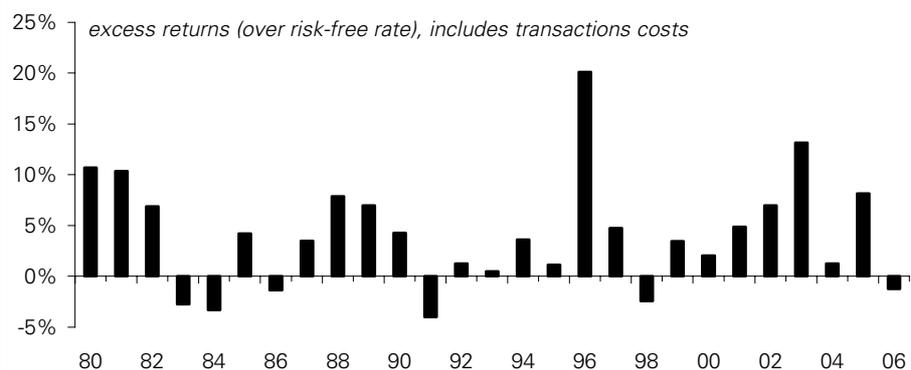


29 March, 2007

Benchmarking Currencies: The Deutsche Bank Currency Returns (DBCR) Index

- In earlier research, we introduced the concept of inherent returns, or beta, of currency markets, and the possibility of a currency benchmark. In this paper, we transform that idea into the first ever investable currency benchmark.
- Currency markets offer inherent returns due to market participants having different objectives and beliefs, the actual existence of a sizeable proportion of market participants who do not maximise profits, and the positive returns of following three widely known approaches (carry, momentum and valuation)
- We show that despite currency markets being a long-short market, or zero-sum game, a benchmark can be constructed. This is because all benchmarks, including bond and equity ones, can be viewed as a system of trading rules that capture the bulk of returns of the given market.
- Consequently, our currency benchmark, the DB Currency Return (DBCR) Index, can be constructed by equally weighting the three trading rules that exploit the profitable aspects of currency markets: carry, momentum and valuation
- The DBCR has delivered excess returns of 4% since 1980 with a risk-adjusted return, or Sharpe ratio, of 0.77, which is higher than the component strategies. Moreover, the Sharpe ratio is higher than both bonds and equities, and correlation is very low, suggesting that allocations to currencies should be high.

Annual Excess Returns of Deutsche Bank Currency Returns (DBCR)



Source: Deutsche Bank

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Remember Benchmarks Are Trading Rules

In earlier research¹, we showed that currency markets do deliver inherent positive returns over time, despite being a long-short market or zero-sum game. The fact that market participants have different objectives and beliefs, the actual existence of a sizeable proportion of market participants who do not maximise profits, and the positive returns of following three approaches (carry, momentum and valuation) all provide evidence for this.

The real paradigm shift, though, is to view the inherent returns as “beta”, rather than “alpha” alone. In other words, to establish that there is a market return to currency markets. Importantly, we can show that benchmarks in other asset classes that are viewed as representing the market return, or beta, are in fact trading rules that capture the bulk of returns of the given market². The following three examples are instructive:

Bond beta - “Lehmans Global Aggregate Index”

- 1) Minimum liquidity requirement. For example, US sovereign bonds must have USD 300mn minimum par amount outstanding
- 2) Must be rated investment grade
- 3) Fixed-rate coupons

Translation:

- 1) Pick bonds based on issuance data
- 2) Pick bonds using fundamentals, such as size and composition of savings and investment, government surplus/deficit trends and government deficit as share of GDP. These criteria are used to define the credit rating.
- 3) Pick bonds with a yield

Commodity beta “Goldman Sachs Commodity Index” (GSCI)

- 1) Only actively traded contracts
- 2) Production-weighted
- 3) Arithmetic average of commodity prices

Translation:

- 1) Use activity data to pick contracts, and have mechanism to expand number of commodities in index to increase diversification gains³
- 2) Have a larger bias towards non-storable commodities (such as energy), rather than storable commodities which would be the case if liquidity-weighted.
- 3) Increase weight towards trending commodities up until rebalancing dates, then “take partial”

profits on rebalancing dates as weights moved back to target weights.

Equity Beta “Standard and Poor’s 500” (S&P500)

- 1) Market-capitalisation weighted
- 2) Four consecutive quarters of positive as-reported earnings
- 3) Ratio of annual dollar value traded to market capitalisation should be 0.3 or greater

Translation:

- 1) Implicit momentum or trend strategy as top-performing shares take increasing share of index
- 2) Use fundamentals to pick stocks
- 3) Use trading activity data to signal which stocks to buy

Currencies: Last One to Join the Benchmark Club?

When viewed as a set of trading rules, the accepted benchmarks of other asset classes indicate a level of subjectivity that would not otherwise be apparent. In fact, they really reflect a set of transparent rules that capture a substantial portion of the returns of a given market. By being widely followed, they become benchmarks. In this vein, there is no reason to believe that currencies should not have a benchmark.

The absence of one is all the more conspicuous when markets such as commodities have one. The commodity indices are based on futures, so like currencies can be viewed as a zero-sum gain. This provides sources of returns not apparent in looking at spot prices, for example the roll yield, which compares to the often over-looked carry earned in currency markets. Indeed, the carry, which is the difference between interest rates across countries, is a permanent feature of currency markets, unlike roll yields.

Easy To Pick the Rules, But Needs to be Investable

The basic criteria for establishing a currency benchmark would to be use widely known and followed approaches to capture currency returns. In previously published research⁴, we highlighted three such strategies: carry, momentum and valuation. However, they were not intended to be investable. So issues such as transparency, transaction costs and stability were not fully dealt with. We have now constructed a set of rules that allow for the resultant benchmark index to be investable, yet capture the essence of the strategies. More detailed accounts of each are featured in accompanying research notes⁵. Our construction for the benchmark for currency beta, which we will name the Deutsche Bank Currency Returns (DBCR) index, would be as follows:

¹ Hafeez (Mar, 2007), “Currency Markets: Is Money Left On the Table?”

² Hafeez (Aug, 2006), “Currencies: Pensions Saviour?”.

³ Erb and Harvey (2006), “The Tactical and Strategic Value of Commodity Futures”

⁴ Hafeez (Aug 2006), “Currencies: Pension Saviour?”

⁵ See Appendix and Hafeez (Mar 2007), “Currencies: Carry Investing”, “Currencies: Momentum Investing”, and “Currencies: Value Investing”. See also Appendix

Currency beta “Deutsche Bank Currency Returns (DBCR) index”

- 1) Developed world currencies, and buy if:
 - 2) Carry - positive net yield
 - or 3) Momentum – positive trend
 - or 4) Valuation – undervalued
- and 5) Equally weight the three strategies

Translation:

- 1) Stick to lo liquid currencies with low devaluation/default risk
- 2) Buy top-3 yielding currencies and sell bottom-3 yielding currencies based on 3-month yields. Re-assess every 3 months
- 3) Buy top-3 performing currencies and sell bottom-3 performing currencies. Performance defined as past 12-month change in spot returns. Re-assess every month.
- 4) Buy top-3 undervalued currencies and sell bottom-3 undervalued currencies (ie the three most overvalued currencies). Valuation is defined as spot deviation from OECD PPP value. Re-assess every 3 months.

The above sets of rules capture in a generic fashion the three most widely accepted approaches of capturing returns in currency markets.

Brief Summary of the Rationale for These Rules

Carry: Exploits the widely observed “forward premium puzzle” or “forward rate bias”, which suggests that systematically buying high interest rate currencies and selling low interest currencies may be profitable. This is because the existence of a risk premia, the use of different models to forecast currencies by rational market participants, or the differing constraints and objectives faced by market participants.

Momentum: Currencies appear to trend over time, which suggests that using past prices may be informative to investing in currencies. This is due to the existence of irrational traders, the possibility that prices provide information about non-fundamental currency determinants or that prices may adjust slowly to new information.

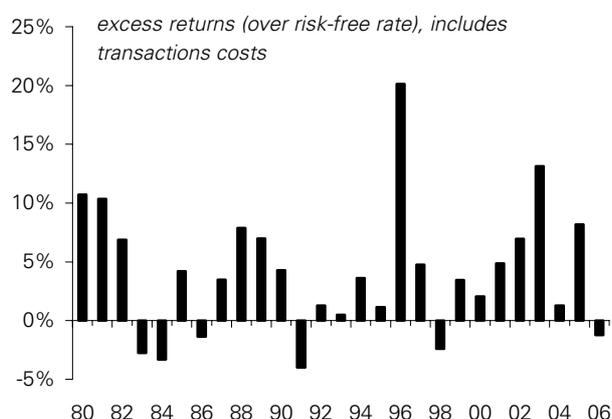
Valuation: In the long-run, currencies tend to move back to their fair value based on Purchasing Power Parity (PPP). However, in the short- to medium-run, currencies can deviate from their PPP values due to trade, information and other costs. This allows the possibility of profiting from currencies as they revert back to their fair values over the long-run.

How Does the Deutsche Bank Currency Returns (DBCR) Index Perform?

Since 1980, the DBCR has delivered excess returns of close to 4% with a Sharpe ratio of 0.80 and a maximum peak-to-trough drawdown⁶ of 11%. Since 1990, the excess returns have been between 4%-5% with a Sharpe ratio of around 0.80 (see table overleaf). It appears that returns broadly follow a cycle, so like in equities, currencies appear to have bull and bear markets, with bull markets tending to last much longer than bear markets (see charts below)

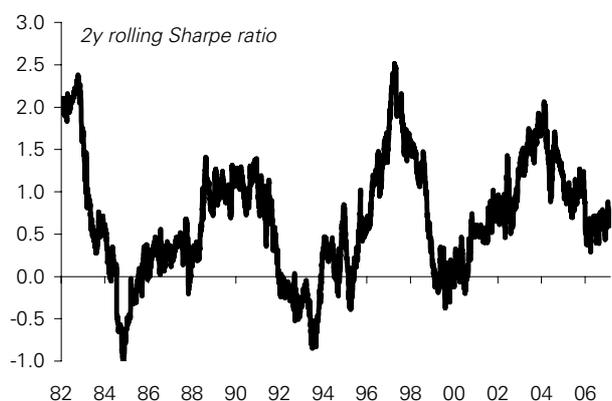
There are two notable aspects of the history of returns. The first is the exceptionally strong returns in 1996, when the stars aligned and all three component strategies were very profitable and resulted in a 20% return for the DBCR. The second is the low frequency of negative years.

Excess Returns of DBCR



Source: DB Global Markets Research

Rolling 2-Year Risk-Adjusted Returns for DBCR



Source: DB Global Markets Research

⁶ The largest decline seen from a previous peak. Put another way, the biggest loss one may have faced, had one entered and exited at the worst times; that is, entered at the highs and sold at the lows. For other stats, we use geometric returns rather arithmetic returns

Summary Statistics of DBCR and Components

	1980-2006	1990-2006	2000-2006
DBCR			
Excess Returns*	4.0%	3.9%	4.9%
Volatility	5.2%	5.1%	5.3%
Sharpe ratio	0.77	0.76	0.94
Max. Drawdown	-11%		
Carry			
	4.9%	5.1%	7.0%
	0.59	0.65	0.98
Momentum			
	3.0%	2.8%	3.5%
	0.35	0.32	0.46
Valuation			
	4.1%	3.8%	4.3%
	0.46	0.41	0.54

* Includes transaction costs and carry, and excludes legacy Euro currencies, save DEM. Including them, would have kept returns close-to-unchanged for DBCR

Source: DB Global Markets Research

In comparison to the DBCR, the investment return statistics for the component strategies are lower for momentum and valuation, but in some cases are higher for carry (see table above). However, the drawdowns are unambiguously lower with the DBCR than any of the individual strategies and the Sharpe ratio is higher over the long-run. This is due the fact that strategies tend to perform well at different times, and so the correlations are low and often negative between the strategies (see final table). It appears that valuation and carry have positive correlations, while momentum has a negative correlation with both .

Comparing to Bonds and Equities

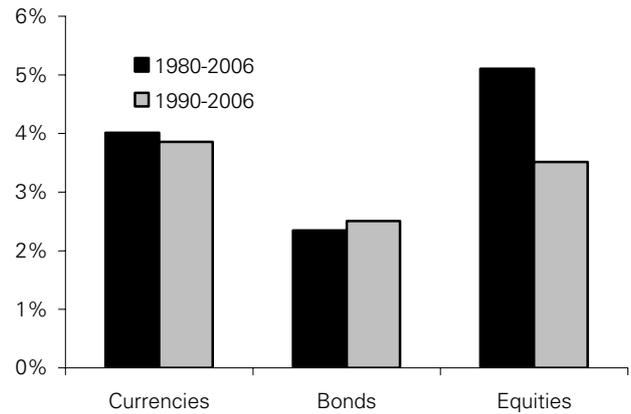
In earlier research⁷, we had made comparisons between a possible currency benchmark and both equities and bonds. Having constructed a more practical currency benchmark that can be invested in and includes transactions costs, we can re-visit the comparison with other markets.. The comparison shows that returns when adjusted for risk (ie the Sharpe ratio) have tended to be higher in currencies than in either bonds or equities. Moreover, the correlations are low between currencies and bonds or equities. So currencies score on both counts of positive expected returns and diversification. The conclusions of our earlier research pointing to 20%-30% allocations to currencies in a global asset allocation context, therefore, remain intact.

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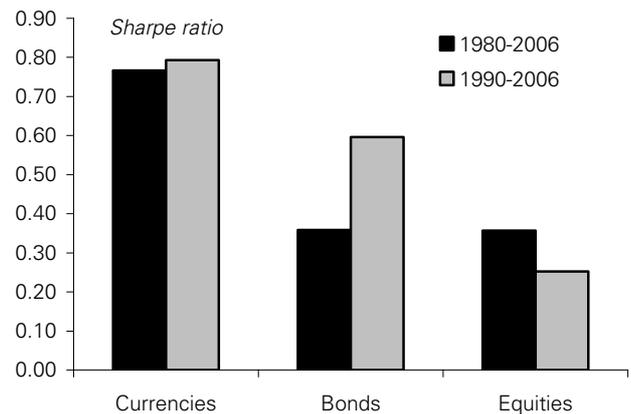
⁷ Hafeez (Aug 2006), "Currencies, Pensions Saviour?"

Excess Returns Across Asset Classes



Source: DB Global Markets Research, Lehmans Global Aggregate Index for bonds, and MSCI World for equities

Risk-Adjusted Returns Across Asset Classes



Source: DB Global Markets Research, Lehmans Global Aggregate Index for bonds, and MSCI World for equities

Correlation Between Asset Classes

	Bond	Equity	DBCR	FX Carry	FX Mom.	FX Val.
Bond	100%					
Equity	26%	100%				
DBCR	-21%	5%	100%			
FX Carry	-16%	4%	74%	100%		
FX Mom.	3%	-2%	38%	-6%	100%	
FX Val.	-25%	7%	66%	40%	-25%	100%

Source: DB Global Markets Research

Appendix

How do the DBCR rules compare to the ones defined in our earlier research?

In "Currencies: Pension Saviour" published in August 2006, we first introduced the concept of beta in currency markets. We argued that carry, momentum and valuation would capture beta. We used some generic rules to give an example of a benchmark. However, the rules were not intended to define a benchmark that was investable, rather it was intended to show the principles of beta. Consequently, issues such as transparency, investability and importantly stability, were not primary considerations in their construction.

Now, with the intention of transforming theory to practice, we have had to confront the more practical issues of transparency, stability, transaction costs and investability. The implications of this are that where possible:

- 1) public sources of information should be used,
- 2) they should minimise any data-mining that would compromise stability, and
- 3) the frequency of re-balancings should be low in order for it be investable for a wide audience.

The final point would require that re-balancings of any strategy should occur at a fairly low frequency, such as every 3 months or at most every month. This would allow for the final indices to be fully investable with the ability for options to be applied to the index. Bearing these in mind, the following changes were made to the original rules:

- 1) **Carry:** originally, we had ranked currencies by 1m yields and re-assessed daily. We now rank every 3 months, and so also use 3-month yield to match the re-balancing horizon. The correlation between the two approaches was very high, so the change in rule has not had much of an impact.
- 2) **Momentum:** originally we used a 5-day and 50-day moving average rule on set of currency pairs that we believed to be commonly used for trend following strategies. The two issues using this approach was that the frequency of trading adjustments was too high (on average one trade a week), and secondly, by picking the currency pairs upfront, there is a risk of data-mining by picking the currency pairs that "work" the best.

The first problem can be solved by using a longer moving average, for example a 20-day/200-day cross-over. This allows one to

continue to capture trends in currency markets, but to re-balance on monthly basis (the highest frequency we can use). It also is not too dissimilar to rules employed by currency investors, and is more likely to capture the longer multi-year trends that are often seen in currency markets.

However, by using moving averages, one needs to pick a set of currency pairs upfront. This opens up the possibility of picking the pairs that have trended most in recent decades and so optimise or fit the data. Particularly since economic theory does not provide any guidance on which pairs should trend. Therefore, we have opted for a different approach. We measure trend by looking at 12-month returns, which is a similar horizon as the 20-day/200-day moving average, that is, a long enough period to minimise trading adjustments. We then rank these changes across G10, and buy the top-3 performing currencies and sell the bottom-3 performing currencies each month. This allows the strategy itself to pick the currency pairs that are trending the most.

In the end, it appears that correlation between using a longer moving average or 12-month returns is very high, so they are both capturing the same trend. However, we believe the ranking of returns approach may be more robust over time, as currency pairs are not picked upfront. Interestingly, the correlation between the original (non-investable) shorter moving average rule (5-day/50-day) and either the longer moving average or the 12-month change is much lower than the equivalent ones between the original and investable rules for carry and momentum. Nevertheless, it is still statistically significant.

- 3) **Valuation:** Originally, we had used a Deutsche Bank calculation of PPP. We now use the publically available OECD PPP values. While it has some shortcomings in terms of including a large share of non-tradeable goods, it has the advantage of not being open to fitting past history. We also re-balance every 3 months, rather than daily. The correlation between the original and investable rules is very high.

The other difference in performance would be that we now incorporate transaction costs. Comparing the returns of the new "investable" index compared to the original rules, we find that the overall Sharpe ratio is closer to 0.8, rather than 0.9-1.0. The correlation between the two indices is high and statistically significant.

Appendix 1

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