risk stock market tactics. Professional arbitrage traders are market participants that form more than 80 percent of market patterns. For a novice trader, these patterns are invisible. But some trading models indirectly rely on what arbitrage creates. The article provides an overview of the basic scenarios of arbitration in the Russian stock market and describes its own technology that is not tied to the terms of the contract with the exchange. This strategy is based on a statistical pattern. The article gives an overview of the basic arbitration scenarios on the Russian stock market and describes the own technology not tied to the terms of the contract with the stock exchange. This strategy is based on statistical regularity and allows to gain an advantage over some categories of market participants. Software has been developed to search for price differences between the same assets that are traded on different exchanges, or to find different assets that have a statistical relationship. The main advantage of the developed system is the speed, since the average duration of the profitable situation is less than 5 seconds.**

***Keywords— arbitrage, stock market, trading, share***

## I. INTRODUCTION

Over the past few years, algorithmic trading technologies had evolved very strongly due to its minimal risk strategy attracts a lot of capital.

Arbitrage is a number of logically related transactions aimed at extracting profit from the difference in prices for the same or related assets at the same time in different markets (spatial arbitration), or in the same market at different times. It is the practice to obtain a positive expected profitability from overpriced or underpriced assets on an inefficient market without additional risks and with zero additional investments

The theoretical justification of arbitration is the expediency of conducting two different transactions, provided that it is economically expedient. Despite the ease of operation, it is necessary to achieve advantages outside the borders of standard trade.

Arbitrage is one of those strategies, for the understanding of which is necessary in the arsenal of the modern trader [1]. Also, necessary to understand the frequency of opportunities for arbitration and their implementation [2].

As a standard, the trader's tool is the system, the interface of which is represented in Fig. 1. In the system, like this, only observation is available.components, incorporating the applicable criteria that follow.

To gain market advantage, requied:

- to determine the actual relationship between exchange-traded instruments that have a single asset in their structure. Assess the sustainability of the relationships;
- to identify the activation's thresholds of trade activity, which is aimed at eliminating inefficiencies;
- to conduct a research of basic arbitrage scenarios in the Russian market. Eventually, to identify the segments of activity, participating in the auction on the basis of statistical constancy. Define their behavior's patterns and conduct reverse engineer of their tactic;
- to estimate the frequency of occurrences' opportunities that pay off transaction costs;
- to evaluate management models of orders which will increase profitability;
- to determine the capacity of capital in this strategy.

As part of the research, not usual market Commission is laid, but the optimized version, which includes exchange and reduced brokerage Commission.

The research is based on own technologies and experience in the market. This method allows you to gain an advantage over some categories of participants.

Any concept of the research is bases on logic of 'edge in trade'. In this instance - full trade's automation on the base of available technologies and opportunity of a statistical approach with not only the analysis of graphical patterns, and also the structure of the depth of market and the methodology of transactions [3].

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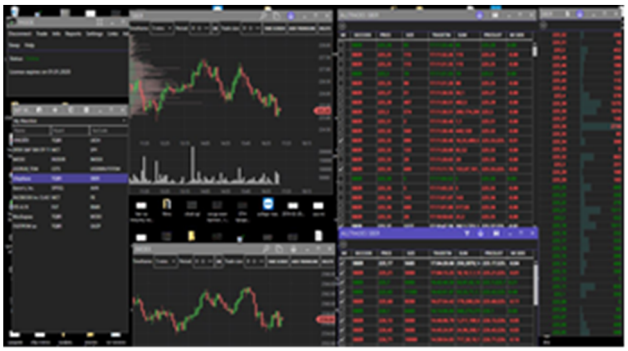

Fig. 1. Standard interface for trading

The popularity of arbitrage's strategies provides a low technological entry threshold level, which allows to start trading with minimal output costs. To realize a market opportunity, it will enough to send two orders at the same time. One of them to buy, the other to sell in the suitable stock exchanges [4,5].

The purpose of this work is to find the price difference between the same assets which are traded on the different exchanges, or different assets which have a statistical relationship.

## II. TYPES OF ARBITRAGE STRATEGIES

### A. *The Global inefficiency*

The Global discrepancy is a statistical anomaly which has no market imbalance between supply and demand, but is caused by "fundamental" shifts.

Such type of opportunities are rare and hold on, because for their neutralization, the disappearance of fundamental factors is necessary.

The advantage of such statistical discrepancies is the difference found significantly overlaps the prime cost of the transaction.

The main disadvantage of this strategy is the opportunity to get to the scrapping patterns - the moment when the market changes the usual scenario. This is the danger in the statistical approach. We don't have guarantees and time is not a guarantee of stability in this example.

### B. *Intraday difference*

"Arbitrage's difference between two identical assets." Its meaning is to find the same asset, or identify a group of assets which should the same cost[6].

This strategy should be more profitable, because of the low input threshold level. Due to the need to implement its own software package, the proposed concept will allow to get a higher advantage in the market in this way, if there are market inefficiencies.

This approach carries minimal risk, because sooner or later the price of identical assets will be equal in any case. It is important to mention that classical arbitration is implemented in the research. Without currency component. In this case, a bundle is possible, when the stock and instruments, which trading outside the borders of our country. Depositary receipts denominated in dollars will be suitable for this purpose [7].

In this case, time is not important as in example of statistical arbitrage in unexpected situation. The profit is based on the difference in the price of the same assets, not a statistical pattern.

However, in order to obtain a profitability above the risk-free rate, we need to borrow from a broker. This makes the factor of time is significant, because the cost of servicing debt capital appears it does not allow to accurately assess the potential of the strategy (brokerage fee).

## III. THE DEVELOPMENT PLATFORM

The ability to access stock exchange datas in real time is implemented on the standard broker connection. Were used raw data, depth of market. And the tape of all past transactions. This will allow us to obtain liquidity and trading activity data in real time.[3]

The quality of data is also important when it comes to the existing infrastructure.

Most of the software solutions available on the market that allow you to build an automatically trading algorithm are based on the price of the last transaction. Therefore, you can get an advantage using the " depth of market" and "tape". So it is possible to evaluate the structure of trading not only on the final momentum, but also taking into account the density of quotations. This is critical for assessing the capacity of a trading strategy.

Result: after a strong market order is seen on the flow of transactions small transactions that are directed against this market order. Their task is to buy at a favorable moment in the low price.

That's assuming that the link "Main index" and the underlying asset have a stable statistical correlation, it is possible to assess the fairness of the movement. To do this, based on the traded pair, it is necessary to allocate the underlying asset, which will be used as a "truth".

## IV. THE ASSERTS RESEARCH

Description of the algorithm.

You would make sure the permanence of the relationship.

A simple proportion is used. The price of one asset is taken and divided by the price of the second. The result is a number that should be constant with any change in the market situation. That when the market rises/falls, the final number should be within the standard boundaries. For convenience, the two sides of the transaction are reduced to the same monetary equivalent at the cost of the position. Piece of code presented in fig. 2.

In success in finding a stable trading pair, you need to understand the profit potential. To do this, an algorithm is launched that will monitor the change in the price difference in real time. This will determine the potential number of situations that can be captured by the algorithm.

Important point:

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```
var dateTime = DateTime.Now;
var first = (Level2ItemsFirst.Count != 0) ?
            Level2ItemsFirst.First().Price :
            0 * _k1;
var second = (Level2ItemsSecond.Count != 0) ?
           Level2ItemsSecond.First().Price :
            1 * _k2;
if (LineVisibility == Visibility.Visible) {
     var coef = first / second;
       LineChart.Append(dateTime, coef);
} else {
     var coef = first - second;
       if (coef >= 0) {
           Buy.Append(dateTime, coef);
              Sell.Append(dateTime, 0);
        } else {
           Buy.Append(dateTime, 0);
              Sell.Append(dateTime, coef);
     }
}
```

Fig2. Code example.

- The calculation of the difference must take into account the existence of a permanent difference in the price of the derivative, which is caused by the time value of money. The graph shows that this ratio is taken into account in the market pattern (Fig.3).
- The Basic principle of market arbitration is that it is necessary to make transactions simultaneously. But in the long term, they can be unsynchronized, which will give an advantage in profitability, but at the same time raise the risk

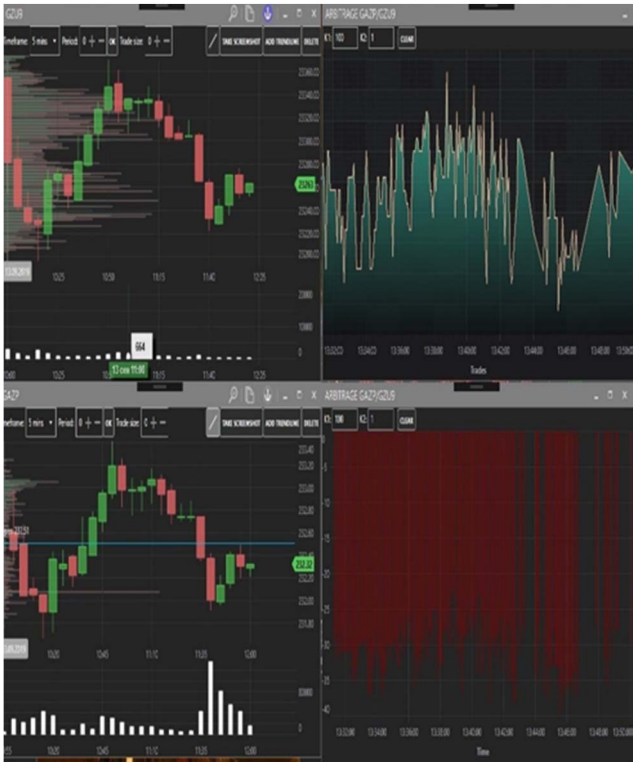

Fig. 3. Share of Sberbank and futures for this share.

The novelty of our approach is that most software solutions use the processed data stream that the exchange sends. The hierarchy of market formation consists of a Depth of Market and "the tape of all transactions" and the last in this scheme is a chart. In our case, the analysis is based not on the schedule, but on the relationship between quotes and past transactions. This allows us not only to determine the availability of opportunities in the market, but also to fix the time of existence of the opportunity for research, as well as the corresponding capacity for capital.

## V. Conclusion

The findings of the research are illustrated in Fig. 4.

*1) The greater the deviation from the fair price, the faster the reaction, which is aimed at eliminating it.*

There is always a certain line, when the movement does not roll back, but goes recoilless. But in the case of this trading algorithm, the strategy is protected by the same asset value.

*2) Found deviations above the norm are removed very quickly. The average duration of a profitable situation is less than 5 seconds.*

*3) Limitations to profitability. Taking into account the current study of average market tariffs. Everything clearly points to the fact that classical arbitration is handled by professional market participants. They realize their advantages through the absence of a Commission in the presence of a license of a professional participant of the securities market and a contract on the organization of market-maker services in the market.*


Fig. 4. Charts arbitrage.

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The average difference between the traded pair fluctuates around the lowest possible Commission on the market. In order to preserve profits, it remains to focus only on extremely fast deviations, which are possible only with a hybrid scheme of work. An additional module of the algorithm is required for placing an order on the predicted deviation, based on the probability of obtaining the execution of the transaction.

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