NEUBERGER BERMAN

UGO LANCIONI
Senior Portfolio Manager
Head of Global Currency

FREDRIK REPTON
Portfolio Manager
Global Currency

NIKOLA PETROVIC, CFA
Associate Portfolio Manager
Investment Grade Fixed Income

APRIL 2016

MANAGING CURRENCY RISK: AN OPPORTUNISTIC FRAMEWORK FOR INSTITUTIONAL PORTFOLIOS

Rising volatility in currency markets is reawakening interest in currency hedging. But traditional approaches to hedging have their drawbacks: "static" approaches are backward-looking and cannot be opportunistic, while "active" approaches are not genuinely integrated into underlying portfolio exposures. In this paper we describe our concept of the "dynamic ideal hedge ratio", which aims to use currency hedging to maximize the expected risk-adjusted return profile of each client's entire portfolio, on an ongoing and opportunistic basis. We believe this represents the next step in currency hedging.

AT A GLANCE

- Foreign currency fluctuations (FX risk) are becoming a critical variable for investors as portfolios internationalize and currency markets become more volatile
- Traditional approaches to FX hedging are sub-optimal:
  - "Static" hedging is backward-looking
  - "Active" hedging can add a good source of alpha but is not necessarily related to underlying portfolio risk
- This paper presents the "Dynamic Ideal Hedge Ratio" (DIHR):
  - Identifies the hedge ratio that, at any point in time, maximises expected overall portfolio efficiency
  - Utilizes forward-looking assessments of underlying currency risk in the portfolio
  - Incorporates swings in valuations, hedging costs and the diversification benefits of foreign currencies to provide regular opportunities to adjust the hedge ratio
- "Best of both worlds": an opportunistic approach that is genuinely integrated into the overall portfolio construction process
- A simplified simulation of the DIHR approach improves the risk-adjusted return of a global equity portfolio held by investors in six different major base currencies, between 2003 and 2015
- Positive effect on whole-portfolio risk-adjusted return regardless of whether base currency is "pro-cyclical" or a "safe haven"

CURRENCY MANAGEMENT MATTERS

Most investors today turn to international assets for extra return potential and diversification. Over the very long term the impact of the foreign-currency exposures that come with those holdings tends to be quite small, but substantial deviations from fair value can build and persist for months and years: over these periods, currency management matters.

Imagine, for example, a USD-based investor allocating unhedged to the MSCI World Index in early 2003. By late 2007 that investor had enjoyed an extra 24 percentage points of return over the hedged index (or 2.8 percentage points annualized), thanks to strengthening foreign currencies. On the other hand, it would have regretted not hedging when capital rushed to the safety of the U.S. dollar during the global financial crisis. Conversely, a fully-hedged EUR-based investor would have outperformed unhedged investors for the years leading up to the financial crisis but given nearly all of that back over the following 16 months.

No-one is forced to take these exposures, as hedging can be implemented easily. Every institutional investor should, therefore, ask how they intend to deal with them. Until now, most investors have followed one of five traditional approaches:

1. Remaining unhedged
2. Hedging 100% of their exposure **"passively"**
3. Part-hedging their exposure (50%, for example)
4. Employing a **"static"** strategic hedge ratio determined by the historical relationship between the underlying portfolio and its foreign currency exposures (a refined version of the part-hedged solution above)
5. Hedging statically with an additional **"active"** strategy that exploits pure alpha-generating opportunities

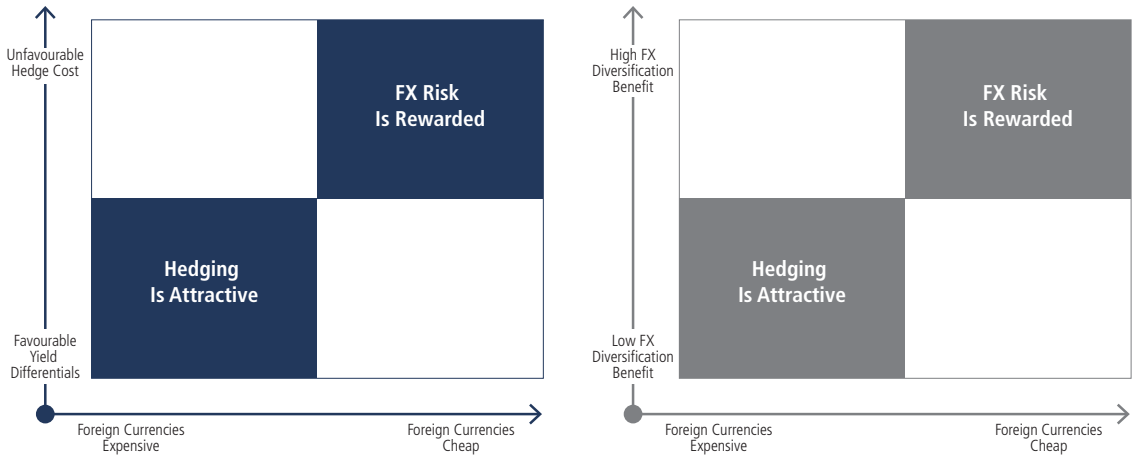
We believe all five approaches have substantial drawbacks (figure 1). Staying unhedged involves unrewarded risk, but a full hedge can be very expensive. A "static" strategic hedge ratio has the advantage of properly integrating foreign-currency risks into the whole-portfolio construction process, but remains non-opportunistic and backward-looking. The "active" approach adds an opportunistic element, but one which is not integrated into the broader portfolio construction process. We believe the optimum approach would be dynamic and opportunistic, but also fully-integrated into the underlying portfolio: we call it the "dynamic ideal hedge ratio".

FIGURE 1: TRADITIONAL HEDGING STRATEGIES HAVE SUBSTANTIAL DRAWBACKS

Program	Description	Advantages	Common Justifications	Our View
Unhedged	Foreign currency exposures left intentionally unhedged.	Zero hedging costs incurred.	"Over the long term currency valuations revert to the mean—it all comes out in the wash." "Foreign currency risk is a diversifier against my underlying assets."	Valuations do mean-revert, but in the meantime foreign currencies are a source of uncompensated risk that can increase overall portfolio volatility dramatically. And why would an investor who believes in mean reversion not take advantage of large swings around fair value to hedge at attractive levels? Currency risk can amplify underlying-asset risk as well as diversify it, and even when it diversifies the effect is rarely strong enough to justify a completely unhedged exposure.
Fully-Hedged ("Passive")	All foreign currency exposures are hedged back to the investor's base currency.	Completely removes foreign currency risks.	"Foreign currency exposures are an unrewarded risk that adds volatility to my portfolio."	True, but not at all times. Hedging in full at all times can be very expensive, and foregoes potential outperformance and diversification benefits from intentional foreign currency exposures.
50% Hedged	Only half of the foreign currency exposures are hedged.	Removes part of the foreign currency risk while maintaining some exposure to beneficial foreign currency moves.	"I cannot predict currency returns, and this is my 'least-regret' solution."	This could be a suitable solution for those without the resources or time to develop a proper strategy, but there is little economic justification for it.
Static Hedge Ratio	A more sophisticated version of the solution above: A permanent, static hedge ratio is set between 0% and 100% of foreign currency exposure, usually based on mean-variance optimization using historical returns data from the currency markets and the underlying assets.	The optimal solution based on long-term historical currency-market performance and correlation trends.	"Once the appropriate policy benchmark has been determined there is little reason to review it."	Using historical return, volatility and correlation data to determine the static hedge ratio may not be optimal for the future—correlations in particular can be very unstable. A static hedge ratio does not adapt to changes in these relationships.
Static Strategic Hedge Ratio with Active Management	A permanent, static hedge ratio is set between 0% and 100% of foreign currency exposure, and that ratio is varied, within tracking-error limits, using a pure return-seeking currency strategy.	Adds flexibility to exploit pure alpha-generating opportunities.	"A static hedge ratio doesn't allow me to exploit potential excess-return opportunities in the currency markets but an active manager may."	True, but the active strategies deployed to vary the hedge ratio are pure return-seeking strategies that bear little relation to the investor's objectives or underlying risk exposures, and which generate substantial exposure to the currency manager's style biases and market views.

Source: Neuberger Berman.

FIGURE 2: THE HEDGE RATIO DECISION SHOULD BE A TRADE-OFF BETWEEN FOREIGN CURRENCY VALUATION, HEDGING COSTS AND DIVERSIFICATION BENEFITS



INTRODUCING THE DYNAMIC IDEAL HEDGE RATIO

Defining the ideal level of currency risk in a portfolio should be an opportunistic decision taken in the context of the broader portfolio asset allocation. In other words, the goal should be to take the level of currency risk that is *satisfactorily rewarding for the overall portfolio at any point in time.* We believe this risk-reward assessment should be based on three main pillars:

- **Valuation:** Ideally an investor would increase its hedge ratio when foreign currencies are overvalued, and vice versa.
- **Cost**: Hedging costs change over time, however, and therefore the investor would also want to increase the hedge ratio when foreign currency yields are lower than the base currency yield.
- **Portfolio Efficiency:** The investor should also be mindful of the interaction between foreign currency risk and the underlying portfolio assets. It should prefer to decrease the hedge ratio when foreign currency risk is expected to diversify underlying returns, and increase it when foreign currencies add too much uncompensated volatility to the portfolio.

In summary, extreme foreign currency overvaluation, cheap hedging costs and a small diversification benefit from foreign currency risk should point to a higher hedge ratio—and vice versa (figure 2).

To arrive at the dynamic ideal hedge ratio we start by isolating the return components available to investors. Solely for the purposes of this discussion, we will refer to each of these three return components as three distinct "securities" in a portfolio construction process:

1. The returns of the foreign currency exposures that come with holding the assets, against the investor's base currency
2. The returns or costs (negative returns) of hedging those foreign currencies back to the base currency (i.e. the aggregate yield differential)
3. The returns of the underlying assets priced in their local currencies, disregarding any currency-translation effect

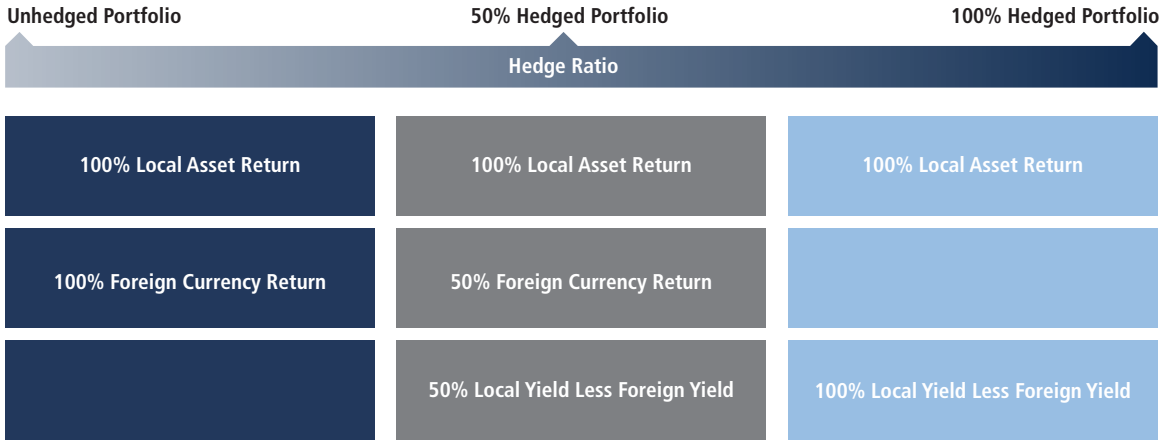
As figure 3 shows, all international investors hold at least two of these "securities". An unhedged investor holds the underlying assets in local currency terms and the foreign currency basket; a hedged investor holds the underlying assets in local currency terms and the cost of hedging the foreign currency basket. A partially-hedged investor holds some combination of the foreign currency basket and the cost of hedging those currencies (half and half for the investor that is 50%-hedged), on top of the underlying assets in their local currencies.

The starting point for portfolio construction should be to assign a level of expected return, and a level of dispersion around that expectation, for each of these "securities".

First let us discuss the foreign currency returns. Any view on the valuation of a currency implies a forward-looking expectation. On which basis should we form this view? While it is widely agreed that purchasing power parity ("PPP") does not hold as a guide to fair value of nominal exchange rates in the short run, when many other forces are at play, research has shown that exchange rates do revert towards PPP levels in the long run.[1] Our experience suggests that adjustments from valuation misalignments can have a major impact on international portfolio allocations and returns, and therefore a proper assessment of "valuation swing risks" is probably the most important strategic decision when setting hedge ratios. As such, when estimating the expected return of foreign currencies over a long time horizon we believe a fundamental value strategy

[1]John Bilson claimed that currency trading strategies based on PPP were profitable as early as 1984: "Purchasing Power Parity as a Trading Strategy", Journal of Finance (July 1984). Evidence of long-run reversion to PPP levels is discussed in, for example, Peter Anker, "Uncovered Interest Parity, Monetary Policy and Time-Varying Risk Premia", Journal of International Money and Finance (December 1999); and Lucio Sarno and Mark P. Taylor, The Economics of Exchange Rates (Cambridge University Press 2002).

FIGURE 3: EVERY INVESTOR HOLDS AT LEAST TWO OF THESE THREE PORTFOLIO "SECURITIES"



Source: Neuberger Berman.

should be employed, rather than a technical or momentum-based strategy that may not have fundamental economic justifications. In our approach, we take into account the extent to which currencies deviate from long-term fair value as well as the length of time that they have spent in mis-valued territory.

Now let us turn to hedging returns/costs. As we have noted, the difference between foreign- and base-currency yields fluctuates, consistent with the evolution of relative growth and inflation in the economies underlying each currency. A forward-looking assessment of these fluctuations is necessary to define the expected cost of hedging: a natural starting point would be the expectations implied in the short end of the respective currencies' yield curves.

Having established a forward-looking estimate for currency returns and hedging returns/costs, we need to integrate these with a forward-looking view on underlying portfolio assets, the third of our "securities": this view could be based on the investors' own expectations, or on neutral indicators such as bond yields or long-term economic growth expectations. We use a Black Litterman-based optimization to combine the three "securities" at weights that maximize the expected return-to-risk ratio of the *overall portfolio.*[2]

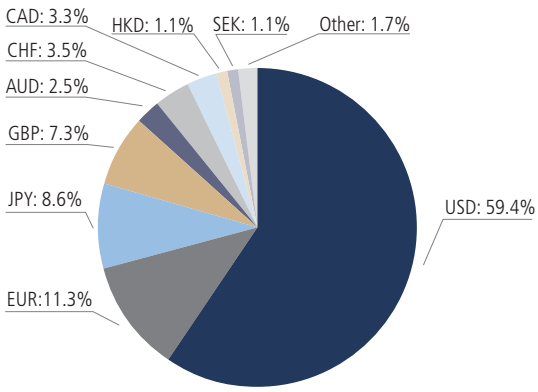
The behaviour and interaction of these "securities", their volatilities and correlations, change over time. For that reason the ideal hedge ratio should be re-assessed regularly, ensuring that the process is dynamic and opportunistic as market conditions evolve. This marks it out against a "set-and-forget" static hedge ratio.

We believe this process can transform the unrewarded currency risks from an asset allocation process into potentially rewarded risks. Indeed, it is curious that investors put so much time and effort into making sure asset-portfolio risk is rewarded, by generating forecasts and confidence levels for those portfolios and acting upon them, while neglecting to do the same with their foreign-currency "portfolios". To paraphrase John Maynard Keynes: "When the facts change, I change my hedge ratio. What do you do?"

CASE STUDY: APPLYING THE DYNAMIC IDEAL HEDGE RATIO TO A WIDELY-USED GLOBAL EQUITY INDEX

Here we apply our approach to the MSCI World Index, from the perspective of a USD- and a EUR-based investor, to show how the three main elements of valuation, cost of hedging and diversification presented different hedging opportunities over the past 15 years. We also show the potential impact of the implied dynamic ideal hedge ratio on risk and return, before expanding those findings to a range of investors with different base currencies. Our aim is to illustrate the significant efficiency improvements our proposed approach can bring to a global portfolio.

FIGURE 4: THE CURRENCY EXPOSURES OF THE MSCI WORLD INDEX



Source: MSCI. Data as of 29 February 2016.

[2]See Wai Lee, Bobby Pornrojnangkool and Alexandre Schutel Da Silva, "The Black-Litterman Model for Active Portfolio Management", *Journal of Portfolio Management* (Winter 2009); Fischer Black and Robert Litterman, "Global Portfolio Optimization", *Financial Analysts Journal* (September 1992).

An investor in the MSCI World Index takes on the currency exposures shown in figure 4. Once we have decomposed the returns to the index into our three "securities" we can show the evolution, over 15 years, of the opportunities and risks they present (figure 5):

1. **Valuation opportunities:** The foreign currencies in the index occasionally reached mis-valuations of more than 20 percentage points, providing opportunities to adjust the hedge to exploit attractive market levels.
2. **Yield differential opportunities:** Hedging returns/costs are shown to be favourable/unfavourable over time as yield differentials fluctuated between positive and negative.
3. **Diversification opportunities:** The underlying assets are shown to have had positive diversification benefits against the foreign currency exposures from time-to-time, especially for the EUR-based investor.

We can then show the resulting ideal hedge ratio through time—the portion of foreign currency exposure that, when hedged, maximizes the expected risk-adjusted return of the overall portfolio. In this example we optimize the hedge ratio once a month at prevailing exchange rates. Because this is an historical exercise we defined our uncertainty levels consistent with past volatilities.

Figure 6 shows that a USD-based investor following this approach would have been hedged during most of the timeframe, which fits with the fact that the dollar was relatively cheap between 2004 and 2014, and the limited diversification benefit from being unhedged. Note, however, that the ideal hedge ratio rapidly declined to zero as the dollar became more expensive after 2014.

Conversely, a EUR-based investor would have employed a relatively low hedge ratio most of the time. The euro was expensive relative to other currencies between 2006 and 2014, at which point it declined sharply, partly as a result of expectations of aggressive ECB balance sheet expansion. Until then, the portfolio diversification benefit of leaving some foreign currency unhedged was still high.

In this analysis we have allowed the hedge ratio to maximize overall portfolio efficiency without constraints, but the magnitude of the deviations can easily be controlled by introducing tracking error limits relative to a reference benchmark of choice.

Why Don't Investors Hedge Dynamically Already?

Currency-hedging decisions have often been surprisingly "cultural", based on investors' past experience rather than any forward-looking, objective assessment of the potential impact of currency risk on their portfolios. As a result very few review their hedge ratios as long as they are "working". Instead they tend to re-examine their hedging policies after significant adverse currency events—losses or missed opportunities.

For example, the last time there was a major, sustained strengthening in the U.S. dollar was during the late 1990s, when most U.S. institutional investors did not worry too much about hedging because their portfolios were still largely domestic. The 2002–2007 period just happened to be one of U.S. dollar weakening, with the result that still-unhedged U.S. investors enjoyed very favourable returns as their (increasing) allocations to foreign assets appreciated in U.S. dollar terms. But that policy was very painful when capital rushed into the dollar during the financial crisis.

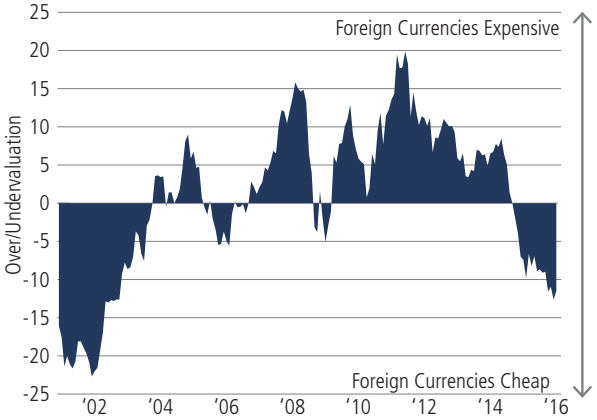
By contrast, large Australian institutions have traditionally been more receptive to hedging strategies because their small domestic markets made them early adopters of international investing. And yet because the Australian dollar has behaved as a strongly pro-cyclical currency over the years, Australian investors would have often benefited from leaving their exposure to other major foreign currencies unhedged: those exposures have generally diversified against underlying risk assets because selling the Australian dollar has often been a proxy for selling risk.

Anecdotally, these habits of thought have begun to shift as unhedged USD-based investors' have been adversely affected by dollar appreciation and EUR-, AUD- and JPY-based investors begin to explore approaches that can dial foreign-currency risk up and down opportunistically.

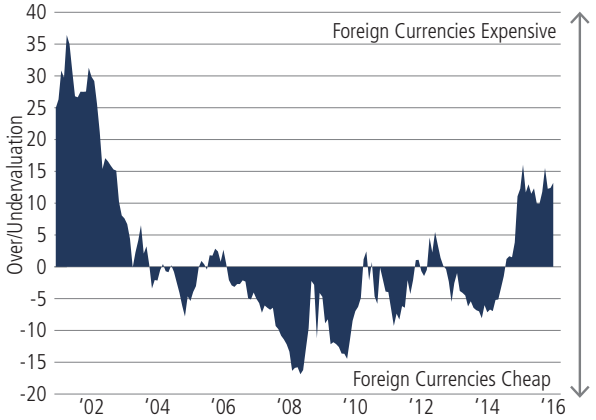
However, these are still only the first steps towards a genuinely integrated and efficient approach to dealing with foreign-currency exposures. Despite spending significant resources and time constructing efficient global asset portfolios, foreign-currency exposures are usually not included among the core asset allocation decisions. Dealing with them remains an afterthought, at best. Genuinely integrated and dynamic currency-hedging programs, designed to take advantage of changing market conditions, deserve a proper place on the agenda.

FIGURE 5: THE DYNAMIC IDEAL HEDGE RATIO SEEKS TO EXPLOIT FLUCTUATIONS IN VALUATIONS, COST OF HEDGING AND DIVERSIFICATION BENEFITS OF THE FOREIGN CURRENCY EXPOSURES

Estimated Relative Valuation of The Foreign Currency Exposures of The MSCI World Index From The Perspective of a USD-based Investor

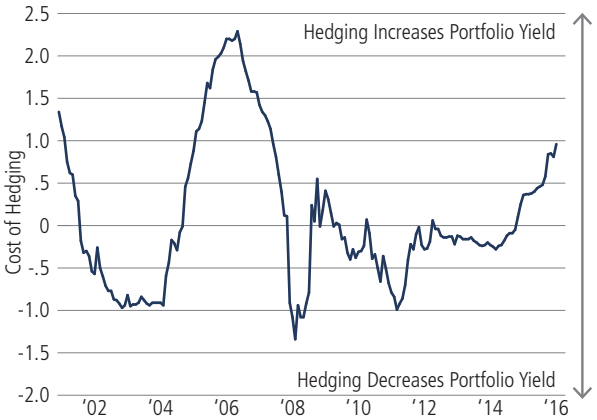


Estimated Relative Valuation of The Foreign Currency Exposures of The MSCI World Index From The Perspective of a EUR-based Investor

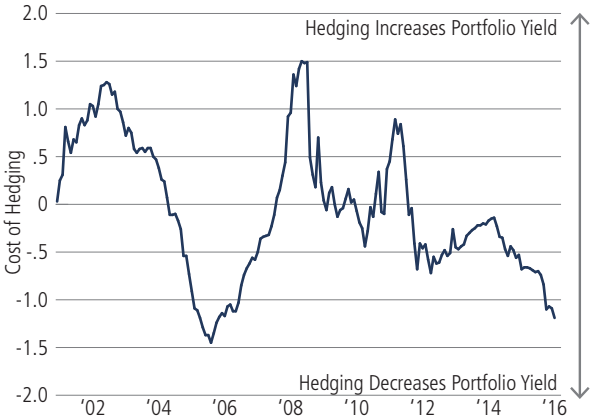


Source: Bloomberg, MSCI, Neuberger Berman calculations. Data as at 29 February 2016. The foreign currency long-term valuation indices are calculated as the inflation differential adjusted currency return against a weighted basket of the foreign currencies. The valuations take into account the portfolio management team's views on the relative values of the foreign currencies, which are subject to change.

Cost of Hedging The Foreign Currency Exposures of The MSCI World Index For a USD-based Investor

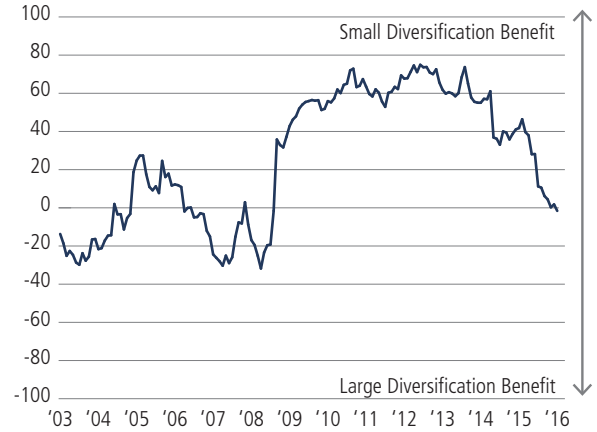


Cost of Hedging The Foreign Currency Exposures of The MSCI World Index For a EUR-based Investor

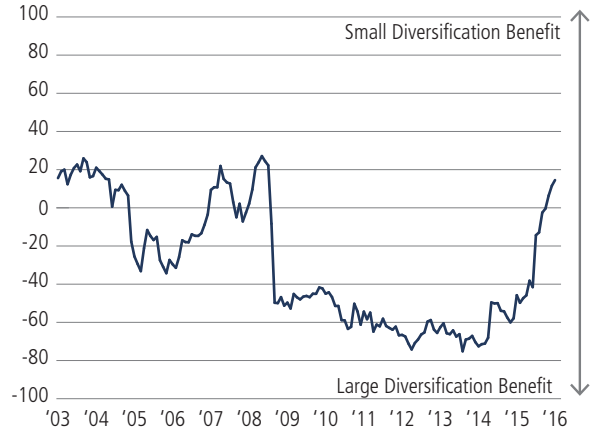


Source: Bloomberg, MSCI, Neuberger Berman calculations. Data as at 29 February 2016. The cost of hedging is calculated as the weighted basket of the cost of hedging of the individual foreign currencies. The cost of hedging takes into account the implied interest rate differential of the foreign currencies.

Rolling Correlation Between The Foreign Currency Exposures And Underlying Assets From The Perspective of a USD-based Investor

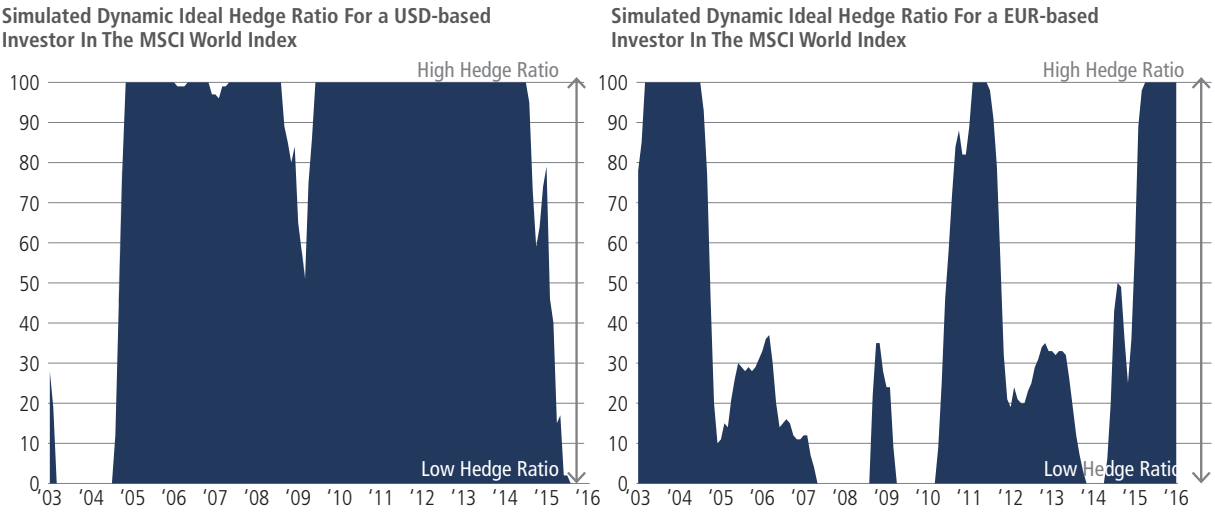


Rolling Correlation Between The Foreign Currency Exposures And Underlying Assets From The Perspective of a EUR-based Investor



Source: Bloomberg, MSCI, Neuberger Berman calculations. Data as at 29 February 2016.

FIGURE 6: THE DYNAMIC IDEAL HEDGE RATIO REFLECTS THE TRADE-OFF BETWEEN VALUATION, COST OF HEDGING AND DIVERSIFICATION BENEFITS



Source: Bloomberg, MSCI, Neuberger Berman Europe Limited calculations. Data as at 29 February 2016.

IMPACT ON PORTFOLIO RISK-ADJUSTED RETURNS

Figure 7 shows the performance that would have been obtained by applying this ideal hedge ratio. For comparison we have also added the performance of the MSCI World Index unhedged, fully-hedged and 50%-hedged. Using this dynamic ideal hedge ratio the USD-based investor would have enjoyed almost 15 percentage points of extra return over the unhedged index (60 basis points annualized), and the EUR-based investor more than 18 percentage points (70 basis points annualized).

Simple alpha generation is not the primary goal of the strategy, however. By far the most important contributor to this overall success is the fact that the dynamic ideal hedge ratio substantially improves both the Sharpe and Sortino Ratio of the overall portfolio returns. The scatter plots in figure 7 illustrate the marked improvement in risk-adjusted return relative to any other static hedge ratio, highlighting the efficiency enhancement of the framework.

It is also notable that we see very similar improvements in risk-adjusted return for both EUR- and USD-based investors, despite these two currencies behaving very differently in relation to the underlying assets. This can be seen in the scatter-plot curves associated with the various static hedges. Consider how much better the risk-adjusted return becomes for a EUR-based investor as it lowers its static hedge ratio (down to around 20–30%). There was no such improvement for the USD-based investor. Over the timeframe observed Europeans leaving their international portfolios unhedged generally enjoyed currency returns that were negatively correlated with their underlying assets. It is this diversification benefit that we see in the shape of the static-hedge curve.

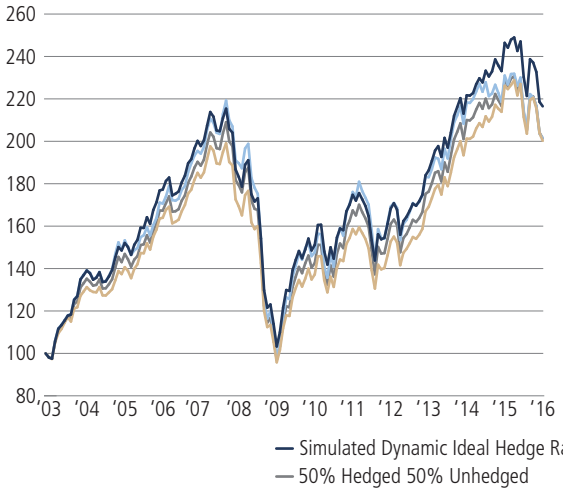
Figure 8 expands this idea by showing the 10-year correlation between the underlying asset and the return to the foreign currency exposures from the perspective of six different investors. For some, such as AUD- and CAD-based investors, adding exposures to foreign currencies would have diversified the overall portfolio due to negative correlations, just as they did for the EUR-based investor.

Does the efficacy of the dynamic ideal hedge ratio differ depending on whether the base currency is pro-cyclical or a safe haven? In our view, it does not. Our test results for six different major base currencies all show substantial improvements in both Sharpe and Sortino ratios (see our summary results in figure 10, page 11).[3] This is intuitive, because, as the name suggests, the dynamic ideal hedge ratio is frequently adjusted to capture opportunities and reflect changing markets (in all of these examples it is adjusted monthly): therefore it does not assume the persistence of long-term currency dynamics, which can break down or even reverse.

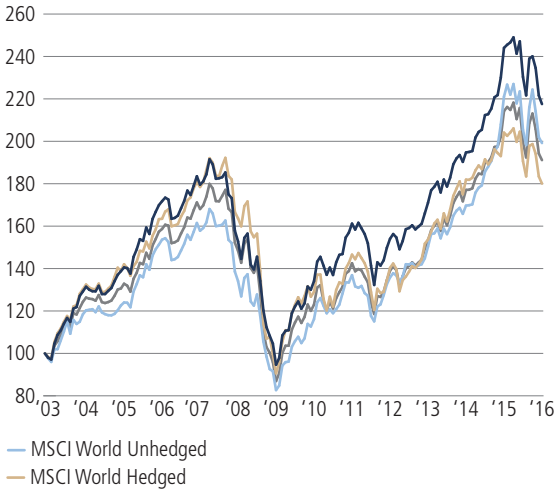
[3]It is worth noting that we have also tested this strategy on a much more complex, real-world investment portfolio, with around 50% in equities, 15% in fixed income and 35% in various real-asset and alternative strategies. Some 70% of this portfolio was denominated in the base currency, and 19 currencies accounted for most of the rest of the exposure—including some emerging-market currencies whose large interest rate differentials translate into very high hedging costs. Over a 15-year testing period, the program using the dynamic ideal hedge ratio added 0.08 points to the Sharpe ratio and 0.12 points to the Sortino ratio, relative to leaving the portfolio unhedged. It is the case that the approach is less likely to work well when the base currency's valuations are particularly subject to large capital flows and less likely to be responsive to central bank policy. Nonetheless, the framework is robust in its own right, and can of course be complemented with an active approach to exploit these shorter-term forces.

FIGURE 7: AGAINST THE 0%, 50% AND 100%-HEDGED SOLUTIONS, THE DYNAMIC IDEAL HEDGE RATIO WOULD HAVE IMPROVED NOT ONLY RETURN…

MSCI World Index Returns To a USD-based Investor Under Different Hedging Programs

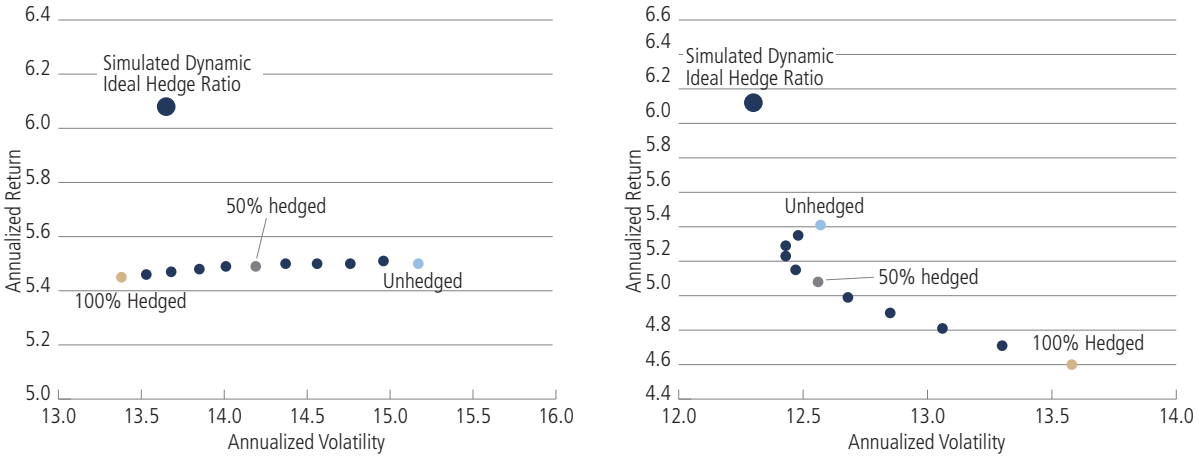


MSCI World Index Returns To a EUR-based Investor Under Different Hedging Programs



… BUT ALSO RISK-ADJUSTED RETURN

MSCI World Index Return and Volatility To a USD Investor (Left) and a EUR Investor (Right) Under Different Hedging Programs

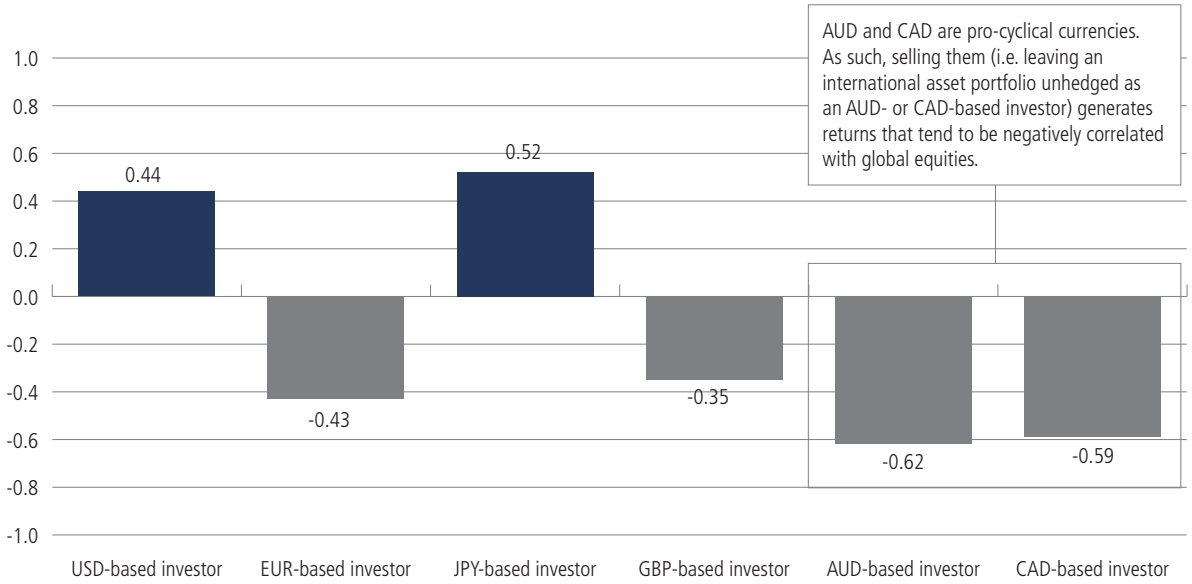


Source: Bloomberg, Neuberger Berman calculations. The simulated backtested performance of the Dynamic Ideal Hedge Ratio approach has been calculated by applying the Dynamic Ideal Hedge Ratio to the underlying index on a monthly basis at month end. Figures are quoted gross of fees in U.S. dollars and euros. The returns presented reflect hypothetical performance an investor would have obtained had it invested in the manner shown and does not represent returns that any investor actually attained. The information presented is based upon the following hypothetical assumptions. Certain of the assumptions have been made for modelling purposes and are unlikely to be realized. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the returns have been stated or fully considered. Changes in the assumptions may have a material impact on the hypothetical returns presented. Returns are gross of tax and fees and include average expected currency transactions costs over time. **Past performance does not guarantee future results.**

Figure 9 shows how different the current dynamic ideal hedge ratio is for six major currencies today, but also the extent to which it has changed for most of them, over just one year. It is also interesting to note how the hedge ratio for a USD-based investor has fallen from 79%-hedged to completely unhedged, while the hedge ratio for all other currencies has increased. This comes as a result of the sharp currency swings of 2014–15, largely dollar-driven, which have changed the opportunity set in the relative-valuation framework.

FIGURE 8: DIFFERENT BASE CURRENCIES HAVE SHOWN VERY DIFFERENT LONG-TERM CORRELATIONS WITH UNDERLYING RISK ASSETS

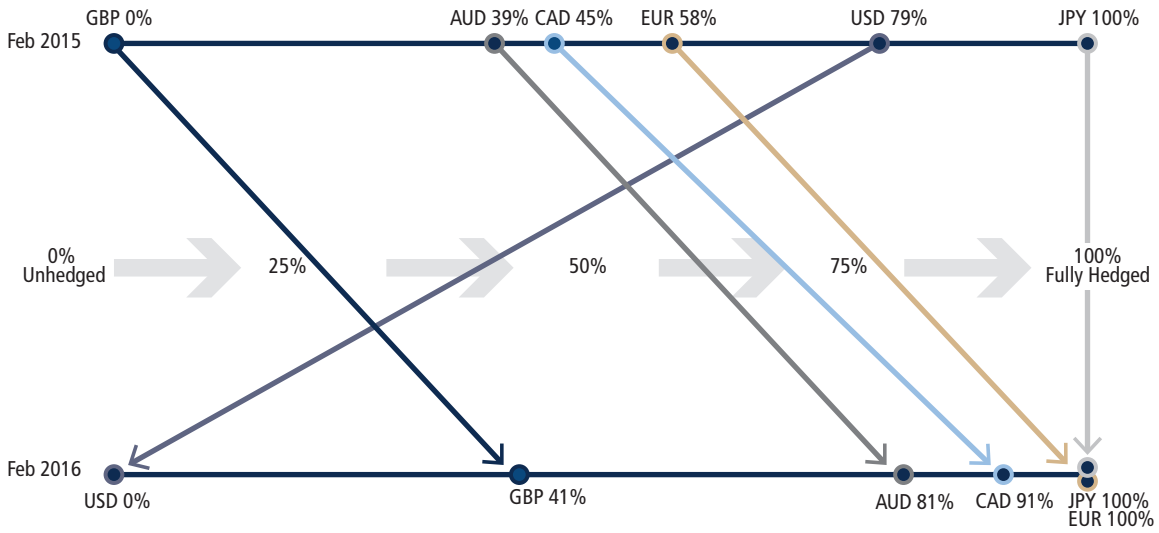
10-year correlation between returns to the MSCI World Index in local-currency terms, and returns to selling the investor's currency against the weighted basket of MSCI World Index foreign currencies



Source: Bloomberg, MSCI, Neuberger Berman calculations.

FIGURE 9: AN INTEGRATED AND OPPORTUNISTIC CURRENCY HEDGING FRAMEWORK

Change In The Simulated Dynamic Ideal Hedge Ratio Between February 2015 And February 2016, For Six Base Currencies



Source: Bloomberg, MSCI, Neuberger Berman Europe Limited calculations. Data as at 29 February 2016.

FIGURE 10: SUMMARY RISK-ADJUSTED RETURN RESULTS FOR MSCI WORLD INDEX INVESTORS BASED IN SIX MAJOR CURRENCIES

		Simulated Dynamic Ideal Hedge Ratio	MSCI World Hedged to Base Currency	MSCI World Unhedged in Base Currency	50% Hedged 50% Unhedged
For a USD-based Investor	Annualised Return	6.1%	5.5%	5.5%	5.5%
	Annualised Volatility	13.6%	13.4%	15.2%	14.2%
	Return / Risk Ratio	**0.45**	**0.41**	**0.36**	**0.39**
	Sortino Ratio	**0.56**	**0.51**	**0.45**	**0.48**
For a EUR-based Investor	Annualised Return	6.1%	4.6%	5.4%	5.1%
	Annualised Volatility	12.3%	13.6%	12.6%	12.6%
	Return / Risk Ratio	**0.50**	**0.34**	**0.43**	**0.40**
	Sortino Ratio	**0.68**	**0.40**	**0.58**	**0.51**
For a JPY-based Investor	Annualised Return	4.5%	4.1%	5.0%	4.7%
	Annualised Volatility	14.3%	13.3%	18.8%	15.7%
	Return / Risk Ratio	**0.32**	**0.31**	**0.27**	**0.30**
	Sortino Ratio	**0.42**	**0.40**	**0.33**	**0.37**
For a GBP-based Investor	Annualised Return	7.6%	5.7%	6.8%	6.4%
	Annualised Volatility	13.0%	13.6%	13.1%	12.9%
	Return / Risk Ratio	**0.59**	**0.42**	**0.52**	**0.49**
	Sortino Ratio	**0.80**	**0.51**	**0.71**	**0.62**
For a AUD-based Investor	Annualised Return	7.8%	7.4%	3.9%	5.8%
	Annualised Volatility	12.8%	13.7%	11.2%	11.2%
	Return / Risk Ratio	**0.61**	**0.54**	**0.35**	**0.52**
	Sortino Ratio	**0.73**	**0.62**	**0.53**	**0.68**
For a CAD-based Investor	Annualised Return	6.2%	5.1%	4.9%	5.1%
	Annualised Volatility	11.2%	13.6%	11.3%	11.8%
	Return / Risk Ratio	**0.56**	**0.37**	**0.44**	**0.43**
	Sortino Ratio	**0.73**	**0.44**	**0.59**	**0.52**

Source: Bloomberg, Neuberger Berman calculations. Period under review is January 2003 to December 2015. The simulated backtested performance of the Dynamic Ideal Hedge Ratio approach has been calculated by applying the Dynamic Ideal Hedge Ratio to the underlying index on a monthly basis at month end. Figures are quoted gross of fees. The returns presented reflect hypothetical performance an investor would have obtained had it invested in the manner shown and does not represent returns that any investor actually attained. The information presented is based upon the following hypothetical assumptions. Certain of the assumptions have been made for modelling purposes and are unlikely to be realized. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the returns have been stated or fully considered. Changes in the assumptions may have a material impact on the hypothetical returns presented. Returns are gross of tax and fees and include average expected currency transactions costs over time. **Past performance does not guarantee future results.**

AN INTEGRATED AND OPPORTUNISTIC CURRENCY HEDGING FRAMEWORK

Institutional investors worldwide are implementing increasingly globally-diversified portfolios at a time of big trends and heightened volatility in currency markets. A combination of these two factors is causing a rethink of currency hedging policies and triggering a renewed interest in currency solutions.

In our view the traditional approaches are unlikely to meet investors' requirements efficiently. Being fully-hedged removes foreign currency risk, but the cost can sometimes be detrimental to performance. Static hedging policies based on historical optimizations tend to fail as market conditions change over time. Active hedging tries to correct for this and in some cases value is added in the form of pure alpha—but these approaches are rarely managed in the context of the broader asset portfolio. For this reason they often fail to improve overall risk-adjusted returns.

We present a new practical framework—the dynamic ideal hedge ratio—which integrates currency risk management with the overall portfolio construction process. Additionally, it makes it forward-looking and opportunistic. It can be applied to any institutional portfolio invested in any major asset classes. Our experience, and historical simulations, confirms the potential of this approach to improve long-term, whole-portfolio risk adjusted returns. While the improvement in returns should be attractive to any investor, the overall portfolio efficiency gains should appeal especially to institutional investors charged with managing assets against bond-like liabilities.

We believe the dynamic ideal hedge ratio is the next step in the evolution of foreign-currency hedging programs.

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Neuberger Berman
605 Third Avenue
New York, NY 10158-3698

www.nb.com