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Efficiency of Currency Asset Classes

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ABSTRACT: Analyzing the risk and return for the S&P Currency Index Arbitrage and the Merk Absolute Return Currency Fund, this study intends to find whether currency asset classes are worthwhile investments. To determine where the efficient currency portfolios lie in the risk and return spectrum, this paper compares the two portfolios to fixed income and equity asset portfolios. The results lead to a baffling conclusion that, in general, the returns to low-risk currency asset portfolios are higher than the equity asset portfolios of same risk level.

Keywords: Currency asset class; risk and return; fund allocation; efficient frontiers
JEL Classifications: G15

1. Introduction

Currencies have been historically viewed merely as a medium of exchange, store of value and unit of account. The gold standard and the fixed exchange rate regime ensured that exchange rates of various currency pairs did not fluctuate under normal circumstances. However, when the era of flexible exchange rates started, foreign exchange rates experienced many upward and downward movements, depending on the dictates of market forces.

The determination of exchange rates by supply and demand has also opened up an opportunity for investors to gain risky returns or losses from exchange rate movements. In other words, currency assets can now be considered as financial assets, similar to stocks and bonds. The astounding growth of currency investment vehicles by 75% from December 2004 to December 2011 supports this point. [1]

A.D. Roy's 1952 paper was one of the pioneering studies that attempted to explain the importance of diversification. Markowitz (1952, 1959) went further by suggesting an efficient diversification in his landmark research on portfolio allocation. The need to reduce risk via diversification has suddenly shifted investments from bits and pieces of stocks or bonds to baskets of currency assets mutual funds.

Currencies, being risky financial assets, also benefit from diversification so long as they are not perfectly positively correlated with one another (Markowitz, 1959:19). Among the currency investment vehicles the S&P Currency Arbitrage Index (SPARCB) and the Merk Absolute Return Currency Fund (MABFX) are the focal points of this study. SPARCB aims to profit by adopting a carry trade strategy. This means SPARCB invests long in currencies that have a higher yield than the USD and invests short in currencies that have a lower yield than the USD. The MABFX, an actively managed mutual fund, does not disclose its strategy. Merk Investments merely informs its potential

1. "Currency Investing: Mutual Funds, ETFs & ETNs" (Palo Alto: Merk Investments, February 2012), 2, http://www.merkfunds.com/currency-asset-class/whitepaper/MerkWhitePaper-CurrencyInvesting.pdf (accessed March 16, 2012).

investors that MABFX is a pure play on currencies with the goal of generating positive absolute returns.[2]

To find out if it is advisable to invest in currency portfolios, this study first ascertains whether the allocation of currencies is optimal using the Modern Portfolio Theory. Next, it compares its relative performance to equity and fixed income asset classes, as measured by its expected returns and volatility. Then it ascertains whether the currency portfolios' superior (inferior) performance is due to the allocation of currencies in the portfolios. After which, this paper derives the efficient frontier by calculating the expected returns and optimal allocations of the currencies for the obtained risk levels. The efficient portfolios' allocations are compared to SPARCB's and MABFX's allocation to determine if the subject portfolios are efficient. If the currencies in the SPARCB and MABFX are not optimally allocated, the expected return (risk) of the efficient portfolio would be determined for the current risk (return) level of the portfolios. Finally, this study compares the efficient SPARCB and MABFX versions to the stock and bond portfolios to find out where the efficient currency portfolios lie in the risk and return spectrum.

1.1. The Efficient Portfolio and Optimal Allocation

According to Markowitz's Modern Portfolio Theory (MPT), efficient portfolios are those that generate the highest expected return given a level of risk, or those with the lowest risk, given a level of return (Fabozzi et al., 2010:242). Efficient portfolios lie on the efficient frontier. Since all portfolios on the frontier are efficient, investors would simply choose based on their risk-return preferences (Berk and DeMarzo, 2011:351).

Investors can also opt to invest in the risk-free asset along with the equilibrium portfolio to mimic the risk-return combination of any of the efficient portfolios. The portfolio with the highest Sharpe ratio, the ratio of the market premium to the volatility of the portfolio, is the equilibrium portfolio (Berk and DeMarzo, 2011:351). The investor's risk-aversion ultimately decides how much of the risk-free asset and how much of the risky portfolio would be purchased.

Sharpe (1966) emphasizes that an efficient market is a precondition to maximize the returns or minimize the risk of the portfolio using the MPT. If the market is inefficient, fund managers can maximize the portfolio's returns or minimized its risk by searching for incorrectly priced securities and allocate most of the funds to the most underpriced securities.

Like any other asset class, the efficient frontier of the currency portfolio is generated through the optimal allocation of the currencies comprising it. The optimal allocation of the currencies depends on the portfolio's return and risk. Among the efficient currency portfolios, the portfolio with the highest Sharpe ratio has the highest reward per unit of risk. When combined with the risk-free asset, it can recreate the risk-return makeup of any of the efficient currency portfolios. The weights of the risk-free asset and the equilibrium portfolio held by an investor depend on investor's risk aversion. MPT determines the optimal allocation of currencies and the efficiency of currency portfolios. Therefore, it follows that currency markets are assumed to be efficient.

Several working papers and articles conclude that currency markets are inefficient. That the uncovered interest rate parity (UIP) is only true in theory is the common consensus. UIP requires that interest rate differentials between currencies equal the forward rate discount or premium. If they are unequal, there is an opportunity to profit through arbitrage (Eiteman et al., 2007:114). Despite the opportunity to profit, entities may not take advantage of this, because they have reasons to hold currency other than to make a profit. Governments need foreign exchange to manage foreign currency reserves. Importers and exporters need it to settle their payments.[3] In other words, entities are willing to hold currencies with negative alphas, making positive alphas pervasive in this market (Berk and DeMarzo, 2011:416).

If entities do not take advantage of the opportunities to have a riskless profit, the market would be inefficient. A number of studies, however, present contrasting results. They conclude that currency portfolios cannot beat the market, and/or the uncovered interest rate parity is observed in

2. "Merk Funds: Merk Hard Currency Fund MERKX, Merk Asian Currency Fund MEAFX, Merk Absolute Return Currency Fund MABFX, Merk Currency Enhanced U.S. Equity Fund, MUSFX," Merk Investments, 2011, http://www.merkfunds.com/fund/ (accessed April 30, 2012).

3. "Portfolio Benefits of the Currency Asset Class" (Palo Alto: Merk Investments, February 2012), 4, http://www.merkfunds.com/currency-asset-class/whitepaper/MerkWhitePaper- PortfolioBenefits.pdf (accessed March 16, 2012).

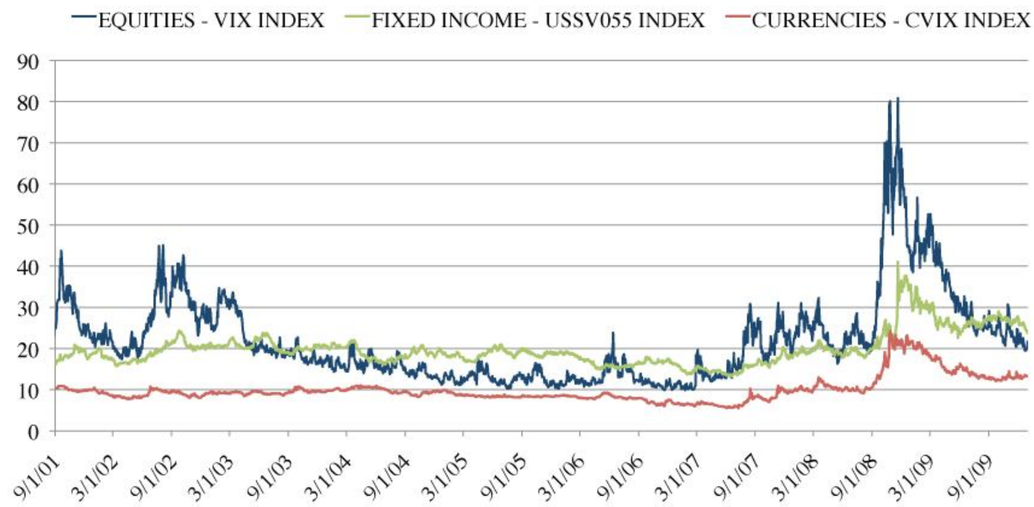
currency markets (Dumas and Jacquillat, 1989; Maclean et al., 2006:15-16). They lend support to this paper's assumption that currency markets are efficient.

1.2. Comparison of Currency Asset with Other Asset Classes

Stocks are riskier investments than bonds (Berk and DeMarzo, 2011:302-3). While it is easy to pinpoint where stocks and bonds lie in the risk and return spectrum, the same cannot be said for currencies. Intuitively though, currencies seem to be more volatile than stocks. For one, economists cannot identify the exact makeup of a currency's underlying fundamentals, leading to existence of several competing theories of exchange rate determination. As well, since currency holders have various reasons for holding them, they are riskier investments than stocks, and more so than bonds.

If currencies are riskier, risk-averse investors must require a higher risk premium. However, the Merk White Paper, "The Currency Asset Class: A New Era of Investment Opportunity," establishes that currency asset classes are less volatile than stocks indices when unleveraged.[4] The study uses data from September 2001 to September 2009 to contrast the volatility of stock, bond and currency indices. The CBOE Volatility (VIX) Index, the USD Swaption 5 year Fixed/Floating Volatility (USSV055) Index and the Deutsche Bank FX Volatility (CVIX) Index represent the equity, fixed income and currency asset class, respectively. Figure 1, which is directly taken from the White Paper, presents each index's volatility. Surprisingly, the CVIX Index's movement is more similar to the USSV055 Index's movement than the VIX Index's. Needless to say, the swings of the VIX Index are very much wider than those of the CVIX's. If currencies are less volatile than stocks and bonds, then a smaller risk premium would be required of them.

Figure 1. Asset classes' volatility comparison, chart by Merk Investments, LLC.



To find out whether Merk Investment's conclusion holds, this study compares the currency portfolios' return and volatility to the return and volatility of equity and fixed income portfolios. The SPDR S&P 500 (SPY) and the iShares S&P 500 Index (IVV), two of the most popular exchange traded funds (ETFs) that track the S&P 500, represent the equity asset class. T-bill indices, specifically, the SPDR Barclays Capital 1-3 Month T-Bill (BIL) and the iShares Barclays Short Treasury Bond (SHV), two of the most widely used T-bill ETFs, stand-in for the bond portfolio. T-bill indices represent the least risky asset classes.

Aside from determining the relative risk-return makeup of currency portfolios, comparing the currency investment vehicles to other asset classes helps establish if the strength or weakness of its performance is due to its optimal (suboptimal) allocation alone. Such comparisons control for factors that contribute to the strength of currency portfolios other than efficient allocation. The measure of the currency portfolio's strength or weakness is its relative risk-return makeup.

4. "The Currency Asset Class: A New Era of Investment Opportunity" (Palo Alto: Merk Investments, January 2010), 4.

1.3. Literature Review

This paper contributes to the vast literature on efficient portfolios, diversification and optimal allocation by studying currency asset classes. Even though the literature on these topics is immense, there is none that focuses on currency asset classes. It also contributes to the literature on efficient portfolios by comparing currency portfolios to stock and bond portfolios, similar to Jin et al. (2007:252-3). However, unlike Jin et al. (2007) and Campbell et al. (2001), this study does not extend to the creation of an optimal mixed asset portfolio, composed of stocks, bonds and currencies.

Markowitz's (1952, 1959) "expected returns-variance of returns" (E-V) rule, more popularly known as the Modern Portfolio Theory (MPT), hinges on the idea that return is not independent from risk. Markowitz states that investors not only desire a high return, but also want a return that is dependable, stable and certain. Diversification reduces risk so long as the securities comprising the portfolio are not perfectly positively correlated (Markowitz, 1959). Holdings of a security that are uncorrelated or negatively correlated with the other securities must be increased (Roy, 1952).

Sharpe (1966) further stresses the need for diversification to ensure that fund managers hold efficient portfolios. Since searching for incorrectly priced securities is a futile endeavor, holding efficient portfolios is the mean to maximize returns or minimize risk (Sharpe, 1966). The Sharpe ratio finds its roots in the quest for a single measurement of fund managers' performance. Tobin (1958), Sharpe (1964) and Lintner (1965) utilized the same measures for return and risk in their respective groundbreaking researches. As well as quantitative measures, Markowitz (1952) suggests combining "statistical techniques and subjective judgment." Statistical techniques entail the use of past observations, while subjective judgment requires adjusting the computed values based on factors and nuances not taken into account.

A number of studies follow Markowitz's suggestion to combine quantitative and qualitative procedures when forecasting returns. Dumas and Jacquillat (1989) use a constrained Bayesian technique and variations of this model while Bauwens et al. (2006) estimate returns using AR(1) (Dumas and Jacquillat, 1989). De Macedo (1982) derives real return from the consumption rule. He argues that an investor's income allocation is a function of his preferences, income and wealth (de Macedo, 1982). Papaioannou et al. (2006) arrive at three ways of measuring returns, namely (1) random walk, (2) the use of forward rates because UIP is assumed and (3) use of equal returns for currencies augmented for transaction costs. The bid-ask spreads proxy transaction costs (Papaioannou et al., 2006:13-4).

There are also several studies that adhere to expected returns as the forecast of future returns. Jin et al. (2007) use expected returns to obtain the optimal allocation of BRIC securities and real estate asset classes, respectively (Jin et al., 2007:250-51). Bauwens et al. (2006) and Papaioannou et al. (2006) present returns using past data to come up with an efficient currency portfolio.

Using expected returns to forecast future returns entails assuming that past returns are normally distributed. Several studies lend support to the assumption of normality. Campbell et al. (2001) show that the returns distribution, be it normal or student-t, does not alter the allocation of stocks, bonds and cash in an efficient portfolio (Campbell et al., 2001:1798-1800). Bauwens et al. (2006) consider a skewed-t distribution, but conclude that it is not needed (Bauwens et al., 2006). Dumas and Jacquillat (1989) lend support to assuming a normal distribution of currency returns if the study is limited to a country-specific investor. They emphasize that currency returns are not normally distributed, because if the direct exchange rate is normally distributed, the indirect exchange rate is not (Dumas and Jacquillat, 1989:1). However, they further state that utilizing the M-V technique would limit their study to a country-specific investor. MacLean et al. (2005) preliminary results indicate that currency returns are not normally distributed and are non-homogenous. Although when the existence of weak interest parity is assumed, the null hypothesis that returns are normal for each regime cannot be rejected (MacLean et al., 2006:25-26).

The measure of risk is a more controversial matter. Classical MPT defines risk as the uncertainty that the return forecasted is different from the actual return. Markowitz (1959) points out that "greatest loss" is not an appropriate measure of risk because it does not capture the security's pattern of past returns (Markowitz, 1959:17). He recommends the use of the variability of return to quantify risk. Minimum variance analysis necessitates the use of the variance of returns, as the measure of dispersion or variability of returns. Its square root, the standard deviation of returns, is the most commonly reported risk measure.

The controversy arises from the fact that the variance and the standard deviation of returns consider the risk of losing and the risk of gaining symmetrical. Most present day analysts advocate measuring only the risk of loss when seeking for the optimal allocation of securities. Even Sharpe (1964) points out that Markowitz suggested a semi-variance risk model to take into account only the downside risk (Sharpe, 1964). The Value-at-Risk (VaR) constraint is the most widely used method to cap risk. VaR ensures that only the downside risk is captured when obtaining the necessary return. Generally, VaR is "the maximum loss for a given exposure over a given time horizon with z% confidence" (Papaioannou, 2006).

Campbell et al. (2001) provide several reasons to subject returns to downside risk through using a Value-at-Risk (VaR) constraint. For one, investors treat losses and gains asymmetrically in the real world setting. VaR also accommodates non-normal distributions when it measures risk. Their research study points out that "many financial return series are non-normal, with skewness and kurtosis pervasive." Following Campbell et al. (2001), Bauwens et al. (2006) and Papaioannou et al. (2006) also constrain their risk measures, specifically the variance of returns and GARCH models, using VaR limits (Bauwens et al., 2006:14).

Since this study maintains using variance as the measure of risk despite the strong and resounding arguments for using a VaR constraint, it is crucial to note a few points. While Campbell et al. (2001) staunchly advocate constraining risk to downside risk, they also demonstrate that the efficient portfolio chosen by the Sharpe ratio is exactly the same with or without constraints imposed. This is the case if the standard deviation of returns is the measure of risk, if returns are normally distributed and if the risk-free rate is zero. Also, for a small time horizon with a positive risk-free rate, only a minimal difference exists in the optimal portfolio allocations of the unconstrained portfolio with the highest Sharpe ratio, and the constrained portfolio with the highest Sharpe ratio (Campbell, 2001).

This study utilizes daily-expected returns, positive risk-free rate and assumes that returns are normally distributed. The variance covariance matrix of the returns is used as the measure of risk. The study adopts Markowitz's mean-variance optimization technique as it is.

1.4. Currency Asset Allocation

A number of studies utilize MPT or a variation of it to scrutinize the efficiency of various asset classes, and to measure their performance against other asset classes. For instance, Jin et al. (2007) analyze real estate asset class to find out how real estate can aid in further diversification of a U.S. investor's international portfolio. They also use the minimum variance analysis to come up with an optimum portfolio composed of Asia-Pacific equity, fixed income and real estate asset classes. Apart from this, they determine the optimal allocation of the securities for each asset class (Jin et al., 2007:252-5).

Using a variation of MPT, Campbell et al. (2001) study the efficient allocation of a broad U.S. portfolio consisting of stocks, bonds and cash for different time periods and for different levels of downside risk as measured by VaR.

MPT has also been used to study currency diversification and its optimal allocation in portfolios. Bauwens et al. (2006) study two hypothetical portfolios priced in USD – GBP and EUR comprises the first portfolio, while the second portfolio includes the JPY and the first portfolio. Their research caters to currency dealers who need to rebalance their portfolios every thirty minutes to make a profit (Bauwens et al., 2006:1). The aim of their work is not to seek for the optimal weights of the currency, but to find the best model, determined by the return-risk measures that would allocate currencies optimally.

Dumas and Jacquillat (1989) employ several diversification strategies to determine whether currency portfolios can beat the market. The strategies vary by the weighting options of the individual currencies as well as the measurement of expected returns (Dumas and Jacquillat, 1989:5-10). Regardless of the strategy applied to the currency portfolio, the authors conclude that the portfolio cannot beat the market. While Dumas and Jacquillat (1989) do not zero in on a single diversification model, de Macedo (1982) constructs a diversification model for risk-averse international investors. He seeks to establish the weights of currencies in an optimal portfolio. With the inclusion of the JPY and the exclusion of the BEF and the NLG, the currencies comprising de Macedo's portfolios are similar to Dumas and Jacquillat's currency portfolio (de Macedo, 1982:11). All the efficient portfolios obtained require a significantly large allocation of funds to the USD. Depending on the level of risk aversion, the GBP or JPY or DEM or FFR require the most allocation of funds after the USD. The

CAD requires a large allocation if the risk aversion level is infinite and a small one if the risk aversion level is 2.

MacLean et al. (2005) divide the economy into stages of recession, normalization and expansion (MacLean, 2006). After which, they estimate the optimal weights of currency portfolios for each stage, using a variation of MPT. The portfolios consist of the AUD, CAD, EUR, GBP and JPY all priced in USD. Efficient portfolios require that the CAD have the largest allocation for all economic stages. The allocation on the other currencies varies depending on the economic stage. They also obtain the portfolio with the highest Sharpe ratio, using the classical MPT. The authors are able to conclude that this portfolio's performance is similar to the Federal Exchange Rate Index (FERI). The performance of hedged version of this portfolio is similar to the T-bill.

Papaioannou et al. (2006) also estimate the efficient allocation of the CHF, EUR, GBP, JPY and the USD in the currency portfolio supposedly managed by central banks. The authors primarily try to determine the impact of the Euro in the composition of reserves by comparing the efficient post-Euro and pre-Euro portfolios, where the FFR, DEM and NLG stand-in for the Euro in the pre-Euro portfolio. They also try to find out whether reserve portfolios are optimally allocated by comparing the estimated allocation of the pre- and post-Euro portfolios with the allocation reported in the International Monetary Fund's (IMF) report of actual aggregate shares. The IMF stands as the representative central bank (Papaioannou et al., 2006:3-5). The study concludes that banks tend to over-allocate to Euro, signifying the increased role that the Euro would play in trade and in international markets. They also conclude that regardless of the risk and return measure used, efficient portfolios require large USD holdings. The authors argue that this is not due to the fact that the USD is viewed as a riskless asset. Rather, it is because the countries that hold large currency reserves, such as BRIC countries, have a huge proportion of reserves in USD.

1.5. Currency Market Efficiency

In line with seeking for an optimal allocation of currency portfolios, it is noteworthy to discuss the uncovered interest rate parity (UIP). In order for efficiently diversified portfolios to provide maximum returns, as determined by MPT, markets must be efficient. Specifically, prices of securities are correct as determined by supply and demand (Sharpe, 1966:138). Otherwise, fund managers have an incentive, or even ought to diversify their holdings in a different manner to take advantage of incorrectly priced securities. UIP dictates that the interest rate differential between two currencies be the unbiased predictor of the forward exchange rates. It implies that no one can profit in the currency market through arbitrage. However, as Sager and Taylor (2006) point out, various studies have shown that this has not been the case historically (Sager and Taylor, 2006:82).

While the common consensus is that UIP does not hold, some studies provide contrary evidence. They conclude either that a weak form of UIP exists or it completely holds even in as short as weekly periods. Papaioannou et al. (2006) state that this is true in the medium- to long-term, while MacLean et al. (2005) evidence the existence of a "weak" version of UIP. The theory states "expected returns on the hedged currency investments are constant across all currencies within each regime" (MacLean et al., 2006:4). The regimes are the economic stages of recession, normalization and expansion. Dumas and Jacquillat (1989), using weekly data of hard currencies, conclude that currency portfolios cannot beat the market (Dumas and Jacquillat, 1989:21). This implies that they find currency markets to be efficient.

2. Methodology and Data

2.1. Methodology

Daily spot prices from April 1, 2011 to May 16, 2011 are used to estimate the expected returns and variance of the currencies and the efficient currency portfolio. The standard deviation of the indices and the variance-covariance matrix of the optimal currency portfolio are obtained afterwards.

The MPT model determines the optimal allocation of the currency asset classes. By definition, it minimizes (maximizes) the portfolio risk (return) subject to the portfolio return (risk) as determined by each currency's return and their weights. The problem to be solved is:

Minimize: $B = X^T A X$ (1)

Subject to: $R^T X \geq r_f$

Where, X is a vector of weights with elements x_i as the weight of currency i in the portfolio. R is a vector of expected returns with elements r_i as the expected return of currency i, while r_f is the rate of return on the riskless asset. A is the variance-covariance matrix with elements σ_i^2 as the sample variance of the return of holding currency i and σ_{ij} as the sample covariance between the returns of holding currencies i and j.

Solving x_i entails utilizing and solving a Lagrangian equation in the form,

$$L = X^T AX + \lambda(r_f - R^T X) \quad (2)$$

The Lagrange multiplier, λ, represents the marginal increase in risk per unit (1%) increase in return. Setting r_f at its historical minimum level, problem (1) solves the currency allocations, x_i, as well as the risk level that produces a return equal to that of the riskless asset. The initial solution results in a risk level of 2.23211×10^{-7}. From this initial risk level, the paper simulates thirty-two more solutions by incrementing the risk level by 1%, $.223211 \times 10^{-7}$, each time and solving the following dual to the risk-minimizing problem (1) to obtain returns for varying levels of risk. The dual to problem (1) is expressed as:

Maximize: $R_p = R^T X$ (3)

Subject to: $X^T AX \geq risk\ leve$

Where, the portfolio return R_p is equal to $R_p = \sum_{i=1}^{10} x_i E(R_i)$. The solution to this constrained optimization problem follows differentiating the following Lagrangian problem and solving it for X and λ.

$$L = R_p + \lambda(risk\ level - X^T AX) \quad (4)$$

The solutions for the first eleven *Mathematica* simulations are classified as "low risk", the next eleven are considered "medium risk", while the last eleven solutions are classified "high risk" levels. The thirty-three risk-return combinations obtained are plotted on the efficient frontier in Figure 5.

2.2. Data

This study utilizes thirty daily data points from April 11, 2011 to May 16, 2011 to obtain the efficient portfolios. The FRED[5] provides the data for the risk-free asset and the individual securities. The 3-month T-bill secondary market rate is the risk-free rate. The smallest risk-free rate for covered period is 0.02%. This serves as r_f's proxy in equation (1).

The FRED's spot rates data are the FRBNY's daily 12 noon buying rates. Direct rates of AUD, EUR, GBP and NZD are available. However, the database provides indirect rates only for CAD, CHF, JPY, NOK and SEK. SPARCB data are from the Standard and Poor's website.[6] Data for all the other indices are from Yahoo!.[7]

The SPDR S&P 500 (SPY) and the iShares S&P 500 Index Fund (IVV) are ETFs that track the S&P 500. Their price and yield performance before expenses correspond to the tracked broad market index. SPY carries all of the securities in the S&P 500, while IVV invests at least 90% to the securities and depositary receipts of the securities in the tracked index.[8]

The investment of the remaining funds is left to the discretion of the fund managers. They usually allocate the remaining funds to cash and cash equivalents, as well as financial derivatives that will help track the underlying index.[9]

Proxy fixed income portfolios are the SPDR Barclays Capital 1-3 Month T-Bill ETF (BIL) and the iShares Barclays Short Treasury Bond Fund (SHV). The Barclays Capital 1-3 Month T-Bill Index "includes all publicly issued zero-coupon U.S. Treasury Bills that have a remaining maturity of less than 3 months and more than 1 month." BIL tracks the underlying index through replication.[10] The Barclays Short Treasury Bond Fund consists of U.S. treasury bonds that have a remaining

5. "Federal Reserve Economic Data – FRED – St. Louis Fed," Federal Reserve Bank of St. Louis,
6. "S&P|S&P Currency Arbitrage Index|Americas," Standard & Poor's Financial Services, 2012.
7. "Yahoo! Finance – Business Finance, Stock Market, Quotes, News," Yahoo! 2012,
8. "SPDR® S&P500® ETF Trust,"Prospectus, State Street, September 30, 2011, 3; "iShares S&P 500 Index Fund 2011 Prospectus," BlackRock, 2012, S-2.
9. "iShares S&P 500 Index Fund 2011" S-2.
10. "SPDR® Barclays Capital 1-3 Month T-Bill ETF Summary Prospectus," State Street, October 31, 2011, 1, https://www.spdrs.com/library-content/public/BIL%20SUM%20PRO.pdf (accessed April 18, 2012).

maturity of between 1 and 12 months.[11] To track this Bond Fund, SHV invests at least 90% of the funds in the representative bonds. At least 95% of assets are U.S. government bonds. It also invests up to 10% of the funds in bonds excluded from the tracked index. Up to 5% of the funds is allocated to cash, cash equivalents and agreements collateralized by U.S. government obligations.[12]

State Street Global Advisers and BlackRock issue the most actively traded ETFs in the market. The former manages SPY and BIL, along with the other SPDR ETFs. The latter issues the iShares ETFs including the IVV and SHV.

The SPARCB follows a carry trade strategy, which means it holds a long position in currencies that have a higher interest rate than the USD and a short position in currencies that have a lower interest rate than the USD. The weight of each currency depends on its interest rate spread and volatility. Currencies with wider interest rate spreads get a bigger proportion of the funds. More volatile currencies get less.[13] MABFX is a mutual fund that derives its currency exposure from investments in future contracts. Currency allocations are based on quantitative and qualitative strategies. Quantitative analysis includes fundamental and technical analysis of currency and economic data. Merk Funds considers a "risk overlay" and a "macro overlay" when determining the optimal weights of each security. A macro overlay entails an assessment of a country's macroeconomic outlook, while a risk overlay constrains the expected standard deviation, perhaps similar to a VaR analysis.[14]

G10 currencies comprise the SPARCB and MABFX. The portfolios' currency allocations as of March 2011 are in Table 1. Both indices' currency weights are reviewed and changed or rebalanced on a monthly basis. It is assumed then that these weights are used for the subsequent 30-day period. Notice that with the exception of the EUR, JPY and NOK, the difference between SPARCB's allocation and MABFX's allocation for each currency is in double digits. This indicates that at least one of the portfolios is not efficient.

Table 1. SPARCB and MABFX Currency Allocations as of March 2011

Currency	SPARCB (%)	MABFX (%)	Allocation Difference (%)
AUD	17.04	-35.70	52.74
CAD	6.25	27.10	20.85
CHF	-0.66	20.90	21.56
EUR	5.66	13.40	7.74
GBP	2.82	-10.10	12.92
JPY	-0.40	0.00	0.40
NOK	12.70	10.70	2.00
NZD	8.98	-7.70	16.68
SEK	9.50	27.60	18.10
USD	38.11	53.80	15.69

Sources: Data from Standard and Poor's, "S&P Currency Arbitrage Index Rebalance Announcement," Standard & Poor's Financial Services, March 31, 2012.

3. Empirical Results and Analysis

Table 2 presents each asset class's returns statistics for the covered period.

As has been empirically observed, fixed income portfolios have a lower expected return and are less volatile compared to equity portfolios. While it is not within the scope of this study, it is worthy to note that SPY, which follows a replication strategy, has higher return than IVV for slightly less volatility.

Surprisingly, the currency portfolios have very different and contrasting performance. On one hand, SPARCB's results concur with this paper's hypothesis. Currency portfolios are more volatile than equity portfolios, and therefore require a higher return. SPARCB's expected return is greater than SPY's and IVV's. On the other hand, MABFX shows that currency asset classes are less volatile and require less return compared to equity asset classes. At the same time, MABFX is more volatile than

11. "iShares Barclay Short Treasury Bond Fund," BlackRock, March 31, 2012.
12. "iShares S&P 500 Index Fund 2011 Prospectus," BlackRock, 2012, S2-S3.
13. "S&P Currency Arbitrage Index," Standard & Poor's Financial Services, 2012.
14. "Merk Absolute Return Currency Fund Fact Sheet," Merk Investments, 2011.

bond portfolios but the return is less. The outcome suggests that the location of currency portfolios in the risk and return spectrum cannot be generalized. However, the efficiency of the currency investment vehicles has not yet been determined at this point. Hence, this paper turns to determining the optimal allocation of currencies in efficient portfolios. Efficient versions of the subject currency asset classes are later on compared to the equity and fixed income indices.

Table 2. Statistics on Index Returns, 04/01/2011-05/16/2011

Asset class	Index type	Index	Expected return (%)	Volatility (S.D. in %)
Currency	Index	SPARCB	0.081400	0.7930
	Mutual Fund	MABFX	-0.060800	0.5947
Equity	ETF	SPY	0.004650	0.6247
	ETF	IVV	0.003340	0.6292
Fixed Income	ETF	BIL	0.000752	0.0136
	ETF	SHV	0.000938	0.0227

MacLean et al. (2005) conclude that equity returns are negatively correlated with foreign exchange rates (MacLean et al., 2006:10). The results obtained by this study do not agree with this. Table 3 shows the correlation of the currency portfolios' returns to the fixed income and equity asset classes' returns.

Table 3. Asset Classes' Correlation Matrix

	Equity		Fixed Income	
Currency Index	SPY	IVV	BIL	SHV
SPARCB	0.642176	0.639378	-0.129799	0.031993
MABFX	0.693954	0.691553	0.027796	0.002005

The correlation between the returns of SPARCB and those of the equity asset classes is 0.64. MABFX's returns correlation with the equity indices' returns is 0.69. The correlations of the currency portfolio returns and the bond portfolio returns are inconsistent. SPARCB is negatively correlated to the 3-month T-bill ETF, but is statistically not correlated with the T-bill ETF containing T-bills with longer maturity terms. MABFX is barely correlated with both bond ETFs. Based on these correlation results alone, it appears that currency investment vehicles cannot be used to hedge the risk of equity portfolios. Rather, currency portfolios are better paired with fixed income portfolios if less risk is desired.

3.1. Currencies' Performance

The individual securities' expected returns and volatility are on Table 4.

Table 4. Statistics on Currency Returns, 04/01/2011 – 05/16/2011

Currency	Expected return (%)	Volatility (S.D. in %)	Currency	Expected return (%)	Volatility (S.D. in %)
AUD	0.071600	0.6794	JPY	0.126300	0.4888
CAD	- 0.024000	0.5125	NOK	-0.020800	0.8999
CHF	0.151800	0.5925	NZD	0.075700	0.7186
EUR	0.000908	0.7129	SEK	-0.013500	0.8895
GBP	0.121500	0.4989			
Index	Expected return (%)	Volatility (S.D. in %)	Index	Expected return (%)	Volatility (S.D. in %)
SPARCB	0.081400	0.7930	MABFX	-0.060800	0.5947

CHF, GBP and JPY are the least volatile currencies, yet they post the highest gains. NOK and SEK are the most volatile currencies despite the negative expected returns. The standard deviation of the CAD is only greater than the GBP's volatility by 0.0136, but GBP displays a positive return while CAD shows a loss. Assuming that the currency market is efficient, this outcome indicates that some currencies are more sensitive to the U.S. domestic market than others. Therefore, investors would benefit from spending on an efficiently diversified currency portfolio, than investing in one currency alone. To have an idea how these currencies ought to be allocated, Table 5 presents the correlation matrix of the currency returns.

Table 5. Currency Returns Correlation Matrix

	AUD	CAD	CHF	EUR	GBP	JPY	NOK	NZD	SEK
AUD	1.000	0.746	0.444	0.638	0.582	-0.227	0.771	0.708	0.734
CAD	0.746	1.000	0.230	0.610	0.619	-0.311	0.770	0.550	0.662
CHF	0.444	0.230	1.000	0.745	0.392	0.177	0.530	0.387	0.619
EUR	0.638	0.610	0.745	1.000	0.571	-0.160	0.850	0.485	0.876
GBP	0.582	0.619	0.392	0.571	1.000	-0.144	0.598	0.345	0.616
JPY	-0.227	-0.311	0.177	-0.160	-0.144	1.000	-0.282	-0.243	-0.194
NOK	0.771	0.770	0.530	0.850	0.598	-0.282	1.000	0.592	0.922
NZD	0.708	0.550	0.387	0.485	0.345	-0.243	0.592	1.000	0.560
SEK	0.734	0.662	0.619	0.876	0.616	-0.194	0.922	0.560	1.000

With the exception of CHF, JPY is negatively correlated with all the securities. This suggests that the JPY must receive a large allocation. Similar to Dumas and Jacquillat's (1989) results, this paper finds that the currencies are highly and positively correlated, perhaps because all the currencies belong to the developed markets and/or most of them are trading partners (Dumas and Jacquillat, 1989). The high and positive correlation of the currencies implies that the efficient portfolio must have a significant USD exposure.

3.2. Optimal Allocation of Currencies

The following figures present the optimal allocation of currencies. Figure 2 presents the currency allocation for median of each risk level. Figures 3 and 4 show the minimum and maximum allocations for each level of risk, respectively.

Figure 2. Currency Allocation for the Median of Each Risk Level

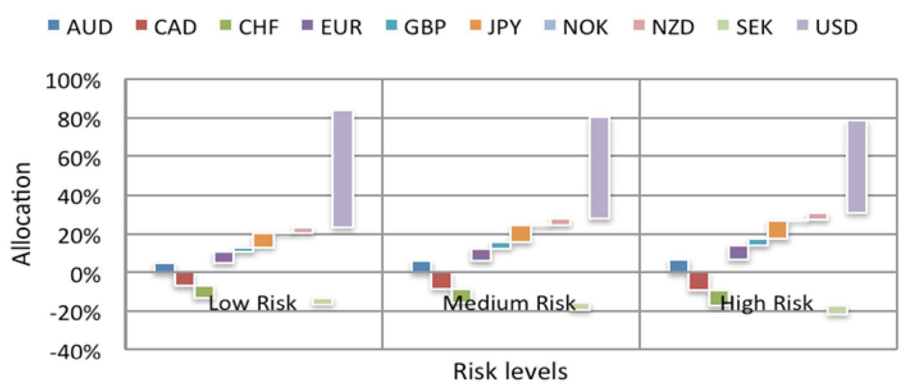


Figure 3. Currency Allocation for the Minimum of Each Risk Level

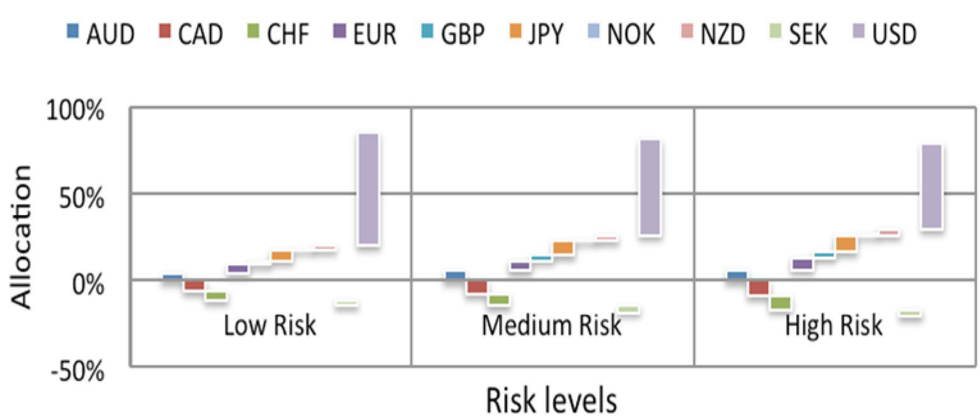
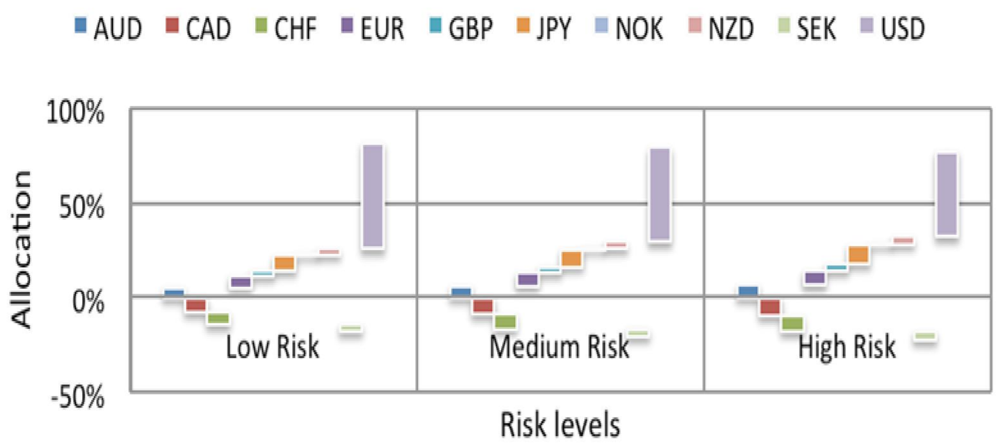


Figure 4. Currency Allocation for the Maximum of Each Risk Level



For all levels of risk, MPT dictates that a sizeable portion of investors' funds must be allocated to the USD. For low levels of risk, investors must allocate 87.88% to 91.43% of their funds to USD. The allocation to the home currency is 84.91% to 87.58% for medium levels of risk. Investors with the highest risk appetite must allocate 82.44% to 84.67% of their funds to the greenback. Some of the remaining currencies must share what little is left of the funds, while some have to be short sold. The results are consistent with de Macedo's (1982) allocation despite the difference in the models used.[15] They are also consistent with Papaioannou et al.'s (2006) allocation conclusion even if the currencies are not held as reserves.[16]

Among the remaining G10 currencies, the JPY receives the largest allocation. Low levels of risk require a JPY share of 8.79% to 12.43%. Optimal portfolios indicate investors with medium risk levels must put 12.74% to 15.48% of their funds to the Yen. It also indicates that 15.72% to 18.01% must be invested in this currency for high levels of risk. After the JPY, the EUR gets the highest allocation, followed by the AUD, NZD and the GBP. The SEK barely gets any of the investors' funds.

Efficient portfolios also require selling the CAD, CHF and NOK short. Dumas and Jacquillat (1989) point out that the Loony has a high positive correlation with the USD.[17] MacLean et al.'s (2005) efficient portfolios require a huge allocation of funds to the CAD.[18] Their portfolios though, do not include the USD. The JPY, which gets a significant allocation, is positively correlated with the Swissie. The NOK, aside from incurring a loss, is very much positively correlated with all other currencies in the portfolio.

The ordinal allocation proportions are the same for all levels of risk. The largest allocation and a sizable proportion must go to USD. The next largest allocation goes to the JPY and so on. The results also maintain even the ordinal allocation proportions for currencies that have to be short sold for all levels of risk. The CAD has to be short sold the most, CHF next, and the SEK the least. As the risk level increases, the bar graphs in Figures 2-5 shifts down. This implies decreasing the share of the USD, and increasing the weights of the other currencies by purchasing more of the long currencies (JPY, EUR, AUD, NZD, GBP, SEK) and selling more of the short currencies (CAD, CHF, NOK).

The simulations suggest that U.S. investors allocate funds to certain currencies, lending support to de Macedo's (1982) conclusion that the preferred monetary habitat theory should be used with caution.[19] Nonetheless, domestic investors still need to have an overwhelming USD exposure to hold efficient portfolios, if the currency market is limited to the G10 currencies. These findings are consistent with Papaioannou et al. (2006). Efficient portfolios entail a huge allocation of funds to the greenback. However, the explanations offered differ. Papaioannou, et al. (2006) explains that the huge USD allocation is due to the fact that central banks with large reserves have a huge proportion of

15. de Macedo, "Optimal Currency Diversification," 12, table 1.
16. Papaioannou, Portes and Siourounis, "Optimal Currency Shares," 7.
17. Dumas and Jacquillat, "Performance of Currency Portfolios," 21.
18. MacLean, Zhao and Ziemba, "Weak Interest Rate Parity," 26-27.
19. de Macedo, "Optimal Currency Diversification," 13.

reserves in USD. This paper maintains that the significant weight given to the greenback is due to its role as the riskless currency. This is evidenced by the shift of allocation to other currencies as the risk level increases.

Table 6 presents what SPARCB and MABFX could have earned given their current risk levels. It also shows what SPARCB's risk level could have been, had it targeted returns at its current level. It does not present MABFX's optimal risk for the given level of return, since it is assumed that no fund manager aims to incur a loss. Had MABFX been efficient, it could have earned 0.33% instead of incurring a loss of 0.06%. SPARCB could have made 0.34% return on investments instead of only 0.08%. Or for the same return on investment, the volatility could have been only 0.19% instead of 0.79% had its securities been efficiently allocated. This could have translated into a lower risk premium for investors. These numbers indicate that had SPARCB or MABFX used MPT, instead of a carry-trade strategy or an active strategy, they would have earned more.

Table 6. Actual vs. Efficient SPARCB and MABFX

Portfolio	Actual Return (%)	Optimal Return (%)	Optimal Risk (S.D. in %)	Actual Risk (S.D. in %)
SPARCB	0.0814	…	…	0.7930
Efficient SPARCB 1 (return given)	0.0814	…	0.1923	…
Efficient SPARCB 2 (risk given)	…	0.3357	…	0.7930
MABFX	-0.0608	…	…	0.5947
Efficient MABFX (risk given)	…	0.2518	…	0.5947

A comparison of the currency returns statistics on Table 4 and the returns statistics of efficient versions of the SPARCB and MABFX show that G10 currencies benefit from diversification. Risk is less for the same level of return or return is higher for the same level of risk. Domestic investors, then, are better off investing in the efficiently diversified portfolio rather than in any one currency.

3.3. Efficient Currency Portfolios' Performance

Table 7 is similar to Table 2 in that it compares the performance of the various asset classes to one another.

Table 7. Statistics on Efficient Currency, Equity, and Fixed Income Returns, 04/01/2011 – 05/16/2011

Asset Class	Index Type	Index	Expected Return (%)	Volatility (S.D. in %)
Currency	Index	Efficient SPARCB 1	0.081400	0.1923
	Index	Efficient SPARCB 2	0.335695	0.7930
	Mutual Fund	Efficient MABFX	0.251750	0.5947
Equity	ETF	SPY	0.004650	0.6247
	ETF	IVV	0.003340	0.6292
Fixed Income	ETF	BIL	0.000752	0.0136
	ETF	SHV	0.000938	0.0227

Table 7, however, compares the optimally allocated currency portfolios to the equity and fixed income asset classes. For levels of risk that are only slightly above or below those of stock portfolios', the expected returns of currency portfolios are greater than those of stock portfolios. Among the efficient currency asset classes presented, SPARCB 1 demonstrates the best performance. For a risk level of only 0.19%, which is way less than the SPY and IVV's risk level of 0.62%, return is at 0.08%. This beats SPY's return of 0.005% by 0.075%.

The risk and return relationship of the currency asset classes, when compared to stock and bond portfolios, is puzzling. The expected returns of efficient currency portfolios are greater than the returns of equity portfolios. It does not matter if they are more or less volatile than equity asset classes. Perhaps the model does not capture the international variables that would explain the higher expected return of currency portfolios. These variables might even be irrelevant to domestic investors. If this is the case, American investors ought to explore currency investment vehicles more due to their high earnings potential.

Figure 5 shows the optimal allocation of the efficient currency asset classes. SPARCB 1 seems to be the only feasible allocation. SPARCB 2 and MABFX require that investors purchase the JPY and the EUR, and short sell the CAD and the CHF. While this is the case, it does not diminish the attractiveness of currency portfolios. SPARCB 1 still outperforms equity asset classes by a large margin.

Figure 5. Optimal Currency Allocation on Efficient Currency Indices

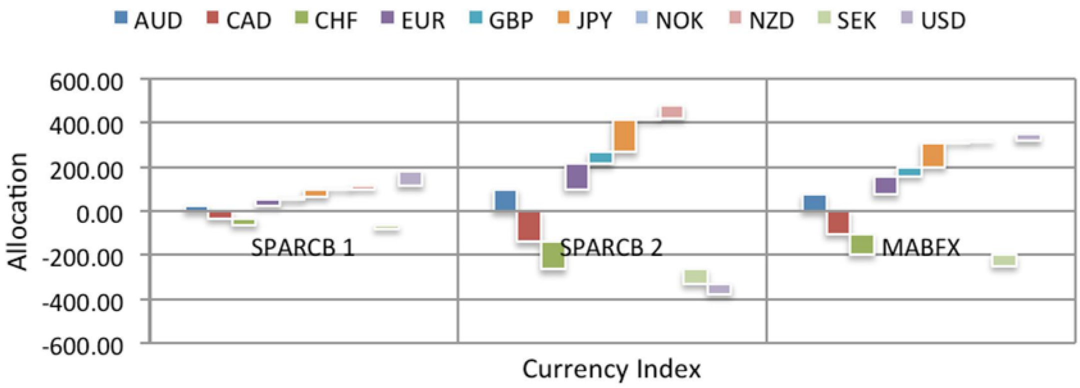


Table 8 emphasizes the allocation difference between the current proportions and the proportions required by the efficient allocation of funds.

Table 8. Difference Between Current Allocations and Efficient Allocations

Currency	SPARCB 1 Gap (%)	SPARCB 2 Gap (%)	MABFX Gap (%)
AUD	7.07	82.38	110.26
CAD	40.51	147.55	133.07
CHF	29.21	122.51	113.27
EUR	21.93	108.11	71.92
GBP	10.16	50.73	50.26
JPY	36.17	147.93	110.64
NOK	11.42	7.43	6.75
NZD	4.61	47.07	11.90
SEK	25.82	76.79	78.07
USD	27.01	81.94	23.83

It appears that fund managers overestimate the CAD and CHF, and underestimate the JPY and EUR. Managers purchase a huge proportion of the CAD and CHF, when they should be short selling them. They do not purchase JPY, when a larger proportion should be allocated to it. They should also allocate more funds to the EUR. The stark gaps between the current allocations and efficient allocations further support the hypothesis that SPARCB and MABFX are inefficient.

4. Concluding Remarks and Recommendations

This paper revolves around one simple question: Should investors invest some of their funds in currency portfolios? To answer this, the paper examined the SPARCB and MABFX, currency assets comprised of G10 currencies. The paper scrutinized the allocations of the indices' components as of March 2011. The significant allocation discrepancies indicate that at least one of indices is not efficient. The study also compared the daily returns and volatility of both currency portfolios to two S&P 500 ETFs and to two fixed income ETFs. This sought to determine how the currency assets' risk and return fared against other asset classes. SPARCB and MABFX showed inconsistent results. SPARCB's expected return and volatility were higher than the S&P 500 ETFs, and even more so, than fixed income portfolios. However, while MABFX's risk and return measures were lower than equity portfolios, compared to the bond portfolios it was more volatile than bond portfolios, while its expected return was lower.

The correlation matrix of the G10 currencies was also calculated to find out whether the currencies would benefit from diversification. The correlation matrix showed that these currency portfolios would benefit from diversification. The derived efficient frontier of the currency portfolios suggested that the currency allocation of SPARCB and MABFX as of March 2011 were suboptimal. The paper proposed an alternative menu of currency portfolios depending on their risk preferences. Most importantly, the efficient portfolios dictate the proportion of funds that must be allocated to each currency.

The optimal allocation of currencies in the portfolios entails that the ordinal allocation proportions remain the same, for all levels of risk. Such an allocation places a significant weight on the U.S. dollar, 82.44% to 91.43%, depending on the risk level. The Yen gets most of the remaining funds followed by the Euro, the Australian Dollar, the Kiwi, the Sterling, and the Swedish Krona. Efficient currency portfolios also entail selling the Loony, the Swissie and the Norwegian Krone short. As the risk level increases, less U.S. dollar must be held and more "long currencies" must be purchased.

Using MPT this study obtained optimally allocated versions of the SPARCB and MABFX. These portfolios perform better than the actual SPARCB and MABFX that follow a carry trade strategy and an active strategy, respectively. Afterwards, this study compared optimally allocated versions of the SPARCB and MABFX to the stock and bond ETFs. The outcome was as puzzling as that found when comparing inefficient currency portfolios to the other ETFs. Even though the currency asset volatility was less than equity ETF's, they still generated a higher return. Putting the efficient SPARCB and MABFX's statistics side by side with the individual currencies' returns, the statistics highlight the benefits of efficient diversification.

Should investors invest some of their funds in currency portfolios? Yes. However, they have to be wary of the inefficiency of these portfolios. Currency portfolios are very promising as investment vehicles given that the returns are higher than equity portfolios for the same or lower risk levels. This being the case, this paper recommends looking into and determining the variables that affect each currency's risk and return and these variables will affect the domestic investor's earnings. This paper also recommends studying the currency asset classes with currencies that are not highly correlated. The MSCI Europe, Australasia and the Far East (EAFE) Currency Index might fit this description. It is composed of currencies from both developed and emerging markets, and it fairly represents the globe.

Surprisingly, this paper found that currency asset classes are highly and positively correlated to equity ETFs. Hence, future studies can look into an optimal portfolio comprised by stocks, bonds and currency asset classes, similar to the studies done by Jin et al. (2007) and Campbell et al. (2001). They can determine how currency asset classes can enhance or hedge portfolios consisting of various asset classes. On a slightly different focus, this study also recommends examining whether currencies are priced correctly using the CAPM. Now that currencies are also used for profit, by reserve banks and by institutional investors, CAPM might help clear the murky path to exchange rate determination.

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