

High-Frequency Trading in the Foreign Exchange Market:

New Evil or Technological Progress?

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Introduction:

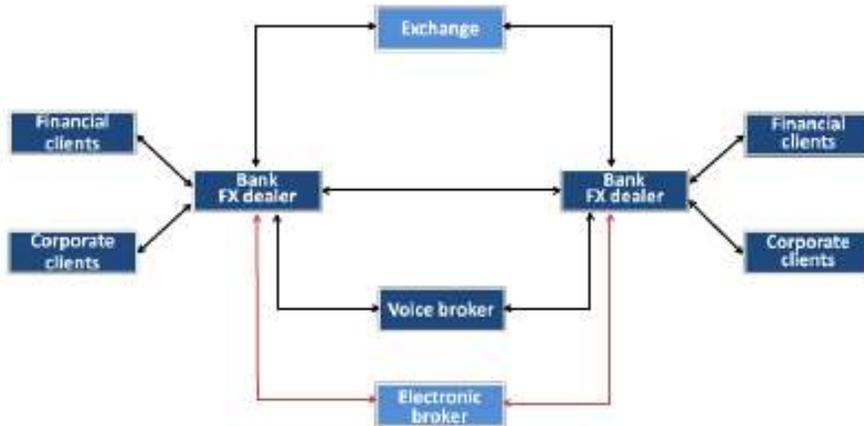
High-frequency trading (HFT) was introduced into the foreign exchange market in the early 2000s when forex banks began offering online trading services and bank prime brokers allowed clients to obtain credit sponsorship, allowing multiple types of clients over-the-counter access to the foreign exchange market (Markets committee, 2011). HFT is a subset of algorithm trading. Algorithm trading is a form of electronic trading that can either involve algorithmic execution or algorithmic decision making. In the former, the algorithm is triggered by a human trader deciding on a trade, and the algorithm chooses the optimal place, time or volume to optimize the trade. Algorithmic decision making is where an algorithm uses market data and a model to determine when to make a trade, and execute it. HFT involve making trades very quickly, so they fall into the category of algorithmic decision making (Source). HFT firms operate by making a large number of trades of a miniscule value, generally earning small profits per trade, which add up over the tremendous number of trades that they make. They typically offer trades for very short holding times, often less than 1 second, which greatly minimizes their risk (Source).

How computerized trading changed the foreign exchange market:

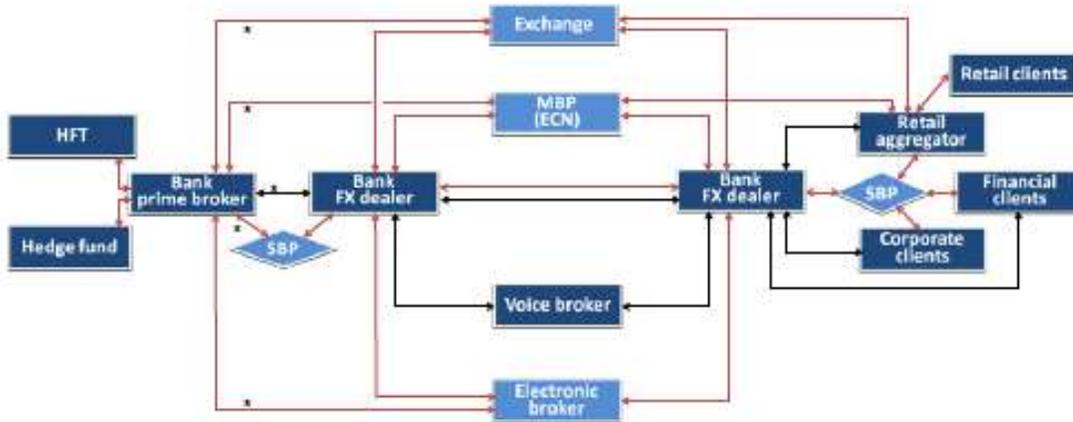
Before computerized trading existed, the foreign exchange market was primarily a broker-dealer market, where brokers made deals with other brokers on behalf of clients. These deals were often performed over the phone. When electronic trading was available to clients, as well as prime brokers providing them with credit, clients could participate in the markets themselves. With the rise of computing power, algorithms could make trades in place of agents having to input them manually. The changing landscape can be seen in figure 1.

Changing structure of the FX market over time

1990s: electronic trading was confined to the inter-dealer market



2000s: electronic trading became available to clients; new participants and venues emerged



The red lines denote electronic communication; the black lines denote voice communication. HFT = high-frequency trading firm; SBP = single-bank platform; MBP = multi-bank platform; ECN = electronic communications network; Exchange = Chicago Mercantile Exchange, for trades involving FX futures. * indicates prime brokered transactions, which are initiated by the clients but appear (to counterparties) in the prime broker's name.

Figure 1. Chart depicting changes in the foreign exchange market. Reprinted from "High-frequency trading in the foreign exchange market" by the markets Committee, 2011, Bank for International Settlements, Markets Committee Publications, (5).

HFT strategies in the foreign exchange market:

There are several strategies employed in high-frequency trading. One of these strategies is triangular arbitrage, where a set of three currency pairs are traded, such as USD/CAD, CAD/EUR

and USD/EUR. The process takes advantage of momentary market pricing issues. Allowing one to trade one currency for a second, the second for a third and finally the third for the first, ending up with more of the first than initially traded. Due to the speed of HFT, there only needs to be an issue with a cross price for a tiny fraction of time for there to be an arbitrage opportunity (King et al, 2011).

Another strategy employed is covered interest arbitrage. This involves trading a currency for another that has a higher interest rate while hedging the trade with a forward currency contract. If done properly, this can result in a riskless profit (King et al, 2011). Latency arbitrage involves acting in the miniscule time lag between when a market-moving trade occurs and the market-maker changes the price they quote. This allows high-frequency traders to act before other traders, resulting in an opportunity for profit. There are also more complex strategies that exploit properties of the foreign exchange market, such as momentum, mean-reversion and correlation (Markets Committee, 2011).

All the above strategies can be used alone or in combination. They all take place quickly and generate small returns, but are performed at such a speed that they add up to significant returns. Since the trade involves small margins, the strategies benefit from low levels of volatility. Some HFT firms have designed new models that are said to function well in times of relatively higher volatility, and that they will change the model based on the circumstances. While many of the above strategies are liquidity taking, as technology in general improves and the number of firms increases, the amount of arbitrage opportunities is decreasing. The result is that some HFT firms are now pursuing liquidity providing strategies. It is also suggested that as HFT firms grow their capital, their tolerance for risk might increase. It seems the trend is that firms are starting to explore making risky trades, instead of sure bets provided by arbitrage (King et al, 2010).

Similarities and differences between HFT in the equities market and the foreign exchange market:

Considering the fact that foreign exchange HFT originated from HFT for equities, it is not surprising that HFT in both markets use similar technologies and techniques. Considering the benefits of liquidity for HFT it is unsurprising that both markets focus on liquid areas. Because of this, HFT in the foreign exchange market is most common in GPD/USD, JPD/USD and EUR/USD pairs (Source).

The two markets have many differences that are worth noting. The foreign exchange market has a decentralized market structure whereas the equities market has an very organized market structured determined by the stock exchanges. The trading venues in the foreign exchange market are self-regulated. The equities market is formally regulated by government bodies. From these two facts one can wonder if a lack of oversight might be present in the foreign exchange market. However, in practice, HFT firms appear to operate in low risk ways. This is likely due to the small margin of their transactions. Even miniscule errors would lead to losses. The markets also differ greatly based on what is being traded. In the foreign exchange market, people are trading one currency for another, so what matters is the relative price. In the equities market, people are trading equities for money, so it is the absolute price that is important. Of note is the fact that equities are traded principally for investment purposes, while currencies can be traded for investment purposes or for transaction purposes, allowing one to trade for foreign goods and services (Source).

A main strategy of HFT in equities, rebate capture, is not available in the foreign exchange market. How it works is that some equity exchanges offer rebates to agents that who perform trades. This allows for some HFT traders to be willing to perform neutral trades, or even slightly

negative trades, and still make a profit from the rebates. For the agent, they make a small profit per trade, and the exchange can boost the liquidity in the market. No rebates are currently offered in the foreign exchange market, so this strategy is not available to agents in that market. While HFT has been shown to increase the liquidity in the equities market, the lack of rebate capture might lessen liquidity effects in the foreign exchange market (Brogaard, 2010)

Effects of HFT trading in the foreign exchange market:

While research on HFT in the equities market is abundant, research on its effect on the foreign exchange market is still in the early stages. Alain Chaboud, Benjamin Chiquoine, Erik Hjalmarsson and Clara Vega, in their paper “Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market” examine the effects of algorithmic trading in the foreign exchange market (Chaboud et al, 2009). While their research was not explicitly on HFT, it can still provide some insight. One common concern of HFT is that it might lead to higher volatility, but the authors find that algorithmic trading had a neutral to negative impact on volatility. One of the reasons that people worry about higher volatility is the idea that the computers that place the orders might have similar strategies, leading to herd behaviour. Empirically, algorithmic orders were found to be more highly correlated than ones made by humans. This is likely due to the limited number of strategies employed in HFT in the foreign exchange market (Chaboud et al, 2009). However, they also found that computers made trades with humans with a higher than random probability, so the danger of herd behaviour is lessened.

One common concern is that using HFT strategies will have disruptive effects on market prices. The authors, using a VAR, found that trades performed by humans had more of an impact than trades by computers. This could be explained by the fact that in HFT and other types of

algorithm based trading, the trades go in both directions, for small amounts, while trades by humans are generally much larger.

HFT does appear to have an impact prior to and following macroeconomic news announcements (Jiang et al,2014). It was found that HFT reduces depth before and after an announcement. They observe this by examining the depth of best quotes and behind the best quotes for U.S. Treasury 2-year notes fifteen minutes before and after an announcement in the sample period of January 3, 2006 to December 29,2011.

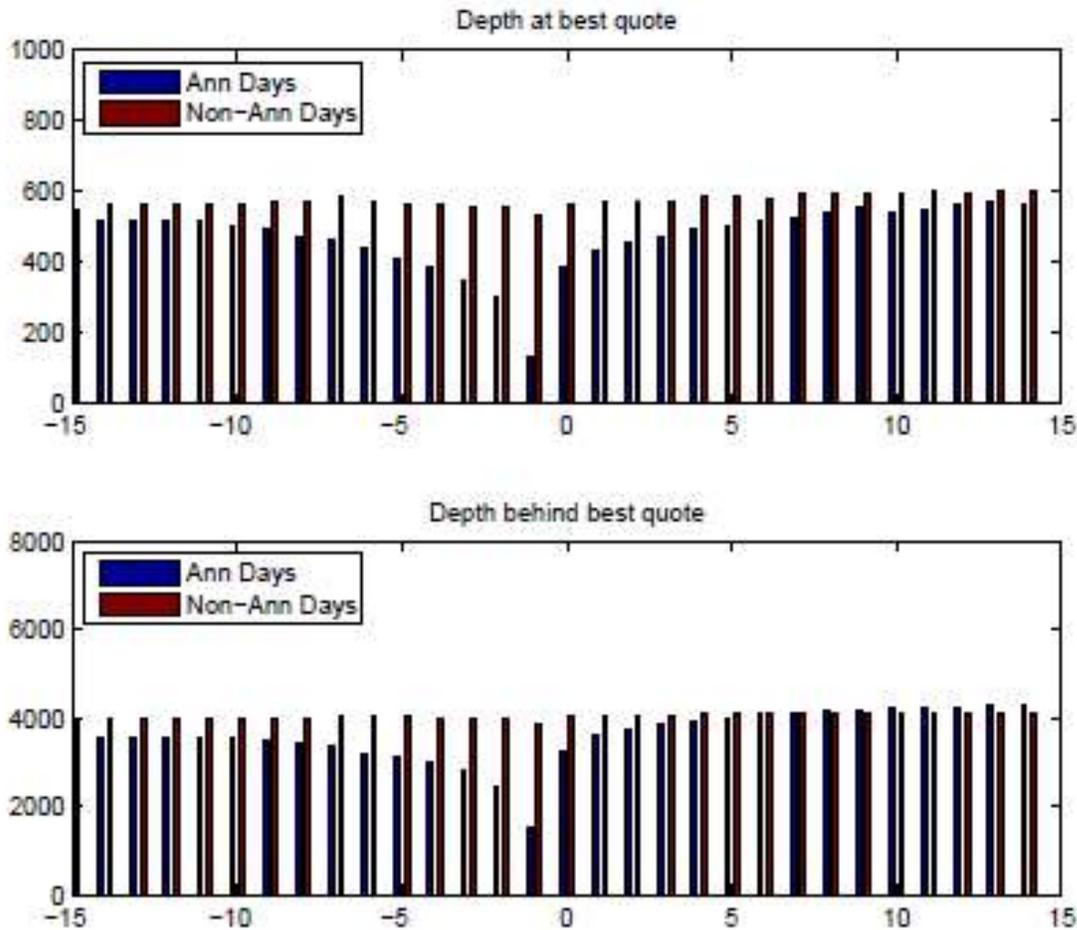


Figure 2. Graphs depicting market depth. Reprinted from "High-Frequency Trading around Macroeconomic News Announcements: Evidence from the U.S. Treasury Market" by George J. Jiang, Ingrid Lo and Giorgio Valente, 2014 Bank of Canada Working Paper.

The thought is that before an announcement, high-frequency traders widen the spreads and trade less, to lower their risk. They would be worried that there could be a significant price change after an announcement, which would disrupt their strategies. Since the margins are very small for the trades they make, uncertainty in prices discourages them from trading. This is seen by the lower than normal depth before an announcement as seen in figure 2. After an announcement, the authors find that high-frequency traders appear to act as informed traders, using their advantage in technology and speed to take advantage of other agents. This would suggest that HFT decreases

depth at macroeconomic events, and lead to adverse selection problems (Jiang et al,2014). Their findings are not all negative, as they find that HFT improves price efficiency. This is likely due to the algorithm’s ability to incorporate the information from an announcement into a price quickly.

The stability of HFT is questioned at times with the belief that any code has bugs, so there are concerns that in chaotic or stressful situations, HFT might only exacerbate the problem. One example would be the “flash crash” of 2010 that is thought to have been mainly caused by a rogue trader in the equities market (Brush, 2015). The crash only lasted for approximately 36 minutes, and had effects in other markets as well. While one might think that trading in the foreign exchange market would drop given the uncertainty, the opposite appeared to occur.

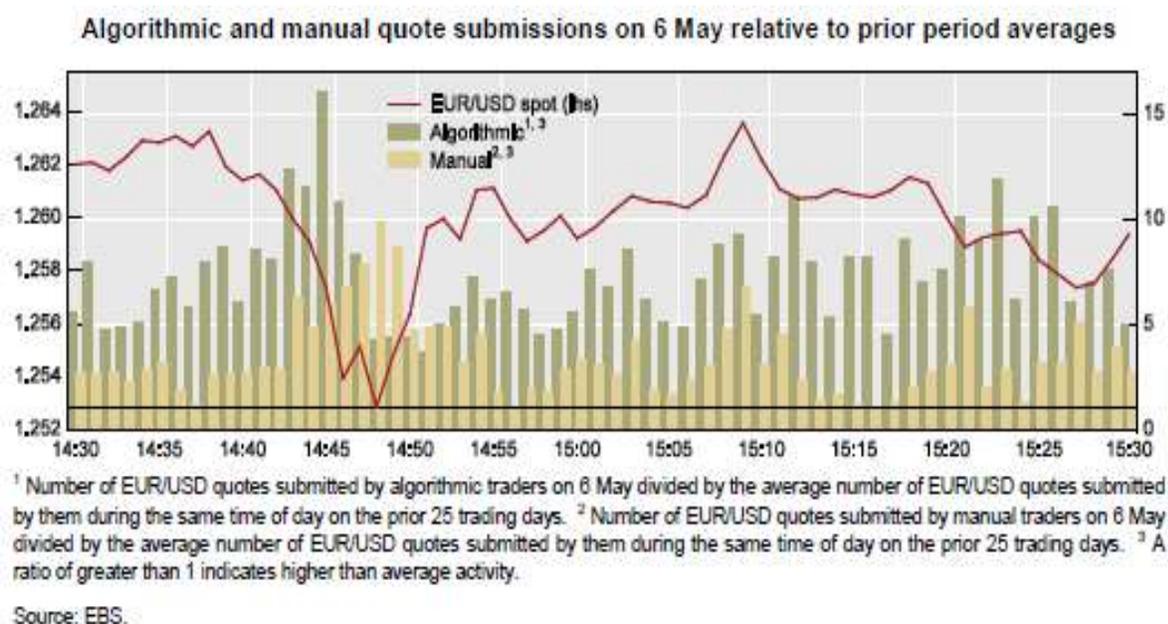


Figure 3. Graph depicting quote submission during the flash crash of 2010. Reprinted from "High-frequency trading in the foreign exchange market" by the markets Committee, 2011, *Bank for International Settlements, Markets Committee Publications*, (5).

At the time of the crash there was a rise in the number of submitted orders, both manual and algorithmic. This appears to go against the idea that HFT would decrease in a moment of high volatility.

Questions for future research:

It is estimated that the daily foreign exchange market turnover is now over \$4 trillion dollars. Of which, it is estimated that \$1 trillion comes from HFT. With such incredible levels of trading, it is certainly worth taking a close look at the costs and benefits of HFT in the foreign exchange market. Of note, a considerable fraction of the currency trade is in the Big 3: the US dollar, the Euro and the Japanese yen.

Increase in global FX market turnover by currency and location				
	Turnover in 2010 ¹	Absolute change from 2007 ¹	Growth since 2007 (%)	Contribution to FX market growth ² (%)
By currency (net-net basis)				
US dollar	1,689	266	8	41
Euro	778	162	5	25
Japanese yen	378	91	3	14
All currencies	3,981	657	20	100
By location (net-gross basis)				
United Kingdom	1,854	370	9	48
United States	904	159	4	21
Japan	312	62	1	8
All countries	5,056	776	18	100

¹ In billions of US dollars. ² Percentage contribution to the total increase of \$657 billion from 2007 to 2010.
Source: 2010 Triennial Central Bank Survey. Table 4

Figure 4. Table describing the market turnover by currency and location.. Reprinted from " The \$4 trillion question: what explains FX growth since the 2007 survey?" by the markets King et al, 2010, *BIS Quarterly Review, December 2010*.

Most of the current research on HFT in the foreign exchange market focuses on the Big 3 currencies, with little said about the others. It would be more informative if other major currencies were considered in the research. While the Big 3 seem to have similar results, perhaps other currencies would have different behaviour. I would be particularly interested in the effects of HFT on emerging markets. Knowing that emerging markets often do not always have positive or trustworthy institutions I wonder if the self-regulated nature of HFT in the foreign exchange market would work as well.

Another potential benefit of looking at different currencies would be to see if the possible liquidity-taking strategies of HFT might be problematic in currencies that are traded less than the big 3. I wonder if the reason that there do not appear to be many problems resulting from HFT is because there are naturally high levels of liquidity for the Big 3.

Conclusion:

The early research into HFT in the foreign exchange market seems to show that it has increased liquidity and tightened spreads for smaller trades, but not as much for large trades (Markets Committee, 2011). While liquidity provided by HFT decreases during financial events, as would be expected by their aversion to volatility, they do not appear to pull back any more than other agents, and they are quick to join back in (Chaboud et al, 2009). At this point, it is unclear if HFT is a truly new phenomenon, or possibly the traditional opportunistic behaviour of the market upgraded by technology. There also could be less risk with HFT since a change in a currency price is not a zero-sum game. If one currency ratio drops, one in the pair appreciates, the other depreciates. This is different from the way that a stock can go to zero. One is a wealth transfer, the other is wealth destruction. More research is needed to be able to determine if HFT is good or necessary, but the current literature seems to think that its impact is not far from neutral in general.

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