Analysis of Currency Investing: Are Emerging Markets More Profitable than Developed Markets?

by

Fan Yang

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Professor Marti G. Subrahmanyam   Professor   Richard M. Levich

Faculty Adviser   Thesis Adviser

1. Introduction

Currency is increasingly considered an asset class for investment, and there are many studies exploring the benefits as well as potential risks with currency investing. It is by default a long-short strategy (borrowing in one currency to fund investing in the other for any given currency pair), there is no standardized market benchmark to measure performance, and some studies suggest that profitability is in decline as markets become more efficient. However, the majority of currency investing as well as research in the area has focused on developed market currencies, and trading volume has been concentrated in a few major currencies such as the USD, EUR, GBP, JPY, etc. Emerging markets have attracted less enthusiasm due to factors such as political risks, less developed financial markets and higher volatility, and limited availability of useful data compared to developed markets. However, in the increasingly globalized environment of today, emerging market assets are a significant segment of the investment landscape and may have valuable diversification properties. This study aims to analyze currency investing in emerging markets by taking the approach of a "naïve investor" and applying classic strategies to historical data. The results from EM currencies will be compared against analogous results from G10 currencies, and also analyzed as part of a diversified portfolio.

2. Methodology and Data

This study will apply simple carry, trend, and value strategies to a basket of EM and DM currencies, respectively. This approach simulates the strategy of a "naïve", rule-following currency investor, and the market return, constructed using a buy-and-hold strategy, will serve as a benchmark for performance. The carry strategy invests in the currency with a higher interest rate within a currency pair financed by borrowing in the currency with the lower interest rate. A momentum strategy examines the difference between the spot exchange rate and a moving average

for each currency pair, goes long the quote currency (and short the base currency) if the difference is positive and goes short the quote currency (and long the base currency) if the difference is negative. The value strategy compares the market rate for each currency pair to the theoretical exchange rate such as Purchasing Power Parity (PPP), and goes long the currency that is undervalued by borrowing in the overvalued currency. In all of these strategies, the investor earns interest on the long currency position and pays interest on the short currency position. All of these strategies are based on public information and therefore none should result in consistent risk-adjusted profits.

The preliminary data set for this analysis is monthly data for 1994 – 2017, for G10 currencies (USD, EUR, GBP, JPY, CAD, AUD, NZD, SEK, NOK, CHF) representing developed markets (DM) and a basket of most traded unrestricted emerging market currencies (SGD, ZAR, MXN, PLN, CZK, THB, HUF) (Pojarliev 2005) representing emerging markets (EM). Because liquidity is highest with USD as the base currency, each currency is analyzed as a currency pair against the USD; i.e. nine developed market currencies and seven emerging market currencies are analyzed.

The main variables in the data set are spot exchange rates, short term market interest rates, and PPP values (at monthly frequency). Spot exchange rate data comes from Bloomberg. Short term interest rate data used is the Money Market rate from the International Monetary Fund International Financial Statistics database, for all countries except Hungary and Norway. Data for these two countries were not available at this source and the 3-month interbank offered rate from DataStream is used instead. There are 3 sets of data for PPP measures, with increasing coverage for the 17 countries: the OECD Relative CPI, available for 15 countries; the IMF Real Effective Exchange Rate (REER), available for 16 countries; the JP Morgan REER from DataStream, available for all 17 countries. Therefore, the JP Morgan REER will be used as the main source for PPP data.

2.1 Potential Challenges

Working with emerging markets data may present some specific challenges. EM interest rate data is prone to noticeable gaps, and those available may not be market determined—in which case they cannot be used for carry trade calculations—or may not reflect the actual borrowing and lending rates attainable in local markets. EM currencies are much less traded compared to DM currencies, and may have large and varying transaction costs. There may be regulatory constraints limiting foreign access to certain EM markets, which would make the implementation of many strategies much costlier if not impossible, potentially making a significant impact on the profitability analysis.

Existing literature on this topic provides some empirical results that may be confirmed or rejected by the empirical evidence presented in this analysis. For example, Pojarliev (2005) concluded that trend-following strategies work better in emerging markets and carry strategies work better in developed markets, even though EM currencies are perceived to be more volatile and generally have a higher interest rate differential. He also concluded that investing in EM provides valuable diversification to a currency portfolio. Since this study uses a similar dataset with approximately 14 more years of data, it will be interesting (and feasible) to see whether these conclusions still hold over the longer time period.

3. Calculation Methods

The analysis in this research project will proceed in three main phases: preliminary single currency analysis, portfolio analysis, and diversification analysis.

In the single currency analysis phase, I will apply the "naïve investor" trading strategies as described above to each currency pair over the entire data set with monthly rebalances to calculate the return series in each scenario. This phase provides preliminary results to compare

DM and EM and look for any patterns. Taking into consideration the idiosyncrasies of individual currency pairs, I will then form DM and EM currency portfolios, applying each trading strategy to each portfolio respectively, to test the patterns that may emerge in the first phase of analysis. Then I will proceed to form diversified portfolios of currencies and strategies to explore trends and/or diversification properties that may not be evident in the simple currency portfolio analysis.

In order to keep all returns calculations consistent and comparable, all exchange rates (S_K) are measured in units of USD per 1 foreign currency (K). Return analysis will be divided into two categories: single currency pair analysis and portfolio analysis. Rebalancing will occur on the first trading day of every month.

3.1 <u>Single Currency Pair Analysis</u>

For each currency K, a market return series (R_k) is generated by implementing a buy-and-hold strategy over the investment horizon, 1994-2018, taking into consideration interest rate earnings and costs.

$$R_k = \frac{S_{k,t}}{S_{k,t-1}} \times \frac{1+i_{foreign}}{1+i_{USD}} - 1$$

This return will be used as a benchmark to evaluate the three trading strategies respectively.

Momentum

For each currency K, calculate the 3-month moving average from daily spot exchange rates, MA(3), and compare this to the spot rate on the next rebalancing day (i.e. first day of the following month t). If the spot rate is above MA(3) then long the foreign currency against the USD for month t, and vice versa. These monthly rebalancing positions generate the momentum strategy return series for all currencies, RM. Mathematically:

$$\delta_M = S_t - MA(3) \qquad\qquad (1)$$

$$\left[\begin{array}{l} \omega_M = 1 \; when \; \delta_M > 0 \\[2mm] \omega_M = -1 \; when \; \delta_M < 0 \end{array}\right.$$

$$RM = \omega_M \times R$$

Carry

Compare the interest rates of USD and the foreign currency each month. If USD interest rate is higher, then short the foreign currency; if foreign currency interest rate is higher, long the foreign currency.

$$\delta_C = i_{foreign} - i_{USD} \qquad\qquad (2)$$

$$\left[\begin{array}{l} \omega_C = 1 \; when \; \delta_C > 0 \\[2mm] \omega_C = -1 \; when \; \delta_C < 0 \end{array}\right.$$

$$RC = \omega_C \times R$$

Value

Compare a PPP measure of USD and the foreign currency, using their Real Effective Exchange Rate, each month. If the USD REER is higher, implying that it is overvalued relative to the foreign currency, then long the foreign currency; if the USD REER is lower, then short the foreign currency. Mathematically,

$$\delta_V = REER_{USD} - REER_{foreign} \qquad\qquad (3)$$

$$\left[\begin{array}{l} \omega_V = 1 \; when \; \delta_V > 0 \\[2mm] \omega_V = -1 \; when \; \delta_V < 0 \end{array}\right.$$

$$RV = \omega_V \times R$$

3.2 <u>Simple Portfolio Analysis</u>

The currencies in this study are divided into two baskets, Developed Market (DM): EUR, GBP, JPY, CAD, AUD, NZD, SEK, NOK, CHF; and Emerging Market (EM): SGD, ZAR, MXN, PLN, CZK, THB, HUF.

First, to calculate the portfolio market returns (RP_{EM}, RP_{DM}), we apply a buy-and-hold strategy to the currencies in each basket with equal weight, respectively. Second, generate the strategy portfolio returns by applying each of the three strategies to each currency in each basket and forming equally weighted portfolios, i.e. average the single-currency strategy returns across currencies to take advantage of any diversification properties. Then, apply each strategy to each basket overall, rebalancing each month according to the rules below:

For each strategy, calculate the corresponding δ value for each currency within the basket using equations (1), (2), and (3). Rank the δ values in decreasing order, long the top 1/3 currencies with equal weights, short the bottom 1/3 currencies, and place zero weight on the remaining currencies. Mathematically,

$$RM_{DM} = \frac{1}{3}(R_{DM1} + R_{DM2} + R_{DM3} - R_{DM7} - R_{DM8} - R_{DM9}) \tag{4}$$

$$RM_{EM} = \frac{1}{2}(R_{EM1} + R_{EM2} - R_{EM6} - R_{EM7}) \tag{5}$$

Subscripts on individual currency market returns R indicate the portfolio it's from (DM or EM) and the ranking of its δ in that strategy. Equations above are for momentum strategy returns; calculations are analogous for carry (RC) and value (RV).

3.3 <u>Diversified Portfolio Analysis</u>

To examine the diversification properties across currency baskets and across strategies, I construct portfolios that hold one of these dimensions fixed and diversify across the other aspect. This results in two groups of diversified portfolios:

- Strategy blended portfolios: calculate the returns of each strategy by equally weighting DM and EM returns for that strategy.

- Currency blended portfolios: calculate returns for each currency basket by equally weighting returns of each strategy applied to that currency basket.

All diversified portfolios have equal weighting on all components. We adopt equal weights based on the known difficulty of identifying optimized weights that can be reliably used out of sample, and also to simulate the method likely used by a naïve investor.

3.4 <u>Performance Evaluation</u>

After calculating the return series for each strategy for each currency pair, and for each strategy for the DM and EM currency baskets, several metrics will be used to analyze and compare these returns. Annualize each monthly return series by multiplying by 12, and calculate:

- Cumulative return over the entire investment horizon

- Mean annualized return

- Annualized standard deviation

- Sharpe Ratio (annualized return / annualized standard deviation)

- Average win (average return for positive return months)

- Average loss (average return for negative return months)

- Hit rate (percentage of months with positive return)

- Max drawdown (biggest single month loss)

4. Empirical Results

4.1 <u>Strategy Mechanics Demonstration</u>

In order to evaluate and compare strategy performances, we first need a solid understanding

of the mechanics of each strategy – how it is applied and how it relates to other variables. I

constructed cumulative value graphs for each strategy over the entire investment horizon (Jan.

1994 – Apr. 2017), overlaid with graphs of its decision variable, using JPY as an example, to

demonstrate the mechanics of each strategy.

The graph for Momentum strategy (Fig. 1) is overlaid with the spot exchange rate (in USD

per JPY terms) and the 3-month moving average, which tracks spot rate quite closely. In the

period 1999-2012, there is a consistent general trend of JPY appreciation, reflected as long JPY

positions under the momentum strategy for most of this period. However, this period of long JPY

positions appears to have modest returns. In fact, the market strategy, which is long the JPY over

the entire investment horizon, lost over 40% of its value over the 23-year investment period,

despite the spot rate—remarkably—being almost the same at the start and end of this period.

This phenomenon is due to the fact that when a U.S. based investor is long a foreign currency, he

pays USD interest and receives foreign interest. In this case, USD interest rates exceeded JPY

interest rates by about 2.38% per annum.

The Carry strategy aims to profit from interest rate differentials, and its cumulative value

graph help shed light on observations about the momentum graph. Fig. 2 shows the cumulative

value of investing through the carry strategy as well as the market strategy, and overlays the

difference between U.S. and Japanese short-term interest rates. The interest differential is

negative for nearly the entire investment horizon (274 out of 279 observations); to make a profit

on this differential, a U.S. investor implementing the carry strategy would borrow JPY and invest

in USD, i.e. establish a short JPY position. This is reflected in the carry cumulative value graph,

which shows consistent inverse shape to the Market curve (though not symmetrical due to compounding in each series). The interest rate differential curve also explains the mediocre Momentum strategy returns and the Market strategy losses: while the long JPY positions are making some profits on currency appreciation, they incur interest costs that average 2.38% per annum over the sample period.

The Value strategy works similarly to the Carry strategy, aiming to profit from a misalignment in the two currencies. In the case of Value, the relevant differential is in PPP measures of USD and JPY; a positive PPP differential indicates that USD is overvalued relative to JPY, and the investor should long the JPY. The opposite is true for a negative PPP differential. This can be observed in the Value strategy cumulative value graph, overlaid with the PPP differential (Fig. 3). In 1994-1997, the differential is negative, and Value returns are the mirror image of market returns (accounting for compounding), indicating a short JPY position; in 2001-2010, the differential is consistently positive, and Value returns are parallel to market returns, indicating a long JPY position.

4.2 <u>Single-Currency Analysis</u>

Graphs of single currency strategy returns provide a direct view of strategy implementation, and major historical shocks in the market can be observed in the graphs, serving as reality checks for the methodology. For each currency pair, I constructed a graph of cumulative returns over the entire investment horizon (Jan. 1994- Apr. 2017, 280 monthly observations for each of 16 currency pairs), plotting market and strategy returns on the same axes to compare performance across the different strategies. A select subset of graphs are discussed here to illustrate general patterns and highlight special cases.

The first currency to highlight is the Swiss Franc (CHF). During 2011-2015, CHF was pegged to the EUR. The Swiss National Bank implemented the peg to control "exceptional overvaluation" caused by capital flowing into CHF from EUR and USD for its perceived safety. However, as this phenomenon subsided, the peg kept CHF value artificially high while EUR depreciated against the USD. This overvaluation is reflected in Value strategy returns for CHF during this period (Fig. 4(a)): its trend of coinciding with market returns reversed in 2011, indicating that the CHF became overvalued relative to the USD and a U.S. value investor would borrow in CHF and invest in USD. Then Value returns became parallel to market returns again in 2015, when the peg was dropped and CHF spot rates jumped to reflect its true value.

The second illustration is the Thai Baht (THB). Returns for the THB are relatively steady over the entire investment horizon across all strategies, with no strategy achieving cumulative returns of over 100%; the only other EM currency for which this holds true is Singapore. However, this relative stability highlights an intense period of volatility during the 1997 that clearly impacted all strategies (Fig. 4(b)). This corresponds to the Asian Financial Crisis, which was triggered by the collapse of the THB.

In addition to graphical views of the single currency strategy returns, I constructed performance metric tables to more holistically analyze and compare results across strategies and currencies. A table was generated for each performance metric included in this study; a few key metrics are discussed below.

Tables 1-3 present the average annualized returns, cumulative returns, and Sharpe Ratios (SR) for each strategy for each currency pair over the entire investment horizon, respectively. The color scale from red to green indicate lowest to highest values. Measures of absolute return (Table 1 and Table 2) suggest that EM currencies generally perform better than DM currencies, while risk-adjusted measures (Table 3) show more strategy specific patterns. Momentum had the

worst performance compared to other strategies by all measures: 5 out of the 16 currency pairs had negative cumulative returns over the 280-month investment horizon, and only 1 currency pair achieving a Sharpe Ratio above 0.3.

By contrast, Value and Carry strategies generally performed well, and more specifically, Value performed better in EM than DM while the opposite is true for Carry. Under the Carry strategy, 4 out of 9 DM currency pairs obtained cumulative returns over 100%, with a high of 289.75% (USDSEK), compared to 2 out of 7 EM currency pairs and a high of 126.24% (USDHUF). The 4 DM currency pairs with top cumulative returns were also the only ones with SR values above 0.4, with a high of 0.599 (USDSEK).

Under the Value strategy, 5 out of 7 EM currency pairs obtained cumulative returns over 100%, with a high of 629.74% (USDPLN), compared to 2 out of 9 DM currency pairs and a high of 154.01% (USDNZD). 4 EM currency pairs were the only ones with SR values above 0.4 (all four values are also above 0.5), with a high of 0.748 in USDPLN.

In summary, single-currency analysis produced currency-specific cumulative return graphs that visually captured historical patterns and events, as well as performance metrics tables that allow for more quantitative comparisons. Over the entire investment horizon, Momentum strategy performed relatively poorly in all currency pairs, while Carry performed well in DM currencies and Value performed well in EM currencies. The best performing currency-strategy combinations produced very high absolute as well as risk-adjusted returns. However, there's a high degree of variation in performance across currencies within each strategy, complicating any attempt to extract performance patterns associated with DM and EM. It also implies high risk in selectively investing in specific currency pairs without diversification, and by extension, the potential benefits of constructing currency portfolios.

4.3 <u>Simple Portfolio Analysis</u>

In analyzing the strategy returns of DM and EM currencies as currency baskets using the

methodology described in section 4.2, I generated cumulative returns graphs for DM and EM

respectively (Fig. 5a, 5b), analogous to the single currency returns graphs. From this graphical

view, Carry performs best in both markets and Value comes second, while Momentum performs

poorly. This is generally consistent with the patterns that emerged in single currency analysis.

However, while the cumulative returns for each strategy manifests a similar shape in both

markets, it's important to note that these two graphs are on drastically different scales,

suggesting that DM and EM markets move in tandem but with bigger magnitudes in EM.

After getting a big-picture sense of returns patterns through the cumulative return graphs, I

constructed the performance metrics table, comprising of all metrics for each strategy-currency

basket combination (Table 4). Analysis of this table give rise to observations and patterns across

dimensions of both market and strategy.

To attempt to answer the central research question of this thesis: whether EM outperforms

DM, I first compare return metrics for DM and EM within each strategy. The results in Table 4

suggest that the EM currency basket does perform better than the DM currency basket across all

strategies except for Momentum. This holds true in measures of both absolute and risk-adjusted

return; mean annualized returns for Market, Carry, and Value strategies in EM are on average

1.9% higher than those in DM, and Sharpe Ratios are on average 0.086 higher. Secondly,

looking across the strategy dimension, Carry is clearly the best performing strategy for both

currency baskets, with the EM-Carry combination achieving the highest Sharpe Ratio in this set

of results, at 0.615. Momentum doesn't perform well in either currency basket, but still modestly

outperforms Market returns in DM; by contrast, EM-Momentum performs particularly poorly,

underperforming Market returns with a mean annualized return of 0.8% and SR of 0.080.

Other performance metrics add more nuance in describing the risk associated with these returns. The hit rate, percentage of positive return months, are highest in Carry for both DM and EM, suggesting that the strategy's success comes from relatively reliable capture of positive returns over time, rather than a small number of large returns. Max drawdown, the largest one-month loss, is consistently higher in EM, making EM riskier in this sense. Interestingly, the magnitude of average wins and losses for Market returns are the same in DM and EM, but those in EM increase when a strategy is applied while those in DM are fairly consistent. This may be due to a partial loss in diversification effects, since the Market portfolio equally weights the entire currency basket, while strategy portfolios only include two thirds of the currencies, and the EM basket contains fewer currencies.

In summary, EM currencies generally outperform DM currencies in terms of return, but by some measures are also more risky. Applied to these simple currency basket portfolios, Carry strategy performs best and Momentum performs worst. Across all strategies, cumulative returns in DM and EM exhibit similar graphical patterns, suggesting some correlation, but are very different in scale, suggesting potential further diversification benefits.

4.4 <u>Diversified Portfolio Analysis</u>

The diversified portfolio analysis consists of two different types of diversified portfolios constructed from the simple portfolios: strategy blended portfolios, equally weighted portfolios comprising of DM and EM portfolios for each strategy, and currency blended portfolios, equally weighted portfolios comprising of all strategies for each currency basket. Intuitively, the cumulative return graphs of these diversified portfolios would be the average of the graphs of their components, but potentially with lower risk when the returns of the various components are imperfectly correlated. Thus, these graphs should show lower volatility relative to their

respective components. This is in fact the case for all of the diversified portfolios; for example, the cumulative returns for the DM blended portfolio (Fig. 6) and the Value strategy blended portfolio (Fig. 7) are visibly smoother than their respective components, plotted on the same graph for comparison. I generated the performance metrics table for these diversified portfolios, with each column corresponding to each of the 4 strategy blended portfolios and 2 currency blended portfolios.

Across the strategy blended portfolios, patterns from Simple Portfolio Analysis persist: Carry performs very well, as does Value, and Momentum does poorly, underperforming Market returns (Table 5). In absolute return terms, Carry and Value have cumulative returns over 200% and average annualized returns over 5%, while Market and Momentum have cumulative returns under 50%, and annualized returns of 1.8% and 1.1% respectively. However, Sharpe Ratios of Carry and Value strategies are significantly improved compared to those in the simple portfolios, with the Carry SR at 0.704, and the Value SR even higher at 0.799. The average SR for these two strategies in simple portfolio analysis is 0.593 and 0.551 respectively, demonstrating that there are significant diversification benefits by combining DM and EM. This effect doesn't appear in results for Market and Momentum.

In the currency blended portfolios, returns fall between the lowest and highest strategy returns for that currency basket, and hit rates are also not much changed. However, there is clearly a diversification effect: the DM blend portfolio has SR of 0.675, compared to an average SR of 0.367 in DM simple portfolios (the components of the blend portfolio). Similarly, the EM blend portfolio has SR of 0.791, compared to an average SR of 0.395 in EM simple portfolios. This diversification across strategies also reduces risk in terms of max drawdown: the biggest 1-month loss for the DM blend portfolio is 5.2%, while the DM simple portfolios have average max drawdown of 7.8%. This measure improves more significantly for EM, with a max draw

down of 4.2% in the blend portfolio—lower than that of the DM blend—compared to an average of 10.3% in the EM simple portfolios, higher than the corresponding measure for DM.

In summary, diversifying across currency basket (by constructing strategy blend portfolios) and diversifying across strategy (by constructing currency blend portfolios) both have significant benefits. The diversified portfolios, while not generating higher absolute returns, have Sharpe Ratios much higher than their respective components. In the currency blend portfolios, EM max drawdown even improved to surpass its DM counterpart. EM also outperforms DM in average annualized return, cumulative return, and Sharpe Ratio in this portfolio setting.

5. Summary and Conclusion

This study analyzed a set of 9 developed markets currencies and 7 emerging markets currencies over a 280-month investment horizon (Jan. 1994 – Apr. 2017) using monthly data on short term interest rates, Purchasing Power Parity (PPP), and daily spot exchange rates. Four different investment strategies were analyzed: Market (buy-and-hold) strategy, used as a benchmark; Momentum strategy, based on the 3-month moving average of spot rates; Carry strategy, based on interest rate differentials; and Value strategy, based on PPP value discrepancies. The analysis progressed in three stages: single currency analysis, applying each strategy to each currency pair; simple portfolio analysis, applying each strategy to the DM and EM currency baskets as a whole; diversified portfolio analysis, diversifying across currency basket for each strategy, and diversifying across strategies for each currency basket.

The results of this analysis suggest that Carry and Value outperformed the benchmark, Market strategy, while Momentum underperformed. In Single Currency Analysis, Carry performed relatively better in DM and Value performed relatively better in EM. In Simple Portfolio Analysis, Carry performed best out of all strategies in both DM and EM. EM

performed better than DM in terms of absolute as well as risk-adjusted returns, but is riskier by measures like average win, average loss, and maximum drawdown. In Diversified Portfolio Analysis, Sharpe Ratios for all diversified portfolios increased significantly compared to their respective component portfolios, indicating strong diversification effects across strategies as well as across currency baskets. Directly comparing the DM and EM blended portfolios, EM performs better than DM by a variety of measures; the cumulative return is 73% higher, the average annualized return is 32.5% higher, the SR is higher, and the max drawdown is lower. These portfolios are the best representations of DM and EM currency investing within the scope of this study, and lead to the conclusion that over this investment horizon and using the specified investment strategies, EM is a better investment relative to DM.

Compared to returns in other assets, such as equity, the returns in currency investing may not seem very competitive. However, each of the currency investment strategies discussed in this study are "self-financing", i.e. borrowing in one currency and investing in another, theoretically requiring no net capital. In practice, some capital may be necessary to cover any losses that occur and to maintain positions; however, these capital commitments are relatively small and still render currency investing capital-efficient compared to other assets. Therefore, currency strategies can be overlaid on a core portfolio of fixed income, equity, or other investments, and the returns generated by currency investing should be viewed as additional profit, comparable to risk premia rather than total return in other asset classes. For example, a U.S. based equity investor could borrow USD using his stock portfolio as collateral and profit from currency investment strategies, while still earning the equity returns.

5.1 <u>Suggestions for Further Research</u>

While our empirical results offer some encouragement for investors, there are several

important caveats to keep in mind. First, emerging markets are generally relatively more illiquid and opaque, and there may be transaction costs or barriers to investment that this study does not account for. It could be interesting to explore the impact of these costs on performance analysis. Second, this study applies each strategy over the entirety of the 23-year investment horizon; there may be more short-term patterns within subperiods that are not explored, or further performance optimization by dynamically changing strategies and currency composition of the portfolio throughout the investment horizon. Another potential option is to analyze part of the data to find optimal strategies, then apply it to the remaining "out of sample" data to test for the robustness of this analysis as a method to generate investment strategies. Third, these currency portfolios may also be analyzed as a component of an asset-diversified investment portfolio. Additionally, alternative data sources for the same variable (e.g. PPP) could be used to construct a comparative study testing the sensitivity of the performance analysis.

Overall, currency investing is an important consideration for any internationally diversified investor. As emerging markets investments become increasingly common and popular, this field offers much to explore and investigate.

References:

Pojarliev, M. (2005). Performance of Currency Trading Strategies in Developed and Emerging Markets: Some Striking Differences. Financial Markets and Portfolio Management, 19(3), pp.297-311.
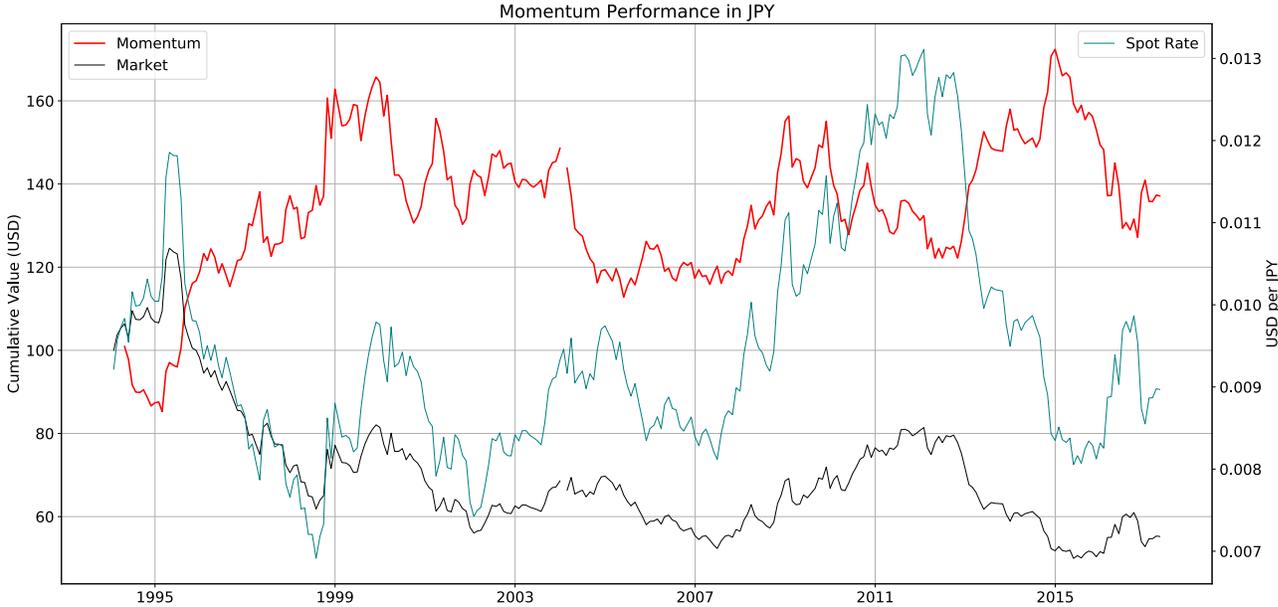
Appendix: Tables and Figures

Fig. 1. Cumulative values for Momentum strategy and the benchmark market strategy applied to JPY (left axis), and the spot exchange rate USD/JPY (right axis), over the entire 1994-2017 investment horizon. 280 monthly observations were used.
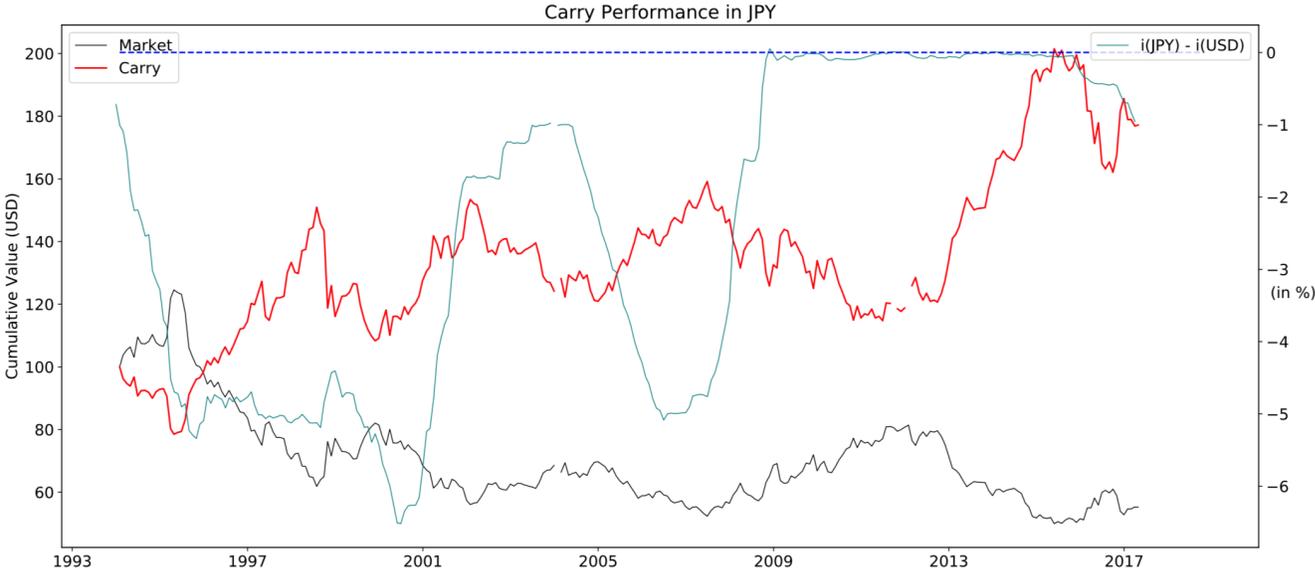

Fig. 2. Cumulative values for Carry strategy and the benchmark market strategy applied to JPY (left axis), and the differential between Japanese and US interest rates (right axis), over the entire 1994-2017 investment horizon. 280 monthly observations were used.
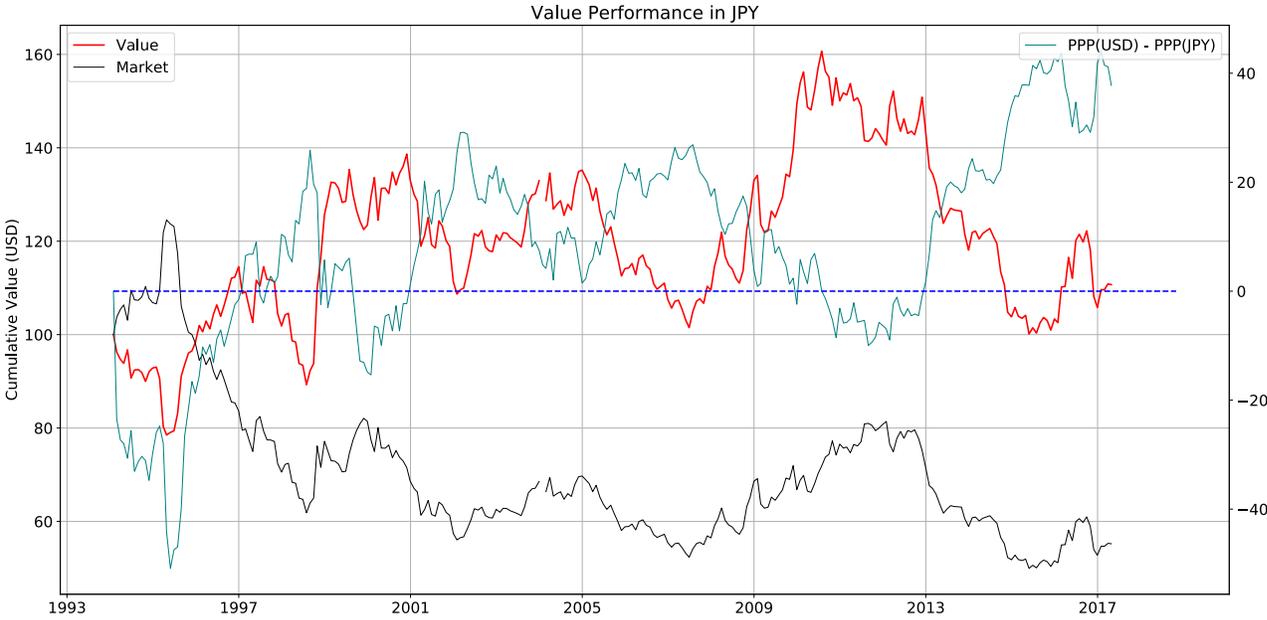
Fig. 3. Cumulative values for Value strategy and the benchmark market strategy applied to JPY (left axis), and the differential between US and Japanese Real Effective Exchange Rates, a PPP measure (right axis), over the entire 1994-2017 investment horizon. 280 monthly observations were used.
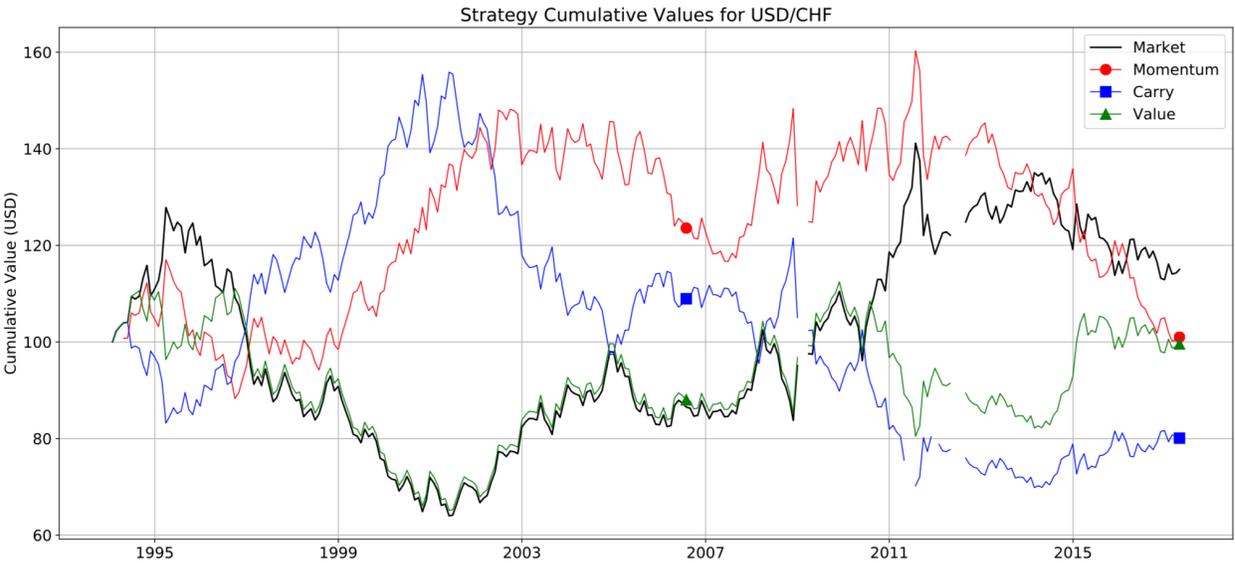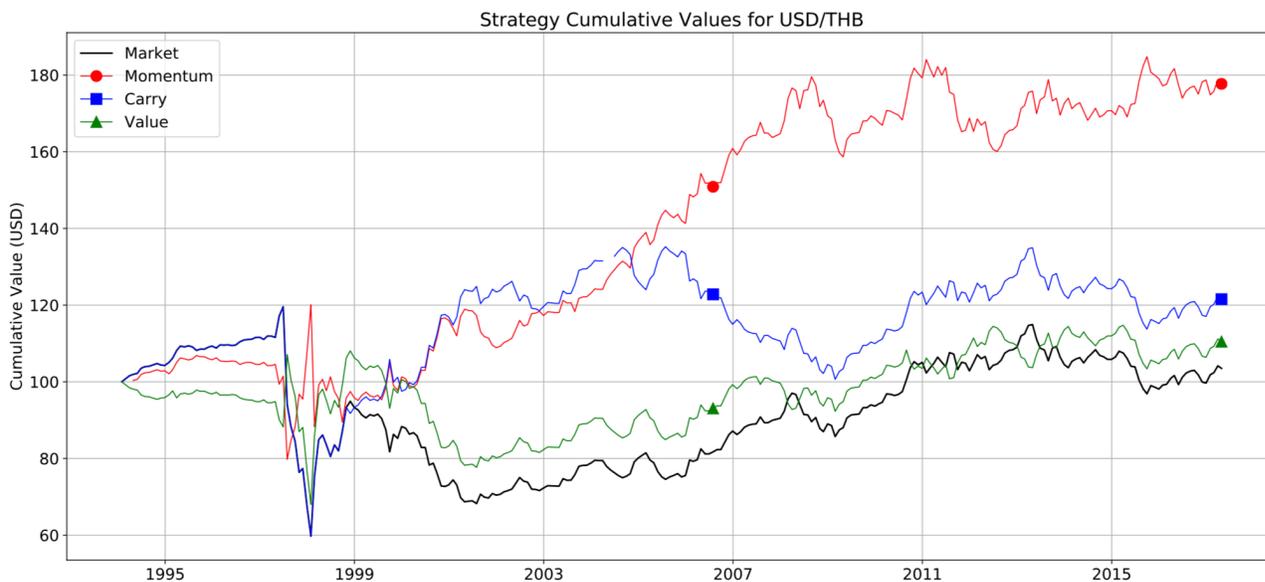

Fig. 4(a)

Fig. 4(b)

Fig. 4 (a) – (b) Cumulative values of each strategy at monthly frequency for single currency pairs USDCHF and USDTHB, respectively, over the entire 1994-2017 investment horizon. 280 monthly observations were used.

Average Annualized Returns				
	Market	**Momentum**	**Carry**	**Value**
USDEUR	0.16%	3.59%	5.28%	3.32%
USDGBP	0.55%	-1.63%	0.59%	-1.27%
USDJPY	-1.94%	1.99%	3.13%	1.06%
USDCAD	0.43%	-0.37%	0.22%	1.95%
USDAUD	3.04%	0.05%	5.80%	3.69%
USDNZD	4.16%	0.97%	5.18%	4.76%
USDNOK	1.24%	1.41%	2.18%	3.84%
USDSEK	0.39%	1.44%	6.45%	2.66%
USDCHF	1.16%	0.61%	-0.42%	0.53%
USDSGD	-0.28%	-0.03%	0.18%	0.79%
USDZAR	1.87%	0.48%	1.87%	4.65%
USDMXN	3.21%	1.21%	3.21%	8.68%
USDPLN	5.34%	1.90%	3.92%	9.35%
USDCZK	3.47%	2.05%	2.19%	6.13%
USDTHB	0.71%	3.10%	1.41%	0.97%
USDHUF	4.96%	2.13%	4.73%	6.59%

Table 1. Average annualized market and strategy returns over entire investment horizon, for each currency pair. Color scale from red to green indicates lowest to highest values.

Cumulative Returns				
	Market	**Momentum**	**Carry**	**Value**
USDEUR	-7.32%	104.59%	203.26%	93.63%
USDGBP	4.62%	-36.76%	5.70%	-31.42%
USDJPY	-44.78%	37.12%	77.17%	10.70%
USDCAD	1.95%	-15.11%	-3.04%	45.08%
USDAUD	71.32%	-14.56%	222.81%	99.48%
USDNZD	120.41%	4.91%	179.39%	154.01%
USDNOK	16.61%	21.06%	45.02%	113.50%
USDSEK	-4.63%	21.42%	289.75%	61.82%
USDCHF	15.01%	1.01%	-19.93%	-0.42%
USDSGD	-10.06%	-4.70%	0.22%	15.40%
USDZAR	17.94%	-14.33%	17.94%	126.06%
USDMXN	70.76%	9.21%	70.76%	524.94%
USDPLN	185.93%	28.53%	105.42%	629.74%
USDCZK	89.90%	36.26%	41.09%	253.31%
USDTHB	3.50%	77.70%	21.54%	10.47%
USDHUF	137.39%	30.75%	126.24%	235.87%

Table 2. Cumulative market and strategy returns over entire investment horizon, for each currency pair. Color scale from red to green indicates lowest to highest values.

Sharpe Ratios				
	Market	**Momentum**	**Carry**	**Value**
USDEUR	0.0166	0.3643	0.5395	0.3375
USDGBP	0.0653	-0.1952	0.0707	-0.1525
USDJPY	-0.1737	0.1780	0.2792	0.0947
USDCAD	0.0519	-0.0438	0.0261	0.2342
USDAUD	0.2536	0.0037	0.4875	0.3084
USDNZD	0.3393	0.0788	0.4236	0.3894
USDNOK	0.1154	0.1306	0.2026	0.3579
USDSEK	0.0359	0.1313	0.5985	0.2441
USDCHF	0.1104	0.0574	-0.0397	0.0504
USDSGD	-0.0475	-0.0053	0.0312	0.1340
USDZAR	0.1233	0.0313	0.1233	0.3085
USDMXN	0.2459	0.0928	0.2459	0.6761
USDPLN	0.4211	0.1483	0.3081	0.7484
USDCZK	0.2922	0.1724	0.1842	0.5205
USDTHB	0.0671	0.2911	0.1324	0.0907
USDHUF	0.3878	0.1651	0.3697	0.5178

Table 3. Sharpe ratios for monthly market and strategy returns over entire investment horizon, for each currency pair. Color scale from red to green indicates lowest to highest values.
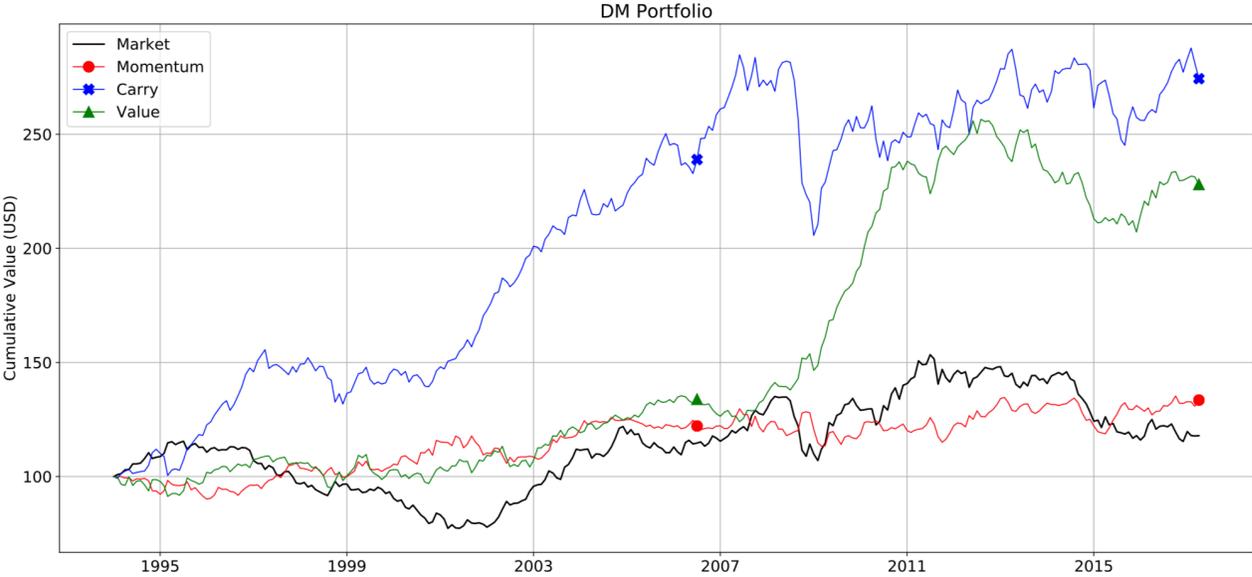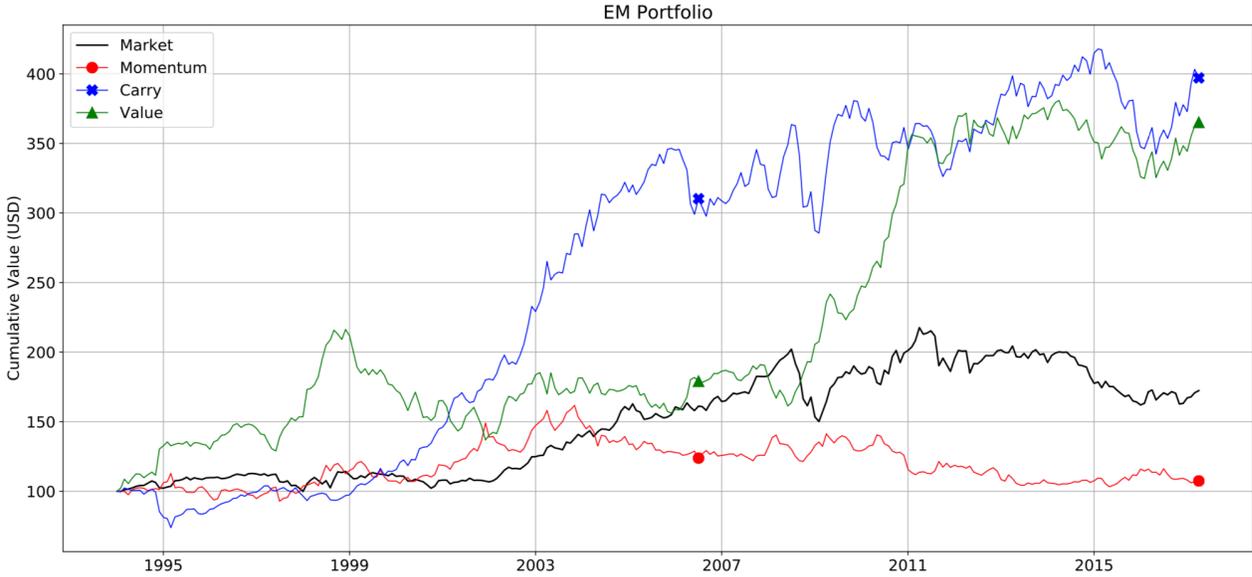
Fig. 5(a)

Fig. 5(b)

Fig. 5(a) - (b) Cumulative portfolio values of each strategy for DM and EM currencies, respectively, calculated over the entire 1994-2017 investment horizon. 280 monthly observations were used. Calculations described in equations (4) and (5).

Portfolio Return Performance Metrics								
Strategy	**Market**		**Momentum**		**Carry**		**Value**	
Portfolio	DM	EM	DM	EM	DM	EM	DM	EM
Cumulative Return	17.89%	72.38%	33.49%	7.45%	174.39%	297.11%	128.03%	265.17%
Mean Annualized Return	1.02%	2.68%	1.44%	0.75%	4.67%	6.49%	3.78%	6.16%
Annualized Standard Dev	7.89%	8.20%	6.42%	9.44%	8.18%	10.55%	6.98%	11.00%
Sharpe Ratio	0.129	0.326	0.225	0.080	0.571	0.615	0.542	0.560
Average Win	1.68%	1.72%	1.46%	2.06%	1.82%	2.46%	1.68%	2.66%
Average Loss	-1.81%	-1.72%	-1.32%	-2.02%	-1.90%	-2.17%	-1.43%	-2.12%
Hit Rate	54.29%	56.43%	51.79%	51.07%	61.43%	58.57%	56.07%	55.00%
Max Drawdown	-8.61%	-10.08%	-5.67%	-9.81%	-10.93%	-14.12%	-5.81%	-7.15%

Table 4. Performance metrics for DM and EM portfolio returns. Mean Annualized Return, Annualized Standard Deviation, and Sharpe Ratio are annualized figures; all other measures are monthly.
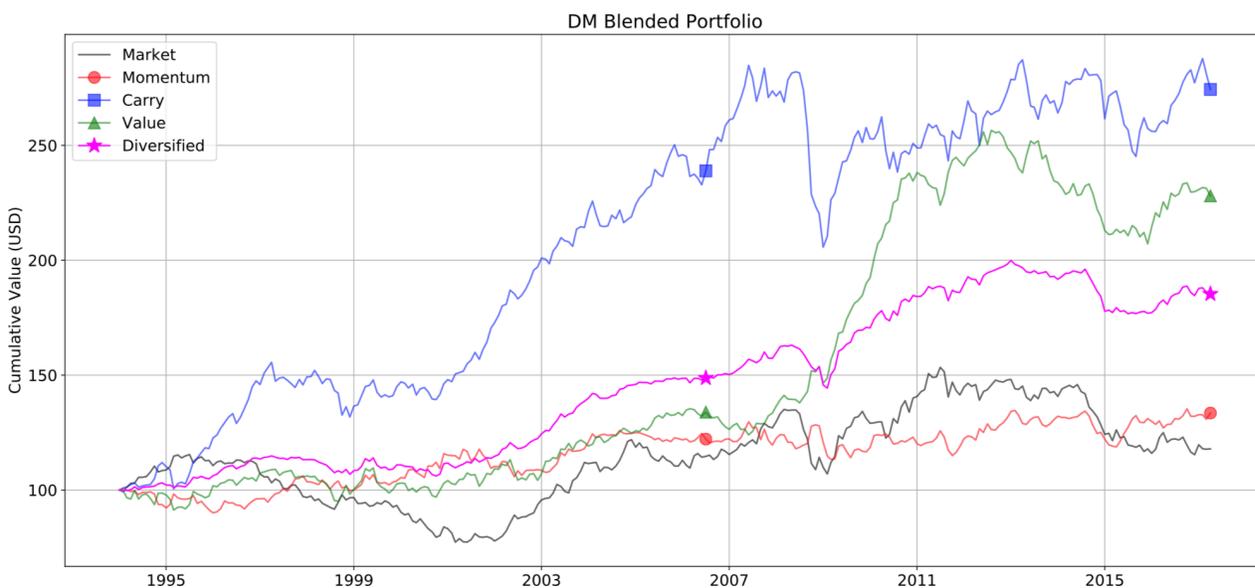

Fig. 6 Cumulative values over the entire 1994-2017 investment horizon for the DM blended portfolio (starred line) and its components, the cumulative returns for each strategy applied to the DM currency basket.
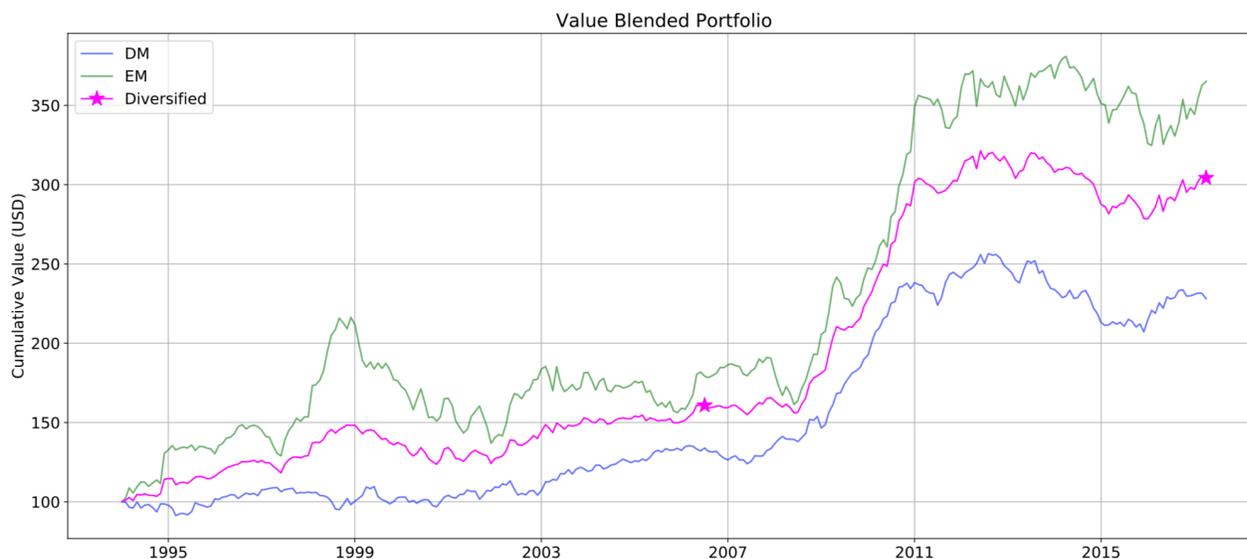
Fig. 7 Cumulative values over the entire 1994-2017 investment horizon for the Value strategy blended portfolio (starred line) and its components, the cumulative returns for Value applied to the DM and EM currency baskets, respectively.

Diversified Portfolio Performance Metrics						
	Market	**Momentum**	**Carry**	**Value**	**DM blend**	**EM blend**
Cumulative Return	43.53%	24.31%	240.45%	204.26%	85.32%	147.51%
Mean Annualized Return	1.85%	1.10%	5.58%	4.97%	2.73%	4.02%
Annualized Tracking Error	7.68%	5.76%	7.93%	6.22%	4.04%	5.08%
Sharpe Ratio	0.240	0.191	0.704	0.799	0.675	0.791
Average Win	1.62%	1.34%	1.84%	1.59%	0.94%	1.25%
Average Loss	-1.72%	-1.19%	-1.65%	-1.09%	-0.79%	-0.87%
Hit Rate	56.07%	50.71%	60.71%	56.07%	58.93%	56.79%
Max Drawdown	-9.28%	-5.46%	-10.97%	-3.76%	-5.20%	-4.19%

Table 5. Performance metrics for diversified portfolios. Metrics for "Market", "Momentum", "Carry", "Value" correspond to returns for each strategy, equally weighted across currency baskets. "DM blend" and "EM blend" correspond to returns for each currency basket, equally weighted across strategies.