ANANTA

A systematic quantitative FX trading strategy

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Abstract

This paper is the first of a series that aims to study in detail the ANANTA strategy, a short term systematic FX model using fixed income signals. We will focus in this part on outlining the context and an initial basic implementation of the methodology, from trading hypothesis to signal construction and results.

Foreword

I would like to thank all the people who have encouraged me to write this paper.

Introduction

The most popular systematic trading strategies among active currency portfolio managers are the carry, value, momentum and volatility trades, which have all been intensively researched, explained, and formulated by the simplest to the most complicated trading rule. Several other factors are also investigated by more sophisticated quantitative currency funds – economic data patterns, news analysis, short-term mean reversion, …

It is clear that the main influence on the foreign exchange market is the change of interest rates, guided by the central banks. With a slow rebalancing, this effect is captured by the carry trade. However this paper will focus on the short-term impact of interest rates evolution, also called interest rates differential momentum.

The ANANTA strategy is based on the idea that the relative tightness-looseness of monetary policy between countries has a meaningful impact on currency performance. This concept is well known and has been applied, usually on a discretionary basis. This paper investigates the systematic implementation of short-term relative changes between countries, i.e. the expectation of tightening of the policy of one of the countries of the pair. Though captured on long-term horizon by the carry strategy (considering interest rates levels and ranking countries accordingly), this paper investigates the relative evolution of interest rates, which would potentially lead to an appreciation of the currency of one of the 2 countries and therefore distinguishes itself completely from a carry approach.

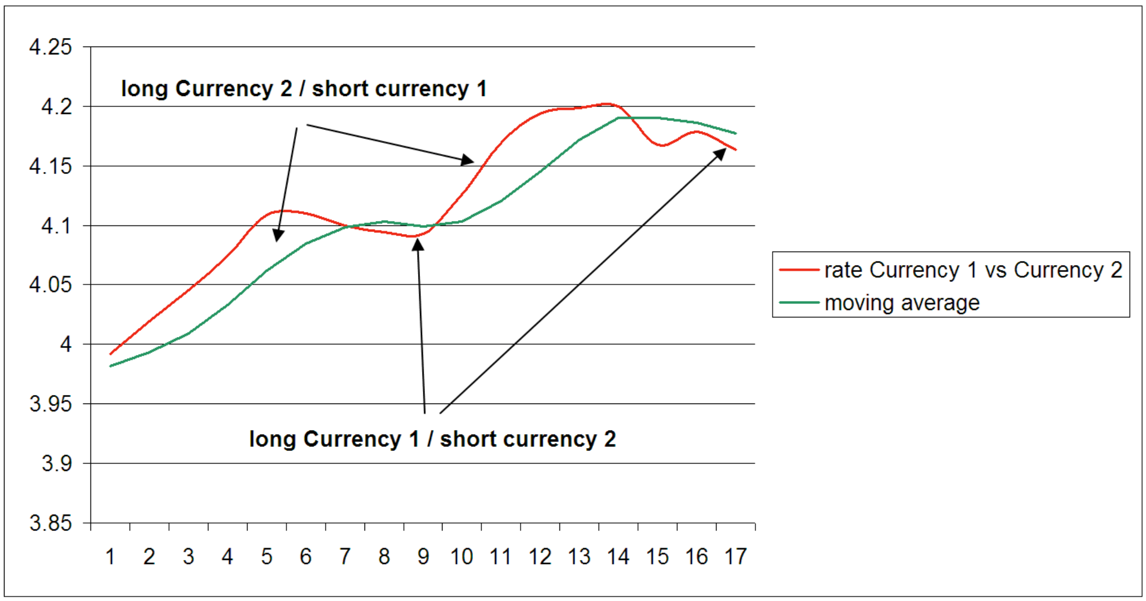
The grounds of the methodology are hardly new, and other models have already proposed an implementation of the interest rates differential momentum in the foreign exchange space, but also in the fixed income space and even in the equity space with a relative country equity futures implementation. Our contribution on the subject will be to present an enhanced implementation covering all the currencies of the G10, with a limited parameterization, and a daily trading horizon with bi-rebalancing per day, including actual trading costs and results over the last 11 years.

This paper, first of the series, will present a fully systematic strategy with no discretionary overlay, from trading hypothesis, market data, to signal construction and actual results.

Concept and Idea

Interest rate differential momentum strategies exploit movements in rate expectations to systematically buy currencies where rate expectations rise and sell currencies where they fall on a relative basis. The strategy determines momentum in yields differentials by comparing the yields for each possible pair of countries, and invests accordingly in a portfolio.

This paper will study the simplest expression of the interest rates differential momentum (rate1 – rate2), and implement a simple signal (+1 / -1) based on a comparison with the simple moving average of this differential. Such process can be represented by this graph:



Therefore, contrary to the carry that also relies on interest rates, the ANANTA model can be long and short any mix of high and low-yielding currencies.

A traditional construction of the interest rate differential momentum model is to use daily data at the close of the US market. The grounds of this model are that information is already present earlier in the day, and can be used to enhance performance, with an approach based on a 2 steps rebalancing. A large part of the relevant signal is already available at the close of the London market, leaving just to take into account a potential move of the interest rates by the close of the US market.

This paper proposes an approach where the rebalancing is done in 2 steps: a first snapshot of the interest data at the London close and rebalancing the portfolio at that time (this also coincides with the maximum of liquidity in the FX market, and more aggressive spreads) then a second snapshot at the New York close and readjusting again. Variations of differentials of interest rates tend to be limited between London close and New York close times, making the adjustments at New York time marginal. In the event of a major move in interest rates just before New York close, a more substantial adjustment of the portfolio will take place.

Trading Hypothesis

- **Currency coverage**: the mandate will focus on G10 currencies (AUD, CAD, CHF, DKK, EUR, GBP, JPY, NOK, NZD, SEK, USD)
- **Portfolio and Country approach**: the approach in FX is usually towards pairs of currencies rather than a portfolio. The ANANTA model is designed to generate a portfolio exposure, rather than signals on a particular currency. This approach is closer to the systematic equity space. It also decorrelates the trading process from any stop-loss on a particular currency, and focuses on adjusting all the signals and on rebalancing the whole portfolio at the same time.
- **Diversification**: we want to have consistent exposure in all countries and avoid overexposure to any currency. Though focusing on the G10, some extreme moves may happen on a currency (for example on CHF in September 2011).
- **Trading execution**: we will assume in this paper that this model is traded aggressively, by crossing the spread. In order to get a correct execution, each order is traded at the best price proposed by a few brokers and ECNs.
- **Slippage**: the spreads are tight in the G4 (EUR,GBP,…), but increase quickly in the end of the G10 (SEK,NOK,…), ranging from 0.3 basis points to 2-3 basis points. Slippage will also increase with a higher turnover.
- **Basis point per dollar traded**: though the standard in FX is the pip, we will use the basis point as we mix several currencies in the portfolio. Ultimately, the number that will matter when judging the model is the *basis point per dollar traded*.
- **Weighting of the instruments**: even though some currencies are more "expensive" to trade, hence increasing the overall slippage, we will not favor any currency by overweighting its signals.
- **Hedging the dollar**: this point will be discussed in a following paper.
- **Constant total gross equivalent dollar exposure**: ANANTA does not integrate any stop loss mechanism, or resizing of the exposure based on volatility/performance/… The total gross equivalent dollar exposure is constant.

Nomenclature and Definitions

- **11 Countries**: USD, EUR, CAD, JPY, DKK, GBP, NZD, AUD, SEK, NOK, CHF

- **10 currency pairs versus USD**: EURUSD, USDCAD, USDJPY, USDDKK, GBPUSD, NZDUSD, AUDUSD, USDSEK, USDNOK, USDCHF

- **10 country instruments**: for practical reasons in the algorithm, all currency pairs are converted in a xxxUSD format for computations, converting inverted ones when required. We will therefore use the following instrument names: **EUR: , CAD: , JPY: , DKK: , GBP: , NZD: , AUD: , SEK: , NOK:** (where **EUR:** means EURUSD and **CAD:** means CADUSD)

- **Total gross (equivalent) dollar exposure:** for any of the instruments xxxUSD, we can compute a net exposure in dollars. By summing the *absolute* value of these exposures, we derive the total gross equivalent dollar exposure. For instance, with a long position of +10M dollars in EURUSD and a short position of -10M dollars in GBPUSD, we have a total gross dollar exposure of 20M dollars.

- **Total net (equivalent) dollar exposure:** for any of the instruments xxxUSD, we can compute a net exposure in dollars. By summing the *net* value of these exposures, we derive the total net equivalent dollar exposure. For instance, with a long position of +10M dollars in EURUSD and a short position of -10M dollars in GBPUSD, we have a total net dollar exposure of 0 dollar.

- **Total gross traded amount in dollars:** for each day, we can compute the gross dollar amount traded in dollars for each order. By summing the *absolute* value of these amounts, we can derive the total gross traded amount in dollars. For instance, if we buy +10M dollars of EURUSD then later sell -10M dollars of EURUSD, we will have a total gross traded amount in dollars of 20M dollars.

- **Sub-signals:** a signal for **XXX**: (**AUD**: for instance) will be the composite of sub-signals of XXXccy1, XXXccy2,... (AUDCHF, AUDEUR, AUDJPY,…).

Market Data

We will use Bloomberg, which offers multiple snapshots of the FX and FI markets, notably its CMP fixes (for example *EURUSD CMPL Curncy* will return a time series of all the prices for the London fixes).

As discussed earlier, we will consider in this paper only 2 signal updates: at London close (6pm London time) and New York close (5pm NY time).

Bloomberg provides the appropriate data with the suffix CMPL (for London close) and CMPN (for New York close).

Here is the list of relevant time series for each country:

country	instrument	bloomberg dataseries (for London close)	bloomberg dataseries (for NY close)
AUD	AUD:	AUDUSD CMPL Curncy	AUDUSD CMPN Curncy
CAD	CAD:	**CADUSD CMPL Curncy**	**CADUSD CMPN Curncy**
CHF	CHF:	**CHFUSD CMPL Curncy**	**CHFUSD CMPN Curncy**
DKK	DKK:	**DKKUSD CMPL Curncy**	**DKKUSD CMPN Curncy**
EUR	EUR:	EURUSD CMPL Curncy	EURUSD CMPN Curncy
GBP	GBP:	GBPUSD CMPL Curncy	GBPUSD CMPN Curncy
JPY	JPY:	**JPYUSD CMPL Curncy**	**JPYUSD CMPN Curncy**
NOK	NOK:	**NOKUSD CMPL Curncy**	**NOKUSD CMPN Curncy**
NZD	NZD:	NZDUSD CMPL Curncy	NZDUSD CMPN Curncy
SEK	SEK:	**SEKUSD CMPL Curncy**	**SEKUSD CMPN Curncy**
USD	(series in **bold** are inverted)		

For the interest data government yields data, we will rely in this paper on the composite swaps.

country	instrument	bloomberg dataseries (for London close)	bloomberg dataseries (for NY close)
AUD	AUD:	ADSW2 CMPL Curncy	ADSW2 CMPN Curncy
CAD	CAD:	CDSW2 CMPL Curncy	CDSW2 CMPN Curncy
CHF	CHF:	SFSW2 CMPL Curncy	SFSW2 CMPN Curncy
DKK	DKK:	DKSW2 CMPL Curncy	DKSW2 CMPN Curncy
EUR	EUR:	EUSA2 CMPL Curncy	EUSA2 CMPN Curncy
GBP	GBP:	BPSW2 CMPL Curncy	BPSW2 CMPN Curncy
JPY	JPY:	JYSW2 CMPL Curncy	JYSW2 CMPN Curncy
NOK	NOK:	NKSW2 CMPL Curncy	NKSW2 CMPN Curncy
NZD	NZD:	NDSW2 CMPL Curncy	NDSW2 CMPN Curncy
SEK	SEK:	SKSW2 CMPL Curncy	SKSW2 CMPN Curncy
USD		USSW2 CMPL Curncy	USSW2 CMPN Curncy

Backtesting structure

The model relies on an update of its signals several times per day, and on the actual execution of the appropriate orders; the backtest must therefore reflect accurately these updates of signals.

The structure of the backtest code can be summarized like this:

- load data, and create appropriate data structures for the backtest
- **current_positions**=[0,0,….,0] for the **instruments**
- loop for each day of the range
    - loop for each time (London, New York)
        - update fx prices and interest rates for each country
        - compute **signals**
        - convert **signals** into **theoretical_current_positions**
        - compute **orders = theoretical_current_positions - current_positions**
        - trade **orders** at **prices**
        - compute **current_positions = current_positions + orders**
    - compute daily pnl and risk

Positions, orders, signals,… refer to the tradable instruments EUR: , CAD: , JPY: , DKK: , GBP: , NZD: , AUD: , SEK: , NOK: . Though we will consider computing **sub-signals** between all the currencies (AUDCAD, AUDCHF,…), these sub-signals will be netted in exposure by country versus USD.

With a high turnover, it is important to consider the slippage inside the backtest and apply it accordingly at each order. Therefore whether the order is long/short, execution prices will be adjusted by the observed slippage for each currency.

In this paper we use the following spreads that represent a ballpark of the market:

instrument	spread
AUD:	0.006%
CAD:	0.010%
CHF:	0.011%
DKK:	0.005%
EUR:	0.0036%
GBP:	0.005%
JPY:	0.006%
NOK:	0.035%
NZD:	0.014%
SEK:	0.032%

Model and construction of the signals

In this part, we analyze how to build the signal for each instrument versus USD. As mentioned in the previous chapter, each signal is the sum of the netted sub-signals of all the crosses. The same process is applied at London time and at New York time.

- Initialize signal=[0,0,….0] for each **instrument** [AUD: ,CAD: …]
- For each country1 in [AUD,CAD,….,USD]
  - For each country2 in [AUD,CAD,…,USD] where country2>country1
    - Compute **difference(country1,country2) = yield_country2 – yield_country1**
    - Compute **average(country1,country2) = average of difference(country1,country2) over x days**
    - **Sub-Signal(country1,country2) = {difference(country1,country2) - average(country1,country2)} / ABS(average(country1,country2))**
  - Compute the **percentile at 50%** of all the absolute values of the **sub-signals.**
  - For each **sub-signal(country1,country2):**
    - If the absolute value of the sub-signal is **over** the **percentile**
      - If country1 is not USD
        - **Signal(instrument of country1) += sign of sub-signal**
      - If country2 is not USD
        - **Signal(instrument of country2) -= sign of sub-signal**

- Compute **theoretical_current_positions** = **signal** * **nominal_per_instrument_in_dollars** where **nominal_per_instrument_in_dollars** is a constant calibrated to get the **required total gross exposure in dollars**

(NB: x += y stands for *set* $x = x + y$*;* conversely, x -= y stands for *set* $x = x - y$)

The double loop structure *for each country1, for each country2>country1* will generate sub-signals in the lower part of the following matrix.

	AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK	USD
AUD											
CAD											
CHF											
DKK											
EUR											
GBP											
JPY											
NOK											
NZD											
SEK											
USD											

By netting vertically the sign of the sub-signals (when over the percentile) through the attribution *Signal(instrument of country1) += sign of sub-signal* and *Signal(instrument of country2) -= sign of sub-signal*, we guarantee that in the extreme case, none of the signal can weight more than 20% by construction.

Among other mechanisms that will be discussed in the next papers of this series, we use the **percentile** as a way to discriminate sub-signals, so we can reduce an excessive turnover.

By selecting different values for the **number of days X** (for the average), we can then create 2 variations: a **short-term model** and a **long-term model**.

Results

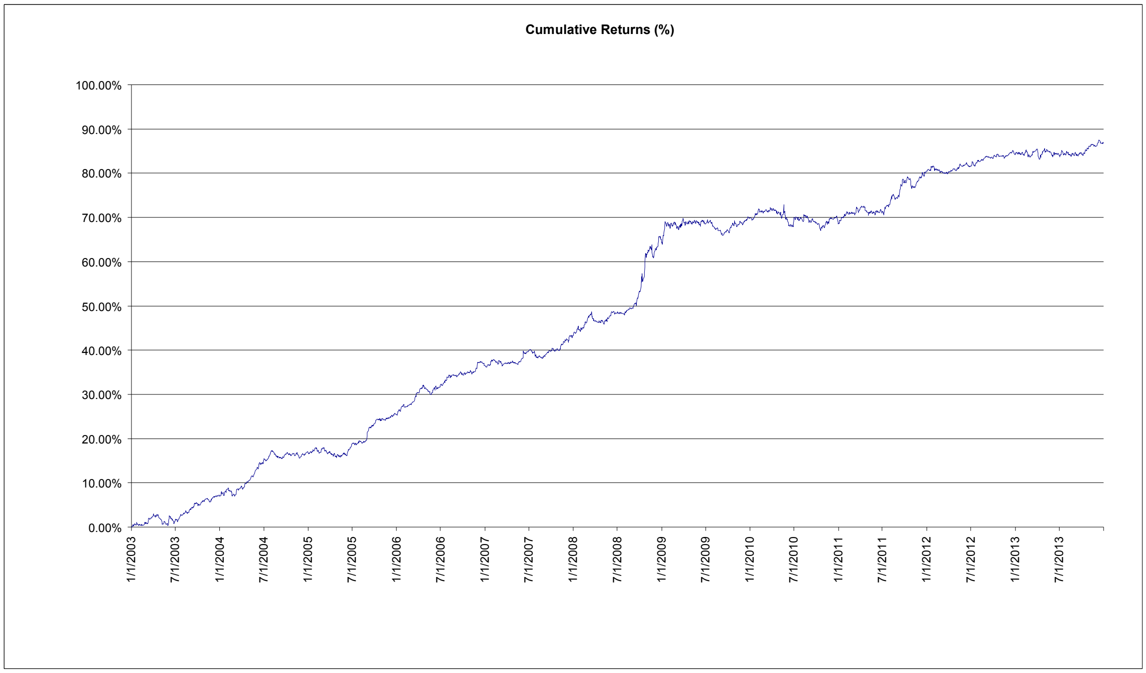
As mentioned above, we can design a short-term implementation and a long-term implementation. One important factor when choosing the number of days is to avoid any over fitting that would produce an optimal result for a particular parameter, but would underperform significantly if we were to select another value next to it. We will select **2 days** for the short-term model and **15 days** for the long-term model.
For the current paper, we use historical data from 1/1/2003 to 1/1/2014.

In order to compute the results, we have applied the following methodology:

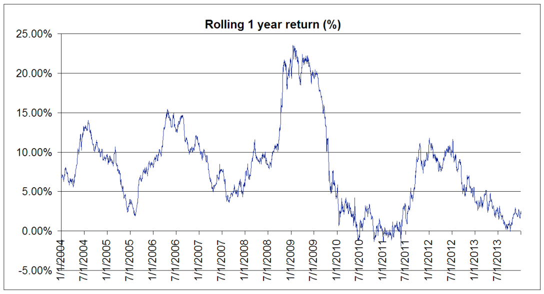
- Positions and orders of each instrument are always in USD. We can then compute their daily pnl, with the appropriate variation of FX rate. This pnl is also in USD, so we can sum all the individual pnls of each instrument into a portfolio pnl in USD. Total gross exposure in USD being quasi constant over time, the daily return of the portfolio is therefore equal to this portfolio pnl divided by the total gross exposure.
- The average annual return is the average of the daily returns, multiplied by 252 business days. The graph of cumulative returns is *not compounded* as we consider a constant exposure. The volatility is the standard deviation of the daily returns, multiplied by square root of 252.
- The sharpe is the average annual return divided by the volatility.
- The maximum drawdown is the worst consecutive loss. The graph displaying the evolution of the drawdowns is a very good indication that displays at a date d the current cumulative return minus the highest watermark.
- For each day, we can compute the total gross traded amount in USD; the turnover for that day is equal to this amount divided by the total gross exposure in USD. The average turnover over the whole period is the average of the total gross traded amount, divided by the total gross exposure.
- As discussed previously, a very important statistic is *the basis point of return generated per dollar traded*. We can then compare it to the slippage per currency, to the slippage for the whole portfolio, and estimate if our model generates enough return to breakeven the costs.

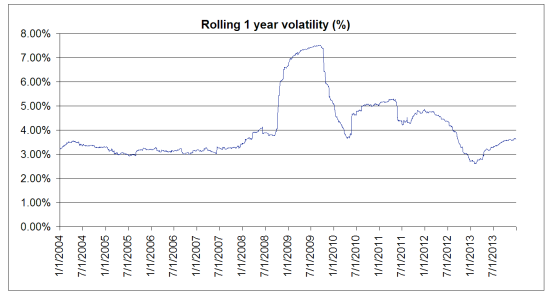
Results - Short-term model

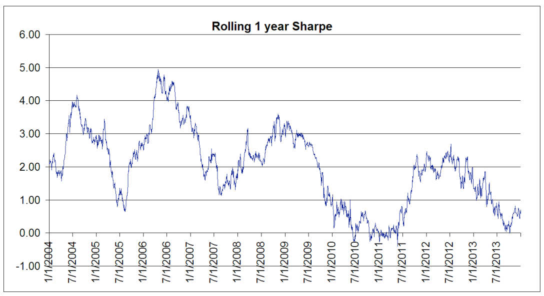
The moving average is computed over 2 days, which leads to a higher turnover.

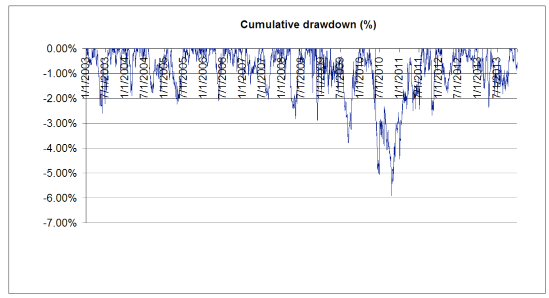


	return	volatility	sharpe
2003	6.73%	3.23%	2.08
2004	9.36%	3.30%	2.84
2005	8.39%	3.20%	2.62
2006	10.80%	3.19%	3.38
2007	6.53%	3.42%	1.91
2008	20.19%	6.67%	3.02
2009	5.47%	5.05%	1.08
2010	-1.37%	5.10%	-0.27
2011	11.61%	4.78%	2.43
2012	3.62%	2.72%	1.33
2013	2.41%	3.65%	0.66
average	7.61%	4.20%	1.81





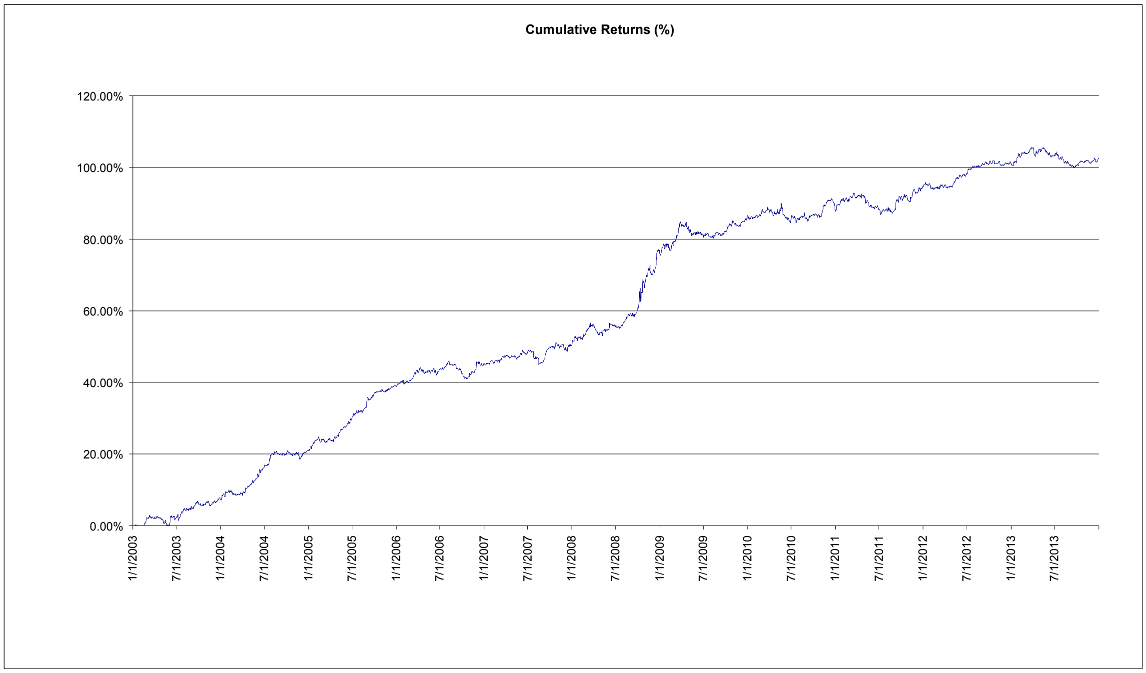




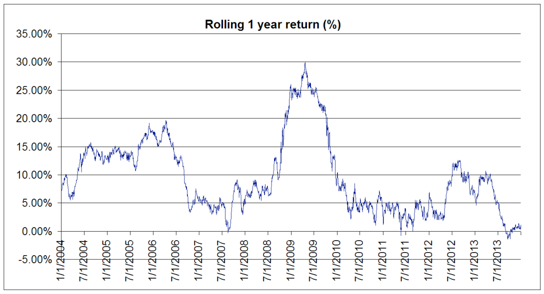
Overall, the short-term model delivers **3.5 basis points per dollar traded,** including fees.

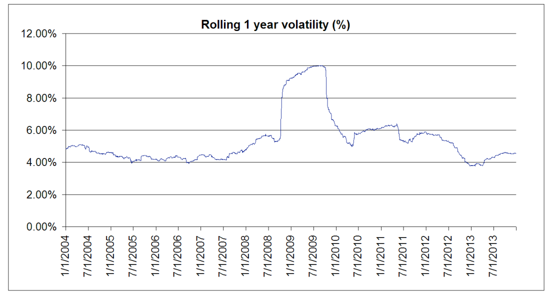
Results - Long-term model

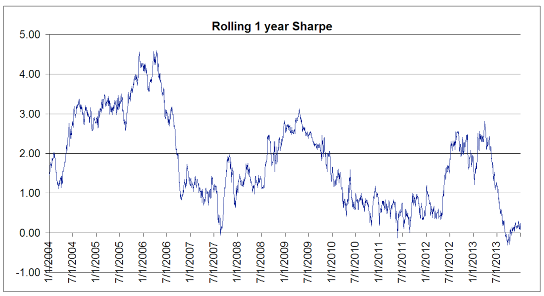
The moving average is computed over 15 days, which leads to a slower turnover.

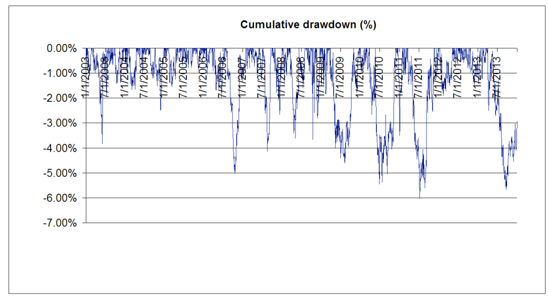


	return	volatility	sharpe
2003	7.02%	4.84%	1.45
2004	13.09%	4.59%	2.85
2005	17.38%	4.20%	4.14
2006	6.19%	4.47%	1.38
2007	4.90%	4.76%	1.03
2008	24.65%	9.24%	2.67
2009	10.26%	6.25%	1.64
2010	1.16%	6.15%	0.19
2011	6.53%	5.81%	1.13
2012	6.27%	3.81%	1.65
2013	1.63%	4.54%	0.36
average	9.01%	5.54%	1.63





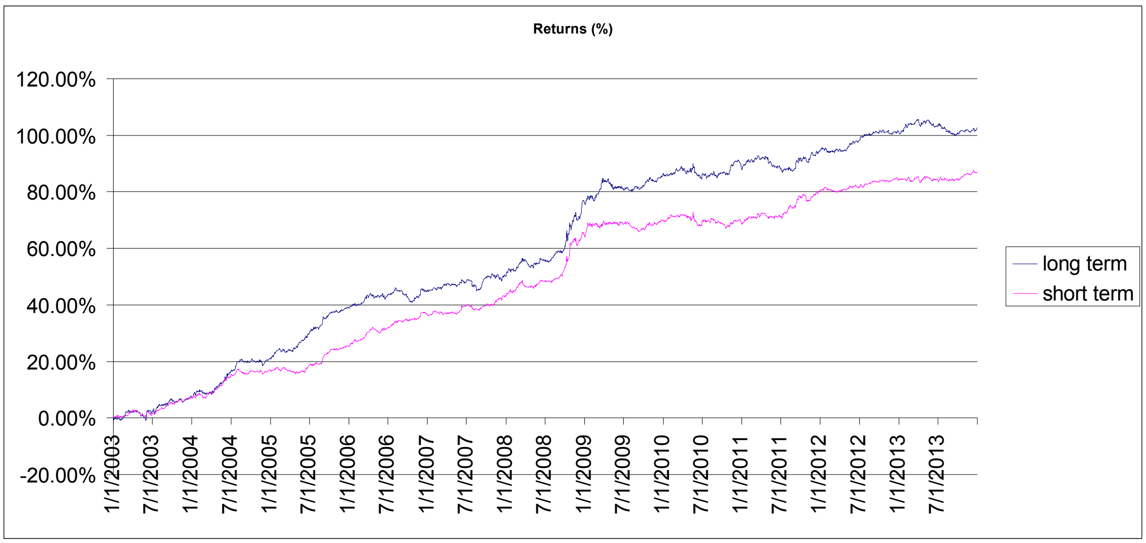




Overall, the long-term model delivers **5 basis points per dollar traded,** after fees.

Results - Comparison of short-term and long-term models

Overall correlation between short term and long-term models is around **50%**.



Conclusion

In this paper we have presented the grounds of the ANANTA model, which can lead to a short term and a long-term implementation of the interest rates differential momentum strategy. We have highlighted hypothesis and defined the relevant metrics, explaining as well how to construct the model itself.

In the wake of 2008, the ANANTA model is still performing, and even more recently with mixed and confused signals coming from central banks, the results have been resilient. In this paper, we have focused on the G10 currencies. However, the same philosophy can be applied to almost any currency, as long as its volatility and cost to trade remain acceptable.

In the following papers, we will investigate how to improve this initial methodology. We will study more in detail the cost of marginal improvement of rebalancing at New York time versus not rebalancing – as well as the need to start adjusting at London time before New York time. We will also devise on how to increase the basis points per dollar traded, reduce the maximum drawdown and improve the return/risk profile, notably in the recent years.