ARBITRAGE

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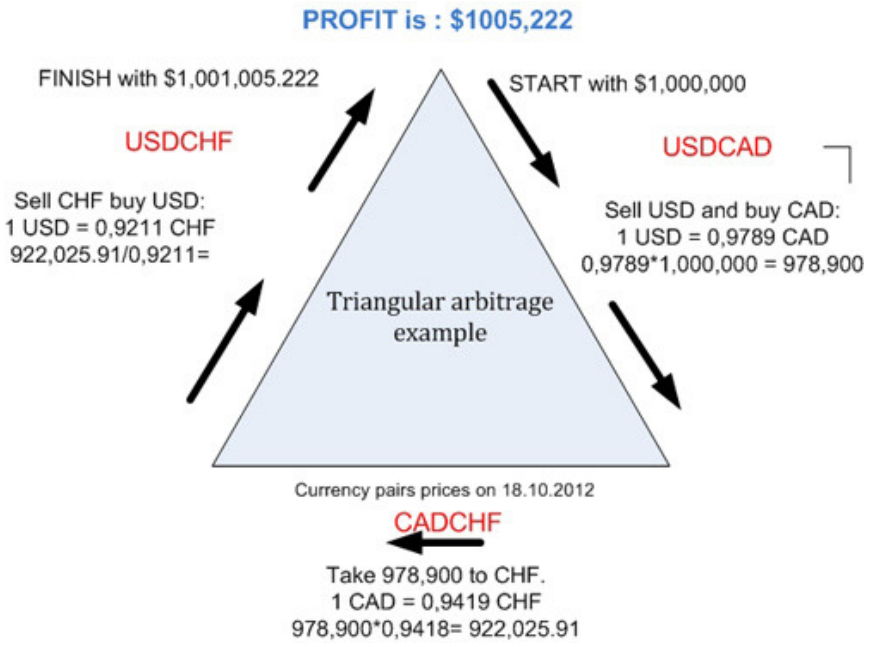


WHAT IS ARBITRAGE?

Arbitrage is an opportunity to make profits of the discrepancies in currency exchange rates by transforming them into more than one unit of the same currency. Arbitrage can happen with two currencies or between more than two currencies.

EXAMPLE:

Start with 1,000,000 USD. Buy Canadian Dollars by selling the US Dollars. Sell the Canadian Dollars and buy Swiss Franc. Sell the Swiss Franc and buy US Dollars again, thus obtaining a profit of 1005,222 dollars.

Algorithm Summary:

Every currency is a node in the graph. There is an edge between every pair of currencies, with the exchange rate between them as the edge weight. To find an arbitrage opportunity, we need to find a cycle in the graph such that:

$$R[i_1, i_2] \cdot R[i_2, i_3] \cdots R[i_{k-1}, i_k] \cdot R[i_k, i_1] > 1$$

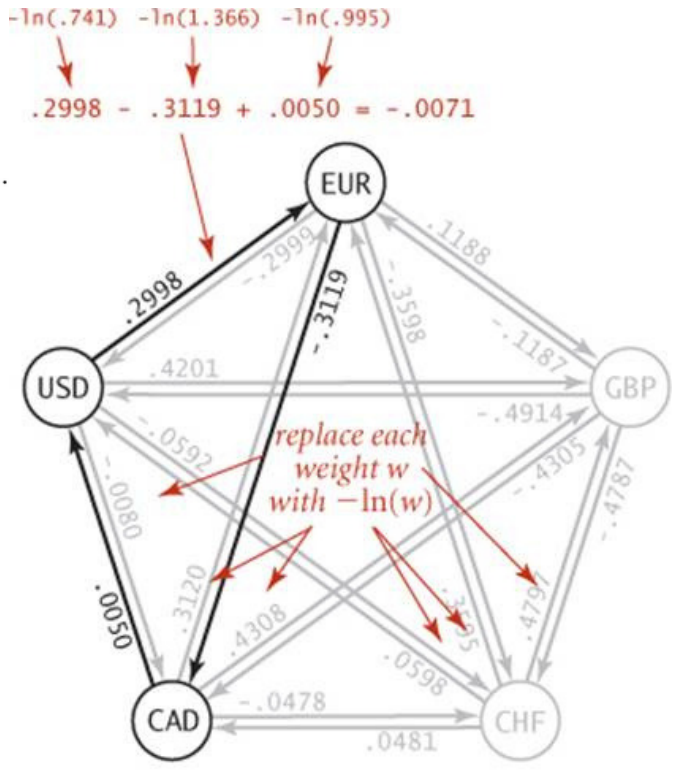
Taking logs of both sides of the inequality above:

$$\lg \frac{1}{R[i_1, i_2]} + \lg \frac{1}{R[i_2, i_3]} + \lg \frac{1}{R[i_{k-1}, i_k]} + \cdots + \lg \frac{1}{R[i_k, i_1]} < 0 .$$

Therefore, if we define the weight of edge (vi, vj) as:

$$\begin{aligned} w(v_i, v_j) &= \lg \frac{1}{R[i, j]} \\ &= -\lg R[i, j] \end{aligned}$$

Hence using, -log R[i, j] as the edge weights, the currency arbitrage problem reduces to finding a negative cycle in the graph.This can be found using Bellman-Ford algorithm (and an arbitrage opportunity) if it exists.



A negative cycle that represents an arbitrage opportunity