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HEDGING CURRENCY RISK IN INTERNATIONAL INVESTMENT AND TRADE

BY MASAKAZU ARIKAWA AND ARUN MURALIDHAR[1]

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Abstract

International investing and trade has one unintended consequence; namely, the creation of currency risk which causes the local currency value of the foreign receivables or investments to fluctuate dramatically because of pure currency movements. The academic literature on currencies has typically misunderstood currency risk and suggested that currencies have no long term return, are difficult to predict, and difficult to take advantage of as the markets are extremely liquid. Hence, typical recommendations include either that companies and investors should remove this uncompensated volatility by naively hedging back into the base currency or leaving the risk unhedged (which is often misinterpreted and, as a result, left unmanaged). The effective financial management of such cash flows or investments provides a completely different perspective as naïve hedging (unhedging) of currency risk implies a strong view that the base currency will appreciate (depreciate) against the foreign currency. Moreover, the currency market has many non-profit participants and while exact currency levels cannot be predicted, the future direction of currencies can be anticipated through relatively simple models and non-profit participants can be exploited. We demonstrate how Japanese corporations and investors can develop a much more robust and SMART (Systematic Management of Assets Using a Rules Based Technique) approach to manage currency risk, thereby adding value from currency fluctuations while managing currency risk. In short, they can easily improve performance, risk management and governance. Such transactions are easy to implement with currency forwards and while the current paper focuses on USD exposures, a more general multi-currency approach can be developed for a more comprehensive analysis.

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SECTION 1: BACKGROUND ON HOW CURRENCY RISK IS CREATED BY INTERNATIONAL INVESTMENT OR TRADE

Currency risk is the bane of foreign investment and trade, as trading products or assets in foreign countries automatically creates exposure to foreign currencies, which left unmanaged can hurt returns. For example, consider a Japanese company which exports a product to or has a foreign subsidiary in the United States. When the product is sold in the United States, in US dollars, those revenues or profits need to be sent back to Japan and hence undergo a currency transformation. If the payment is instantaneous, then the company can conduct a spot currency transaction. However, if the payment is to be received after a delay, then there is uncertainty as to the future spot rate and hence uncertainty as to the Japanese yen amount that is to be received in the future. We can show this in a simplistic way in equation (1). A rise in the value of the US dollar between the time of sale and actual remitance will lead to a windfall gain in yen terms, whereas a decline in the value of the dollar will cause a loss in yen terms.

Cash flow in yen = Cash flow in US dollars + Appreciation/Depreciation of US dollars versus yen between time of sale and actual remitance *(1)*

In a similar vein, when a Japanese investor buys assets abroad say in the United States, the first transaction is to convert Japanese yen into US dollars, and these dollars are then used to purchase stocks, bonds or real estate. As the value of the investment changes over time in US dollar terms, the mark-to-market Japanese yen value of the investment is also being affected by the dollar-yen exchange rate. In a simplistic way, the returns on a foreign investment can be expressed as in equation (2) and again, an appreciation of the US dollar leads to an additional return in yen terms, while a depreciation of the US dollar leads to a loss.

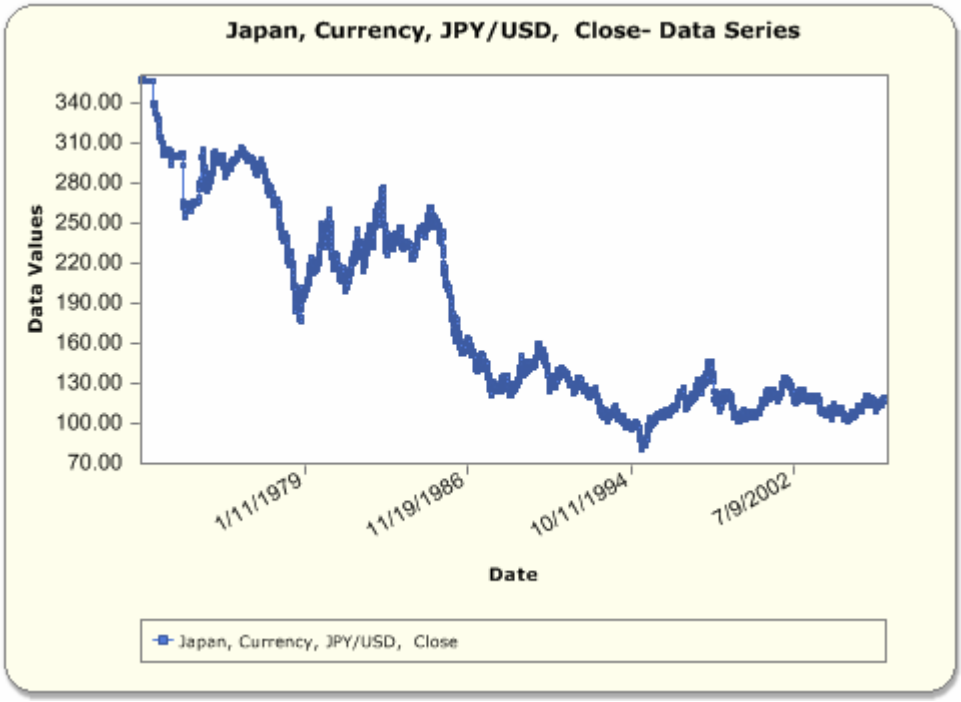
Returns in Japanese yen = Returns in US dollars + Appreciation/Depreciation of US dollars versus yen *(2)*

Currency risk is the fluctuation of the yen (or base currency) value of the cash flow or investment and typically an appreciation of the US dollar (foreign currency) is a good risk, while a decline is considered a bad risk. Currency risk is effectively the translation risk of foreign investment or trade activity and can lead to large swings in performance. Most corporations and investors would be foolish to not accept the good risk, but would be negligent to not eliminate the bad

risk. Since investors and corporations have had difficulty identifying whether good or bad risk is likely to result in the future, the tendency has been to try to eliminate this risk entirely , because it is believed that over the long term, currency risk is uncompensated and that hedging was not costly (Perold and Schulman ___).

If we consider a long term chart of the number of yen it takes to purchase 1 US dollar, Chart 1 tells a unique story of the yen appreciating in value to 1/3 its original value. One dollar purchased 360 yen in 1971; by November 2006, that value was closer to 117. In other words, the US dollar has been in a secular decline against the yen and has lost 2/3s of its value – hence a Japanese investor would be inclined to believe that US dollar receipts or investments must be hedged. We provide some summary statistics on the exchange rate from 1971 to 2006 and the mean value is 181 with a standard deviation of 74.

Chart 1: Yen per USD, January 1971 – October 2006



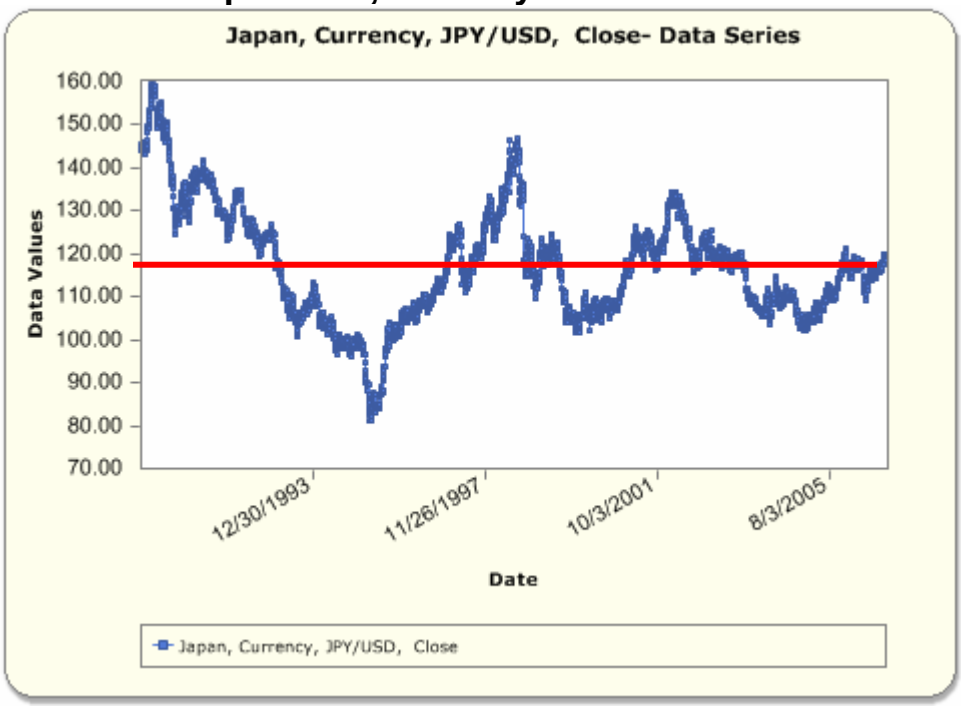
Source: Data: EcoWin/Reuters; AlphaEngine®

Series	Mean	Max	Min	Range	Std Dev	Median	Mode	Skew	Kurtosis
Japan, Currency, JPY/USD, Close	180.46	358.4	81.16	277.2	74.3	141.81	301.11	0.60	-1.02

However, if one should examine the data from the perspective of the last 15 years, a slightly different picture emerges. Chart 2 plots the

same exchange rate from January 1990 – November 2006, but now the story is a very different one. Not only is the range much smaller, but the standard deviation is lower and the mean value is very different suggesting that as of November, the exchange rate is at its long term (approximately) 15 year mean. The fact that when one looks at a 15 year chart and sees an oscillation of the value of the currency around a mean level of 117 has led many to conclude that currencies have no long term return and hence only add volatility to international trade and investment.

Chart 2: Yen per USD, January 1990 – October 2006



Source: Data: EcoWin/Reuters; AlphaEngine®

	Mean	Max	Min	Range	Std Dev	Median	Mode	Skew	Kurtosis
Japan, Currency, JPY/USD, Close	117.19	159.76	81.16	78.6	13.43	116.6	108.37	0.4337	0.4095

SECTION 2: BASIC CONCLUSIONS FROM THE ACADEMIC LITERATURE

The case for why currencies should have no long term return is more sophisticated than just looking at a 15 year chart and concluding that it oscillates around some mean value. The most basic premise of finance is that the value of a security or an asset is equal to the discounted present value of all future cash flows (at the appropriate rate). While an exchange rate qualifies as a security because it is traded daily, it generates no cash flow like a bond, offers no dividend like an equity and has no "terminal value" as in any typical asset. Currencies have been termed a "medium of exchange" and hence while traded like a security, they are not an asset in the true sense of the word. Hence, one should not expect exchange rates to have a return as they are just the "grease" to exchange products across different geographical borders. However, because there are various forces that affect the demand and supply of currencies, currency values change daily thereby generating a return (positive or negative) even though theoretically they should not. Hence, if currencies are in excess demand relative to a given rate because of an influx of foreign investors, the currency will appreciate, but through changes in international trade and investment, the assets in the foreign country will be overvalued leading to either a reduction in demand or an increase in the quantity supplied leading to a subsequent depreciation.

There is an extensive literature on currencies and why they overshoot their equilibrium values (e.g., see Dornbusch 1976; Yotopoulos, Pan A. and Yasuyuki Sawada (2005). More importantly, according to the Bank for International Settlements, this is one of the most liquid markets in the world with over Yen 200 trillion traded daily, which is greater than the sum of all equity market trades globally (http://www.bis.org/). In addition, many researchers have tried to predict future currency levels using various structural and time series models and have come to the conclusion that currencies are extremely hard to forecast and that these models perform no better than a random walk model (Meese and Rogoff 1983). Yet coincidentally, Richard Meese went on to head currency research at a major asset management company and developed successful models to manage currency risk. The Meese-Rogoff result has been subsequently contested in more recent research (Guo and Savickas 2005).

How has the academic community responded in terms of advice to investors? "In 1988, Andre Perold and Evan Schulman[2] advocated a fully hedged position on the basis of foreign currency risk not offering a commensurate return. In what they deem a "free lunch", they argue

that as a result of its zero long-term expected return, currency risk can be removed without the portfolio suffering any reduction in long-term return"[2]. Therefore, many analysts incorrectly came to the conclusion that the availability of extreme liquidity (and hence low bid-ask spreads), a long term zero return and an apparent lack of predictive power of academic currency models meant that investors and corporations should naively remove currency risk by implementing passive hedges back into the base currency as one could reduce voltility without paying for it. Another academic took exactly the opposite approach and suggested that investors do nothing and leave investments unhedged and unmanaged. "In his 1993 paper, Harvard University's Kenneth Froot[3] argues that over long investment horizons, real exchange rates revert back to their means according to the theory of Purchasing Power Parity and investors should maintain an unhedged foreign currency position. He also concludes that, even over shorter horizons, the small transaction costs and counterparty risks associated with maintaining a currency hedge add up over time and cause the optimal hedge ratio to decline as the investment timeframe increases. However, Froot does acknowledge that real exchange rates may deviate from their theoretical fair value over shorter horizons and currency hedging in this context is beneficial in dampening volatility."[3] Coincidentally, Ken Froot also was a partner in a firm that offered currency management products!

[2]http://www.ssga.com/library/esps/anthonygolowenkohowmuchtohedgeinvolatileworld20030314/page.html. See Perold and Shulman (1988).

[3]http://www.ssga.com/library/esps/anthonygolowenkohowmuchtohedgeinvolatileworld20030314/page.html. See Froot (1993).

SECTION 3: THE MECHANICS OF HEDGING

How can an investor/corporations implement an unhedged or fully hedged position? For an investor or a corporation to be unhedged is very simple – do absolutely nothing, but exchange the future cash flow or convert the foreign asset value at the then prevailing spot rate. The method through which currency risk is eliminated or "fully hedged" from a future US dollar cash flow or a current US dollar investment for a Japanese base currency corporation or investor is as follows: enter into a simple forward contract to lock in a future dollar-yen exchange rate of the entire proceeds or asset value. In other words, a simple derivative contract is entered into that formalizes an agreement that the investor agrees to buy yen (sell dollars) in the forward market at a pre-agreed rate, for a pre-agreed foreign notional value and for a pre-agreed date. If priced appropriately, no monies are exchanged at the initiation at the forward contract and hence forward contracts do not require any upfront funding.

What determines this "appropriate" forward price? There is a very simple formula that is derived from covered interest rate parity that states that the no-arbitrage price of the forward contract or the forward price is determined by the spot rate today and the interest rate differential between the two currencies for the relevant maturity. A simple example explains the calculation of this rate. If the spot rate today for yen required to purchase a dollar (which we will refer to as Yen/USD even though market convention calls this USD-yen rate) = 100 and US interest rates for 1 year maturity is 5% and Japanese interest rates for 1 year maturity is 1%, then the 1 year forward rate would be a stronger Japanese yen by approximately 4%.

$$\text{Forward Rate}_{t,\,t+1} = \text{Spot}_t * (1 + \text{Japan Return}_{t+1}) / (1 + \text{US Return}_{t+1})$$
$$= 100 * (1.01)/(1.05) = 96.19$$

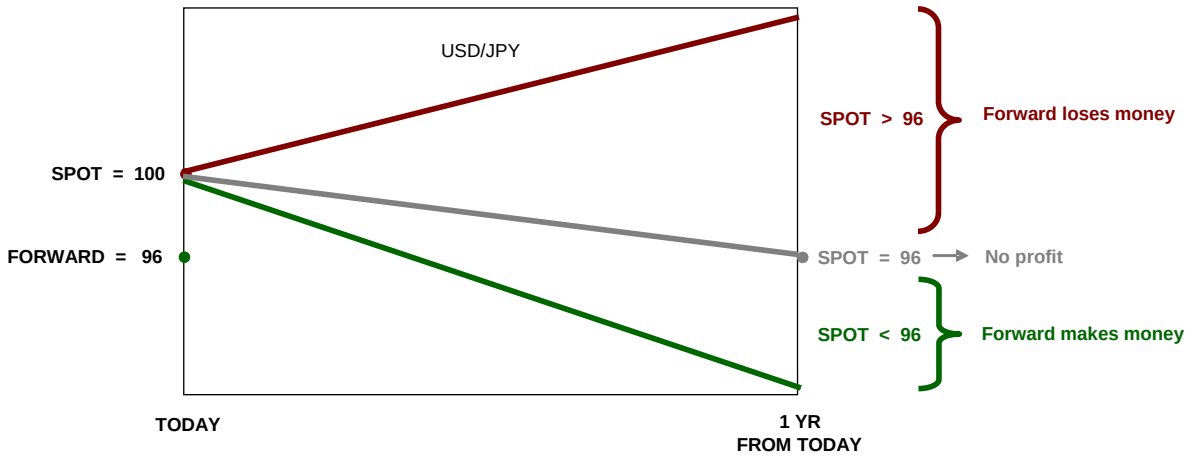
Why is this price the no-arbitrage price and no other? To ensure that individuals are indifferent between holding their money in dollars or yen, the anticipated appreciation of the yen must equal the interest rate differential otherwise it will be profitable for investors to move assets to the country that offers the better payoff. For example, if the anticipated appreciation of the yen is less than 4%, then investors would borrow dollars causing the yen-dollar exchange rate to adjust until equilibrium is reached at the time of entering into the forward contract. Therefore, hedging of the dollar cash flows or investments involves selling dollars and buying yen in the forward market. However, as one can see from the example above, such a transaction involves

selling the currency with the higher interest rate and buying the currency with the lower interest rate (or what is refered to in the market as “negative carry”). In other words, when yen interest rates are lower than dollar rates, the forward rate that is locked in, implies an appreciation of the yen to compensate for the negative interest rate carry.

Clearly, as the contract approaches maturity and the spot rate moves (or interest rates change), the forward contract will either lead to cash losses or gains that have to be settled at maturity. Hence, some cash is required to settle losses and cash is earned if there are gains.

SECTION 4: THE CORRECT FINANCIAL MANAGEMENT PERSPECTIVE

The financial management perspective is a little more sophisticated than the academic perspective. In reality, the realized yen-dollar spot rate one year from today will, with 99% certainty, be different from the forward rate of 96.19 because of movements in currency markets. If the rate is below 96.19 (i.e., the yen is stronger than was predicted in the forward market), the investor or corporation will make a loss on the spot valuation of the asset or cash flow, but make a gain on the forward contract and hence the rate they locked in provides a hedge. The same would apply if the rate rose above 100, wherein there is a gain on the spot value, but a loss in the forward contract and hence a hedge against the currency movement. The attached chart demonstrates the profit and loss implications from forward contracts depending on where the spot rate actually is one year from today.



One aspect that the academic literature has not examined is that implementing a passive hedge implies a view on exchange rate movements. If one implements a hedge, then one implicitly believes

that the yen will be strong. If they do not believe this, then the correct transaction would be to not hedge. Very often, corporations and investors believe that if they do not hedge or if they hedge they do not have a view on the markets. Quite the opposite is true. The act of doing nothing or implementing a passive hedge is actually expressing a strong view on the future direction of the currency, and if the explicit view of the manager or portfolio manager is different from the implied view, such actions must be corrected. Some have deemed such implicit market/currency bets being extracted from financial transactions as showing the investors their "Implied Views" (see Muralidhar and Pasquariello 2001; Black and Litterman 1991).

More important, there is a vast academic (Fama 1984, Engel 1996, Sarno 2005) and practical literature (Baz, Breedon, Peress and Naik 1999) on how forward rates are bad predictors of future spot rates, but more important are biased predictors. What this literature implies is that historically, rather than the yen appreciating as suggested by the forward rate, the yen actually has a very high probability of depreciating leading to losses for the hedger. In our chart above, instead of the yen moving along the grey line, it has a tendency to move along the red line. This result has been found to hold in a multitude of currencies and has led to suggestions of a profitable yet simple active currency management that focuses largely on being long a basket of high yield currencies against a basket of low interest rate currencies (Strange 1998, James 2004, Baz et al 1999). Major investment banks such as JP Morgan, Deutsche Bank, ABN AMRO, Citigroup etc., regularly report the performance of their own customized "carry" portfolio (Deutsche Bank 2002). What that also implies is that an investor or a corporation enters into such a transaction, they are implicitly taking a very limited and low probability bet that the hedge transaction will be profitable. Such behavior would clearly not be considered effective financial or portfolio management. The academic literature has many complex explanations for why this is the case using terms such as "incomplete information process" (Bacchetta and van Wincoop 2005) or "rational expectations…generalized equilibrium….stochastic market volatility and risk averse utility" (Bansal and Shaliastovich 2006), but the explanation for this is much simpler as shown in Muralidhar (2001).

In short, in a market with many traders, portfolio managers and asset managers acting as agents of pension funds and banks (or principals), entering into a negative carry trade implies immediate losses (as one is borrowing more expensively than one is lending) and this gap must be made up exchange rate movements. Therefore, it takes very high

conviction on the part of the agent to enter such trades, but very low conviction to do the opposite and hence the market has an enormous incentive to enter positive carry trades (sell yen and buy dollars) thereby causing the yen to depreciate. However, when the market's appetite for risk changes and such agency traders, who are working on behalf of principals who own the capital, become risk averse, these traders have to buy back yen (or the low interest rate currency) to cover their borrowing and the yen appreciates. Such a simple example is borne out by the evidence during the collapse of Long Term Capital and other hedge funds, whereby purchases of Russian bonds had been financed through borrowing in yen (or yen sales leading to a weak yen) and when Russia defaulted, investors were scrambling to buy yen, causing the yen to appreciate dramatically in the matter of a few days. Therefore, it is not surprising that all the banks mentioned earlier who publicize their version of the carry trade also condition their positions (long or short; big position or small position) based on their estimate of the market's risk appetite. They condition the recommended trade on variables including swap spreads, credit spreads, and volatility indicators such as implied currency or equity volality.[4]

Another well documented anomaly in the currency market is the conclusion that currencies exhibit positive autocorrelation (Liu and He 1991; Levich and Rizzo 1998). What positive serial correlation implies is that currency markets will trend and therefore simple trend based strategies can be profitable (Strange 1998, Levich and Thomas 1993, Reinert 2000). Therefore, there are positive returns to be gained with a clearer understanding of the trending nature of currency markets.

Equally important, if one believes that the currency market is a zero-sum game, then all losses are equal to some one else's gain. Again, there is a lot of evidence that many of the transactors in the currency markets are often making decisions to remove volatility and not necessarily to make profit. This is not to suggest that transactors are foolish, but rather their motives are focused on volatility reduction only. For example, the average corporate treasurer is glad to remove the volatility of earnings by hedging currency risk as income statement volatility may be penalized by the stock market. One of the interesting facts that is observed in examining currency data is that options have tended to be over-priced. In other words, the implied volatilities used to price options are consistently higher than realized volatilities. This may reflect the fact that there is excess demand for options as

[4] See JP Morgan (1999).

evidenced by the fact that selling short dated currency options can be a profitable strategy (Muralidhar and Neelakandan 2002).

In other cases, transactions are made out of necessity. For example, pension funds hire international stock portfolio managers and measure them relative to an unhedged currency benchmark such as the MSCI Kokusai Index or the Russell 3000 Index. Assume that the equity portfolio manager believes that the US dollar will depreciate and this will allow General Motors to export more cars to Japan. This portfolio manager will convert their yen into US dollars (sell yen and buy dollars) to purchase General Motors stock. While the stock trade may be effective, the currency transaction needed to enter the trade is entirely opposite to the currency view of the manager. This is a very common occurrence and many international equity and bond portfolio managers do not implement active currency strategies, but only conduct equity or bond transactions. This has led to the creation of an entire industry of “currency overlay managers.”

Third, central banks can intervene in currency markets to improve the domestic macro economic environment. For example, if the yen is very strong, it can affect employment in Japan or if it is very weak, it can lead to inflationary pressures. Central banks will often intervene in currency markets to move exchange rates, not to make profits, but to alter the economic path. There are numerous examples of the Bank of Japan intervening in the currency market to attempt to depreciate the yen by buying US dollars. However, academic research has shown that these transactions, by themselves have not been profitable and that central banks often are more effective at altering the course of the exchange rate through coordinated announcements (recall the reference for this).

With so many suggestions of imperfections in currency markets ranging from a market filled with non-profit participants, presence of auto-correlation, forward premium-discount bias and overpriced options, effective financial management of assets will definitely benefit from intelligent hedging as opposed to naïve full or no hedging. Intelligent hedging requires that the investor or corporation conduct an analysis to determine whether there is a strong or weak possibility that the foreign currency will depreciate or appreciate. If the indication is in favor of an appreciation, then being less than fully hedged will lead to gains in the spot market conversion, and lower losses (or no losses) on the forward contract leading to much better financial results. If the indication is in favor of a depreciation of the foreign currency, then being hedged is preferable to being unhedged and will lead to gains in

the forward contracts. However, establishing whether a currency is likely to depreciate or appreciate or more appropriately how much to hedge is the focus of the next section.

SECTION 5: MANAGING CURRENCY RISK WITH SIMPLE MODELS

Since the earlier analysis has suggested that there are many anomalies in the currency market, this section examines whether investors or corporations can exploit these anomalies by using a systematic, dynamic approach to hedging. We develop a SMART approach or Systematic Management of Assets using a Rules based Technique (SMART). The advantage of a SMART approach is that it ensures consistency, transparency, reduction of emotion and the possibility to evaluate whether such approaches can truly outperform a naïve constant hedge based on skill and not just luck.

Benchmarks: The practical research method developed here is as follows: we built some simple rules as described below and we compare these rules based on two possible benchmarks. Currency managers tend to ignore the risk of the underlying spot position (as that is incorporated in the performance of the foreign equity and bond manager) and hence compare the performance of the SMART dynamic hedge to a passive benchmark. We will test this same set of models that set the weight between unhedged and fully hedged against three simple benchmarks: (a) unhedged; (b) 50% hedged and (c) fully hedged. We will call this the “Asset Management Perspective.”

However, corporations may want to examine the performance of the combination of the spot currency risk plus the dynamic SMART hedge to a benchmark that also incorporates the spot exposure. Hence we again compare this mix of positions to the same three benchmarks listed above, but where the spot risk is incorporated into each of the benchmarks. We call this the “Corporate Management Perspective.” We do this to show why many corporations prefer to be fully hedged (as it has the lowest volatility), whereas in many asset management arrangements the benchmark is unhedged (as it requires no transactions and hence appears to have no risk).

SMART Rules and Strategies: We will develop certain models that have been discussed in the practical literature and attempt to improve performance and risk for the currency manager and corporate treasurer using a simple approach. We will create four simple rules based on each indicator and these Rules will only trigger once a month at month end and hold the position for the entire montb. The Rule for

each indicator will have a simple binary recommendation to whether to be fully hedged or unhedged. For example, in the extreme version of the “carry” trade, if US interest rates are higher than Japanese interest rates, then the hedge ratio is set at 0% or unhedged as the assumption is that the interest rate differential is likely to lead to an appreciation of the dollar (and vice versa). We will weight each of the Rules equally (at 25%) into what we will call a Strategy. Hence, the Strategy recommendation is the equally weighted aggregate of each of the Rules and will be as follows: if two rules are recommending a fully hedged position and two are unhedged, then the net recommendation of the Strategy will be 50% hedged (25%*100% +2*25%*0%). The only difference between the fully hedged, 50% hedged and unhedged Strategy will be the starting position on day 1 as we will assume that the investor or corporation is at the benchmark position. After the first day, the recommended allocation will be the same for all three Strategies that are measured relative to the three benchmarks, but the deviation from benchmark will depend on the benchmark allocation. For example, if the SMART Strategy recommends a 50% hedge, then it is long yen relative to the unhedged benchmark (of 0%), neutral to the 50% and short relative to the fully hedged (or 100%) benchmark.

A quick comment on benchmarks: when the benchmark is unhedged, the dynamic SMART approach can only add hedges; when the benchmark is fully hedged, the dynamic SMART approach can only “lift” or reduce hedges. Both of these are one-sided benchmarks (i.e., the dynamic action is to only unhedge/hedge as opposed to unhedge and hedge) and hence there will be periods when such strategies will not perform well. This would be the case when the yen is appreciating and in a fully hedged benchmark the best strategy would be to not deviate from the benchmark. In a more symmetric approach where the benchmark is 50% hedged and either increasing the hedge to 100% or reducing a hedge to 0%, a stronger yen would allow for additional purchases of yen.

For simplicity, we will develop Rules that capture the anomalies indicated above. The three most common approaches to developing smart currency models fall under the categories of Trend - exploiting the positive serial correlation; Carry - exploiting the tendency for low interest rate currencies to depreciate or in a different approach, favoring the currency where the long rates are rising rapidly; and Yield Curve – favor the currency with the highest momentum of 10-year rates (as indicating currencies that will attract capital because of rising

yields).[5] In addition Gao and Savickas (2005) indicate that the default premium and what they term idiosyncratic stock market volatility are useful predictors of currency. We will focus simply on the default premium.

In short, we will develop Rules that (a) favor the trending currency defined as the currency where the moving average over a short term window is greater than the moving average over a longer term window; (b) favor the currency with the higher short term interest rate; (c) favor the currency with the highest momentum of 10 year yields; and (d) favor yen when the US default premium is high relative to its mean and favor the dollar otherwise. These are very simple Rules and indicates that there can be much greater value and risk management from more complex Rules, but the intent of the paper is to show that even such simple Rules provide valuable performance and risk management and implu outperformance relative to the three benchmarks based on skill.

Objective: Our goal would be to ideally improve the performance of the dynamic SMART hedge relative to the passive static benchmark, but ideally also improve risk. We will define risk across various measures such as either lowering the volatility, worst single monthly performance, the ratio of good risk to bad risk[6] or even drawdown compared to a passive hedge. This is a bit more extensive than the simple approach of lowering volatility as some of these measures capture the risk of non-normal distributions but also includes measures more appropriate to principal-agent delegated transactions (which one can easily argue applies to investors and corporations).

In addition, using the measure developed in Muralidhar (2004) called "Confidence in Skill", we will examine how confident one can be that the performance generated by the SMART hedge is better than the naïve benchmark approach. In other words, this technique compares the excess return generated by any one rule or a combination of rules and normalizes for the difference in volatility between the active approach and the benchmark, the correlation between the two and the length of history. Other simpler measures used in the industry include the 'Success Ratio" or the number of non-negative months relative to

[5] Another approach exploits the tendency for currencies to be influenced away from the mean value because of differing inflation expectations. One of the simplest ways to capture this example is to make rules based on the slope of the Yield Curve and to favor currencies with the flattest slope (Acar and Middleton 2004)

[6] This measure captures the semi-deviation of positive events divided by the semi-deviation of negative events and gives an indication of the skew of the results. Ratios greater than 1 are good.

total months or what is called the “Hit Rate” in baseball. We ignore transactions costs as the amount of turnover is very low and currency trading typically in USD/JPY has a transaction cost of 1.5 pips. Therefore, unless turnover were meaningful, this should not affect the final result.

Data: Data utilized for this analysis is as follows: Spot data and 1-month LIBOR/TIBOR data was available from January 1990 – October 2006 from EcoWin Reuters. We use the spot and interest rate data to create a series of one-day forward contracts to calculate performance of the forward contracts. In addition, data on the 10-year yields are used as is the difference between Baa US bond yields and long term yields (to create the Default Premium).

Method and Time Window: We test these rules over the entire period and do not partition it for in-sample or out-of-sample testing as we have not optimized the formulae of either the Rules or weights of the Strategy. However, one could argue that Trend based rules can be based on data snooping as setting the long term and short term averaging period can be biased be total period performance. Since the attempt here is not to develop the Optimal policy, but rather to show that simple ideas beat a passive benchmark, we use a single period back test. In future research, we will create more optimized version of these Rules and partition data into sub-periods. The reason that no optimization is carried out is that we assume that Rules based on simple and different factors will tend to not be highly correlated and hence a simple equal weighting is adequate.

This data window covers appreciations of the yen (to its strongest point in 1995) and depreciations (dramatic in 1998 prior to the collapse of Long Term Capital) and hence is meant to represent reasonable currency cycles. However, as the spot rate chart 2 shows, the first period is marked by two pronounced appreciation and depreciation cycles, whereas the second period is marked by less volatility and more cycles. As a result, one should expect less pronounced performance in the second period as typically greater trending results in greater performance opportunities. This is where one could argue that optimized rules set based on first period data will fail to perform over the second period.

Results – Asset Management Perspective: Over this period, the spot rate from a yen perspective has declined by 1.13% annualized with a volatility of approximately 11% annualized (line 1 in Table 1),

whereas a portfolio of forwards to hedge the USD exposure would have generated -0.44% annualized return for 11.14% volatility (line 2 in Table 1). A 50% hedge of USD exposures would have generated a lower negative return and volatility at -0.07% annualized and 5.59% annualized, respectively (line 3 in Table 1). Needless to say, in the asset management perspective, an unhedged benchmark would have no return and volatility. One interesting result from the table is that the success ratio of the 100% hedge back into JPY had non-negative performance only 45% of the months over this window giving some hint as to why the “carry” trade is so popular and possibly leading to the conclusion that uncovered interest rate parity does not hold. However, the spot rate has a success ratio of 50% over the same period. The worst single month ranges from -14.5% for the spot rate to -10% from examining just the hedging contracts to be fully hedged and the worst drawdown can be quite large at -42% for fully hedged.

The table compares the performance of the three dynamic SMART strategies in isolation and then against their respective benchmarks. As shown in lines 4, 6 and 8, the performance of the three strategies in absolute terms in nearly the same as we use the same Rules weighted equally and the only difference is attributed to different starting points for each. In the case of full hedging, the dynamic SMART strategy (line 4) generated an annualized 1.22% for 4.76% annualized risk, indicating a dramatic value added of 1.66% annualized return (line 5) relative to a naïve monthly full hedge of USD exposures. In addition, the absolute annualized risk of the SMART hedge (4.76%) is substantially less than that of the naïve hedge (11.14%). Further, the drawdown is substantially lower on an absolute basis and the ratio of good risk to bad risk is higher. On a relative basis (line 5), 55% of the months have non-negative value-added and one can be 88% confident that this outperformance is skill-based and not noise.

		ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RETURN /RISK RATIO	WORST MONTH (%)	RATIO OF GOOD TO BAD RISK	WORST DRAWDOWN (%)	SUCCESS RATIO (%)	CONFIDENCE IN SKILL (%)
	BENCHMARKS								
1	SPOT RATE UNHEDGED	-1.13	10.94	-0.10	-14.5	0.81	-47.13	50.5	N/A
2	PORTFOLIO OF FORWADS FOR 100% HEDGING	-0.44	11.14	-0.04	-10.03	1.47	-42.2	45.54	N/A
3	PORTFOLIO OF FORWADS FOR 50% HEDGING	-0.07	5.59	-0.01	-5.11	1.47	-23.55	45.54	N/A
	DYNAMIC SMART STRATEGY								
	FULL HEDGING								
4	PORTFOLIO OF ACTIVE FORWARDS FOR FULL HEDGE	1.22	4.76	0.26	-4.2	1.52	-12.11		
5	RELATIVE TO BENCHMARK (2)	1.66	7.5	0.22	-9.39	0.86	-16.01	54.95	88.17
	50% HEDGING								
6	PORTFOLIO OF ACTIVE FORWARDS FOR 50% HEDGE	1.3	4.72	0.28	-4.2	1.56	-12.11		
7	RELATIVE TO BENCHMARK (3)	1.37	2.92	0.47	-4.63	1.05	-6.15	56.44	97.66
	UNHEDGED								
8	PORTFOLIO OF ACTIVE FORWARDS VS UNHEDGED	1.38	4.69	0.29	-4.2	1.08	-12.11		
9	RELATIVE TO BENCHMARK (NONE)	1.38	4.69	0.29	-4.2	1.08	-12.11	57.43	86.66

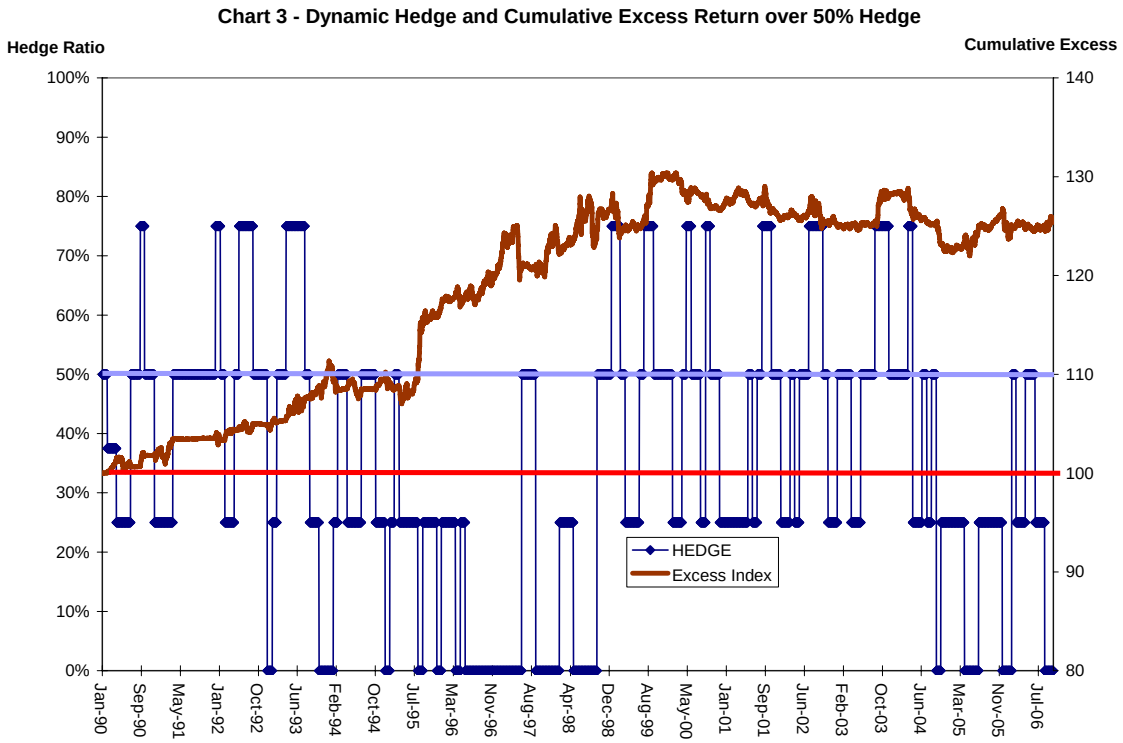
Table 1 – The Asset Management Perspective: Comparing Smart Management to Static Benchmarks

In the case of 50% hedging, the dynamic SMART strategy (line 6) generated an annualized 1.3% for 4.72% annualized risk, indicating a dramatic value added of 1.37% annualized return (line 7) relative to a naïve monthly 50% hedge of USD exposures. In addition, the absolute annualized risk of the SMART hedge (4.72%) is slightly lower than that of the naïve hedge (5.59%). In addition, the drawdown is substantially lower on an absolute basis (-23.55% vs -12.11%) and the ratio of good risk to bad risk is higher. On a relative basis (line 7), the ratio of excess return to risk is a very high 0.47 because of the symmetry of the benchmark. 56% of the months have non-negative value-added and one can be 97.6% confident that this outperformance is skill-based and not noise.

In the case of the unhedged benchmark, the dynamic SMART strategy (line 8) generated an annualized 1.38% for 4.68% annualized risk, indicating a value added of 13.8.% annualized return (line 9) relative to a naïve unhedge position. This is the case as the benchmark in this case implies doing nothing and hence the volatility of the dynamic SMART strategy is higher than the benchmark volatility. The drawdown

as a result is higher. On a relative basis (line 9), 57% of the months have non-negative value-added and one can be 86% confident that this outperformance is skill-based and not noise.

As shown in the above analysis, from an asset management perspective, the fully hedged benchmark is the most volatile and hence there is the greatest opportunity for reducing risk. However, the most symmetric benchmark, 50% hedged offers the best relative performance per unit of risk and also the highest confidence in skill.

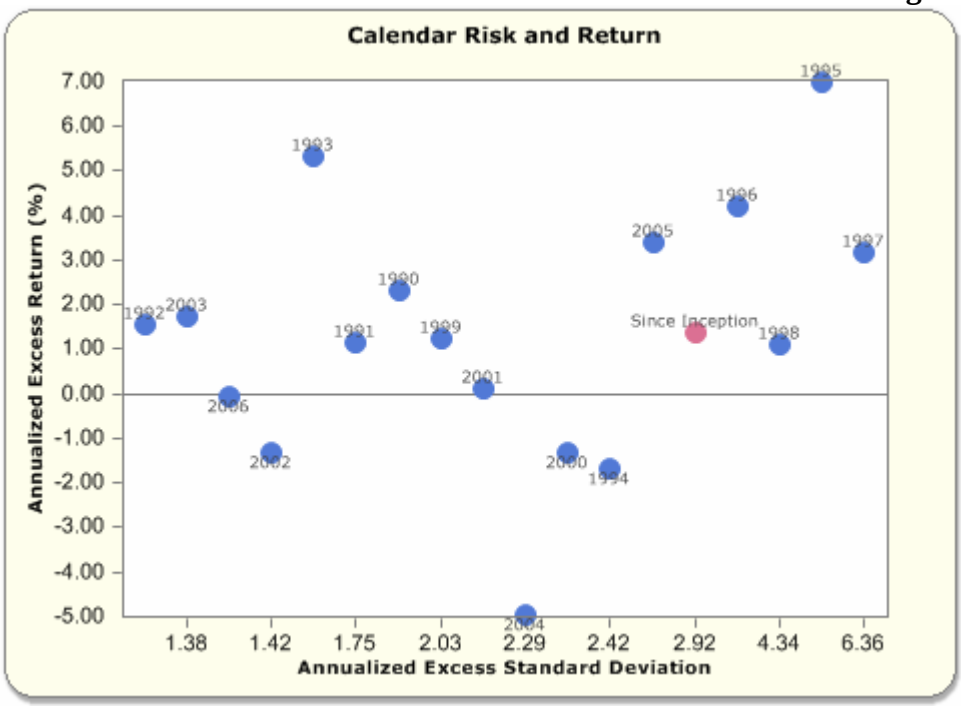


Source: AlphaEngine® - www.mcubeit.com

For completeness, in Chart 3, we show the dynamic allocation recommendations of the SMART approach relative to a 50% hedged benchmark (or any benchmark) over this window. We also show the cumulative growth of the excess returns on the RHS axis. Since interest rates in Japan have always been below US rates over this time period, the carry model is always short yen and long USD. Therefore, the Strategy has a maximum hedge of 75%. However, Chart 3 demonstrates when constantly being hedged or unhedged would be sub-optimal. We also show the annualized excess and relative risk of the SMART strategy relative to the 50% hedged benchmark in Chart 4.

It shows clearly the value of a dynamic hedge in managing currency risk.[7]

Chart 4 – Calendar Year Excess Return and Risk over a 50% Hedged Benchmark



Source: AlphaEngine® - www.mcubeit.com

Results – Corporate Management Perspective: The corporate management perspective integrates the spot risk with the currency hedging transactions and hence will give a different perspective. Since the spot rate and the forward hedge are highly negatively correlated, the risk profile of the benchmark changes dramatically.

Over this period, the spot rate from a yen perspective has declined by 1.13% annualized with a volatility of approximately 11% annualized (line 1 in Table 2), whereas a portfolio of forwards to hedge the USD exposure would have generated -0.44% annualized return for 11.14% volatility (line 2 in Table 2). However, as shown on line 3, since the two are negatively correlated, the combined profile has a negative return of -0.33% annualized, but a volatility of 1.04%. This is one reason why corporate Treasurers are glad to hedge currency risk as it can eliminate volatility of performance, even though the performance is negative.

[7] For Japanese corporations and pension funds, the fiscal year perspective may be more relevant, but will show the same profile of a fairly consistent outperformance.

From a corporate management perspective, the unhedged benchmark is the most volatile and hence offers the best potential for risk reduction (comparing the annualized risk of line 1 to line 11) and adds meaningful value of 1.78% annualized. The fully hedged benchmark has the lowest risk of 1.04% and while dynamic SMART management could add 0.77% annualized, this may not appeal to a Treasurer who is purely volatility focused. However, what the result shows is tht an intelligent Treasurer should realize that naïve hedging is giving up the potential to add value in a market with many non-profit participants and such value-added can add yen to the company bottom line with minimal effort.

The 50% hedged benchmark has lower volatility than the dynamic approach, but a return that is lower by more than 1%. The worst drawdown of the dynamic SMART strategy is better than the unhedged and partially hedged benchmarks but not better than the fully hedged benchmarks.

Table 2 – The Corporate Management Perspective: Comparing the SMART Strategy to Different Benchmarks.

		ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RETURN /RISK RATIO	WORST MONTH (%)	RATIO OF GOOD TO BAD RISK	WORST DRAWDOWN (%)	SUCCESS RATIO (%)	CONFIDENCE IN SKILL (%)
	BENCHMARKS								
1	SPOT RATE UNHEDGED	-1.13	10.94	-0.10	-14.5	0.81	-47.13	50.5	N/A
2	PORTFOLIO OF FORWADS FOR 100% HEDGING	-0.44	11.14	-0.04	-10.03	1.47	-42.2	45.54	N/A
3	SPOT + FULL HEDGED = (1) + (2)	-0.33	1.04	-0.32	-2.1	0.63	-21.62	56.3	N/A
4	PORTFOLIO OF FORWADS FOR 50% HEDGING	-0.07	5.59	-0.01	-5.11	1.47	-23.55	45.54	N/A
5	SPOT + 50% HEDGED = (1) + (4)	-0.61	5.55	-0.11	-6.97	0.83	-34.36	48.51	N/A
	ACTIVE OPTIONS								
	FULL HEDGING								
6	PORTFOLIO OF ACTIVE FORWARDS FOR FULL HEDGE	1.22	4.76	0.26	-4.2	1.52	-12.11		
7	SPOT + ACTIVE = (1) + (6)	0.47	7.47	0.06	-8.48	N/A	-31.13		
	50% HEDGING								
8	PORTFOLIO OF ACTIVE FORWARDS FOR 50% HEDGE	1.3	4.72	0.28	-4.2	1.56	-12.11		
9	SPOT + ACTIVE = (1) + (8)	0.57	7.5	0.08	-8.48	N/A	-31.13		
	UNHEDGED								
10	PORTFOLIO OF ACTIVE FORWARDS VS UNHEDGED	1.38	4.69	0.29	-4.2	1.08	-12.11		
11	SPOT + ACTIVE = (1) + (10)	0.65	7.53	0.09	-8.48	N/A	-31.13		

SECTION 6: EXTENSIONS AND LIMITATIONS

The purpose of this paper was to establish that investors and corporate treasurers are taking implicit bets when they select simple static currency hedging policies. By developing 4 simple Rules and combining them equally, the goal was to show that (a) the naïve benchmark could be outperformed with, ideally, risk reduction; and (b) by combining different rules on different factors, that the performance of the Strategy would diversify the risk of the dynamic SMART hedging program. In Table 3, we demonstrate the performance of the Unhedged Strategy (USD UNH SIM) and the Rules that compose the Strategy. First, every Rule (CAR = Carry; Def Prem = Default Premium; Mom = comparison of a short Moving Average vs a long Moving Average of USD/JPY; and Yld Mom = Yield Momentum) has positive performance. We can see that the strategy has an annualized return-to-risk ratio of 0.29, which is higher than any of the Rules that make up the strategy as is the case with the Ratio of Good Risk to Bad Risk. Similarly the Confidence in Skill is higher as well, and the Worst Single Negative Month of the Strategy is better than that of any Rule that makes up the Strategy. Finally, the Annual Turnover is just 100% or less than 10% every month and hence with costs of 1.5 pips (1/100 of a basis point), one can see that the value added would be preserved even after costs.

Table 3: Strategy = Diversified Combination of Rules

Performance Summary - Total Period

Name		Annualized Return	Annualized Standard Deviation	Annualized Return-Risk Ratio	Worst 'Single' Negative Performance	Ratio of Good/ Bad Risk	Maximum Drawdown	Confidence in Skill	Annual Turnover
Strategy									
USD UNH SIM	Excess	1.38%	4.69%	0.29	-4.2%	1.59	-12.11%	86.66%	93.07%
Rule									
USD UNH CAR SIM	Excess	0.49%	3.52%	0.14	-6.2%	0.42	-9.56%	69.2%	47.52%
USD UNH DEF PREM SIM	Excess	1.25%	7.54%	0.17	-6.14%	1.06	-22.47%	70.06%	11.88%
USD UNH MOM SIM	Excess	1.98%	7.96%	0.25	-5.58%	1.44	-13.24%	80.51%	285.15%
USD UNH YLD MOM SIM	Excess	1.39%	6.77%	0.21	-6.09%	0.96	-20.84%	76%	308.91%

Source: AlphaEngine® - www.mcubeit.com

The attached correlation table examines the static correlation of the excess returns of the various Rules in the Strategy over the 1990-2006 period. It demonstrates that each of the Rules is not highly correlated with the other Rules leading to the benefit of diversification across such factors. The correlation table is intentionally static for simplicity. One could calculate rolling correlations and use that as an input to dynamically weighting the Rules in the Strategy to further improve performance and risk management.

Table 4: Correlation among Rules and Strategies

Correlation

	USD UNH SIM	USD UNH CAR SIM	USD UNH DEF PREM SIM	USD UNH MOM SIM	USD UNH YLD MOM SIM
USD UNH SIM	1.00	0.36	0.78	0.87	0.71
USD UNH CAR SIM	0.36	1.00	0.00	0.24	0.22
USD UNH DEF PREM SIM	0.78	0.00	1.00	0.63	0.33
USD UNH MOM SIM	0.87	0.24	0.63	1.00	0.42
USD UNH YLD MOM SIM	0.71	0.22	0.33	0.42	1.00

Equally important, this is a single currency experiment and adding more currencies to a portfolio of exposures should ideally add more diversification dimensions and potentially improve the performance-to-risk profile. In addition, the Rules were made very simple in that they made recommendations just once a month, at month-end, and held for the entire month, but a more dynamic process given the low transactions costs, could update the dynamic SMART hedge more frequently than once a month to improve risk management.

The challenge however in managing cash flows is that the size of the flows can vary from month to month and we have assumed a constant exposure and that the rolls of transactions took place only at month end. In this approach, if a loss is sustained on a large cash flow and a series of gains experienced on a small cash flow, the net yen impact on the profit and loss can be negative. Further, in managing foreign investment exposures the future value to be hedged is uncertain as is the date of the receipt (as it depends on the return of the foreign asset in local currency) so there is the potential that if one sets the notional value of the hedge to the currency exposure, and this is the market convention, that at maturity of the contracts, the dynamic or static hedge may be in excess of the exposure, though this is a relatively small problem as with such small costs one can constantly manage the hedge size if they wanted to.

SECTION 7 – CONCLUSIONS

In this simple paper, we wanted to demonstrate that many Japanese investors and corporations are often taking an unintended risk when

they conduct business or invest abroad – namely, currency risk. This risk if unmanaged can impact performance and risks and hence many investors have applied naïve static hedging policies. The academic literature on currency management has identified many anomalies in the currency market but still have proposed relatively naïve hedging policies. We demonstrate through a simple example with USD exposures that capturing these anomalies through simple Rules that change the recommended hedge dynamically based on easily observed current market factors can lead to better performance and risk management than a naïve static hedge. More important, combining some simple Rules in a very simple way to create a dynamic SMART strategy can lead to diversification of performance of the combination, in turn leading to better performance per unit of risk, where risk can be defined in many different ways (worst single month, worst drawdown, ratio of good risk to bad risk). We used the exact same Strategy for various benchmark choices (unhedged, 50% hedged and fully hedged) and showed that from an asset management perspective, the fully hedged option had the highest volatility and potential for volatility reduction, whereas the 50% hedged mandate gave the most symmetric opportunity set and best relative return per unit of risk. The corporate management perspective finds that by adding back the risk of the spot exchange rate that the fully hedged benchmark has the lowest volatility and that the unhedged perspective which is what most accounting measures would support is the most volatile. In short, regardless of benchmark and composition of currency exposures, effective financial management of foreign transactions requires clients to develop such dynamic SMART approaches as the currency market has unique inefficiencies. Not exploiting such anomalies and engaging in naïve static hedging is effectively lending one's balance sheet for other participants to exploit as shown in this paper.

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