This note considers currency effects in the context of efficient equity indices. The note analyses the effect of currency components within stock returns on efficient index construction. It also considers how currency hedging can be implemented by investors who hold efficient index portfolios with foreign currency exposures. Finally, it provides empirical results for an assessment of links between efficient index outperformance and currency effects.
Introduction

Exchange rate variation is an important factor in equity portfolios. For an investor who holds securities denominated in foreign currency, his return $R_I$ will depend on both the security’s return in the currency of denomination $R_S$ and the relative change in the exchange rate between the security’s currency of denomination and the investor’s home currency, the currency return $R_C$:

$$(1 + R_I) = (1 + R_S)(1 + R_C)$$  \hspace{1cm} (1)

This expression can be simplified through the following approximation, where we omit the cross product term $R_SR_C$ which is typically small:

$$R_I \cong R_S + R_C$$  \hspace{1cm} (2)

Thus the investor’s return on a given security is a sum of two components, the security return in its home currency as well as a currency return. From the perspective of the investor, the currency return component affects the expected returns of the foreign asset. Likewise, volatility of the foreign asset depends on the volatility of currency return as well as on the correlation of currency return with the asset return (see e.g. Elton, Gruber, Brown and Goetzmann 2006 for a detailed derivation).

The exchange rate component of foreign security returns can be hedged out using offsetting positions in the futures or forward market. Early work by Perold and Sharpe (1998) argued for a full hedge of exchange rate risk for equity investors based on the notion that exchange rate volatility can be avoided without any loss of expected returns, while Froot (1993) argued for a complete absence of any hedge, as maintaining the exchange rate exposures improves inflation hedging in the long run. As a practical matter, many investors nowadays situate themselves between these two approaches, adopting a partial hedge. Such hedges are typically implemented as overlays, where an external manager implements the currency strategy that will best (fully or partially) offset the exchange rate exposure of the investor’s portfolio (see e.g. Duarte and Rajagopal 1999). An overlay strategy also allows an implementation of optimal hedging strategies which – rather than defining a hedge ratio relative to existing currency exposure – tries to find the currency positions that would minimize overall portfolio risk given the current portfolio of the investor (see Campbell et al 2010).

When adopting a new weighting scheme in their global passive portfolios, equity index investors meet several questions regarding their exchange rate exposure. First, in addition to hedging decisions, what is the impact of currency effects on index construction? In particular, how are optimization-based strategies that analyse past returns dependent on currency effects? Second, once the new weighting scheme is implemented, how can hedging decisions be implemented? And finally, when considering the outperformance of improved weighting schemes, is this outperformance in any way related to currency movements?

We provide answers to these questions for efficient equity indices by providing a detailed explanation of how different parts of the construction methodology deal with potential currency effects, and by discussing the properties of efficient indices that relate to currency effects.

1. Currency Effects when Deriving Efficient Weights

When constructing efficient indices, one relies on returns data for the derivation of the optimal weights. In particular, the covariance matrix of stock returns is estimated using an implicit factor model and a stock’s total downside risk (semi-deviation) is estimated in order to penalize low-risk stocks and thus avoid excessive concentration in low risk stocks, which is a common problem with minimum volatility strategies (see Amenc et al 2011). In the context of such a portfolio optimization, it is important to assess whether currency returns have an important effect at the level of input parameter estimation.

The computation of efficient index weights is mostly unaffected by any currency effects as the optimization is conducted within universes with a single currency or with relatively homogeneous currencies. The global equity universe is in fact broken down into several regional building blocks, and optimization is performed at the level of these building blocks. For global indices, these building blocks are then combined by their market cap, without running another optimization. Most of the building blocks actually contain a single currency, notably the building blocks for the UK, the Eurobloc, the US, Canada, Japan, and Israel. These building blocks make up about three quarters of global equity market capitalization, and thus about three quarters of the FTSE EDHEC-Risk Efficient All World Index.
The remaining building blocks are based on regions with relatively homogeneous currencies such as Developed Asia Pacific ex Japan where currency fluctuations between regional currencies such as Australian dollar, New Zealand dollar, Singapore dollar etc. are quiet well-behaved. Other regional building blocks are Developed Europe ex UK and ex Eurobloc, Emerging Europe, Emerging Latin America, Emerging Asia, Emerging Middle East and Africa, which all correspond to relatively homogenous sets of currencies. Therefore, any currency components in the returns series used for parameter estimation are limited to fluctuations of related currencies (e.g. the New Zealand dollar versus the Australian dollar in the Developed Asia Pacific ex Japan building block or the Swedish kronor versus the Danish kronor in the Developed Europe ex Eurobloc and ex UK building block), while currency effects between heterogeneous currencies do not have an effect on the optimization results (e.g. Danish kronor versus Australian dollar movements do not affect the optimization results as we do not directly optimize weights across these two countries).

In the case of a building block which contains different currencies, we base the optimization on US dollar returns to have a convenient way of computing returns of all stocks on a comparable basis. The variation of US dollar returns of stocks which are quoted in different currencies may be partially explained by currency effects. However, as noted above, currency effects should be relatively small when dealing with relatively homogenous universes. In addition, the implicit factor model which EDHEC-Risk uses in estimating the covariance matrix is nothing but a statistical procedure that picks up the risk factors that describe most of the variability in returns, while keeping the model parsimonious, which means limiting the number of factors. The statistical factor model used in estimating the covariance matrix at the level of each regional building block will therefore pick up currency effects if they matter.

In summary, while most of the weight in a global efficient index goes to stocks where weights have been derived through an analysis of returns in their home currency, a small part of the global efficient index portfolio will be based on weights which have been derived in an analysis of US dollar returns of stocks listed in several different currencies. These currencies however consist of a related set of currencies as the optimization is conducted with regional subsets of the universe. In the presence of different currencies, the use of an implicit factor model in efficient index construction means that the statistical process will be likely to consider currency factors if they matter within the respective universe.

2. Hedging Currency Exposure when Implementing Efficient Indices

The previous section addressed the question of how the currency component is dealt with when estimating risk and return parameters for optimization. We have argued that currency components in stock returns bear little effect on the optimized portfolio weights. However, an investor in a global efficient index will take on important currency exposure, as is the case with any global equity portfolio. This section will qualify this currency exposure and will discuss issues that arise when fully or partially hedging currency risk for an efficient index investor.

Since global efficient indices are made up of optimized regional building blocks which are weighted by the regional market cap, the currency exposure of a global index of all developed and emerging markets has an exposure to the main currencies that is not different from the standard cap-weighted global indices (such as the FTSE All-World index). In particular, efficient indices match the US dollar, Japanese Yen, British Pound, and Euro exposure of standard cap-weighted indices, as these currencies correspond to regional building blocks which are weighted by their market cap share in the global index. These regional exposures make up almost three quarters of the currency exposures of a global All-World index. Even for building blocks which involve different currencies, efficient indices respect the regional weightings of market cap-weighted indices and the broad exposure to regional currencies (e.g. Asia-Pacific Developed Market currencies) will match that of the cap-weighted index, while exposures to individual currencies within the regional group may differ.

In terms of currency hedging, a practical approach would be to aggregate the overall currency exposure in the entire portfolio of the investor. It is common practice to then manage a currency overlay separately which will fully or partially offset the currency exposure of the underlying assets in the portfolio. The advantage of an overlay is that the investor can make an overall currency hedging decision considering all stock, bond and other investments, and implement the desired level of hedging in a dedicated vehicle (see Binny 2001 or Duarte and Rajagopal 1999 for a discussion of currency overlays). Also, the desired level and nature of currency exposure will likely depend on the stock-bond mix of the overall portfolio. In fact, Campbell et al (2010) have shown that, while it may be reasonable for equity investors to seek currency exposure due to favorable correlation properties of some currencies with equity returns, bond investors should avoid holding any currency exposure. For

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1 In particular, Campbell et al (2010) find that taking on Swiss Franc and Euro exposure allows lowering portfolio risk for an equity investor as these currencies are negatively correlated with both their own equity market return and world equity returns.
investors who hold both stocks and bonds, the final conclusion on the optimality of taking on or avoiding
currency exposures would depend on the overall properties of the portfolio.

3. Sensitivity of Efficient Index Outperformance to Currency Exposure: Empirical Results

An additional consideration when assessing efficient indices and currency effects is that a relation between the
outperformance of the efficient index over the cap-weighted index may be relevant for an investor who is using
the efficient index while being measured against the cap-weighted reference index. For example, for an investor
in the efficient index who makes the decision to stay unhedged against exchange rate risk, it would be
unfavourable if under-performance over cap-weighting comes at times when currency losses occur. Likewise, for
an investor who makes the decision to increase his hedge against exchange rate risk, it may be unfavourable if
under-performance over cap-weighting occurs when the hedge tends to pay off, as the adoption of the efficient
index would undermine his decision to increase exchange rate hedging.

We thus assess the relation between out-performance of efficient indexation over cap-weighting and exchange
rate-risk. While the exchange rate risk depends on the home currency of the particular investor, for purposes of
illustration, we consider two currency risk factors in this analysis. The first factor is a currency carry trade
strategy, and the second factor is the return on holding a diversified basket of currencies relative to the GBP. To
be more precise, the exchange rate risk proxies used in the analysis are:

- **DB Currency Carry Trade Index**: reflects a strategy of buying 3-month forward contracts on
  high interest rate currencies and selling similar contracts low interest rates currencies. The
  analysis is over a short time period due to limited availability of the carry trade data (weekly
  data from February 2008).
- **Currency Basket**: GBP returns to holding a market cap-weighted basket of USD, EUR, JPY
  and GBP: We use weekly data from December 2002.

*Figure 1: Efficient Index (All World) Outperformance over Cap-weighted All-World index vs. Currency Carry
Trade: Efficient Index Outperformance is unrelated to carry trade returns*

![Figure 1](image1)

The results in figure 1 show that the correlation between excess returns of the efficient index compared to the
cap-weighted index (labeled as “MSR Overperformance” where MSR stands for Maximum Sharpe Ratio) and
returns to the currency carry trade are very low. The correlation coefficient is -0.32 and the regression slope
coefficient is close to zero at -0.0659.

*Figure 2 below shows a similar analysis for the relation between efficient index outperformance and the returns
to holding a foreign currency basket from the perspective of a GBP based investor. Note that the use of this
particular currency is for illustration purposes only.*

![Figure 2](image2)
Figure 2: All World Outperformance versus Currency Basket: Efficient Index Outperformance is unrelated to currency returns (GBP versus global currency basket)

Overall, when assessing sensitivity of outperformance, there is no evidence of a relation with currency factors, suggesting that the decision to choose an efficient or a cap-weighted index is independent of the decision to hedge exchange rate risk or to take on this exposure.

References


