High frequency FX trading: technology, techniques and data

The FX market has a number of features that make it attractive for High Frequency Trading (HFT) and many believe we can expect to see continuing interest and substantial future growth in this type of FX trading. e-Forex invites Dr Richard Olsen, Chairman and CEO of Olsen, Thomas Parry, Director of Algorithmic trading at Plimsoll Capital and Jonathan Webb, Portfolio manager at C-View Ltd to discuss some of the key issues involved.

Is success in high frequency trading (HFT) in FX almost entirely dependent upon having superior technology?

Olsen: Definitely, HFT is technology-driven. At Olsen we have developed a systematic trading environment that executes approximately 3,000 trades per day. The platform is computer-based, where humans oversee the trading activity without actively intervening. We human beings check that the processes are running according to plan. In an emergency we will reactivate a process.

Our trading-model environment comprises the following services: the core trading model taking trading decisions; a trading-support service for trade execution (the actual trades); customer reporting; and a host of monitoring tools. As is typical of modern technology, the success of our environment does not rely on one or two ideas, but builds on a complex system that has been well-tuned at all levels of operation.

Parry: Although superior technology can be a significant competitive advantage in high-frequency trading, technology alone without people possessing the "intellectual horsepower" to fully utilize it will not lead to any sustainable form of alpha generation. Additionally, with the increasing number of technology vendors and ISVs now offering "off-the-shelf" algorithmic trading applications, I believe that the vast majority of new entrants to the space would be wise to allocate their resources to extending these existing applications to meet their needs as opposed to duplicating proven technology already widely available in the marketplace.

Webb: Not at all, HFT covers many types of trading. Whilst simple FX cross arbitrage models are undoubtedly a battle for the lowest latency, there are many other ways to exploit HFT opportunities rather than just better technology.

Dr Richard Olsen

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What trading metrics and tools would you consider essential for any HFT operation?

Olsen: At Olsen we focus on a broad range of risk measures. One of the most important is the Calmar Ratio, which compares annualized return with maximum draw down. The Calmar Ratio focuses on the worst-case scenario–the relationship between average return and extreme loss–and is thus more relevant than, say, the Sharpe Ratio.

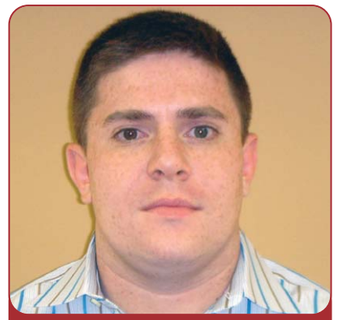
Another risk metric we use is the "ExposureFactor," a term we coined to describe the relationship between annualized return and maximum exposure. In financial markets, where uncertainty abounds, one fact is sure: at low levels of exposure, risk increases in linear increments; at higher levels of exposure risk increases exponentially, and so becomes very dangerous. It is therefore important to monitor exposure and to develop and pursue strategies that have relatively small exposure at all times.

Parry: I think that one of the most important tools for any firm looking to engage in high-frequency trading is an integrated development/trading application to test, evaluate, and tune potential strategies before rolling them out to the production environment and taking on market risk. Although there are any number of applications in the market that enable users to perform some type of "backtesting" on the buy/sell logic of a particular trading system, very few enable users to perform any tests or simulations of the performance of the pricing, messaging, and order routing components of the system.

One of the primary reasons that Plimsoll recently chose to deploy Athena Trader from Aegis Software was that their platform enabled us to perform a full range of automated regression tests on each component of our trading systems in parallel with complex failover/recovery tests to assure that functional and performance capabilities are not adversely affected at all by failures.

Additionally, by being able to develop and test our strategies in the same environment that they will eventually be deployed in, we have been able to significantly reduce the time needed to develop new strategies. This allows us to deploy new strategies to the market faster, as well as explore more ideas.

Webb: Reliable, robust technology is the foundation for any high frequency trading.



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Why do you think FX is considered by some to be the most advanced market for high frequency trading and what advantages does it have?

Olsen: In FX spreads are extremely low–approximately 0.01 percent for EUR-USD. If a trader has perfect foresight, he can earn–without taking on any leverage–approximately 2 percent of return every day, or approximately 500 percent during one year. This return potential assumes that the trader can take advantage of every small price spike. If a trader cannot trade at high frequency (for example, only once a day), then the annual return potential is only 125 percent. Other things being equal, going to HFT enhances the return potential of an investment strategy because a trader can take advantage of many more price spikes. For sophisticated investment managers with the

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appropriate computing power and know-how this is a great enticement.

Parry: I don't know if I'd go as far to say that the FX market is the most advanced market for high frequency trading (yet), but I do feel strongly that it is evolving much faster than other markets such as equities or futures, and it has several structural features that make it particularly attractive for high-frequency trading. Unlike many equities and futures markets where algorithmic trading was developed as a response to a lack of liquidity, the high levels of liquidity in FX allow participants to focus on alpha generation.

Webb: Many of the ideas and much of the technology are from the equity markets so I am not sure that is true. However in FX, HFT can be used, for example, to hide large orders which is increasingly important given the size of cross border flows and more active management of FX exposures. The other advantage is that there is large amount of price information available from banks, EBS, CME etc which is essential to exploiting HFT ideas.

Some commentators have remarked that HFT is not an inherently better way to trade the market and indeed given the transaction costs and the small margins being captured, it is a relatively expensive way to trade. Would you agree with that and how do you leverage technology to overcome this issue of costs?

Olsen: FX is an over-the-counter market with strong competitive pressure among market makers. This has helped to bring down spreads and stopped banks from introducing ticket fees, as is customary for the futures and stock markets. Because an FX trader pays only the spread, he is not penalized for making many small trades, so HFT is not expensive at all. HFT is all about making many small trades at relatively low risk.

HFT infrastructure is not that costly–at least when compared to the lofty salaries of top traders. The hardware and software infrastructure of HFT is relatively durable and not lost when an employee leaves, which is what happens when a top trader walks out the door.

Parry: I think that some of these commentators may have come to this conclusion by possibly assuming that high-frequency

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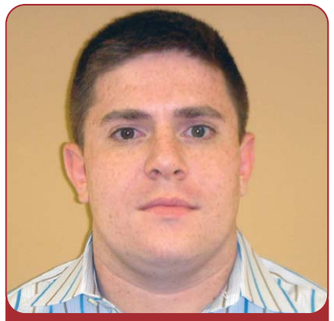
strategies are subject to the same cost structure as lower-frequency types of strategies. Typically, HFT strategies are able to enjoy significantly lower trading costs due to the large amount of volume they generate, allowing them to capture profits that have previously been 'overlooked' by more traditional types of strategies. Additionally, simply comparing the per trade return margins of different strategies without taking into consideration the variance of those returns is a naïve analysis at best. Perhaps one of the best arguments for the efficiency of HFT is that although high-frequency trading strategies generally attempt to capture smaller margins than more traditional types of trading strategies, they are often able to do so with a much higher probability of success (profitability) and with a lower risk per trade.

At Plimsoll, we have been able to utilize advances in technology to improve the execution efficiency of our strategies by aggregating



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multiple liquidity pools to maximize the opportunity for price improvement. We have also created a series of FX-specific trade execution algorithms based on high-frequency analysis to improve our execution efficiency of both our medium-term and high-frequency trading strategies by maximizing their opportunities for price improvement and minimizing slippage and market impact.

Webb: HFT covers many facets of trading, but in terms of trading simply on a proprietary basis, rather than as an aid to execution, some of the initial opportunities such as exploiting latency of bank FX feeds were never a sustainable business model. In addition the costs of maintaining the infrastructure, settling deals etc was probably underestimated and like all trading ideas not everyone will make money out of HFT. Good technology is a necessary but not a sufficient condition for successful trading. It is how you use the technology that will determine the profitability of the endeavour.

Can you illustrate or describe the type of new technologies that make HFT possible in FX?

Olsen: Building an HFT strategy requires three basic tool sets:

- a data repository for tick data, including data-cleansing capabilities;
- a trading-model environment to develop and test the models under real-world conditions; and
- a trade-execution service capable of faultless execution of the trading signals.

Without modern computers and advanced software tools it would be extremely expensive to build a successful HFT trading environment. All three domains–data collection, trading models, and trade execution–have their specific complexities that must be overcome.

Parry: The introduction of electronic order book trading platforms or FX-ECNs (such as Hotspot, Currenex and FXMarketSpace) coupled with the ability to easily aggregate these new liquidity pools through standardized interfaces (i.e. FIX) have significantly increased the levels of pre-trade transparency in the market and have highlighted the existence of previously hidden but profitable trading opportunities. Another key effect of this liquidity aggregation is that liquidity providers have had to tighten their spreads in order to

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attract order flow and remain competitive. Spread reduction has further fuelled the rise in HFT by making many strategies which would have previously been unprofitable now viable. Finally, technology advances such as complex-event processing and event-stream-processing, combined with low latency market connectivity, have enabled traders to identify and capture these inefficiencies as they occur in real-time.

Webb: The three key elements are price discovery via FX pricing feeds, auto-trading interfaces and straight-through-processing.

The quality and availability of relevant historical FX spot data is a challenge for those building HFT models. How much of a concern for you is availability of relevant spot data and how do you address the problem?

Olsen: At Olsen we started to collect tick data in 1986; we have

a lot of experience in storing, filtering, and using data for real-time applications. In addition, we have established a company, Olsen Financial Technologies (OFT), dedicated solely to gathering, cleansing, and formatting data. OFT sells tick data in any shape or form. Also available are all the tools required for storing, filtering and processing that data. Today, the availability of spot data is not the challenge for HFT; it is more an issue of project implementation–the sort of task that any software engineer experienced in executing larger projects is used to.

Parry: I don't really think that there is a significant problem concerning the availability of historical FX tick data. Although it is difficult to obtain tick-by-tick market data for most currency pairs before 2003, several structural changes have taken place over the last few years and using data from before this period could very likely introduce unwanted estimation biases into your models. Fortunately, in most cases, one to two years of high-quality high-frequency market data is more than sufficient to generate statistically significant high-frequency models.

What should be of a far greater concern than data availability is the cost of the high-frequency FX market data compared to similar market data in equity and futures markets. In some instances, the cost of FX tick data can be upwards of 1,000 times more expensive than futures or equities data with similar levels of granularity. Reducing these costs to levels comparable with other markets will increase market participants' understanding of the high-frequency aspects of the FX market, enabling them to build more models, resulting in more trades, more liquidity, and more efficient market. The greater the quality and granularity of the data available, the more trading strategies will be built around that data.

Webb: This is not such a large issue. In the high frequency arena, because of the large number of trades, it does not take many weeks of data before you can have statistically significant results. More importantly is ensuring that the simulations accurately reflect the real world environment when they are replayed.

Risk management is another key consideration. Do you mainly tackle this by diversification and position size management or do you employ other additional methodologies?

Olsen: Yes, agreed–risk management is a key issue. We tackle this by diversification and position-size management. More important, we have introduced a multi-layered approach to risk management. In our software we manage risk trade by trade; then, on a more aggregate level, per exchange rate; at a higher level, per currency; and, finally, at the global level. By managing risk across multiple horizons we can get a better handle on concentration risk–for example, when all the players in the market go for the carry trade and there is exuberance in one direction.

Parry: Plimsoll utilizes a number of risk measures such as VaR, Conditional VaR, Monte Carlo simulations, and maximum drawdown analysis to identify potential losses under extreme market conditions. This analysis is used in our portfolio construction process to determine trading limits, position sizing, and optimal leverage to meet our investment objectives. Furthermore, we employ a multi-level diversification scheme that includes diversification by instrument, trading model, and trade duration.

Finally, our high-frequency portfolio utilizes an adaptive risk model that dynamically allocates risk to each of the underlying strategies in the portfolio based on a mean-variance optimization technique that continually re-optimizes the risk allocated to each strategy to maximize the expected growth rates under the constraints that a CVaR or maximum drawdown objective will be satisfied with a 99% probability level.

Webb: Systematic trading approaches, in general, are well suited to risk management procedures as optimal position-sizing can be determined from combining the p/l streams. In addition, C-View's approach to risk management is to use trading experience to determine when trading conditions are no longer conducive to any particular trading approach.

Why do you think we have seen recent substantial growth and interest in HFT in FX trading and do you expect this to continue in the future?

Olsen: HFT offers a lot of return potential. As I have outlined, building a solid HFT environment is an extremely challenging exercise; but once this has been accomplished the platform runs smoothly and operates at far lower risk than a traditional setup with human traders. Incremental improvements are relatively easy; it is the start-up where you have to get things right without major hiccups– that's the hard part. Nevertheless, I expect the substantial interest and growth in HFT to continue.

HFT–at least as practiced by Olsen–is counter-trend and thus not subject to the typical capacity constraints. In the hedge-fund industry there is a shortage of highly liquid and outperforming investment strategies, so I believe investors will automatically gravitate towards HFT. Finally, HFT in FX is extremely attractive from a funding point of view. Institutional investors can invest in HFT without putting up equity, purely on credit. So HFT is ideally suited to enhance returns in the context of another investment strategy. This investment story has yet to be picked up; once it is, we think we'll see unprecedented growth in HFT.

Parry: The FX market's unique combination of high liquidity and low volatility make it an ideal environment for deploying high-frequency trading strategies. These factors along with tight bid-ask spreads and low transaction costs enable HFT strategies to be much more scalable in FX than other asset classes. This scalability could be the single most important factor for the future growth of FX high-frequency trading because it allows for the creation of the economies of scale necessary to offset the high developments costs associated with the development of HFT strategies such as of highly-skilled traders/quants/programmers, long development cycles and technology investments.

Webb: HFT covers three distinct areas: banks using algorithms to auto price FX, as a way of hiding and reducing slippage of large flows in the marketplace and as a proprietary trading tool. The time that a position is held also varies from under a second to a number of minutes. As trading technology continues to become more ubiquitous there is no reason why all theses areas will not increasingly use HFT ideas and technology.