Currency Arbitrage: Discovering Opportunities and Predictive Factors in the Forex Market

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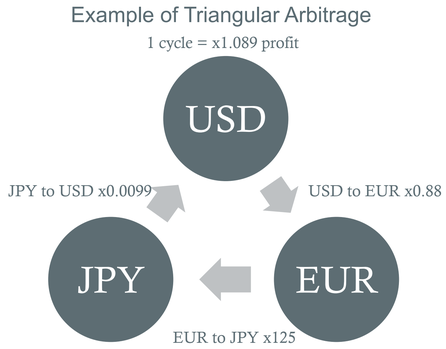
Introduction

Every day, hedge funds and major banking corporations profit from the foreign currency exchange market, also known as Forex. Riskless profit can be made by making high frequency trades that exploit small discrepancies in exchange rates.



These opportunities do not last very long, at most several seconds at a time. Market forces equalize these discrepancies throughout the day and opportunities is lost. Thus it is important for traders looking for arbitrage to be aware of the risks of exploiting these opportunities by finding ways to measure them.

Project Goals

Our project will collect high frequency tick data from the Forex market and related stock index data for analysis in an attempt to achieve the following:

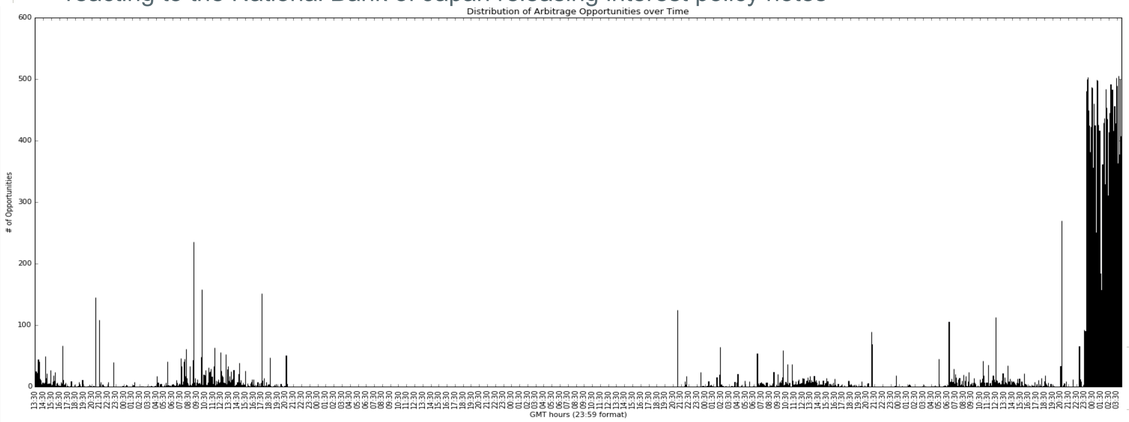
1 – Identify important trends in incidences, magnitude, and persistence of arbitrage
2 – Find correlation between magnitude and arbitrage if it exists
3 – Observe clusters of arbitrage points and attempt to group points according to stock price movements and the time of day

Dataset

We focused on taking the 6 most traded currencies at 0.1 to 0.5 second intervals, dependent on the last currency update from 4/21 to 4/26. We also collected data for 6 corresponding stock indices for each currency.
– USD, JPY, EUR, AUD, CHF, and CAD
– SPX, NKY, N100, AXJO, SMI and SPTSX.
To find triangular arbitrage, we implemented the Bellman Ford algorithm to detect negative cycles. This allowed us to find live arbitrage opportunities and record the magnitude and duration of their existence.

1) Distribution

- 6889 arbitrage instances, magnitude varied from 1 + 3.615e-09 to 0.0804 of 0.109 to 141.95 seconds
- Largest spikes in arbitrages during New York and Tokyo closing hours i.e. 9:00 PM and 9:00 AM
- Gap in the middle 4/22 – 4/23 is due to closed market, lull in activity until 4/24 5:00 PM
- Huge spike at 4/26 9:00 PM, heavy trading in JPY; mostly likely due to American investors reacting to the National Bank of Japan releasing interest policy notes



2) Correlation

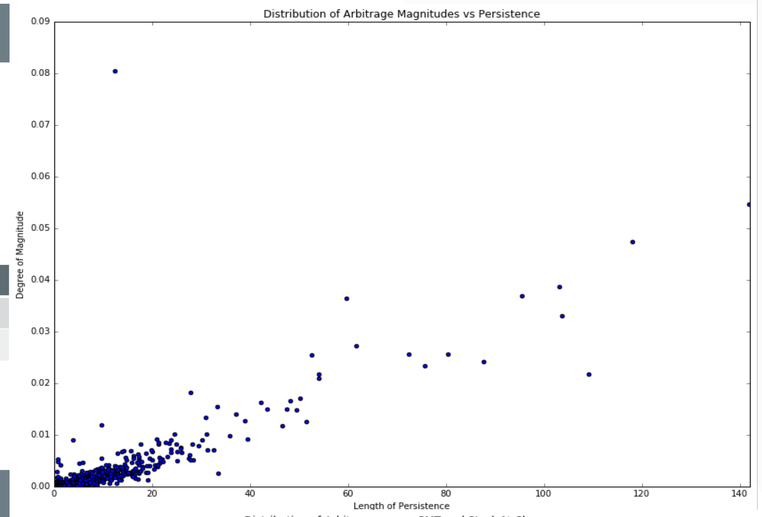
- Pearson Correlation factor of 0.84301 with p-value of >> 0.00
- Regression results show magnitude as very strong indicator for duration of arbitrage
- Adj. R-squared: 0.828
- F-statistic: 1.258e04

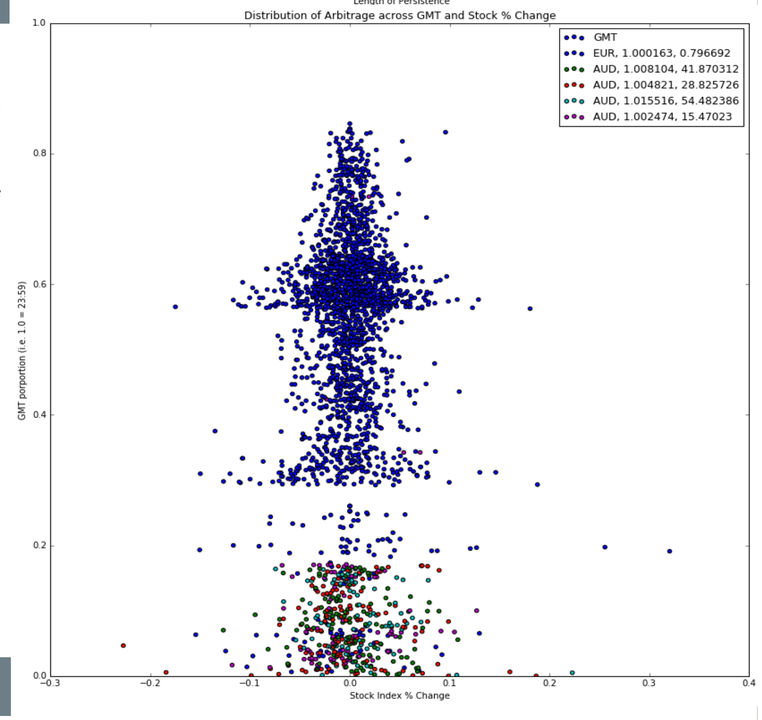
Variable	Coefficient	Std Error	T-value	P > |T|
Intercept	-3569.6672	31.878	-111.980	0.000
Magnitude	3571.2150	31.834	112.182	0.000

- Greater magnitude = longer persistence before market corrects for it

3) Clustering

- K-Means clustering method: 5 clusters after elbow plot analysis
- Clustering weighted more on magnitude and persistence to group high value arbitrage opportunities together
- Clear separation between the blue cluster of low value (Mag of 1.0002, Per of 0.79 seconds) and high value clusters
- Mostly Asian currencies in high value clusters and much fewer in number compared to low value
- No clear grouping along horizontal axis suggests that stock market changes do not affect Forex movements
- However there is clear intraday seasonality: hours corresponding to closing hour of Sydney (0.29) show the most high value arbitrage instances, and the opening hours of New York (0.54) and London (0.33) show a spike in low value arbitrage instances





Conclusion

From our project we can see the clear relationship between arbitrage magnitude and persistence, and observe the intraday seasonality of arbitrage. However there is also no conclusive proof of any effect the stock market has on Forex trades, most likely due to the players involved in the Forex market. Banks and hedge funds divest into currencies for long term investment rather than short term growth, and the correlation between stock prices and currency values are weak at best. Market expectations pay a larger role in defining the movements of prices rather than any other measure. However, for high frequency traders, the correlation between persistence and magnitude is important to account for in the market, as higher magnitudes means longer opportunities for trade. Potential improvements we could've done is to collect much more Forex data over a longer time span to confirm our results about seasonality. It would also be interesting to model a recommendation system to predict whether or not an arbitrage cycle is worth trading if it persists long enough.