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INTRODUCING RISK PARITY ON

MOMENTUM AND CARRY PORTFOLIOS

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Abstract

The momentum and carry anomalies have been extensively documented in the literature. However, there are still many issues relating to the risks associated to them that are left unexplained. One is the fact that an investor holds for too long the most volatile assets, both under momentum and carry strategies. Therefore, they present a level of risk and a probability of extreme events to happen inconsistent. This work project hypothesizes and proves the introduction of risk parity rules on the weights of the portfolios do increase risk rewarding of carry strategies. However, it fails under momentum strategies.

Keywords: Momentum, Carry, Risk parity, Commodities, Currencies

1. Introduction

The momentum and carry strategies are two of the most known and persistent anomalies on the market. The former is a strategy based on the thesis that recent winners will outperform recent losers. The latter rejects the uncovered interest rate parity and tries to yields returns by investing in high carry securities in expense to low carry securities.

However, these strategies have come alongside inconsistent levels of risk and have failed on wild markets. One possible reason for this to happen is that both strategies tend to ignore the volatility of the assets they are invested on, and overweight the most volatile ones, which carries a lot of crash risk. To try to overcome this issue, I will introduce risk parity rules in the construction of portfolios.

Risk parity intends to equalize the risk contribution of the assets, instead of the capital invested on assets. This way, the strategy attempts to guarantee that each asset that one is invested on contributes with the same amount of risk to the overall portfolio's risk.

Most of the studies found about the topics this paper intends to investigate concentrate their analysis on portfolios composed by stocks only, or balancing stocks and bonds for momentum strategies, and currencies or stocks for carry strategies. So I assumed that there may be more opportunities to exploit returns and achieve results under portfolios of alternative asset classes: commodities and currencies.

The paper is organized as follows: in Section 2 a literature review is addressed; in Section 3 the data used for the purpose is presented; in Section 4 the methodology adopted and the strategies approached to construct the models are introduced; in section 5 I present and discuss the results achieved from the former section; and finally, Section 7 concludes the paper and some limitations of the models are presented.

2. Literature Review

The capital market phenomena based on the relation between an asset's return and its recent relative performance history – momentum – and on the relation between expected returns and the expected price appreciation – carry – have received substantial attention from financial economics due to their ability to predict returns and to their statistical and economic significance relative to traditional asset pricing models.

There is several literature that supports the returns captured by a momentum strategy. Some authors, such as Grinblatt and Moskowitz (2004) had focused their research only on stocks, while Miffre and Rallis (2007) look for a strategic allocation on commodities through momentum rules, identifying 13 profitable strategies on commodity futures markets, that allocating wealth towards the best performing commodities and away from the worst performing ones can achieve an average return of 9.38% a year. Asness et al (2012) studied the evidence of value and momentum in a broader universe, including currency selection.

A momentum strategy consists on going long on assets that had a high positive momentum and going short on the ones with negative or worst momentum. According to Fama-French (1992), the assets with high positive momentum (winners) tend to outperform assets with low positive momentum (losers). This is based on the belief of exiting trends on the market, Asness et al (2014) describe it as a phenomenon where securities that had a better performance than their peers in a recent past, continue to outperform, while the ones with relative lower performance are likely to keep underperforming.

A carry trade strategy consists on investing in assets with high carry, and going short in assets with low carry. This is one of the most popular speculation strategy for currency asset class, where the trader attempts to hold the difference between two interest rates, the local and the

foreign one. This strategy is also known for commodities asset class, however, the main objective is to capture the spread between a longer and a shorter contract.

According to Koijen et al (2014), the carry of an asset is the income an investor earns on holding it for a period of time, assuming market conditions remain the same. They applied it for a variety of asset classes and found out evidence that this strategy is able to predict returns, rejecting the famous generalize theory of uncovered interest rate parity. While Burnside, Eichenbaum, and Rebelo (2011) stand for the thesis that a well diversified carry trade strategy can generate a sharp ratio two times higher than the US stock market.

The returns of the carry trade and momentum are well known, as so the risks they bear. For example, high yielding assets are known to "go up by the stairs and down by the elevator", implying that the carry trade has a significant crash risk, and the value gained over time can be lost quickly. While the momentum rules are likely to crash in the former stage of a bear market, erasing much of the gains from latter stages of the prior bull market, like what was experienced on 2008 financial crisis. One possible explanation consists on the fact that these strategies don't take into consideration the volatility of invested assets, since the decision is based only on average historical performance.

According to Ilmanen (2011), investors would be better off by ranking financial instruments according to their past volatility, instead of past price performance. He argues that failing to do so, leads investors to fall into the situation where the most volatile assets spend an unbalanced amount of time in the highest and lowest momentum and carry portfolios. Which can be illustrated on a high probability of extreme events to happen – high kurtosis.

Clare et al (2012) show that investment weightings based on risk parity rules yield improved risk-adjusted returns in recent years compared to the same comparable buy and hold and equally weighted portfolios. Risk parity strategies are in contrast to traditional allocation methods. It

focuses on the allocation of risk, instead of the allocation of capital, and aims to earn the same of higher level of return, with lower risk. Introducing risk parity rules on a portfolio, one can then avoid the risk of overweighting the most volatile assets, which also have the higher probability of crashing during wild markets.

3. Data

In order to test the possibility of increasing value to the well-known trading strategies momentum and carry by using risk weighting on the portfolios of commodities and currencies, I considered a sample of time, from the beginning of 2000 to the end of 2014.

The commodities sample includes the 24 commodities that belong to Goldman Sachs Commodity Index and those are representatives of commodities universe: Unl. Gasoline, crude oil, gasoil, WTI crude, heating oil and natural gas representing energy; cotton, coffee, cocoa, sugar, soybeans, Kansas wheat, corn and wheat representing agriculture; lean hogs, feeder cattle and live cattle representing livestock; and gold, silver, aluminum, nickel, lead zinc, and copper are representing metals. Since most of commodities have no reliable spot prices, to compute the portfolios, I used the monthly first-nearest, the second-nearest and the third-nearest to expiration generic futures price downloaded from Bloomberg. The contract prices for Unl. Gasoline are only available October 2005 on, so this is only considered on the portfolios from then on.

The industrial metals that are traded on the London Metals Exchange, have different contracts from the others, since the contracts can have daily expiration dates up to three months out. Therefore, I followed the LME market practice, using the near cash and the 3-month contract and applied the linear interpolation to get the representative of 1-month contract (first-nearest to expire).

On currencies portfolios, I took into account the G10 currencies, those are the most traded and liquid currencies on the market. They are representative of G-10 countries. Therefore, the list of currencies is: US Dollar (USD), Euro (EUR), Japanese Yen (JPY), British Pound (GBP), Swiss Franc (CHF), Australian Dollar (AUD), New Zealand Dollar (NZD), Canadian Dollar (CAD), Swedish Krona (SEK) and Norwegian Krone (NOK). Since the strategies are applied for a USD based investor, only 9 currency pairs will be taken into account, and monthly foreign exchange generic futures rates will be used to calculate the returns. Thus, the exchange rates are Foreign/USD of currency pairs. The Swedish Krona and Norwegian Krone are only considered in the models from May 2005, because there was no data available before.

To follow the same methodology used in commodities, the contracts applied on the construction of portfolios are the first and the third-nearest to expire.

4. Methodology

In this study, the momentum and carry strategies will be rebalanced every month. In that sense, the weights of the portfolios will change in the end of each month considering the previous performance of the securities.

The approach used to model the performance of a carry trade follows the methodoly adopted by Koijen, Markowitz, Pederson and Vrugt (2014) for both, the commodities portfolio and currencies portfolio. They defined "carry" as the income one can earn if the price of a holding asset remains the same over the holding period. Therefore, decomposing the total return by the return achieved by the carry and the expected/unexpected return gain/loss by the price appreciation:

$$r = carry + E(p) + P_u$$

Where, *r* is the return, *p* represents the price appreciation and *Pu* the unexpected price shocks.

As already mentioned above, to calculate the carry I am going to use the futures prices of the assets. So, assuming at time *t*, a futures contract that expires at *t+1* with a current price *Ft*, a spot price of the underlying of *St*, and assume one invests *Xt* dollars in each futures contract. At *t+1* the value of the investment must be *Xt * (1+rf)+ Ft+1- Ft*, where *rf* is the risk-free rate. Therefore, the excess return in *t+1* is translated as:

$$r_{t+1} = \frac{F_{t+1} - F_t}{X_t}$$

Once the carry is calculated under the hypothesis that the spot prices remain constant from one period to another, then the futures contract price at *t+1* must be equal to *St*, given that the price expires at the futures spot price. Consequentially, by substitution the carry is represented as:

$$Carry = \frac{S_t - F_t}{X_t}$$

In order to have a fully collateralized position, the amount of capital invested on the futures equals the price of the futures contract, so *Xt* will be equals to *Ft.* As I faced some obstacles to found accurate spot prices of several commodities, I will assume the price of nearest to expire as *St*, and the third-nearest to expire as *Ft*. As so for currencies portfolio, in order to keep consistency across the study.

After calculating the carry for each pair of currencies or for each commodity, the next step is to rank them, to get to know which have the higher carry and the lower carry. In that sense, the carry is a way of signaling assets with high carry to take a long position and assets with low carry to take a short position. From here, an equally weighted portfolio was constructed.

The momentum portfolios followed a different methodology. The momentum was calculated according to the approach presented by Daniel and Moskowitz (2012) and Barroso and Santa-Clara (2012). They suggest that one should rank the cumulative returns from a recent past. The

momentum portfolio would then be constructed by buying the best performing securities and selling the worse performing ones. It is important to take into consideration that one should not invest in commodities or currency pairs that display a negative momentum, neither should sell the ones with a positive momentum.

In order to access in which asset I should take a position, I calculated the momentum, based on 6 month lag, 9 months lag and 12 months lag. Because I wanted to be on a neutral basis, I needed to go long and short in the same amount. However there are months where all commodities and currency pairs display positive or negative momentum, so in those particularly cases I would not take any position.

In what regards risk, momentum and carry present a high volatility levels on an equally weighted based portfolio. In order to counteract this issue, I will introduce risk parity measures to try to decrease the level of risk associated to these strategies.

The first approach was to consider the volatility of each commodity and currency pair on the exposure of the portfolio to it. That comes with the purpose of avoiding an overweight on the most volatile assets, which can perform the worst in wild markets, and avoiding unwanted skews and risks of traditional asset allocation strategies.

Hence, the weights were calculated based on the inverse volatility of the assets, given that the ones with lower volatility would have a higher weight, and the ones with higher volatility would have a lower weight. To achieve an optimal risk weighted portfolio, different tenors when calculating the past volatility will be considered: 1) calculating the volatility based on the past 12 months returns from investing in the first-nearest futures contract, 2) calculating the volatility based on the past 9 months returns from investing in the first-nearest futures contract, and 3) calculating the volatility based on the past 6 months returns from investing in the first-nearest futures contract.

A final approach will be tested, taking into consideration momentum and risk. On this final model, the momentum will be calculated as the average returns from a recent past, divided by the volatility of the same recent past. Once again, three different tenors will be reflected when evaluating the portfolios, the six months, the nine months and the twelve months. In this case, the contribution of risk is incorporated in the model since the beginning of its construction, instead of in the end, when calculating the weights. I will call it Risk Momentum Strategy. Therefore, the constructed portfolios will be equally weighted, because the risk has been taken into account before. This last model will be only evaluated to momentum strategies.

For the purpose of this study, the bid ask spread and transaction cost are not going to be reflected in the models. The objective is to compare the different strategies and the possible value added by introducing risk parity rules to the models. Given that, these costs should be similar among all strategies, so for comparison I will ignore it. However, the impact of trading costs can affect the profitability of strategies due to the monthly rebalancing of the portfolio.

5. Results

Before going through the comparison of results, it is important to stablish how the different strategies would be compared. The first objective I'm trying to achieve is to find a strategy which is able to deliver high compassion for the risk taken, so the first measure is the info sharpe ratio. In the purpose of futures transaction and long-short strategies, the info sharpe ratio should be used in expense of the regular one. In fact, both futures contract and long-short strategies require few capital transaction and so there is no purpose to subtract the opportunity cost that the risk-free rate represents. This is a simple measure of the tradeoff between risk and return, where we can easily find how much additional return investors receive for the additional volatility of holding a risky asset over a risk-free asset. Moreover, I will take into account the

symmetry of the distribution of each asset in order to realize if the standard deviation is underestimating or overestimating the risk by using the skewness. Then, I will examine the likelihood of extreme events by measuring the degree of fat tails. In other orders, I will measure whether the data are peaked or flat relative to a normal distribution, by observing the returns' kurtosis of each strategy. Finally, the maximum drawdown will be measured to understand what the biggest loss is the portfolios held during the observed time.

a. Commodities

When analyzing the carry strategy for commodities on an equally weighted portfolio, it is possible to observe that it delivers a good compensation for risk (Table 1). The info sharpe ratio is equals to 0.850, where the investor gets an annual return of 16.2% on average, and the volatility of the strategy is 19.1%. I observe that the skew is really close to zero, and lies at 0.07. The kurtosis computed for the observations of this portfolio is equal to 0.54. Since it is above zero, the distribution's tails are fatter than in a perfect normal distribution, in other words, there is a considerable probability of extreme events to happen. The maximum drawdown for this strategy on the observable sample is -30.3%. Any investor should not be comfortable with a so high number, since it means that in one month, the investor can lose more than what he/she is able to gain in a whole year.

By adding the risk parity rules to the portfolio, it is true that an improvement will be realized. When I weighted the strategy based on the past 6 months volatility, the info sharpe ratio increases to 0.891, majorly because the volatility decreases by 180 bps. At the same time, the returns turn to be more skewed, and the kurtosis is higher than before. Furthermore, increasing the tenor to 9 months, also increases the results on the annualized return and volatility, and consequentially on the info sharp ratio, which is then 0.945. However, in the third momentum (skew) an overestimation of risk in getting more importance, given that on a perfectly normally

distributed sample, the skew should equals zero and it is now 0.4, also the kurtosis increases to 1.03 and the maximum drawdown to -32.8%. Finally, it is possible to conclude that the portfolio would be worse if the volatility is computed based on the last 12 months, because the info sharpe would be 0.933, lower than with 6 months volatility.

Table 1 – Carry Strategy on Commodities

Carry				
	EW	6 M vol	9 M vol	12 M vol
Return	16.2%	15.4%	15.8%	15.0%
Volatility	19.1%	17.3%	16.7%	16.0%
Info Sharpe	0.850	0.891	0.945	0.933
% months +	61%	58%	63%	63%
Skew	0.07	0.29	0.40	0.34
Kurtosis	0.54	0.85	1.03	0.84
Max drawdown	-30.3%	-30.5%	-32.8%	-35.2%

Since the carry strategy has been commented, one should get through the momentum strategy. First, I compared the different lags of momentum on an equally weighted portfolio. The one that delivers better results is the 12 months momentum. The info sharpe ratio equals to 0.116, against -0.501 and -0.255 (Table 2) from 9 months and 6 months momentum, and the skew is the lowest one. Moreover, the returns distribution have fat tails, with a kurtosis of 0.69. Hence, this strategy is far from being the best investment strategy.

Table 2 – Momentum Equally Weighted Portfolios on Commodities

Equally Weighted Portfolios			
	6 Months	9 Months	12 Months
Return	-5.7%	-11.1%	2.3%
Volatility	22.4%	22.3%	20.1%
Info Sharpe	-0.255	-0.501	0.116
% months +	47.4%	38.8%	50.0%
Skew	-19.7%	37.6%	19.2%
Kurtosis	46.7%	83.3%	69.1%
Max drawdown	-79.8%	-91.3%	-56.0%

Contrary to what literature may suggest, the introduction of risk parity to the portfolios with 6 and 9 months momentum lag doesn't seem to be a contributor for performance. It is possible to observe that with a risk weighted portfolio, the info sharp ratios continue to be negatives. On the 6 months momentum portfolio, the annualized returns are lower than on the equally weighted portfolio, while the standard deviation tends to increase. On the other hand, on the 9 months momentum portfolio, the risk weighting built with 9 months volatility delivers better returns.

The 12 months momentum portfolio is the only one that when adding risk weighting it is possible to continue to retain positive returns. However, those are lower than before, and the standard deviation is higher. Additionally, in all momentum lags, the kurtosis are becoming further away from zero, meaning that the probability of extreme events to happen is increasing and the risk is being underestimated.

Table 3 & 4 & 5 – Momentum Strategy with risk parity on Commodities

6 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	-5.7%	-6.0%	-7.1%	-6.5%
Volatility	22.4%	25.4%	25.2%	24.4%
Info Sharpe	-0.255	-0.236	-0.281	-0.268
% months +	47%	49%	46%	45%
Skew	-0.20	-0.36	-0.37	-0.21
Kurtosis	0.47	2.60	2.38	2.21
Max drawdown	-79.8%	-81.3%	-83.7%	-81.8%

9 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	-11.1%	-15.3%	-9.7%	-10.1%
Volatility	22.3%	25.1%	21.6%	21.6%
Info Sharpe	-0.501	-0.609	-0.447	-0.466
% months +	39%	40%	45%	45%
Skew	0.38	-0.25	-0.59	-0.66
Kurtosis	0.83	1.53	4.30	4.44
Max drawdown	-91.3%	-95.2%	-86.6%	-87.5%

12 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	2.3%	3.3%	-3.1%	1.6%
Volatility	20.1%	28.2%	14.7%	27.7%
Info Sharpe	0.116	0.116	-0.208	0.059
% months +	50%	55%	52%	55%
Skew	0.19	-0.19	-0.53	-0.23
Kurtosis	0.69	1.90	1.68	2.10
Max drawdown	-56.0%	-66.0%	-65.8%	-69.6%

The portfolios generated from the momentum calculated as the average divided by the standard deviation, considering a 12 months lag, is the only one that displays positive annualized returns (2.6%) but, the volatility is high, and then the compensation for risk is only 0.105. Moreover, the skewness and the kurtosis are better under the 12 months lag than under the lower ones. The biggest improvement that can be observed, is the decreasing in the maximum drawdown, from -64.4% with 6 months lag, and -93.5% with 9 months lag, to only -57.3% with 12 months lag.

Table 6 – Risk Momentum Strategy on Commodities

Risk Momentum			
	6 MOM	9 MOM	12 MOM
Return	-1.3%	-13.2%	2.6%
Volatility	23.6%	25.1%	25.1%
Info Sharpe	-0.056	-0.527	0.105
% months +	48%	41%	50%
Skew	0.43	-0.09	0.16
Kurtosis	2.58	2.54	1.39
Max drawdown	-64.4%	-93.5%	-57.3%

b. Currencies

The carry strategy is best known for currencies portfolios. So, one would expect its better perform on the currencies portfolio than on commodities portfolio. Unfortunately, that is not the case under study. An equally weighted portfolio following a carry strategy to signal which currency pair one must invest on displays an annual return of 3.32% with an annual standard

deviation of 11.88%, which can be translated into an info sharpe ratio of 0.280 vs. 0.850 from commodities under the same model. Moreover, the skew is negative and equals to -1.02, meaning the strategy is underestimating risk and there is a significant number of extreme negative outliers in the returns sample, and the returns distribution has fat tails, given that kurtosis equals 6.66. The maximum drawdown represents almost twelve times the annualized returns, in other words, in one month, the investor can lose as much as he/she earns in twelve years.

When risk parity weights are added, in fact, the volatility of the strategy decreases to 8.76%, skew turns positive and very close to zero (0.06) and the kurtosis suffers a huge decrease to 1.57, assuming the 6 months volatility tenor, though it comes in deterioration of return, given it falls to 1.93% annualized from 3.32%. Although the strategy applies from being safer, the risk rewarding is worse than before, because the shrinkage of volatility and other higher momentum originated a decrease on the annual return.

Increasing the tenor of volatility to 9 months on risk weighting brings benefits, in all most all stages. First, the standard deviation decreases comparing with the equally weighted portfolio, the risk weighted with 6 months tenor and 12 months tenor. Also, the kurtosis is only 1.30, decreasing the probability of extreme events to happen in a significant amount. However, the skew is worse than from the 6 months lag portfolio, but still better comparing with equally weighted portfolio. Although the return declines comparing to the equally weighted portfolio, the investor will be better off by risk weighting because the risk adjusted measure is higher. One can observe it on the info sharpe ratio, which is 0.318. As a result, the better strategy is the one with risk weighting with a tenor of 9 months.

Table 7 – Carry Strategy on Currencies

Carry				
	EW	6 M vol	9 M vol	12 M vol
Return	3.32%	1.93%	2.60%	2.48%
Volatility	11.88%	8.76%	8.17%	8.29%
Info Sharpe	0.280	0.220	0.318	0.299
% months +	54%	49%	52%	53%
Skew	-1.02	0.06	-0.15	-0.29
Kurtosis	6.66	1.57	1.30	1.82
Max drawdown	-39%	-22%	-14%	-13%

Once I have observed the carry strategy, I can now focus on the results from momentum strategy. Following the same methodology from commodities, the former portfolios to be compared are the equally weighted ones, assuming different momentum lags. The portfolio that has the better compensation for risk is the 12 months momentum. It has an annualized return of 2.03%, comparing to 1.32% and -0.69% (Table 8) from 9 months and 6 months momentum respectively, and an annualized standard deviation equals to 7.66%. However, the strategy has a very high probability of extreme events to happen, once the kurtosis equals 11.66, and also risk is being overestimated and that there are frequent small losses and a few extreme gains because the returns distribution is positively skewed.

Table 8 - Momentum Equally Weighted Portfolios on Currencies

Equally Weighted Portfolios			
	6 Months	9 Months	12 Months
Return	-0.69%	1.32%	2.03%
Volatility	7.66%	7.37%	7.79%
Info Sharpe	-0.09	0.18	0.26
% months +	49.57%	50.93%	50.46%
Skew	-180.69%	107.97%	186.97%
Kurtosis	1513.41%	767.44%	1165.75%
Max drawdown	-6.93%	-10.47%	-13.93%

Adding the risk weighting rules to the portfolio, as in commodities portfolios, are not contributors to an enhance performance. It is possible to observe that the info sharp ratio is weakened when risk accounts to the weights in some cases. Though, ignoring the equally weighted portfolio, one can also confirm that the higher the tenor, the better the performance is. More else, the skewness of the strategies come closer to zero values, and the kurtosis decline significantly.

It is possible to conclude the best strategy lies in the 12 month momentum portfolios. The one that delivers the higher sharpe ratio is the equally weighted portfolio, though the higher momentums are far from being desirable, while the risk weighted with 12 months volatility portfolio has a lower risk adjusted measure, but the skew and the kurtosis are improved.

Table 9 & 10 & 11 – Momentum Strategy on Currencies

6 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	-0.69%	1.12%	0.23%	0.25%
Volatility	7.66%	12.84%	12.64%	12.65%
Info Sharpe	-0.090	0.087	0.019	0.020
% months +	50%	48%	50%	50%
Skew	-1.81	0.57	0.58	0.58
Kurtosis	15.13	9.32	10.08	10.04
Max drawdown	-7%	-16%	-16%	-16%

9 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	1.32%	-1.24%	-1.62%	-1.32%
Volatility	7.37%	12.35%	12.17%	12.10%
Info Sharpe	0.179	-0.100	-0.133	-0.022
% months +	51%	53%	52%	53%
Skew	1.08	-0.04	-0.15	-0.18
Kurtosis	7.67	8.47	8.21	8.38
Max drawdown	-10%	-20%	-19%	-19%

12 Months Momentum				
	EW	6 M vol	9 M vol	12 M vol
Return	2.03%	2.03%	2.00%	2.11%
Volatility	7.79%	12.55%	12.50%	12.47%
Info Sharpe	0.260	0.162	0.160	0.169
% months +	50%	52%	52%	52%
Skew	1.87	0.07	-0.02	-0.04
Kurtosis	11.66	6.82	6.47	6.50
Max drawdown	-14%	-18%	-18%	-17%

The final set of portfolios to be analyzed are the Risk Momentum. Comparing the results from the three different momentum lags, it is possible to determine that the 12 months momentum has superior performance than the lower lags. This strategy delivers a compensation to risk of 0.279 and the lower kurtosis. Although, the performance of this model is not better than the ones from the former strategy.

Table 12 – Risk Momentum Strategy on Currencies

Risk Momentum			
	6 MOM	9 MOM	12 MOM
Return	-1.12%	0.66%	1.79%
Volatility	7.04%	6.26%	6.42%
Info Sharpe	-0.159	0.105	0.279
% months +	49%	50%	50%
Skew	-2.51	0.85	1.11
Kurtosis	20.44	9.81	7.28
Max drawdown	-5%	-11%	-11%

6. Conclusion

This study looks at the performance of different approaches of carry and momentum strategies within currencies and commodities asset classes. Those strategies are very well known, as so the risks associated to them and their failure on the worst financial crisis. One reason to this events is that signals for investing or divesting are based only on the recent past returns, not paying attention to the volatility of the securities. Therefore, I attempted to incorporate risk

parity rules on the portfolios to erase the risk of holding the most volatile assets for too long and in unproportioned amounts, and then achieving better results.

On carry trade strategies, both on currencies and commodities portfolios, I can observe that the introduction of risk parity rules enhances the performance of the portfolios, comparing with the equally weighted ones. An investor can then find the better compensation for risk on a risk weighted portfolio. The risk parity was calculated based on three tenors, and it is possible to conclude that the risk weighting with a 12 months tenor. Although the higher momentum risk measures improve from an equally weighted portfolio within the currencies asset class, the same is not true for commodities asset class. Therefore, the literature only applies partly to the back testing results.

The analysis of the introduction of risk weighting on momentum strategies was not as successful as on carry strategies. As the literature suggests, the volatility, the skewness and the kurtosis of the models must decrease when the risk is taking account. Though this is not the case neither to commodities portfolio nor to currencies portfolio. In fact, the portfolios delivering better performance are the equally weighted ones, where the momentum signal is calculated based on last twelve months return. Unfortunately, the risk parity does not seem to be a contributor to enhance the results of simple momentum strategies.

Also, it is important to discuss some factors and limitations of the models, some drawdowns the strategies may be facing, may have faced or may face in the future and potential biases that can be present in the outcomes.

First, one must bear in mind that the former back testing was focused on historical data, which may not reflect what will happen in the future, what works in the past does not have to work well in the future.

The models are built based on the last price, which may not correspond to the actual price the investor would be able to complete the transaction. In other words, the bid-ask is not included on the model. Also, I haven't taken into account transaction cost. These costs would be important to consider once, they might end up by erode the presented returns. Though, since the purpose of this study was to compare strategy, they were not counted in.

Furthermore, the liquidity risk may be associated to some securities. I have tried to consider the most liquid assets, however in the end it will depends on the amount of the purchases and sales and how much they will impact the price of the contracts. This risk also gives more emphasis to the bid-ask spread, which must be proportional to the liquidity of the assets.

Concluding, in order to obtain a more realist profitability of the strategies, and to understand if the introduction of risk parity rules still enhances the carry trade strategy on commodities and currencies portfolios, one should include those risks on the analysis.

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