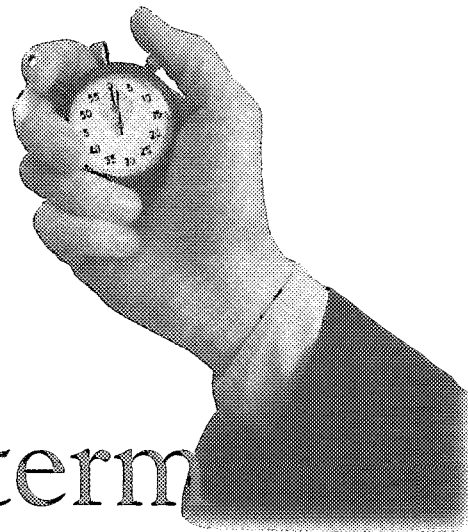


Many traders have discovered that if they dial down the frequency of the data they are trading, they can increase their bottom line as well. However, this step is not without its risks.



Extreme short-term profits in stocks

BY DAVID SEPIASHVILI

High-frequency trading (HFT) is gaining popularity and driving demand for new trading applications. This demand is challenging more researchers and developers to create efficient real-time automated trading systems.

While the main principles of lower frequency trading are well-studied and well-proven, fundamental concepts in HFT, or short-term trading, especially when applied to stocks, are in desperate need of original research.

PANACEA OR PANDORA'S BOX?

When using trading strategies that have a high trade count, investors can expect excess returns on their investments, and their expectations can be rewarding, but risk assumed can be commensurately higher.

"In the short-term" (right) shows the price of a Nasdaq security through a one-month period along with a hypothetical cumulative percentage net profit obtained by using a two-point reversal rule. The rule is based on the patterns of

the type that are "down, down, up" and "up, up, down." That is, buy long after two consecutive down moves, and sell short after two consecutive up moves.

When this strategy is applied to the high-frequency data, this simple rule has proved its efficiency in comparison with some trend-following trading rules, including moving average crossover rules. Although such an aggressive strategy generates a very high trade count, on average 130 trades per day, it produces high total net profit — about 90% per month without reinvestments.

But that's only half of the story. You also need to examine whether such a strategy can win consistently.

Consider "Out-of-sample surprise" (right) for part of the answer. This presents the performance of the strategy on the same stock in the succeeding one-month period. Here, the trading system produces substantial losses. This confirms our earlier statement: high returns and high risk go hand-in-hand, and HFT is not an exception.

Many wonder how the same strategy

applied to the same security produces opposite results, even though the market looks, at first glance very similar, having the same degree of recurring up-trending, down-trending and non-trending periods. However, a deeper insight into intraday volatility, which changes through time, reveals a strategy's propensity to be profitable at high frequencies. The good and bad scenarios are determined at this high-speed level, not by the surface picture, but by the deep, inherent structure of the security, a property that needs to be considered.

THE BENEFITS OF HFT

High-frequency trading is capable of generating excess profits even when using simple predictive rules and conventional technical analysis techniques. Returns are characterized by a higher stability than in lower frequency trading systems.

Another obvious advantage of HFT is flexibility in diversification. It facilitates different types of diversification, namely by time frame, by trading model, by various securities, and in this way allows the

trader to reduce risk on a portfolio level.

A further advantage of high frequency trading is that it can stimulate the liquidity of the market and improve the smoothness of the longer time frame's price curves. In the environment of growing interest in recent years to automated trading, HFT for these reasons can become an excellent driver to create efficient, high-performing automated trading systems.

BOTTLENECKS

Along with the benefits, HFT also has some side effects and limitations. By increasing liquidity, it increases traffic as well and can cause big problems: a need in selecting the most liquid securities to ensure easy execution of orders, as well as a need for speed in quick execution.

While these critical needs can be eliminated with sophisticated technological advances, until there is a further narrowing of bid-ask spreads, HFT will suffer a disadvantage. In some ways, commissions can be compensated for by using block trading techniques, but bid-ask spreads are a major determinant of trading costs and remain the stumbling block for HFT.

However, Electronics Communication Networks (ECN) allow investors to execute their orders at a lower cost, decrease the spreads on liquid, heavily traded stocks to well below one penny, and generate high profits by trading large blocks. Given all that, the existing bid-ask spreads still remain unrealistically high and unstable for HFT to gain much popularity.

The excessive returns earned in HFT are sensitive to the level of the bid-ask spreads. The existing spreads, unless executed at mid-quote, may render the strategy unprofitable by making otherwise winning trades losing ones.

"In the short term" shows the excessive net profit per month, about 90%, with an average profit per trade of 0.033% can withstand only the spread of 1¢ or 0.02%, on condition of zero or very low commission fees.

In "Hidden ruin" (page 36), you can see what happens to the HFT net profit after a gradual increase in the transaction costs from 0.03% (green curve) to 0.05% (blue curve) and further to 0.07% (red curve). The transaction costs of 0.05% per trade can wipe out this excessive return, while the transaction costs of 0.07% per trade make the system vulnerable and lead it to crash.

For comparison, forex investors may fall prey to this factor. The HFT hypothetical profits earned in forex markets, which are up to 100% per month by

executing around 300 trades per 12-hour trading sessions, can be lost due to the transaction costs of one to two pips per trade.

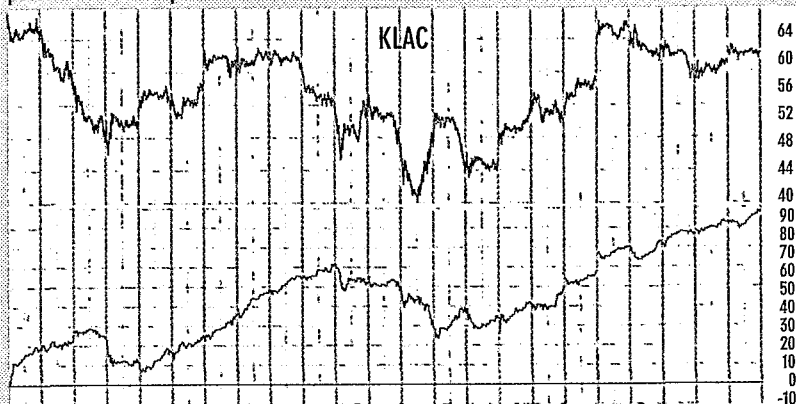
REGULARITIES OF HFT

One of the most important regularities pertaining to HFT is a high degree of probability in the prediction of turning points. The prediction ability of patterns and models developed for high frequencies can be striking.

Win probability ranges from 75% and higher, increasing with the improve-

IN THE SHORT TERM

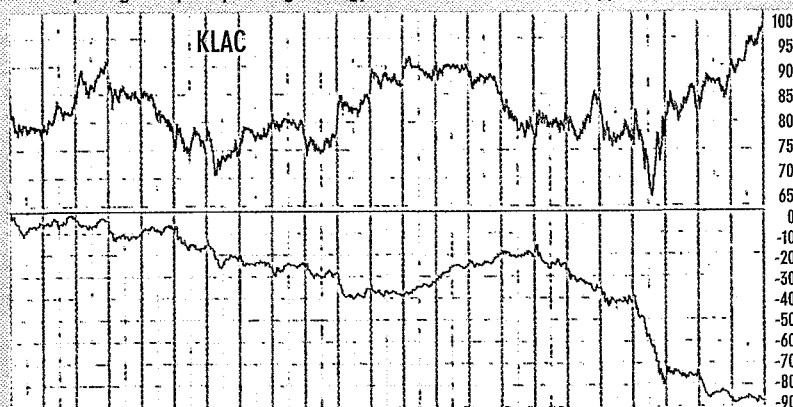
This high-frequency trading strategy looks like a real money maker when applied to this period of a Nasdaq stock.



Source: Algorithmic

OUT-OF-SAMPLE SURPRISE

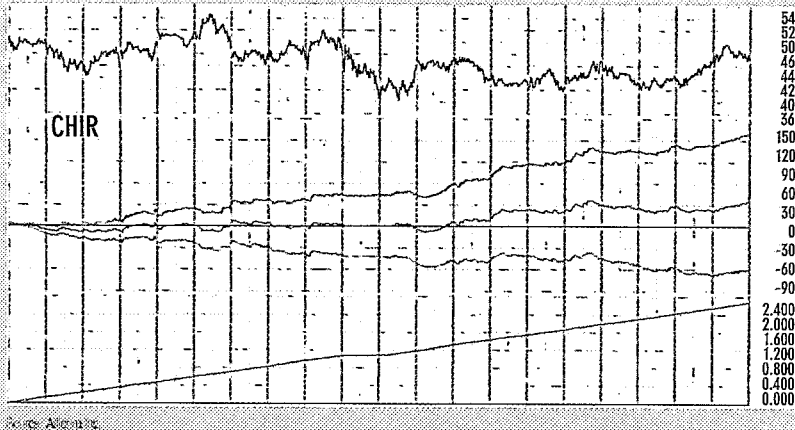
Our simple high-frequency trading strategy didn't work so well when applied to this new data.



Source: Algorithmic

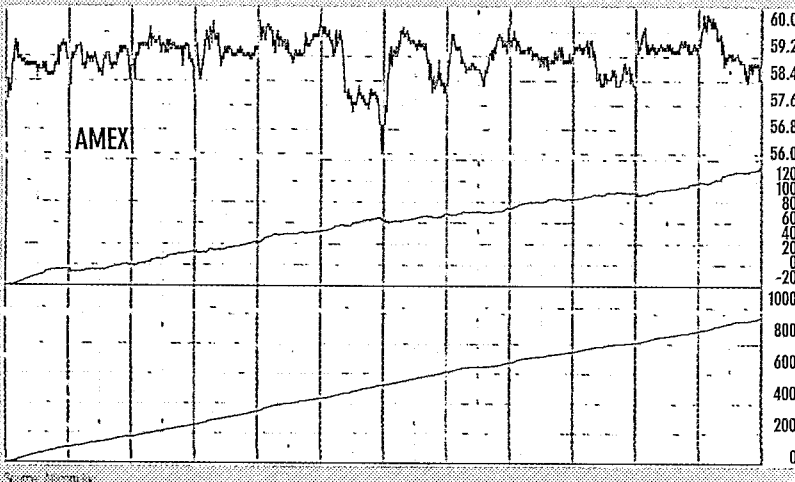
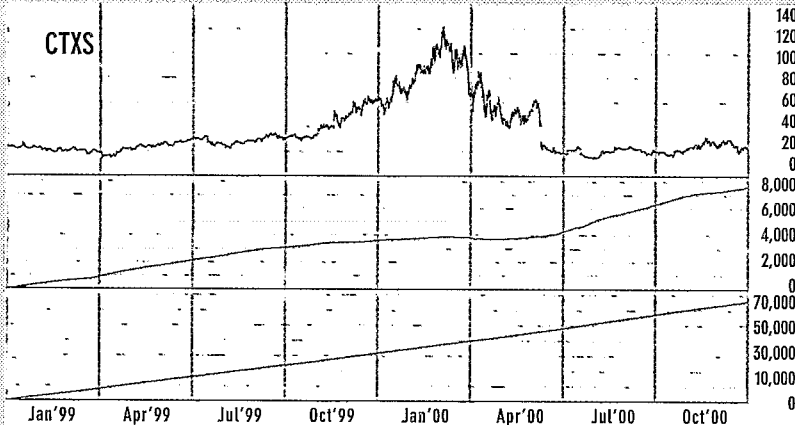
HIDDEN RUIN

When trading costs increase, the viability of a high-frequency trading strategy can go down the drain quickly.



DUAL PERSONALITY

While this high-frequency strategy is pretty bad during strong trends, it is quite profitable during trading range markets.



ment of trading strategies. Compare that to the win probabilities of 35% to 40%, that are considered typical of robust lower frequency trading systems based on trend-following techniques.

Unfortunately, an accurate prediction of turning points is not a guarantee of high profits, as it is accompanied by a low win/loss ratio ($W/L < 1$), a second key property of HFT that highlights the risk involved.

This exceptionally asymmetric, one-sided character of HFT performance is an important regularity that affects its efficiency.

There is another specific related to the application of HFT. It has an inability to perform comparatively well in strongly trending markets. Studies reveal that HFT should mostly be used in neutral and slow trending markets. To illustrate this statement, we can turn back to the unique experience of 1999 to 2001, years that saw the Nasdaq enjoy one of its strongest upward runs in its history, followed by consecutive declines and quiet narrow markets.

The first chart in "Dual personality" (left) shows the performance of the same strategy applied to the high-frequency data in strongly trending and ranging phases of the price movement. You can see how strong trending performance, lasting for eight months, destroys the strategy's efficiency. The net profit curve lies nearly flat while during the first 10 and last six months of the period the strategy is most successful. Look at the ascending net profit curve in the ranging and slow-trending markets.

An example of how well HFT can perform in the congestion zone is shown in the second chart in "Dual personality," which shows the security's price chart through a 12-day period, HFT net profit without reinvestment and the number of trades, correspondingly.

HOW TO APPLY

Only certain avenues are appropriate for implementing HFT. It cannot gain wide popularity in today's stock market, as

well as in the forex market, as its returns on average are comparable with transaction fees, or even lower. While it is possible to find pockets of profitability for these markets, that is rare.

For HFT to be successful, it needs to be more profitable or transaction fees have to be reduced. Simply put, the average return per trade has to exceed the transaction cost.

The ratio, or the return per trade divided by transaction costs, is the indication of HFT applicability. A prerequisite for a viable HFT approach can be achieved in three different ways.

The most direct way to tackle the problem is to develop strategies that enhance profit or limit loss via advanced risk-control techniques. This will improve a low win/loss ratio, the primary shortcoming of HFT models. The possible success of such a route is illustrated in "Frequency of success," (right) which shows QQQ performance throughout 21 months.

A simpler route is to trade on lower frequency data. Models developed on this basis usually have a higher average net profit per trade. "Go long for profits" (right) illustrates QQQ performance throughout 21 months using different data frequencies.

We can also see in "Go long for profits" that the performance of an intraday trend-following model greatly depends on whether the selected frequency resonates with the market cycle. The nearer the chosen frequency is to this cycle, the higher the final performance.

The best model here, namely the 30-minute model, has the highest net profit and a sufficiently small number of trades. It provides a good win probability $p(w) = 0.39$ and win/loss ratio $W/L = 2.6$. Compare them to the values $p(w) = (0.35 - 0.4)$ and of $W/L = (2 - 3)$, which are considered one measure of a robust trading system.

REGULATION THE ANSWER?

Oddly enough, one solution might be the revision of existing regulations in

FREQUENCY OF SUCCESS

It's pretty clear that better models earn more money, but that isn't always the case if trade frequency increases. These examples show the numbers based on three models of different profitability. I is least profitable, III the most.

Performance of high frequency trading models based on a predictive technique.

Transaction fees of 0.03% per trade are included.

Model	Number of trades per day	Net profit per month (%)	Net profit per trade (%)
I	118	27.5	0.011
II	126	59.9	0.023
III	132	93.4	0.034

Source: Altiq Inc.

GO LONG FOR PROFITS

Here we can see profits per trade in the 15-, 30- and 65-minute time frames produce positive returns and considerably outperform the existing transaction costs. However, their overall net profit does not match up with the success of HFT models.

Performance of intraday trading models based on a crossover rule of EMA 4-EMA 9.

Transaction fees of 0.03% per trade are included.

Data freq. (min.)	Number of trades per day	Net profit per month (%)	Net profit per trade (%)
1	43.6	(-43.03)	(-0.047)
5	8.1	(-4.42)	(-0.026)
10	3.8	0	0
15	2.4	+5.54	+0.11
30	1.1	+8.78	+0.38
65	0.5	+4.94	+0.47
195	0.2	(-1.30)	(-0.31)

Source: Altiq Inc.

the stock market. This should concern institutional investors who trade blocks.

Rules could be designed to ensure the narrowest possible spreads for high-frequency investors. The quotations to the third decimal point are a policy that would increase the stock market's liquidity and possibly reduce the spread to one-tenth of a penny.

To interest individual investors in HFT, brokerage firms would have to introduce low or zero commissions. The narrowest spreads would provide the potential for institutional and individual investors to get high returns by scalping the price and scratching the market on a micro-level.

Paradoxically, this can turn out to be equally profitable to the market makers and brokerage firms as trading volumes would grow exponentially.

As for the currency market, most brokers already don't charge commissions, even though they are built into the spreads. However, the same benefits could be found by extending the quotations to the fifth decimal point and eliminating the common practice of pip manipulation.

Given these technology and regulatory changes, high frequency trading on one basis-point spread trading platforms will take its rightful place in the modern markets of the future. **IFM**

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