



# To hedge or not to hedge? Evaluating currency exposure in global equity portfolios

Vanguard Research

September 2014

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- Decreasing investor “home bias” (namely, overexposure to an investor’s domestic market) has resulted in rising allocations to foreign assets and increased investor interest in managing foreign-currency exposure.
- A reasonable forward-looking assumption is for an unhedged and a hedged investment to produce similar *gross* returns over long time horizons. Therefore, we propose a framework for evaluating currency exposure based on risk, not return, for investors willing to tolerate a modest return drag from hedging, evaluated using an *ex ante* (that is, “before the event”) perspective.
- Since currency is typically more volatile than fixed income assets, we urge investors to consider fully hedging their portfolios’ fixed income allocation.
- The case for hedging an equity portfolio is more nuanced, since hedging’s impact on risk is a function of two key factors: the relative volatility of the asset versus that of the foreign currency, and the asset–currency correlation.
- We argue that investors should consider hedging at least a portion of the foreign-currency exposure within their equity allocation, based on the following criteria: (1) availability of a low-cost hedging program or hedged equity product; (2) belief that the foreign currency is unlikely to be a diversifier in the investor’s local market; (3) smaller domestic allocation, resulting in greater currency exposure; (4) a portfolio objective specifically targeting volatility.

When investors buy foreign assets, they obtain exposure not only to the underlying securities but also to foreign currency, meaning that movements in exchange rates play a significant role in determining the performance of a foreign investment. Increasingly, investors are wondering whether to hedge<sup>1</sup> this foreign-currency exposure. One reason driving this heightened interest is the fall in “home bias,” defined as an investor’s overweighting to his or her home market relative to its share of the global market. For U.S. investors, home bias dropped 11 percentage points from 2001 through 2012. During the same time period, equity investors in the United Kingdom, Canada, and Australia reduced their home bias by 23, 10, and 14 percentage points, respectively (Philips, Kinniry, and Donaldson, 2012).<sup>2</sup> This smaller home bias, resulting from a larger foreign allocation, means a larger foreign-currency exposure. To provide context for investors who are examining their currency exposure, this paper analyzes relevant factors in deciding whether to hedge that exposure or to leave it intact.

### Currency can lead to different results for an identical investment

Foreign-currency exchange rates are not static. The resulting impact of this volatility on unhedged portfolio returns can be significant. **Figure 1** presents the annual performance of the developed global equity market denominated in various developed currencies over

the ten years through 2013. The stronger the foreign currency—and the weaker the home currency—the more positive will be the impact on the return of a global equity portfolio when translated back into the investor’s home currency.

### Defining success for a hedging program: Return production or risk reduction?

Foreign-currency exposure affects a portfolio’s volatility as well as its long-term returns. A currency management strategy that seeks to maximize portfolio returns as its primary goal may be quite different from one that seeks to reduce overall portfolio risk.<sup>3</sup> But whatever the goal, the strategy should be consistently designed, implemented, and evaluated against the primary objective: return impact or risk reduction (Statman, 2005). To start with one objective and then evaluate the results against another is a self-defeating approach.

In considering the hedging decision, some investors may distinguish between a strategic versus a tactical approach. Extensive research indicates that short-term currency movement is very volatile and extremely difficult to forecast accurately, diminishing the case for a short-term tactical approach to currency management (Solnik, 1974; Meese and Rogoff, 1983; Perold and Schulman, 1988). Although some investors may choose to engage in an active, tactical approach to generate added return through

*Notes on risk: All investing is subject to risk, including the possible loss of the money you invest. Bond funds are subject to interest rate risk, which is the chance that bond prices overall will decline because of rising interest rates, and credit risk, which is the chance that a bond issuer will fail to pay interest and principal in a timely manner or that negative perceptions of the issuer’s ability to make such payments will cause the price of that bond to decline. In a diversified portfolio, gains from some investments may help offset losses from others. However, diversification does not ensure a profit or protect against a loss. Past performance is no guarantee of future results.*

*Investments in stocks issued by non-U.S. companies are subject to risks that include country/regional risk, which is the chance that political upheaval, financial troubles, or natural disasters will adversely affect the value of securities issued by companies in foreign countries or regions; and currency risk, which is the chance that the value of a foreign investment, measured in U.S. dollars, will decrease because of unfavorable changes in currency exchange rates. Stocks of companies based in emerging markets are subject to national and regional political and economic risks and to the risk of currency fluctuations. These risks are especially high in emerging markets.*

1 Currency hedging is the process of reducing risk to fluctuations in foreign currency exchange rates, and is typically carried out using forward currency contracts.

2 For further discussion of the recent trend of investors reducing the bias toward their own home market, see Philips et al. (2012).

3 Investors have often directed their foreign equity investments into hedged or unhedged products based on the recent strength or weakness of the foreign currency. For example, during a period of yen strength, for the 12 months ended April 2010, 100% of U.S. net cash flows into Japanese-equity ETFs went into hedged vehicles, but only four years later, after a period of yen weakness (and relative U.S. dollar strength), U.S. investors who invested in Japanese-equity ETFs directed more than 97% of their cash flows into hedged products.

Figure 1. Currency's impact on portfolio return has been significant and variable

Ranked annual returns of MSCI World Price Index in various currencies, 2004–2013

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15.2%	27.5%	21.8%	9.6%	-17.4%	34.3%	20.1%	-1.8%	31.0%	54.8%
10.8%	26.8%	20.7%	7.7%	-24.9%	30.8%	15.9%	-2.7%	16.5%	47.8%
10.2%	26.7%	20.2%	2.7%	-25.4%	27.0%	12.3%	-4.3%	15.1%	35.9%
7.5%	23.0%	12.3%	1.6%	-37.2%	26.7%	6.5%	-4.7%	14.7%	27.4%
6.9%	17.6%	11.7%	-1.2%	-40.3%	16.4%	1.3%	-5.0%	14.1%	25.0%
6.9%	10.0%	7.9%	-1.6%	-43.9%	11.1%	-1.4%	-5.0%	14.0%	23.7%
6.0%	7.3%	5.8%	-7.1%	-51.6%	1.4%	-2.1%	-9.9%	11.4%	21.9%

- U.S. dollar
- Swiss franc
- Japanese yen
- British pound
- Euro
- Australian dollar
- Canadian dollar

Sources: Vanguard calculations, using data from Thomson Reuters Datastream.

currency trading, we do not consider that approach here. Rather, in evaluating the hedging decision, we focus on long-term, static, strategic allocations.<sup>4</sup>

Over the long term, for a currency management program to produce added return in strategic asset allocations, one must believe not only in a persistent return (positive or negative) from foreign currency, but also that this return will differ substantially from the return realized by hedging.<sup>5</sup> Hedging produces a return that reflects differences in interest rates across markets. Over the

long term these interest rate differences adjust for underlying fundamental differences across markets, such as inflation levels. Arguably, long-term foreign-currency movement is driven by similar factors, even if it is much more volatile in the short-term. Therefore, with forward-looking financial markets, persistent arbitrage between a hedged and unhedged investment seems a difficult proposition over the long term.<sup>6</sup> It is true that any ex-post (that is, “after the fact”) outcome is possible.<sup>7</sup>

<sup>4</sup> One could argue for a dynamic, yet strategic, approach to currency management to capture the dynamic nature of currency-asset correlations. Although this is not our approach here, see Opie, Brown, and Dark (2012) for a discussion of dynamic currency hedging.

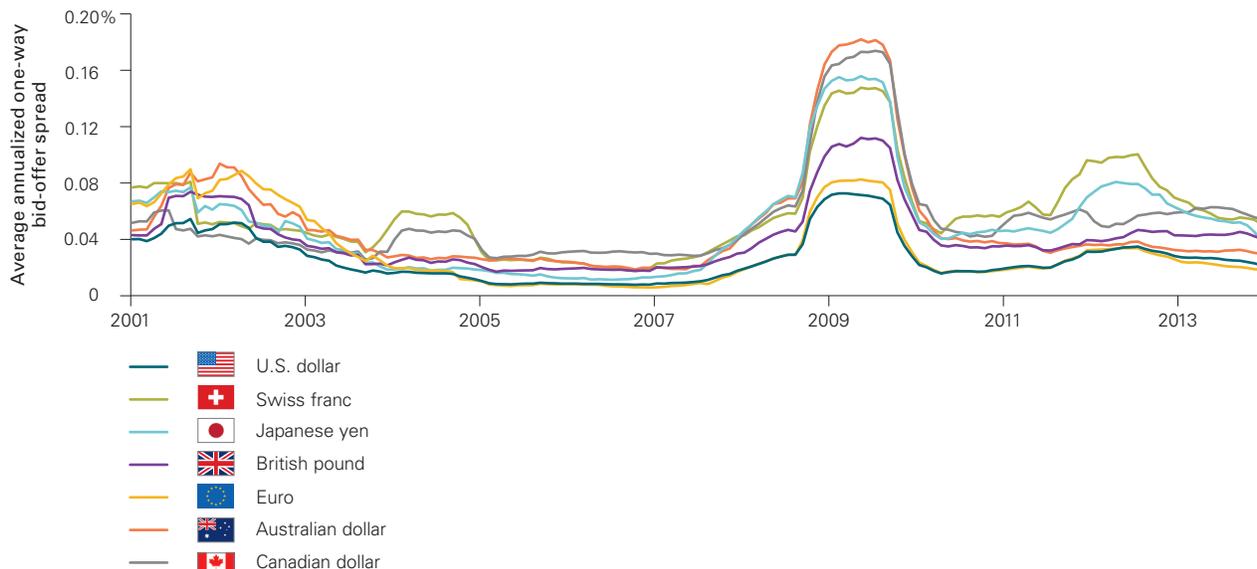
<sup>5</sup> It is important to remember that a hedged investment is not merely one with the return impact of the exchange-rate change removed. There is also an interest rate differential that influences a hedged investor's return. For further details, see Thomas and Bosse (2014).

<sup>6</sup> Said another way, we believe the unbiasedness hypothesis is likely to hold over long time periods. This hypothesis states that the forward exchange rate is an unbiased predictor of the future spot exchange rate (Levi, 2005). This expected equality follows from the fact that both the covered and uncovered versions of interest rate parity depend on the same interest rate differential. In other words, the market's expectation for currency movement is already embedded in the prices of forward contracts, which are used for hedging. For further discussion, see Chinn and Quayyum (2012).

<sup>7</sup> As Lothian and Wu (2011) pointed out, although uncovered interest rate parity (UIP) tends to hold over the very long haul, long periods of UIP deviation can occur due to slow adjustment after regime changes. This slow adjustment can be for actual and anticipated regime changes or other nonmaterializing events.

**Figure 2. Transaction costs of hedging are variable but generally modest, and should be considered in the hedging decision**

12-month average annualized one-way bid-offer spread to hedge majority of MSCI World Price Index back to the stated currency: January 2001–December 2013



**Notes:** Figure displays annualized bid-offer spread associated with hedging the MSCI World Price Index from each currency’s perspective, calculated as one-half of the spread between the bid and offer quotes of forward rate points, as an annualized percentage of the midpoint spot rate. We included the weighted-average cost to hedge the seven largest foreign currencies, weighted by the capitalization weights of the MSCI World Price Index. This weighting methodology produced a cost estimate that hedges about 95% of the foreign-currency exposure.  
**Sources:** Vanguard, based on data from MSCI and Bloomberg.

### The impact of cost

In addition to the points just discussed, we would expect the long-run returns of a hedged foreign equity portfolio to be lower than the long-run returns for the same unhedged portfolio, all other things being equal, with any hedging costs driving a wedge between the two returns (more on this later in the paper). If an investor is willing to tolerate this modest ex ante return differential, then we would frame an investor’s hedging decision in terms of portfolio risk.

Foreign assets come with currency exposure intact, and an additional transaction is needed to implement a hedging program. In addition to the direct transaction costs of the hedge, the successful execution of a currency hedging strategy has many additional operational costs, which are likely to be reflected in higher fund expense ratios for hedged mutual funds and ETFs. These additional

costs should result in somewhat lower expected net returns for the hedged portfolio relative to that of the unhedged portfolio.

Although product expense ratios are likely to be stated up front, transaction costs are hidden and subtract from performance over time. As shown in **Figure 2**, the direct transaction costs of currency hedging have generally been low to moderate, historically in the range of 1 to 18 basis points annually for developed-market currencies.<sup>8</sup> Notably, during times of market turmoil such as in 2008–2009, the hedging cost may rise dramatically.

Although both the explicit expense ratio and implicit transaction costs of hedging are fairly certain, the benefits may be quite uncertain, as this paper will demonstrate. Because of this, regardless of their objective, many investors may choose to leave currency risk unhedged, or pursue a partial hedging strategy to limit the cost impact.

<sup>8</sup> Unlike most major developed-market currencies, emerging-market currencies tend to have lower trading volumes and may be more difficult and costly to hedge. Additional considerations when analyzing the decision to hedge in emerging markets include market size, political risk, and data availability (Mackintosh, 2010). Although this paper focuses exclusively on developed markets, the results and conclusions should still hold for emerging markets (see Zhang, 2011).

Either way, investors should consider whether the higher costs of hedging are justified in pursuit of the objective. For many investors, access to low-cost products that provide hedged exposure will be a key consideration in the hedging decision. In the subsequent sections, we evaluate a risk-management objective for hedging currency, keeping in mind the potential impact of cost.

### Theory of a risk-management approach to currency exposure

The exposure to both a foreign asset's underlying securities and to the relevant foreign currency may be analyzed in a risk–return portfolio context, using familiar portfolio evaluation concepts. In a basic two-security context, average portfolio returns are a simple weighted average of the two security returns, but, as a rule, portfolio volatility is *not* a simple average of the standard deviations of the returns of the two underlying securities: Portfolio volatility contains a third term to capture the co-movement, or correlation, between the two securities' returns. From Markowitz (1952), we can apply the familiar formula for the variance of a portfolio comprising two assets to reflect currency exposure. Measuring the volatility of the portfolio composing the foreign asset  $s$  and foreign-currency exposure  $f$ , we have:<sup>9</sup>

$$(1) \sigma_p^2 = \sigma_s^2 + w_f^2 \sigma_f^2 + 2 w_f \rho_{s,f} \sigma_s \sigma_f,$$

where

$\sigma$  = the standard deviation of returns for the portfolio  $p$ , the foreign asset  $s$ , and the foreign currency  $f$ ;

$w_f$  = the percentage weighting allocated to foreign currency; and

$\rho_{s,f}$  = the correlation between the returns for the asset and the foreign currency.

As shown, currency exposure introduces its own volatility to the portfolio and will interact with the portfolio depending on its correlation with the foreign asset. Taking this a step further by rearranging equation 1, we can derive the theoretically “optimal” foreign-currency exposure that minimizes portfolio volatility:

$$(2) w_f^* = -\rho_{s,f} / \theta,$$

where

$\theta = \sigma_f / \sigma_s$ , the currency-asset volatility ratio.

A key takeaway from equation 2 is that there are two factors influencing the impact that currency will have on the portfolio: the volatility of currency relative to that of the underlying asset and the interaction between currency and the underlying asset. The larger the volatility ratio,<sup>10</sup> the greater the impact of the foreign-currency exposure on the portfolio's volatility. In addition, asset and currency volatilities are not additive (Solnik, 1997; Perold and Schulman, 1988).<sup>11</sup> Currency offers risk-reduction potential through the co-movement, or correlation, between the asset returns and currency movements. As correlation falls, the third co-movement term in equation 1 becomes smaller; this effect is captured in the numerator of equation 2. Generally speaking, the lower the volatility ratio, the more important the asset–currency correlation will be in determining the portfolio risk outcome. It is the net effect of the two influences that determines whether total portfolio risk is increased or decreased by hedging the foreign-currency exposure (Kritzman, 1993).

Thus, at any point, equations 1 and 2 emphasize that both the volatility of currency relative to the underlying portfolio and the foreign asset–currency correlation are important in determining the effect of currency on a portfolio's risk (see the box on page 6, “Defining risk”).

<sup>9</sup> The foreign-asset volatility is measured in local currency. For the initial unhedged portfolio, both the asset weight and the accompanying currency exposure are 100%, or 1.

When the portfolio is fully hedged,  $w_f$  equals zero and the two last terms drop out, so that the volatility of the portfolio equals that of the underlying foreign asset:  $\sigma_p^2 = \sigma_s^2$ .

<sup>10</sup> The volatility ratio is higher for lower-volatility assets. For example, using  $\sigma_s$  of 5% for bonds and 20% for stocks and  $\sigma_f$  of 10% for currency, the resulting volatility ratio would equal 2 for bonds and only 0.5 for stocks.

<sup>11</sup> The exception to this rule occurs when  $\rho_{s,f} = +1$  (perfect positive correlation). Substituting +1 for the asset–currency correlation coefficient into equation 1 and simplifying yields  $\sigma_p = \sigma_s + w_f \sigma_f$ . When the correlation is perfectly inverse ( $\rho_{s,f} = -1$ ),  $\sigma_p = \sigma_s - w_f \sigma_f$  and the portfolio's risk equals the weighted volatility of the foreign asset minus that of the foreign currency.

### Defining risk in this analysis

Given that our framework for the currency hedging decision is based on risk reduction, defining the most appropriate measure of risk is important. We have used standard deviation as our definition of risk throughout this paper, given its common use in the investment world. However, some investors may be concerned with other measures of risk. Some alternative definitions are: (1) divergence of returns between hedged and unhedged portfolios over time; (2) tracking relative to a defined liability; (3) tracking relative to a consumption basket in a particular currency (managing real purchasing-power risk); and (4) tracking relative to the local asset returns (which has no currency effects).

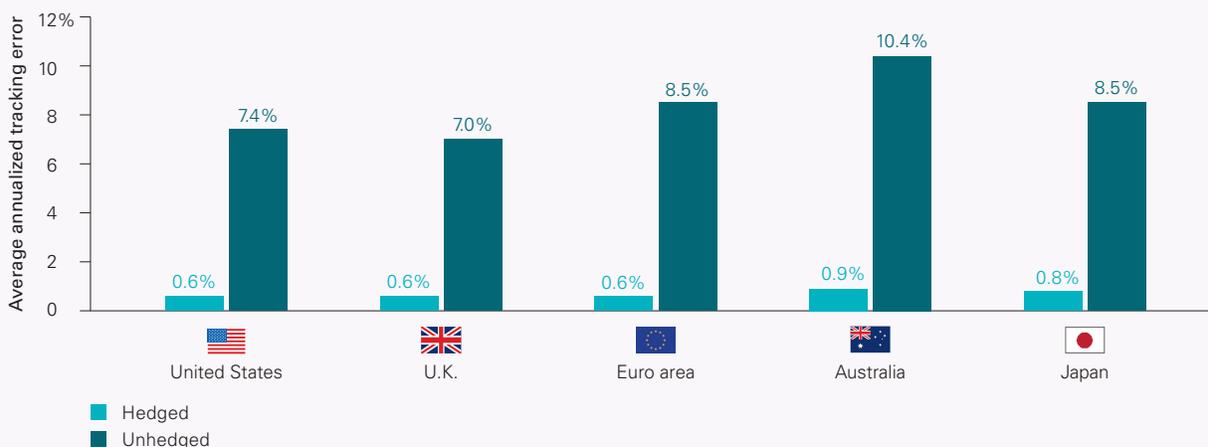
The latter three definitions all involve tracking errors: How much dispersion is caused by exchange-rate risk relative to the underlying benchmark, denominated in

the local home currency? For example, significant tracking error may be a concern for a pension plan with required payouts in euros, an Australian investment portfolio designed to fund spending in Australian dollars, or a multinational corporation with revenue streams from the countries it operates in.

Figure 3 presents the tracking error of the hedged and unhedged foreign-equity return relative to the local-equity index return (definition 4, as just mentioned). Notably, the hedged portfolio's tracking error was significantly tighter across the five currencies, and by a significant margin. Thus, investors with a home-currency asset or a liability benchmark may opt to hedge to reduce the tracking error resulting from foreign-currency exposure.

Figure 3. Defining risk differently may lead to different conclusions

Average annualized tracking error of monthly returns to the underlying local equity index:  
January 1999–December 2013

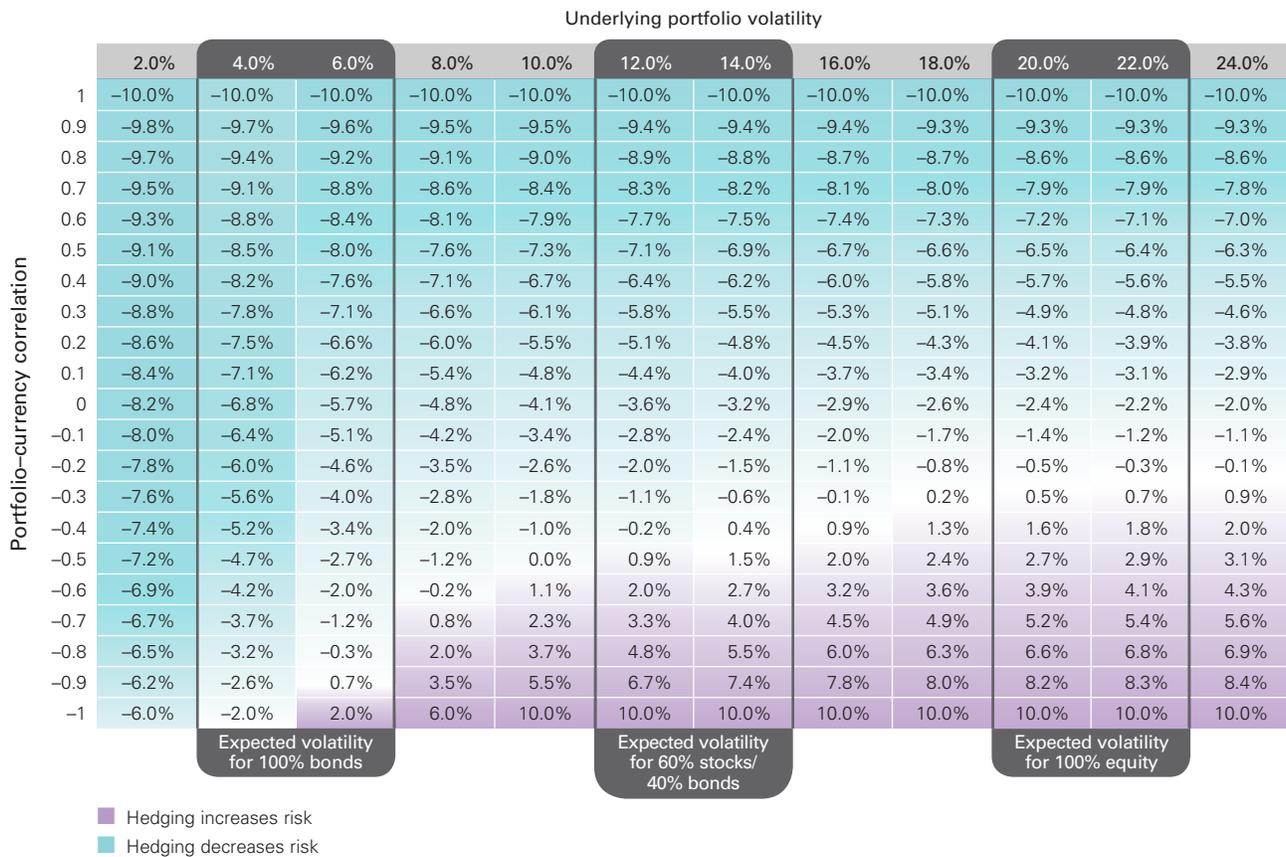


**Notes:** Figure displays annualized tracking error of monthly returns of a hedged and unhedged foreign equity index, with the specific index depending on the availability of a hedged returns series from MSCI. For the United States, U.K., and euro areas, we used the MSCI World ex-[region] Price Index. For Australia and Japan, we used the MSCI World Price Index. In all cases, the hedged series was hedged back to the respective domestic currency, and the unhedged index included the impact of currency return.

**Sources:** Vanguard, based on data from MSCI.

Figure 4. Both relative volatility and correlation affect portfolio risk

Hypothetical volatility impact from hedging across a variety of portfolio risk profiles and currency correlations



Notes: Hypothetical illustration of difference in volatility between a hedged and unhedged investment, with various assumptions regarding underlying portfolio volatility and currency correlations. Figure assumes 10% currency volatility. Purple shading indicates hedging produces a higher volatility outcome, while blue shading indicates hedging lowers portfolio volatility. Expected volatility ranges for various asset allocations are hypothetical projections, based on the Vanguard Capital Markets Model® outlook (Davis et al., 2014).

Source: Vanguard.

### Applying investment theory in making the hedging decision

In examining the potential risk impact of currency, we demonstrate the hypothetical interplay of the asset–currency correlation with that of the relative currency volatility (see Figure 4), assuming a foreign-currency volatility of 10%,<sup>12</sup> along with forward-looking expected volatility ranges for a range of balanced portfolios. Blue shading in the figure indicates a reduction in volatility from hedging, while purple shading indicates that hedging is adding risk relative to not hedging.

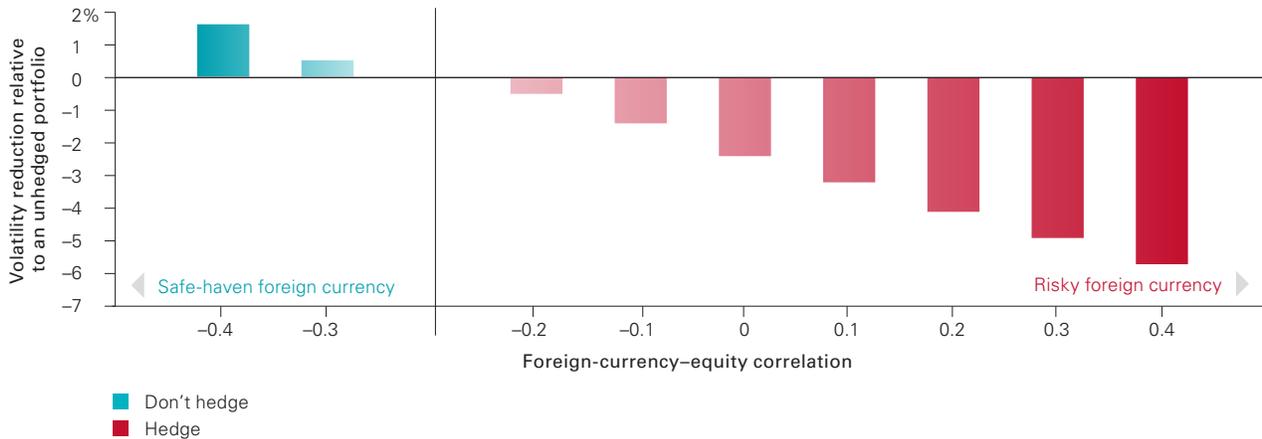
This analysis demonstrates the importance of the relative volatility of foreign currency—the  $\theta$  term in equation 2—in the hedging decision. For portfolios with more fixed income exposure, the hedged portfolio is typically less risky than the unhedged portfolio, irrespective of the asset–currency correlation, simply because the fixed income volatility is markedly lower than that of the foreign currency.<sup>13</sup> However, as the allocation to equities rises, the volatility impact becomes more dependent on the correlation. Pairing currency with an already risky asset such as equities implies that the interaction between these two investments begins to matter more.

<sup>12</sup> From 2000 through 2013, annualized volatility of monthly returns for our cap-weighted foreign developed-market currency series, discussed in the appendix, has ranged from 7.5% to 10.5%, depending on the investor’s perspective.

<sup>13</sup> See Philips et al. (2014), for further discussion of global fixed income portfolios.

**Figure 5. Currency correlation is a key driver of risk impact from hedging foreign-equity portfolios**

Hypothetical volatility impact from a full hedge as currency–equity correlation changes



**Notes:** Hypothetical illustration of difference in volatility between hedged and unhedged investments, with various currency–equity correlations. Figure assumes 20% equity volatility and 10% currency volatility.

**Source:** Vanguard.

The result in Figure 4 led us to conclude that the volatility ratio of the underlying portfolio, largely determined by the equity–bond asset allocation, is the most significant factor in the hedging decision. Therefore, given the relative volatility differences between fixed income, currency, and equity, a reasonable starting point for managing currency can involve fully hedging the foreign fixed income allocation, then targeting currency exposure within the foreign equity allocation. By implementing a currency allocation within a portfolio’s foreign equity allocation, investors can balance the overall risk of currency with the diversification benefits that this currency brings to the portfolio. For equity-heavy portfolios, an additional parameter that becomes important is the expected correlation between the portfolio’s assets and currencies.

**Figure 5** examines the hypothetical effect of various equity–currency correlations on portfolio volatility. The volatility of the unhedged portfolio increases with more positive foreign–equity–currency correlations; this means that the risk reduction from a full hedge also increases. It is important to note that given the skew in the relationship between the volatility change and the correlation, the currency–equity correlation must be

at least moderately negative (in this case, less than  $-0.2$ ) to justify leaving foreign-currency exposure intact. Otherwise, there are likely to be diversification benefits from hedging on a gross-returns basis.

In summary, theory would suggest that investors focus on two specific questions when determining appropriate currency exposure within a risk-management framework:

1. *What is the portfolio’s asset allocation?* Fixed income-oriented portfolios will benefit more from hedging than equity-oriented portfolios, because bonds typically have lower volatility than equities. Thus, a simple strategy can involve fulfilling the desired currency exposure within the portfolio’s equity allocation and fully hedging the fixed income allocation.
2. *What is the expected correlation between currency and equity?* For equity-oriented portfolios, there is potentially a diversification benefit in owning foreign currency, depending on the direction and magnitude of the correlation between these two assets. As such, any target for currency exposure should consider the interaction that currency will have with the rest of the portfolio.

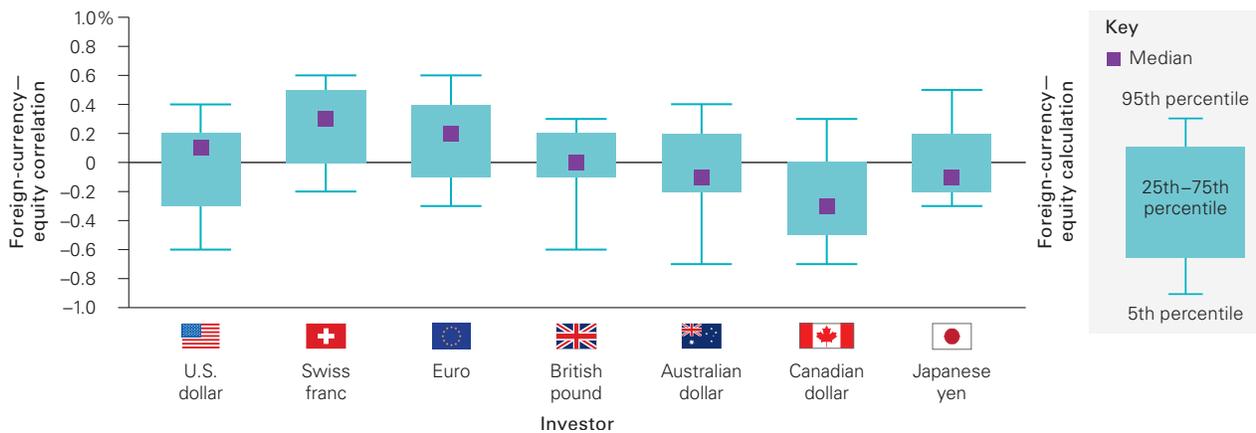
**Hedging the hedging decision:  
Managing risk in an uncertain world**

There is a potential diversification benefit from hedging exposure to currencies with historically positive correlations—sometimes termed “risky” or “risk-on” currencies—and from leaving intact exposure to currencies with low or negative correlations—termed “safe-haven” or “risk-off” currencies.<sup>14</sup> However, although there is an ex-post theoretical argument for

some currencies to favor a positive or negative correlation, ex-ante correlations have proved hard to predict in the long term. Empirically, the realized correlations between currency and equity returns have varied significantly across markets and over time, even changing sign, as shown in Figure 6. The result is that the ex-post “optimal” currency exposure varies over time, as does the impact on realized portfolio volatility from hedging.

**Figure 6. Currency correlations have been highly variable, across both time and markets**

Percentile distributions of ten-year foreign-currency–equity correlations from the stated currency regions’ perspectives: January 1972–December 2013



**Notes:** Figure displays percentiles for ten-year correlations of annual returns, with correlations calculated between foreign currency and foreign equity from the perspective of the stated currency region. See appendix for details on data.

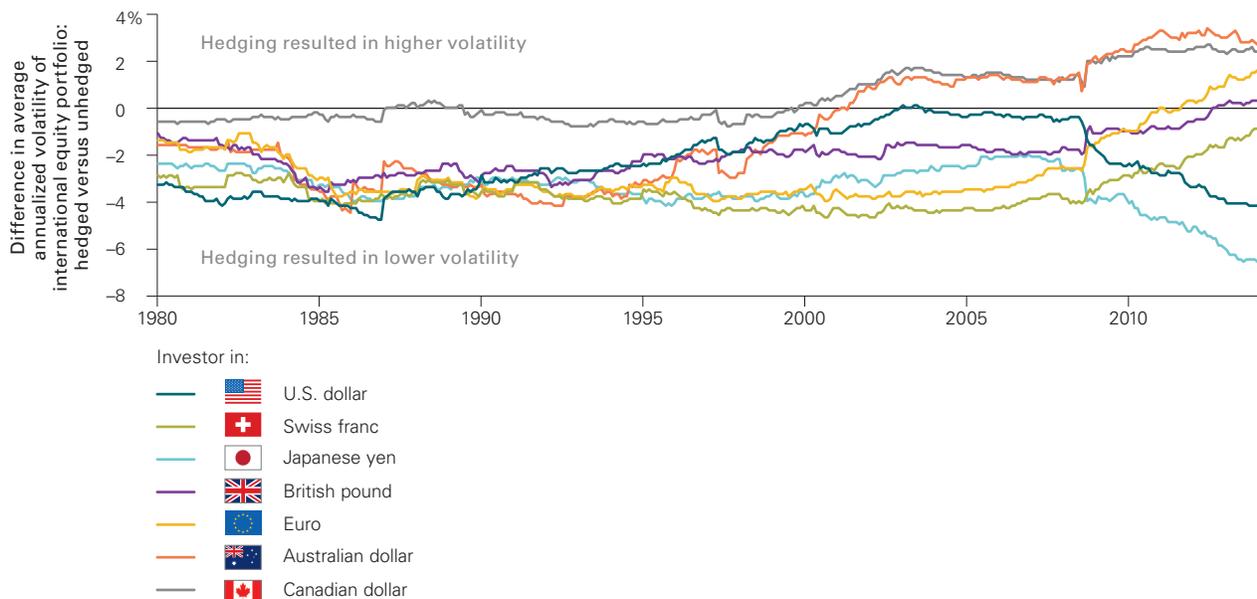
**Sources:** Vanguard, based on data from MSCI and International Monetary Fund.

<sup>14</sup> These terms are often applied to currency co-movements with global equity markets. For example, from an international investor’s perspective, the currencies of Australia and Canada—countries with large exposures to global commodities—have often appreciated in periods of strong global growth and equity upswings. Conversely, the U.S. dollar has often been termed a “safe-haven” currency as investors flock to it in a flight to quality. As we discuss later, it is also critical to note that these past relationships may or may not hold in the future. Perspective matters, too, in applying these labels. Throughout this paper, we have framed the hedging decision from a domestic perspective looking out while examining foreign-currency exposure. From this perspective, investors might want to keep exposure to “safe-haven” currencies and hedge exposure to “risky” currencies. Alternatively, an investor could examine his or her own domestic currency and come to the same conclusion, just expressed in different terms: That is, investors with a “safe-haven” domestic currency might want to hedge foreign-currency exposure, whereas investors with a “risky” domestic currency might want to leave foreign currency intact.

Figure 7. Volatility impact of hedging is variable across time and markets

a. Variable correlations have led to variable risk outcomes, across both time and markets

Rolling ten-year difference in annualized volatility of monthly returns between hedged and unhedged portfolios invested in developed foreign equity: January 1971–December 2013



Notes: Figure displays difference in ten-year rolling annualized volatility of monthly returns between hedged and unhedged portfolios invested in foreign developed equity. See appendix for details on data.

Sources: Vanguard, based on data from MSCI and International Monetary Fund.

b. Statistical tests of volatility differences show that hedging has usually reduced risk, but with results that vary over time

F-statistics for tests of whether hedging lowered variance of monthly returns of an international equity investment, from perspective of investors in the stated regions

	Australia 	Canada 	Euro area 	Japan 	Switzerland 	United States 	U.K. 	Degrees of freedom	Critical value at 0.05	Critical value at 0.01
1971–2013	1.12	0.93	1.31	1.56	1.50	1.41	1.24	514	1.1563	1.2281
1971–1990	1.46	1.06	1.40	1.39	1.54	1.56	1.33	226	1.2452	1.3640
1990–2013	0.89	0.84	1.26	1.70	1.47	1.31	1.17	287	1.2147	1.3169
2000–2013	0.69	0.72	1.02	1.73	1.27	1.47	1.09	167	1.2908	1.4356

Percentage of rolling ten-year time periods from 1971 through 2013, during which hedging significantly reduced volatility at 0.05 level:

35.9%	0.0%	68.4%	89.9%	89.1%	58.1%	42.2%
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Notes: Figure displays F-statistics for tests of whether hedging reduced volatility of an international equity investment from perspective of investors in the stated regions. Degrees of freedom are identical for numerator and denominator. Red values indicate that hedging lowered volatility relative to remaining unhedged, when tested at the 0.05 significance level. See appendix for details on data.

Sources: Vanguard, based on data from MSCI and International Monetary Fund.

**Figure 7a** presents the rolling volatility impact from fully hedging a foreign-equity portfolio. Echoing the correlation estimates in **Figure 6**, the volatility impact of hedging has been variable both across time and markets. **Figure 7b** provides the results of statistical one-tailed tests of the volatility between a hedged and unhedged investment. Over the full 1971–2013 sample, the difference in volatility between a hedged and unhedged investment was statistically significant at the 0.05 level for all markets except Australia and Canada. Over the shorter-term period of 2000–2013, the variance of the hedged portfolio was significantly lower than that of the unhedged portfolio only in Japan and the United States. However, as noted, these results vary significantly throughout time. For example, from the U.S. perspective, a hedged investment was statistically significantly less volatile than an unhedged investment in just 58.1% of the rolling ten-year time periods examined from 1971 through 2013.

It's interesting that the markets in which a risk reduction strategy would have generally suggested leaving foreign currency intact, such as Australia and Canada, have demonstrated a greater propensity to hedge relative to markets where there has been a clearer benefit to hedging. In addition, a notable conclusion from **Figure 7** is that any hedging strategy that does depend on a given correlation being realized may experience potentially long periods of time during which the intended risk reduction outcome is not realized, if it occurs at all. For example, based on past relationships before 2008, many investors might have expected the euro to behave like a "safe-haven" currency, implying that euro-area investors would have favored hedging their foreign-currency exposure; but this relationship has flipped in recent years, potentially reversing the direction of this decision.

The historical results in **Figure 7** also present an opportunity to place the cost of hedging into context. The volatility impact of hedging in any given ten-year period across the markets examined ranged from a 6.7% reduction in Japan (for the ten years ended 2013) relative to remaining unhedged to a 3.2% increase in Australia (for the ten years ended 2011). So although a hedging cost of, say, 0.25% to 0.5% on an annual basis<sup>15</sup> may sound relatively inexpensive, the benefit one is paying for may not be realized. Alternatively, considering the average over time aggregated across all the markets we examined, at –1.9% the risk reduction from hedging might be worth it, assuming an investor can access hedged products at a reasonable cost.<sup>16</sup>

A potential solution to this uncertainty in the risk-reduction benefits of hedging is to implement a partial hedge. Having decided on an equity–bond asset allocation, an investor could then target a given currency exposure framed as a percentage of the equity allocation and implement a partial hedge to achieve this exposure (either directly or through a combination of hedged and unhedged equity products). Such a strategy is likely to reduce an investor's regret from making the "wrong" currency allocation (Michenaud and Solnik, 2008; Statman, 2005) and can be viewed as a reasonable way to address the uncertainty involved when attempting to forecast correlation.

<sup>15</sup> These rough estimates of hypothetical cost assume transaction costs of 0.18% per year (the maximum from **Figure 2**) plus a higher expense ratio ranging from 0.07% to 0.32% to account for operation costs. These estimates are hypothetical, but roughly align with typical financial products.

<sup>16</sup> For example, consider an unhedged global equity portfolio with an expected return of 8% and expected volatility of 20%. Assuming that gross returns are equivalent between hedged and unhedged investments, an expected 1.9% reduction in volatility from hedging would result in an investor paying up to 0.76% in hedging costs and still generating a better risk-adjusted return by hedging foreign-currency exposure.

**Figure 8. Market size and home bias can have significant impact on currency exposure**

Foreign-currency exposure from different country perspectives using unhedged equities and hedged bonds

	Australia 	Canada 	Eurozone 	Japan 	Switzerland 	U.K. 	United States 
Global equity, market-cap-weighted	3%	4%	11%	7%	3%	8%	50%
Foreign-currency exposure in global equity	97	96	89	93	97	92	50
Foreign-currency global exposure							
60% stocks/40% bonds	58	58	53	56	58	55	30
Equity home bias	79	71	N.A.	76	58	55	44
Bond home bias	87	90	N.A.	69	36	61	58

**Notes:** Figure displays implied foreign-currency exposure based on market-capitalization weights. For a balanced 60% stocks/40% bonds portfolio, we assumed the fixed income allocation was fully hedged. Home bias is defined as the overweighting to domestic stocks or bonds, compared with the domestic percentage allocation in the global stock or bond market cap.

**Sources:** Market cap of MSCI World Index as of December 31, 2013, from Bloomberg; home-country biases for year 2010 from Vanpée and De Moor (2012).

### Home bias or hedging? Two approaches to currency management

The size of a local equity market can also have a significant impact on the currency hedging decision. A small local market would necessarily have a large foreign-currency exposure for a global portfolio. As an example of the market-size effect, consider a global equity portfolio that is weighted by market capitalization. **Figure 8** shows that, for such a portfolio, Australia had a foreign-currency exposure of 97%, whereas the United States had a foreign-currency exposure of 50%. Thus, the argument for hedging foreign-currency exposure is stronger when the home market is a small fraction of the global market, all else equal.

It's interesting that **Figure 8** demonstrates that investors in smaller markets have a larger overweighting to domestic securities—or home bias—than do investors in larger markets.<sup>17</sup> For example, the typical home bias allocation for larger markets such as the United States tends to be somewhat less than those in Australia or Canada.

For investors that use a home-bias allocation as a rough tool to achieve a desired foreign-currency allocation,<sup>18</sup> a currency hedging program may offer a more attractive solution. Accordingly, a partial hedging strategy expressed as a percentage of the overall equity allocation may be a reasonable compromise, allowing for a targeted approach to currency without reducing the underlying portfolio's diversification potential.

<sup>17</sup> Philips et al. (2012) found that the home-bias decision is affected by factors including a preference for the familiar, transaction costs, liquidity, and taxation.

<sup>18</sup> See, for example, Litterman (2003).

### Conclusion: A practical risk-management framework for investors

Rising allocations to foreign assets have heightened investor interest in the accompanying currency exposures. Foreign currency affects both the return and risk of a portfolio. Based on this paper's analysis, we would expect the long-run returns of a hedged foreign-equity portfolio to be lower than the long-run returns of the same unhedged portfolio, all other things being equal, with any hedging costs driving a wedge between the two returns. If an investor is willing to tolerate this modest ex ante return differential, then we would frame an investor's hedging decision in terms of portfolio risk.

The volatility of currency relative to an underlying portfolio is a significant factor in determining whether a hedging program will reduce that portfolio's risk. Fixed income-oriented investors will tend to favor hedged exposure to limit risk, while equity-oriented investors may elect to consider other factors. Because of this, many investors may consider fully hedging their fixed income allocation, therefore linking portfolio currency exposure to their equity allocation.

In pursuing a risk-management approach to currency, investors may be more inclined to implement a hedging program within their equity allocation if they:

- 1. Have access to low-cost products for achieving hedged exposure.** Relative to an unhedged investment, hedging incurs additional operational costs likely reflected in product expense ratios as well as transaction costs that serve as a drag on returns.
- 2. Do not believe that foreign currency will diversify their portfolio.** The correlation between foreign currency and the underlying portfolio increasingly influences the hedging decision as the equity fraction of the portfolio increases. However, this correlation must be at least moderately negative for *unhedged* foreign-currency exposure to have lower risk. Therefore, investors who believe that the correlation will not be negative or who are agnostic with respect to forward-looking correlations would be likely to favor hedging.

- 3. Have greater exposure to foreign assets.** Investors who live in regions where market capitalization makes up a relatively small portion of the global portfolio may be more exposed to foreign currency in a global investment. This is especially true if these investors do not hold large home-bias allocations to their own domestic market.

- 4. Have an explicit portfolio objective of minimizing realized global equity volatility.**

There is no one-size-fits-all hedging prescription, but the preceding factors suggest that tying a currency allocation to the overall equity allocation may be an excellent starting point for many investors. By linking currency exposure to their equity allocation and potentially using a partial hedging strategy within their foreign-equity portfolio, investors are likely to limit the cost impact of hedging. In addition, this strategy links currency exposure with the asset that is most important in both determining the portfolio's relative volatility and the correlation between currency and the portfolio: the two drivers of the risk impact of currency. This framework allows investors with different home-bias allocations to target an appropriate level of currency exposure, given their particular exposure to foreign assets.

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## Appendix. Details of our currency and equity returns series

For this paper’s returns data, we used the developed-market equity universe, defined as those countries in the MSCI World Price Index. “Foreign equity” for each currency region is defined as the MSCI World ex [market] Index—for example, the MSCI World ex US Index for a U.S. dollar perspective. For markets in which such an index is not produced by MSCI, we created a custom benchmark using MSCI’s market capitalization data to infer the foreign region from the MSCI World and MSCI [market] for each country. For pre-1999 history for the euro area, we computed a custom index by cap-weighting the individual euro constituent countries.<sup>19</sup>

Our currency returns are the cap-weighted basket of currencies comprising the foreign developed-equity universe for each market. We computed this by measuring the difference in price returns between the foreign-equity investment in local (no currency impact) returns relative to the price returns translated to that region’s currency. In cases where MSCI does not produce an index in the desired currency, we translated the index using exchange rates from the IMF’s International Financial Statistics database.

This methodology produced an equity index and a currency series for each region, corresponding to the cap-weighted baskets listed on the right in the accompanying box.

	Australian dollar:	MSCI World ex Australia
	British pound:	MSCI World ex United Kingdom
	Canadian dollar:	MSCI World ex Canada
	Euro:	MSCI World ex European Monetary Union
	Japanese yen:	MSCI World ex Japan
	Swiss franc:	MSCI World ex Switzerland
	U.S. dollar:	MSCI World ex United States

In measuring correlation and volatility, we used the local version of the equity index (with currency return removed) as a proxy for a hedged investment. This version ignored the small return impact on returns from hedging, but allowed us to display a longer history, as hedged benchmarks have limited data. Our usage of the local index as a proxy for hedged returns is consistent with the results from Thomas and Bosse (2014), who found that the hedge return tended to affect performance over long time horizons, and therefore should have only minor impact when computing statistics measuring risk. So although our local benchmarks would be inappropriate for comparisons between hedged and unhedged returns when measuring average returns over long time periods, for the purposes of comparing volatility and correlations, the local benchmark serves as a very good proxy for a hedged investment (see **Figure A-1**). For example, when comparing the MSCI World Index hedged to Australian dollars versus the index in local terms (with no currency return), the performance statistics indicate that the two track each other very closely on a monthly basis.

**Figure A-1. Comparison of MSCI World hedged indexes with MSCI World local index: January 1988–December 2013**

	 Australian dollar	 British pound	 Japanese yen	 U.S. dollar	Local
Volatility	14.3%	14.2%	14.0%	14.1%	14.1%
Correlation to local index	0.998	0.999	0.999	1.000	1.000
Beta to local index	1.013	1.003	0.993	1.002	1.000
R-squared to local index	0.996	0.998	0.998	0.999	1.000
Tracking error to local index	0.94%	0.62%	0.69%	0.36%	N.A.

**Note:** Table compares statistics based on monthly price returns of MSCI World Index, hedged to the stated currency, relative to MSCI World local (currency return removed) index. Beta is a measure of the magnitude of share-price fluctuations in relation to the ups and downs of a given market index. R-squared is a measure of how much of a security’s past returns can be explained by returns from the market in general, as represented by a given index.

**Sources:** Vanguard, based on data from MSCI.

<sup>19</sup> Since the euro did not formally come into being until January 1, 1999, researchers who report findings for this currency before this inception date use a variety of methods to derive a hypothetical euro series. For example, Campbell, Serfaty-de Medeiros, and Viceira (2007) defined “Euroland” as a value-weighted currency basket including Germany, France, Italy, and the Netherlands. By contrast, as detailed in Buldorini, Makrydakis, and Thimann (2002), the Bank for International Settlements constructed a theoretical euro exchange rate based on a weighted average of the legacy currencies—the currency basket of those countries that founded the European Monetary Union in January 1999—to use as the proxy for the euro before 1999.

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