



C A M B R I D G E A S S O C I A T E S L L C

CURRENCY HEDGING

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SUMMARY

Introduction

As investors have increasingly abandoned their home-country bias and diversified their portfolios geographically, they have also increased their allocations to currencies other than their “home” currency. However, since their liabilities, in the form of spending, are typically concentrated in that home currency, this increased exposure to exchange rates results in the addition of risk for which there is no *prima facie* presumption of compensation. Consequently, global investors should consider whether (1) it would be feasible, cost effective, and worthwhile to hedge out some or all of that risk; (2) they should hire managers that themselves manage the currency risk inherent in foreign securities; or (3) they are prepared to make an active decision regarding the relative strengths and weaknesses of the currencies to which they are exposed. None of these is the “right” answer; however, the wrong answer is to incur this risk without realizing one is doing so.

Currency Hedging in Theory

The Strategic Case for Hedging

Investing boils down to putting capital at risk, and getting paid by capital seekers for doing so. The challenge, of course, is to determine *ex ante* which risks offer sufficient compensation and to diversify among them.

Owning a currency that is different from one’s future spending currency creates a fundamental misalignment that can impair the spending power of the portfolio. It can also increase short-term and intermediate-term volatility (particularly in lower-volatility assets such as bonds), and do so without any offsetting promise of compensation.

Unlike, say, equities (but like active management of equity portfolios), currency is a zero-sum game, since every currency movement creates both a winner and a loser.¹ In other words, the long-run expected return for foreign currency exposure is zero, yet the expected volatility is relatively high (i.e., the holder is taking on uncompensated risk). Investors with significant allocations to assets denominated in foreign currencies² should therefore assess the likely impact of this uncompensated risk on their total portfolio to determine whether the cost and effort of hedging are warranted. Those that decide to hedge their currency exposure (and have the scale and resources to do so) should consider adopting currency-hedged benchmarks across their developed non-U.S. or global equity portfolios and their global or global ex U.S. bond portfolios.

¹ Despite a massive decline in the dollar since the early years of this century, overall returns over the past two decades seem to bear this out. Thus, the annualized return of the unhedged MSCI EAFE Index in US\$ terms differs from that of hedged EAFE by only 24 basis points (bps) per year over the past 20 years. Shorter time windows during this 20-year span, of course, show alternating periods of regret and celebration for currency-hedged US\$-based investors.

² The use of “foreign” refers throughout to assets domiciled outside the investor’s home country or to currencies other than the investor’s base currency. Our thoughts on how global investors might choose the appropriate base currency are contained in Appendix C.

We recognize that investors that adopt currency-hedged policy benchmarks may periodically implement tactical overrides. Currencies tend to trend for multiyear periods, and therefore present investors with opportunities to add value by increasing or decreasing the hedge ratio relative to that of the benchmark.³ However, tactical decisions to change the hedge ratios should be seen as an active bet, the results of which should be measured against those of the strategic, hedged benchmark.

Why Now?

In the past two decades, sophisticated institutional investors have embraced a global approach to equity investing, with the trend accelerating rapidly over the past four years. For example, U.S. endowment funds devoted 12% of their traditional equity allocation to non-U.S. equities in 1993, 22% in 1997, 25% in 2003, and 47% in 2008.⁴ Investors outside the United States appear to be moving away from home-bias portfolios as well. According to a 2006 working paper by the European Central Bank, the average degree of home bias in both the bond and equity portfolios within mature economies shrank by about one-sixth from 1997 to 2003.⁵ This growing allocation to foreign assets has significantly increased the foreign currency exposure of portfolios.

Together with decreasing home bias, investors have increased allocations to alternative assets substantially during this decade. Many hedge funds and private equity funds are denominated in U.S. dollars, which has also contributed to boosting foreign currency exposure for non-US\$-based investors.

What Level of Foreign Currency Exposure Is Sufficiently Material to Warrant Concern?

If ownership of foreign equities diversifies an otherwise domestic equity portfolio, thus reducing portfolio risk, while the associated foreign currency exposure *adds* risk to the portfolio, is there some tipping point at which the added risk from the currency exposure exceeds the added benefit from the asset diversification to such an extent that it has a material impact on the total portfolio? It would be comforting to have a simple numerical rule of thumb—a level of foreign currency exposure below which the added currency risk might be considered insignificant. Unfortunately, no such rule of thumb exists: there are situations where currency exposure will clearly have *de minimis* impact, and situations where it will clearly

³ Related to this, some investors may wonder how to synthesize Cambridge Associates' view of individual currencies with our view on currency hedging. We advocate for currency hedging, but that is not because of our opinion on a given currency. Our view that the U.S. dollar is overvalued versus managed Asian currencies, for example, is a longer-term viewpoint. We expect the dollar to depreciate versus these currencies but do not know when. Currency hedging has an impact in shorter-term periods. For investors that have views on their home currency or on particular currency pairs, it is certainly conceivable that those views would be expressed by varying the hedge ratios tactically versus their strategic level. The existence of modest valuation differentials between currencies, however, is probably not a sufficient reason to "go tactical."

⁴ The largest U.S. endowments have gone even further, committing 62% of their equity allocation to non-U.S. securities in 2008, up from 42% in 2003.

⁵ For more on home bias, see Michael Fidora et al., "Home Bias in Global Bond and Equity Markets: The Role of Real Exchange Rate Volatility," European Central Bank, 2006. Glenn Yago et al., "Home Bias in Global Capital Markets: What Is the Potential Demand for U.S. Asset-Backed Securities," Milken Institute, 2006. "Fixed Income: Why Investors Should Think Globally," Lazard Asset Management, 2008. Seth Masters et al., "Home Country Bias: Where Traditional Asset Allocation Falls Short," Alliance Bernstein, 2006.

have major impact. There is also, however, a large gray area where the impact, while clearly nontrivial, would be of greater concern to some investors than to others.

To some degree, however, this question poses a false choice. The implication is that investors can benefit from international diversification up to a point, and that diversification beyond that point is counterproductive. This could be true for investors that view assets and their associated currencies as inextricably linked. But for investors that have the ability to separate assets from their currencies, this line in the sand, broad and fuzzy to begin with, becomes arbitrary.

If one assumes that currency pairs have volatility, that the movements of currencies are not negatively correlated with the returns of their associated assets, and that currency has an expected return of zero, then any exposure to foreign currency—whether 1% of the portfolio, 10% of the portfolio, or 100% of the portfolio—adds a degree of uncompensated risk. For investors that share those assumptions, hedging eliminates the false dilemma, allowing the investor to benefit from the asset exposure without taking on uncompensated risk from the currency exposure.

However, this freedom to separate currency exposure from asset exposure begs the question of whether the game is worth the candle; i.e., whether hedging has sufficient impact on the total portfolio to justify the costs and resources required to implement. In fact, the incremental volatility from leaving currency exposure intact has historically been quite modest because correlations of foreign equities and their associated currencies have often been negative, and because the equities themselves are sufficiently volatile as to camouflage the currency volatility. For example, over the past two decades, the annualized standard deviation of the unhedged MSCI World Index⁶ translated into sterling has been 15.5%, compared to 14.1% for the version of the index that is *hedged* to sterling. This is a meaningful reduction, but if foreign equities are just 15% to 30% of a total portfolio, for example, the impact on total portfolio volatility is minimal.

Currency Volatility

Currency volatility is substantial, and can be comparable in some periods to the volatility of long-duration bonds (Exhibits 1a–1e). An examination of the annualized difference in historical returns between unhedged and hedged versions of global indices over rolling periods (Exhibits 2a–2e) shows that differences of 10 percentage points or more are relatively common over rolling one-year periods.⁷ Over five- and ten-year periods, however, the annualized dispersion tightens up considerably as mean-reversion kicks in (although an *annualized* return difference of say, 5 percentage points over five years or 2 percentage points over ten years is quite substantial, of course). Modeling based on our long-term return, risk, and correlation assumptions indicates that the expected volatility difference between unhedged and fully hedged global bonds is generally 200 bps to 300 bps, while the volatility difference between unhedged and hedged equities

⁶ Throughout this paper, we use the MSCI World Index of developed market equities to represent an investment in global equities.

⁷ A histogram can have the effect of obscuring the activity in the tails of the distribution; for reference, the largest one-year differences during the sample period for the US\$ version of the exhibit were +17.7 percentage points and -19.7 percentage points.

is 100 bps to 200 bps (Exhibits 3a–3e).⁸ This additional volatility from foreign currency exposure would have a noticeable but tolerable impact if that exposure is limited, but at higher levels of exposure the impact becomes significant, with incremental volatility that many investors may find uncomfortable.

Exhibits 4a through 4e illustrate how the expected volatility of a diversified portfolio shifts as various percentages of the portfolio's foreign developed long-only equities are hedged. Increasing the hedge ratio of long-only developed equity from 0% to 100% decreases the expected volatility of an entire U.K. portfolio by about 70 bps, and of an entire U.S. portfolio by about 40 bps. (For a US\$500 million portfolio, we estimate that the annual cost of applying the 100% hedge ratio would be approximately 3 bps at the total portfolio level, so hedging would increase the expected Sharpe ratio, lowering the portfolio's expected return by about 3 bps while lowering the portfolio's expected volatility by 40 bps.) As for returns, for a diversified portfolio that does not include non-marketable assets, the historical performance differential between an unhedged version of the US\$ portfolio and one with fully hedged developed equities would have ranged from a 350 bp one-year outperformance to a 370 bp underperformance in extreme periods (Exhibits 5a–5e).⁹

Historical Correlations of Foreign Currencies and Foreign Assets

In some periods, the U.S. dollar's rate of exchange against a particular foreign currency has been uncorrelated with the value of assets tied to that foreign currency, while in other periods it has exhibited a negative *or* positive correlation. During periods of significant negative correlation, the currency volatility may dampen the combined currency/asset volatility somewhat, while in *all other periods* it will be additive. We believe the most sensible assumption for future currency/asset correlation is in fact zero, but if future correlations are actually positive, or are only slightly negative, rather than zero, then our conclusion still holds (currency exposure adds volatility). In other words, only if one can make the case that foreign assets and their associated currencies are likely to be negatively correlated—to a significant and consistent extent—should one dismiss the case for hedging.

Our zero-correlation assumption is based primarily on the lack of compelling economic reasons why future correlations *should be* anything other than zero. Elroy Dimson, Paul Marsh, and Mike Staunton of the London Business School looked at historical correlations for 15 currency/asset pairs for the period 1900 to 2005, and for the subperiod 1972 to 2005. They found that over the broad time period, the correlation of local currency returns with real exchange-rate changes was negative for 13 of the 15 countries, and ranged from 0.14 for Canada to -0.32 for Italy. For the post-Bretton Woods time period, the correlation was negative for 12 of 15 countries, ranging from 0.15 for Canada to -0.49 for the Netherlands. Correlations vary over time, as evidenced in Exhibits 6a through 6e. Investors assuming persistent and robust negative correlations should have markedly different expectations for currency exposure, since it would lower

⁸ Our long-term equilibrium assumptions reflect our assessment of the expected return and volatility of asset classes over long periods of time. The smaller volatility difference shown for S\$ portfolios in Exhibit 3e reflects the high correlation of the S\$ to the US\$; S\$-based investors would expect to experience limited volatility impact from translating US\$ gains or losses into S\$, and the global indices include large US\$ representation.

⁹ The portfolios illustrated in Exhibits 4a through 4e and 5a through 5e are not necessarily intended to illustrate a typical or optimal asset allocation. The US\$ portfolios are adapted from the average asset allocation of college and university endowments surveyed by Cambridge Associates.

portfolio volatility and enhance portfolio diversification, and should therefore remain unhedged. However, we see no compelling rationale for future correlations to *consistently* be sufficiently negative to generate a diversification benefit from residual currency exposure.¹⁰

In most environments, currency volatility will have less impact on an equity portfolio than on a bond portfolio, simply because the volatility of equities exceeds that of bonds. However, currency volatility is fungible across asset classes. Thus, the euro/sterling exchange rate has an identical impact on a sterling-based portfolio whether the euro exposure is coming from equities, bonds, or even bottles of wine. Some academics and investment practitioners counsel investors to look past currency volatility (which is primarily a short- and medium-term phenomenon) and focus on the expectation that currencies losing ground this year may gain ground the next; in other words, over time these fluctuations all wash out. Yes ... but ... we keep returning to the fundamental point that, if possible, investors should never incur uncompensated risk (and increased volatility is certainly one form of risk). Spending needs are continuous, rather than deferred to some indeterminate future, and for many investors portfolio volatility is transmitted to spending, with adverse budgetary consequences. Hence our concern with the short- to intermediate-term volatility foreign currency exposure can bring into a portfolio.

Central to this argument is the recognition that foreign currency exposure is separate and different from exposure to foreign assets and is fungible across asset classes. One million euros is one million euros, whether tied to a hedge fund, or a sovereign bond, or an equity portfolio. And the dollar impact on the portfolio of hedging the euro exposure, or leaving it unhedged, is exactly the same no matter the underlying asset.

Diversification Benefits: Foreign Currency as Insurance Against a Home-Currency Rout

Investors with globally diversified portfolios often regard their substantial, unhedged exposure to foreign currencies as a hedge against the possibility of a precipitous decline in their home currencies.

This begs two questions:

1. Is it necessary to hedge against a precipitous decline in one's home currency?
2. Would unhedged exposure to a portfolio of foreign equities provide investors with such protection?

The answer to the first question seems at first glance to be obvious. Potential catastrophes, after all, should usually be insured against whenever possible: homeowners buy fire insurance; breadwinners buy

¹⁰ Some currency overlay firms suggest separate hedge ratios for each currency, using the historical correlation of the currency and the asset to determine which currency exposures have been diversifying and leave those unhedged, and to eliminate or sharply reduce the exposure to currencies that have tended to rise when equities are under pressure. By this logic, for example, exposure to the yen would likely be left unhedged or underhedged, while exposure to the Australian dollar might be fully hedged (the *Aussie* has been positively correlated with equities, while the yen has been negatively correlated). This approach, however, assumes that correlations are stable.

disability and life insurance. But the answer to whether investors should insure against a home-currency rout is more complicated than this.

The most predictable impact of a decline in the value of an investor's home currency would be a decrease in purchasing power for that investor, since it would take more currency to buy the same quantity of imported goods and services. But the risk of such unanticipated inflation is already addressed in many modern investment portfolios by significant allocations to commodity futures, real estate, natural resources equities, inflation-linked bonds, and other inflation-sensitive assets.

Another, less certain, impact is the possibility that panicked foreign investors could at some point dump bonds denominated in the investor's home currency, forcing interest rates higher. Rising yields would have a negative impact on both equities and bonds, and some investors hold a modest allocation to foreign sovereign bonds in an attempt to address this risk, while others concerned about devaluation of paper currencies in general may hold a small amount of gold.

Moreover, there is no guarantee that unhedged exposure to the underlying currencies of a diversified global equity portfolio would provide adequate cover in the event of a home-currency rout. This is because the investor's home currency would not necessarily depreciate by the same amount against every other currency. For example, a portfolio with market-weighted equity exposure has a very different currency profile than one with outsized exposure to emerging markets. Even if specific insurance against a home-currency rout (rather than against its likely or possible outcomes) were desirable, this approach may have too much basis risk¹¹ to be effective. That said, even those investors that have a hedging program in place are likely to have at least a modest amount of residual exposure (from a hedge ratio less than 100%, and from the inability to easily hedge exposures to some asset classes), and there is no need to be dogmatic about eliminating all such exposure. Investors in some countries that have experienced currency devaluation shocks in the past have probably benefited from residual exposure to the U.S. dollar and other currencies that remained relatively strong. Leaving a small amount of residual exposure to other currencies may prove beneficial in this scenario.

Currency Hedging in Practice

Three Approaches to Decreasing Foreign Currency Exposure

Investors that have more currency exposure than they deem prudent have several options: (1) decrease exposure to foreign currency assets; (2) allocate some global equity or bond assets to active or passive products that hedge currency exposure; and/or (3) hedge some or all of the currency exposure.

Decrease exposure to foreign currency assets. This should be a nonstarter for most investors—a case of allowing the currency tail to wag the asset allocation dog. We are unabashed proponents of global

¹¹ Basis risk is present when an imperfect hedge is used to provide cover against a particular risk to the portfolio.

portfolio diversification, believing that any expansion of the equity investment opportunity set, especially when likely to reduce total portfolio volatility, is unambiguously positive. That said, portfolios with very substantial allocations to unhedged foreign equities may experience greater volatility than those with a home bias, depending in large part on the volatility of the investor's domestic market. For example, once the unhedged foreign equity exposure of a US\$-denominated portfolio invested 70% in equities and 30% in domestic bonds exceeds one-third of assets, total portfolio volatility will increase (based on our long-term performance and correlation assumptions) as a result of the attendant currency exposure. For many markets that are relatively volatile, such as Singapore, globalizing the portfolio's equity exposure would be expected to moderate portfolio risk substantially, even if the exposure were not currency hedged. Exhibit 7 provides an illustration of the impact on portfolio-level volatility from globalizing the equity exposure, if the currency risk inherent in the foreign equities added to the portfolio is *not* hedged.¹²

Allocate some global equity or bond assets to active or passive products that hedge currency exposure. Most traditional equity managers do not typically hedge any portfolio currency risk; however, some do. Consequently, investors seeking to limit or reduce currency exposure should consider active or passive products where this risk is hedged. We would stress, however, that only managers or passive products that would likely make the cut *regardless* of currency concerns should be considered. For investors denominated in dollars, sterling, or the euro, there may be a good selection of such managers. For investors whose base currency falls outside of those three, the selection of hedged managers is likely to be less robust.

Hedge some or all of the currency exposure. This is the optimal solution, but one that has historically been operationally complex (as described below) and therefore accessible only to larger investors with the necessary resources.

Currency Market Basics

The foreign exchange market is the most liquid market in the world, with \$3.1 trillion in foreign exchange transactions per day, compared to perhaps \$600 billion in U.S. Treasury securities, and \$83 billion and \$24 billion in average daily trading volume on the New York Stock Exchange and London Stock Exchange, respectively.

The market consists of hundreds of currency “pairs”—the amount of one currency necessary to buy another currency. Shifts in value for various pairs are interdependent (otherwise an arbitrage opportunity would exist). For example, if Currency A becomes more valuable versus Currency B, and Currency B becomes more valuable versus Currency C, then Currency A will become more valuable against Currency C.

Each currency has a particular value against all other currencies at any given time, set in what is called the spot market. However, hedging (and speculative) activity is concentrated in the forward market. In this market, participants agree to buy or sell units of currency at a particular time in the future. The price of a

¹² Additionally, if the investor's home currency was pegged (either *de jure* or *de facto*) to the U.S. dollar or the euro (or another major currency), the level of unhedged global exposure required to offset the asset-diversification benefit would be higher, provided the peg remains intact.

forward contract today includes the market's current expectation of the shift in spot rates between today and the maturity date of the forward—predominantly determined by interest rate differentials between the two countries. Thus hedging investors cannot lock in today's spot exchange rate, but only today's forward exchange rate for a future date (one or three months from today, for example), eliminating the *unexpected* movement in exchange rates versus their own reference currency.¹³

How Does Currency Hedging Work?

Let us assume a pound sterling-based investor owns €100 million worth of French equity shares, and wants to retain exposure to the underlying equities but not to the euro over the next three months. The investor (or overlay manager hired to transact on the investor's behalf) would commit sufficient cash to prepare for settlement of transactions in the currency forwards market (as with the futures market, significant leverage is permitted), and then sell three-month forward contracts promising future delivery of €100 million. If the French equities show no price change, but the euro appreciates more versus the pound during the three-month period than was discounted by the forward markets, the investor loses money on the hedge, since it has promised to deliver euros at a price below what is now the market price, but gains an equal amount on the underlying investment in French equities because of the appreciating euro. This process can be repeated indefinitely by simply buying new forward contracts at prevailing rates every three months—a process normally accomplished by instructing the broker (or overlay manager) to keep rolling the contracts forward until further notice. If exchange rates have moved against the investor (as in the example above), more collateral will be required. Since investors should seek to minimize the potential opportunity cost of tying up assets in a currency hedging cash collateral pool, they may be subject to frequent calls to top up that pool. This is where operational complexity deters many smaller investors that lack the staff resources needed to oversee the cash management demands of such a hedging program.

To overcome this problem, however, Cambridge Associates has worked with two firms to develop a hybrid currency-hedging structure that minimizes or eliminates both collateral calls and cash drag, and therefore offers significant advantages to any nontaxable investor seeking to hedge out all or some of the foreign currency risk inherent in non-domestic equities.¹⁴ This hybrid structure is described in detail in Appendix A.

Investors should be aware that not all forward currency contracts are liquid. Depending on their client's preference, hedging firms may leave some exposures (such as to the Danish *krona*) unhedged, or those may be proxy hedged using a liquid contract that has historically been correlated to the target currency.¹⁵ This approach typically minimizes transaction costs and generates very modest tracking error for

¹³ This is typically, but not always, the currency used in the country where the investor is geographically based. More accurately, it is the currency (or basket of currencies, in a few cases) in which the investor's liabilities and future spending are denominated. (See the Appendix C for discussion of currency hedging for investors that spend, or plan to spend, in multiple currencies.)

¹⁴ Tax implications of currency hedging programs may be significant, and likely vary from one jurisdiction to the next. Coordination with tax counsel is important.

¹⁵ For investors with base currencies that are not as widely traded, the lack of liquidity may even make hedging of exposures to major currencies such as the euro or the yen expensive. We address this in Appendix C.

investors with diversified portfolios. Investors with highly concentrated exposures to illiquid currencies, on the other hand, may choose to suffer the higher transaction costs associated with the illiquid contracts.

An important consideration in any environment (but one with increased visibility in the current setting) is counterparty risk. Currency forwards are traded over the counter rather than listed on an exchange or settled through a central clearing corporation. Consequently, investors evaluating firms for their currency hedging capabilities should ask about their choice of counterparties, their ongoing monitoring of counterparty suitability, and any other practices they engage in to reduce counterparty risk. More details on managing counterparty risk are found in Appendix D.

Currency-Hedge Ratios

Investors deciding to hedge against currency risk must determine how much risk is worth eliminating. In other words, what percentage of foreign currency exposure should be hedged?

A **hedge ratio of 0%** may be suitable for investors with long time horizons and a high tolerance for interim volatility. Except for war-related extreme devaluations, currency movements tend to mean-revert over long horizons. Harvard University's Kenneth Froot made the case in an influential 1993 paper that hedging does *not* lower portfolio volatility over time horizons of several years.¹⁶ However, we do not believe investors are well programmed to simply ignore large interim fluctuations in value, even if they do not materially affect the rate at which the portfolio compounds. If two assets have the same expected return, we would tend to recommend the one that has less volatility, all other things equal. Nevertheless, it is important for investors to analyze their currency exposure *in the context of their total portfolio*, since the potentially adverse impact of currency fluctuations on a subset of total assets might be of little consequence on the whole.

A **hedge ratio of 100%** makes sense if investors hold the three assumptions noted above¹⁷ and a fourth assumption that there is no cost to hedging marginal currency exposure. Clearly this fourth assumption cannot be literally true, but perhaps the cost to hedge an additional euro, yen, or other exposure is so low for a large institution that it can be ignored. The 100% hedge ratio was championed in an influential paper two decades ago by André Perold of Harvard Business School and Evan Schulman, then a partner at Batterymarch Canada.¹⁸

Some practitioners and academics advocate a quantitative approach to determine an **“optimal” hedge ratio**.¹⁹ This approach is tempting, in that it generates a “right answer” that appears considerably less

¹⁶ Kenneth Froot, “Currency Hedging Over Long Horizons,” NBER Working Paper No. 4355, May 1993.

¹⁷ To refresh, these assumptions are that (1) the currency pairs established by the investor's portfolio have volatility; (2) the currency returns do not have a strongly negative correlation to the returns of the investor's assets; and (3) the currency movement provides an expected return of zero.

¹⁸ André Perold and Evan Schulman, “The Free Lunch in Currency Hedging: Implications for Investment Policy and Performance Standards,” *Financial Analysts Journal*, May-June 1988.

¹⁹ Fischer Black, “Universal Hedging: Optimizing Currency Risk and Reward in International Equity Portfolios,” *Financial Analysts Journal*, July-August 1989.

arbitrary than alternative postures. However, it tends to be dependent on currency return assumptions that are difficult to pin down, or on historical correlations or precise historical return anomalies (such as the forward-rate bias) that may or may not hold true in the future. An “optimal” hedge ratio based on inaccurate starting estimates is no more likely to be truly optimal than a thumb-in-the-wind approach.²⁰ Garbage in, garbage out.

A hedge ratio of 50% is relatively common among investors although it is unlikely to be the optimal hedge ratio, either *ex post* or *ex ante*. However, the greatest enemy of a *good* plan (to paraphrase General Karl Von Clausewitz of Prussia) is the dream of a *perfect* plan. And a 50% hedge ratio is a good plan. Academic support for a 50% hedge ratio stems primarily from behavioral finance theorists,²¹ but practical benefits abound as well.

In the words of the behavioral finance theorists, the 50% hedged investor “minimizes regret” by taking a position that will always prove half right. This may not be optimal in risk/return terms, but it is perhaps less likely to be second-guessed and eventually overturned (by oneself, or by incoming committee members, for example). A second benefit is that a half-hedged strategic posture leaves room for an overlay manager (or a committee with an informed viewpoint on the direction of their home currency) to tactically add value by increasing or decreasing the hedge ratio (Appendix B provides an overview of active currency management strategies).²² Finally, a partially hedged strategy accommodates the practical difficulties of hedging certain assets like the underlying exposures of private equity funds or emerging markets equities.

On the other hand, a 50% hedge ratio seems on the surface to do too little to mitigate the uncompensated incremental risk foreign currency exposure introduces. However, the volatility reduction from hedging is governed by a diminishing marginal utility function; to wit, as one increases the percentage of assets that are hedged, the decrease in risk is significant at first, but less later. Thus, Stephen Gorman and Edward Qian found that for the time period of their research (roughly the last two decades of the 1900s), U.S. investors that hedged 50% of their non-US\$ equities delivered three-quarters of the volatility reduction that could be gained by hedging the entire exposure, while hedging 50% of non-US\$ bonds delivered two-thirds of the total volatility reduction. That is to say, the volatility reduction for an investor moving from 0% hedged to 20% hedged should be much greater than the incremental volatility reduction to be gained in moving from 80% hedged to 100% hedged. The actual reduction in volatility will vary from one period to the next (and in periods where correlations of currencies and underlying assets are negative, volatility of hedged assets will actually be higher), but we would expect that in most periods a half-hedged approach will

²⁰ Grant Gardner and Douglas Stone argue in “Estimating Currency Hedge Ratios for International Portfolios” in the November-December 1995 *Financial Analysts Journal* that “the estimation error is so large that estimates of the optimal hedge ratio are of little practical use to an investor with moderate or low aversion to risk.”

²¹ Support for a 50% hedged posture is found in Grant Gardner and Thierry Wuilloud, “Currency Risk in International Portfolios: How Satisfying is Optimal Hedging?” *Journal of Portfolio Management*, Spring 1995. Stephen Gorman and Edward Qian, “International Benchmarks: In Support of a 50% Hedge Ratio,” *Journal of Investing*, Summer 2000. Gary Gastineau, “The Currency Hedging Decision: A Search for Synthesis in Asset Allocation,” *Financial Analysts Journal*, May-June 1995.

²² It is of course possible for an active currency overlay firm with a strategic hedge ratio of 0% to actually go short the client’s base currency on a tactical basis if the client permits, and for an overlay manager given a strategic hedge ratio of 100% to tactically overhedge, but these approaches are uncommon and may be perceived as rather aggressive.

continue to deliver significantly more than half the possible volatility reduction from hedging (this effect is evident in Exhibits 3a–3e).

There is adequate *theoretical* justification for any of these four approaches and no right answer for every investor, but on balance we would generally lean toward 50% for *practical* reasons, even though our assumptions (including the assumption that hedging is costless) would point to a 100% ratio as the optimal approach in risk/return terms. In any case, the selected *strategic* hedge ratio should be the basis for the benchmark, and this benchmark should be the basis of comparison against which any tactical changes to the hedge ratio should be measured.²³

Since Active Managers' Currency Exposures May Change Dynamically, How Can These Be Hedged?

The currency exposure of an active manager of a global equity and bond portfolio is a moving target. This is doubly difficult for investors in commingled vehicles, rather than separate accounts, since transparency is frequently limited and delayed, relative to the transparency a custodian can provide to a separate-account holder. How can one hedge an indeterminate exposure? For investors using commingled vehicles, the solution is to simply hedge the manager's *benchmark* currency exposures, rather than the manager's *actual* currency exposures.

For those investors with real time transparency into actual manager exposures, hedging *actual* exposures is a reasonable option. Hedging the actual real time exposures avoids the possibility of the investor establishing a net-short position in a particular currency and is probably the best way to minimize unintended, residual portfolio exposures.²⁴ If managers shift their exposures frequently and aggressively versus the benchmark, this approach will increase transaction costs (because hedging exposures will need to be adjusted when manager currency exposures shift significantly).

Even for investors with real time transparency, however, hedging actual exposures is certainly not the only reasonable option; hedging the benchmark can be quite sensible. Managers may explicitly consider currency when evaluating a security, or they may not, but differences between the manager's currency exposure and that of the benchmark are the responsibility of the manager; that is, they are simply a component of active risk. Investors that would not generally override a manager's country bets or sector bets also have the option of leaving the manager's currency overweights and underweights relative to the benchmark, while significantly reducing currency exposure. The easiest way to achieve this is to simply hedge the *benchmark's* currency weights.

²³ Some overlay managers, even those employing a relatively passive approach, advocate using different hedge ratios for each currency the investor is hedging. This approach forecasts returns for each currency pair and incorporates a correlation assumption. Such an approach is perfectly valid, but the hedge ratios derived by this exercise are somewhat dynamic and should *not* be part of the strategic benchmark.

²⁴ For example, if an active manager with an MSCI World benchmark has no (or a very low) exposure to Japan, the investor that hedges the equity portfolio back to MSCI World will end up selling yen despite having no or few yen-denominated securities in the portfolio and will end up with a significant net-short position in the yen. Investors should be mindful of governance-related restrictions on using derivatives to establish directional exposure.

Which Asset Classes Are Most Suited to Hedging?

As noted before, currency exposure is fungible across asset classes. A million euros has the same impact on the overall portfolio, whether from bonds, or stocks, or first-growth Bordeaux. That said, there are differences across asset classes—differences in exposure, differences in the ability to hedge, and differences in volatility—that have behavioral and perceptual implications.

Bonds. Investors frequently hedge global developed markets bonds because the currency volatility often swamps the return of the underlying bonds. Bond benchmarks may have much different currency exposure than do equity benchmarks, so a 50% hedge of a \$100 million global sovereign bond portfolio will impact returns somewhat differently than a 50% hedge of a \$100 million MSCI World Index portfolio (for example, the yen exposure is higher in some global bond benchmarks than in the MSCI World Index). Developed markets bond strategies can be easily hedged and some products are offered prepackaged in both currency-hedged and unhedged versions. From a behavioral perspective, investors seeking stability from a bond program should consider hedging that program. Although currency exposure is fungible across the portfolio, investors may still get a lump in their throats (or a memo from an outside stakeholder) when a tame bond investment appears to fluctuate wildly as a result of currency translation.

In the case of emerging markets local currency bonds, however, investors are often looking for additional exposure to emerging markets currencies, and in any case would likely find it expensive to hedge away the currency exposure.

Traditional Long-Only Equities. Long-only equity products are typically benchmarked to an unhedged index, and the volatility of the underlying equities is larger than that of the associated currencies, so many investors are only vaguely aware of currency's impact on returns. However, we do not think investors in developed foreign equities should incur currency risk by default, so investors should consider benchmarking their portfolios to hedged indices (which are available from MSCI). Developed markets equity portfolios are eminently suited to currency hedging; however, emerging markets equity portfolios are more problematic.²⁵

²⁵ Emerging markets equities generally remain expensive to hedge, with higher transaction costs resulting from much lower liquidity in the market for currency forwards. Indeed, some emerging markets currencies may only be hedged with nondeliverable forwards. The cost of hedging emerging markets currencies diminishes the appeal of doing so. Investors in emerging markets equities should consider whether they can stomach the volatility incurred by virtue of their unhedged exposure. The 14% decline in emerging markets currencies in September and October 2008 versus the U.S. dollar (as measured by the compounded daily return difference between the U.S. dollar and local currency versions of the MSCI Emerging Markets Index) reminds investors of the significant currency moves that can be generated by extreme capital flows into, and recently out of, emerging markets countries.

Hedge Funds. A large number of hedge funds are denominated in U.S. dollars.²⁶ This can be problematic for non-US\$ based investors that invest in these partnerships and do not hedge the residual currency exposure. Investors generally expect less volatility from hedge funds than from conventional long-only equities. But if investors are translating returns of US\$-denominated hedge fund shares into a currency other than U.S. dollars, they will likely experience much higher volatility than that of US\$-based investors. The annualized standard deviation of the HFR Fund of Funds Composite Index in U.S. dollars since 1999 is 5.8%; when left unhedged and translated into sterling or euros, the volatility is several percentage points higher, and when translated into Swiss francs the volatility nearly doubles compared to the volatility in U.S. dollars. The hedged returns of the index, however, have essentially the same volatility as that experienced by US\$-based investors (Exhibit 8).

The astute reader may object that hedge fund managers are increasingly investing in a global fashion, and that the fund's underlying currency exposure is not known, preventing effective hedging. Unlike managers of traditional long-only equity accounts, however, hedge fund managers are often evaluated on an absolute return basis, and importantly the manager does not receive an incentive fee unless the fund delivers profits *when measured in U.S. dollars*. Consequently, we expect managers of US\$-denominated funds to generally avoid unhedged, residual exposure to currencies other than the U.S. dollar unless they believe that (a) the exposure cannot be hedged in a cost-effective manner; (b) it presents *de minimus* risk to the portfolio; or (c) it has a positive expected return versus the dollars the manager's profit is measured in. Therefore, hedge funds should, as a general rule, not be expected to have significant residual non-US\$ currency exposure.

Unfortunately, hedging out the hedge fund portfolio's currency exposure stemming from the prevalence of US\$-denominated funds is not as simple as it might seem at first blush. The illiquidity of a hedge fund portfolio is not particularly compatible with currency forwards that must be settled each month. We attempt to address this issue in Appendix E.

Non-Marketable Alternative Assets. Investors are increasingly diversifying their private equity and real estate exposure to target markets that may offer better return prospects than their home market. Thus, foreign currency exposure is becoming a significant component of non-marketable equity portfolios. However, the irregular and uncertain timing of capital calls and distributions makes the underlying currency exposure of private equity partnerships almost impossible to hedge. Moreover, a European-focused private equity fund may call capital in euros, convert the euros to *krona* to buy a Norwegian company, and then three years later sell the company to a strategic buyer in Japan (or list it on London's AIM stock exchange). Meaningfully hedging this series of transactions with any precision would be virtually impossible. The manager's incentive fee (often a percentage of any profits over an absolute return hurdle rate) would theoretically encourage general partners to hedge the fund's currency exposure back to the currency in which

²⁶ Some hedge fund managers do offer share classes denominated in sterling, euros, and occasionally other currencies as well. If managers that are worthy of inclusion in a portfolio also offer share classes in the investors' home currency, this is a simple way to decrease the currency risk in the hedge fund portfolio (however, the existence of other currency share classes should not be the tail that wags the dog—do not be tempted to use this convenient fund feature as an excuse to shortcut proper due diligence of a manager).

the fund is denominated, just as it does for hedge funds, but in reality managers that have looked into this possibility are likely to throw up their hands. In short, our advice to investors that wish to hedge underlying currency exposure of non-marketable partnerships is that they should recognize the currency risk implicit in these private market allocations when sizing their commitments, but hedge out their exposure in other asset classes instead.

The funds themselves are often denominated in dollars or euros, and like non-US\$-based hedge fund investors, private equity limited partners may be interested in shorting the U.S. dollar or euro versus their own currency as a way of eliminating the resulting currency exposure. Unfortunately, the illiquidity of the non-marketable alternative assets portfolio is not compatible with currency hedging, because distributions cannot be counted on when the currency forwards are set to settle. Increasing the hedge ratio of the marketable equity portfolio is one way to compensate for this problem.

Commodities. Since commodity futures contracts and many commodity products are US\$ denominated, investors that are *not* similarly US\$-based will experience currency volatility as returns are translated into their home currency. However, unlike for many other asset classes, we believe that there is a reasonable case to be made for leaving this currency exposure *unhedged*. The reason why commodities are often included in a portfolio is to hedge against unanticipated inflation. For an investor not denominated in U.S. dollars, commodity prices may rise from the investor's perspective because of rising commodity prices, a rising dollar, or both. The price of commodities in the investor's base currency should be a reasonably close cousin to the inflation that the investor experiences.

One scenario in which this unhedged posture would perform relatively poorly would be if commodity prices soared in US\$ terms as the dollar sold off sharply versus other currencies. Commodity investors that did not hedge their US\$ exposure would not benefit in that scenario. At the same time, however, the prices that consumers and businesses in the investor's country would pay for commodities would remain stable, thereby limiting inflation.

If instead, commodity prices were stable in U.S. dollars, but the U.S. dollar appreciated versus other currencies, this would be inflationary to investors based in those other currencies (because the prices of the commodities would rise in local currency terms). In that scenario, exposure to commodities that does not incorporate a currency hedge would be expected to provide cover from that inflation.

The Cost of Currency Hedging

Investors should expect to pay passive currency overlay managers 3 bps to 5 bps for passive hedging, often subject to a minimum fee (e.g., US\$50,000). This implies that an investor with \$30 million in hedgeable assets and a 50% hedge ratio would pay the manager 33 bps in fees (the minimum \$50,000 fee, divided by \$15 million in hedged assets). Scale that up to US\$100 million in hedgeable assets and a 50% hedge ratio and the fee declines to 10 bps on the hedged assets. A 100% hedge ratio and \$100 million equates to a 5 bps fee. Add in perhaps 10 bps for the annual cost of transacting currency forwards, which will vary depending on liquidity conditions (for example, foreign exchange liquidity has been terrible during the

ongoing credit crisis, such that transaction costs are currently closer to 30 bps than to 10 bps annualized). Exhibit 9 attempts to estimate the cost of hedging for investors in various asset ranges,²⁷ but the bottom line is that hedging can be an expensive proposition for investors without sufficient scale. For those investors, the desire to pare back currency exposure may mean steering more assets to hedged managers, tolerating the increased volatility transmitted by currency exposure, or making tough choices regarding the trade-off between a home bias and global diversification.

What Is the Return on a Currency-Hedged Portfolio?

As discussed, currencies continually shift in value versus other currencies, with some of those shifts constituting the normal impact of interest rate differentials, and some resulting from “currency surprise.” Only the latter can be hedged since the former are already discounted by market prices.

The return on a currency-hedged equity position is equal to the sum of the *excess* return of the underlying equities (i.e., return in excess of the cash return in the country where the equity is listed) and the cash return of the investor’s own market. Thus, the excess returns (i.e., returns in excess of domestic cash) of a local investor and a hedged investor are identical. For this reason, it is helpful to think of the currency-hedged return as the closest possible approximation of the local investor’s perspective on markets. For example, if a Japanese investor owns shares of East Japan Railway Company, its return can be thought of as an *excess return* above the return on cash, plus a risk-free or *cash return*. A currency-hedged U.K.-based investor holding shares of East Japan Railway Company will receive the same excess return as the local investor, plus the cash return available in the United Kingdom (which may have higher or lower short-term market interest rates than Japan at any given time). Forward exchange rates for low-interest rate countries bake in those countries’ low cash returns, but hedged investors based in low-rate countries are still able to achieve the same *excess* returns as investors in high-rate countries.

How Does a Hedging Program Affect My Liquidity Requirements?

The need to settle currency forwards at their maturity (typically either one or three months after the contract is initiated) in cash can substantially increase the amount of liquidity that must be available in the portfolio. Let’s take the example of a euro-based investor hedging half its 35% non-euro exposure. In some quarters with substantial dollar declines, the investor would need to raise significant cash to settle the forwards (perhaps 4% to 5% of the total portfolio’s value, or 12% of the value of assets being hedged). The losses on forwards would be accompanied by a boost to the value of the underlying assets due to the rise in the foreign currency, but that boost may be swamped by price declines. These assets would need to be held in a vehicle from which they could be tapped relatively quickly, such as in cash (equitized as described in Appendix A) or in mutual funds with daily liquidity.

²⁷ Exhibit 9 estimates the combined manager fee and transaction costs in the currency forwards market, assuming that transaction costs decline to 10 bps from their current elevated level. This estimate does not include cash drag or transaction costs resulting from adding to or subtracting from managers to rebalance the collateral pool, nor does it include transaction costs resulting from any equitization of the collateral pool via futures.

Conclusion

We have been a vocal proponent of global equity diversification for many years, but we recognize that unless the diversification is accompanied by currency hedging, this process entails increased exposure to foreign currency risk.

Contrary to those who believe that currency exposure provides diversification in addition to the diversification provided by the exposure to the underlying asset, our strategic expectation is that it provides uncompensated risk. The assumptions underlying this conclusion are that currencies have volatility, but no expected return, and that their shifts in value will not manifest consistent and significant negative correlation with those of the associated equity markets.²⁸

Investors should evaluate the level of currency exposure in their portfolio and determine whether it is worth addressing, and if so what they can do about it. Three options for paring back foreign currency exposure are: (1) decrease allocations to foreign currency–denominated *assets* (not an option we generally recommend); (2) consider shifting some assets to managers or passive vehicles that employ currency hedging (a reasonable option for some, provided the managers or vehicles have much more to recommend them than simply their habit of hedging back to the investor’s base currency); or (3) retain the current manager structure and employ currency hedging (a good option for investors with sufficient scale and resources, and whose expected benefits outweigh the various costs).

Investors that hedge a significant portion of their currency exposure are likely to find themselves underperforming significantly during periods when their home currency declines,²⁹ and should determine in advance whether other stakeholders will be able to tolerate short- to medium-term underperformance versus peers during periods of home currency weakness. Investors in some regions may be viewed as pioneers or mavericks if they hedge, since the practice is widespread in some countries for institutional investors and rare in other countries. Nevertheless, we regard this as the rational approach for those with large exposures and sufficient resources to implement effectively.

²⁸ As noted in an earlier section, this important assumption of nonnegative correlation is at odds with many *historical* periods, but we remain unconvinced that past periods of negative correlation will necessarily repeat, and that correlations will be sufficiently negative as to generate diversification benefits from residual currency exposure.

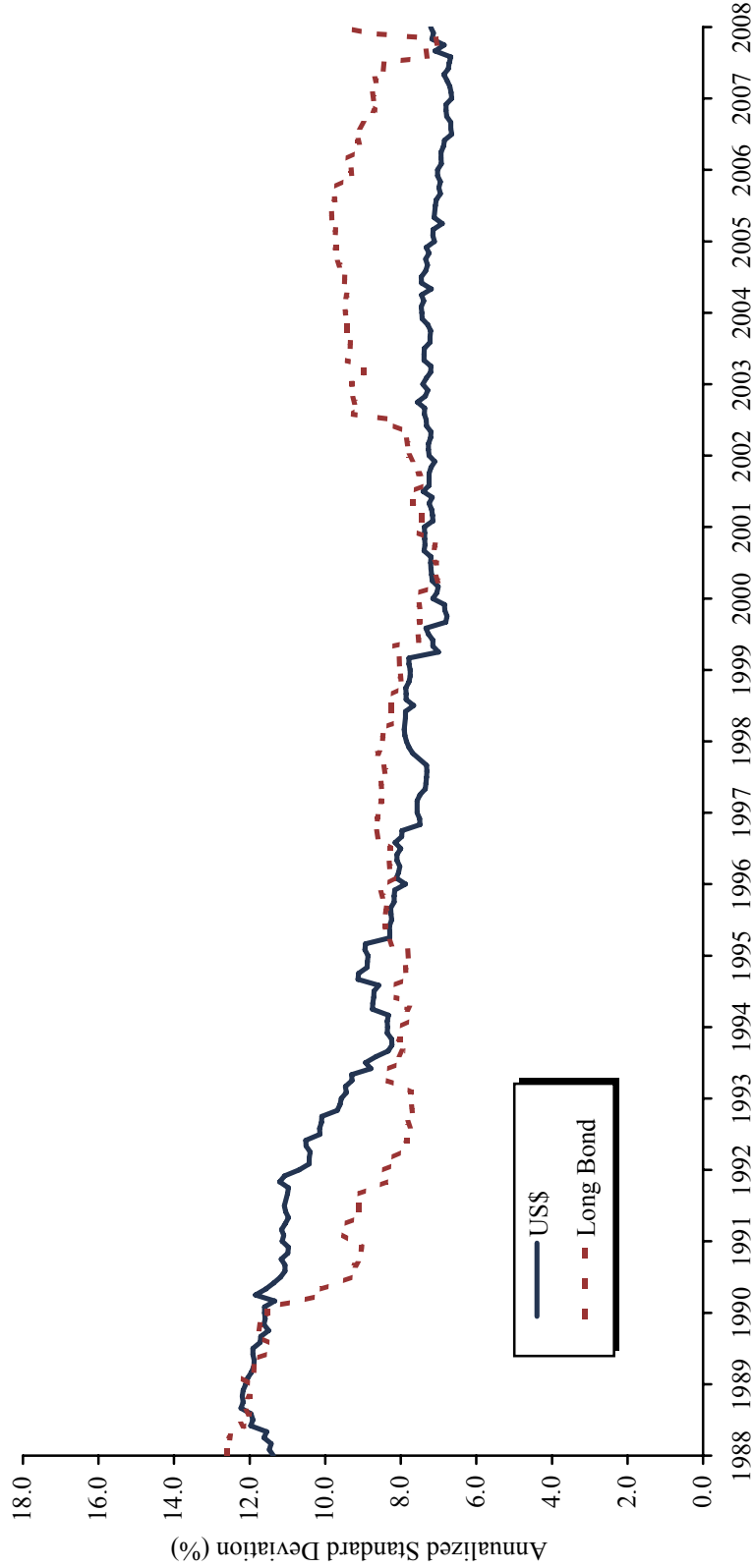
²⁹ Review Exhibits 5a through 5e for a rough indication of the potential underperformance in those scenarios.

EXHIBITS

Exhibit 1a

ROLLING FIVE-YEAR VOLATILITY OF LONG-TERM U.S. TREASURY BONDS AND THE EQUITY-WEIGHTED U.S. DOLLAR

December 31, 1988 – December 31, 2008



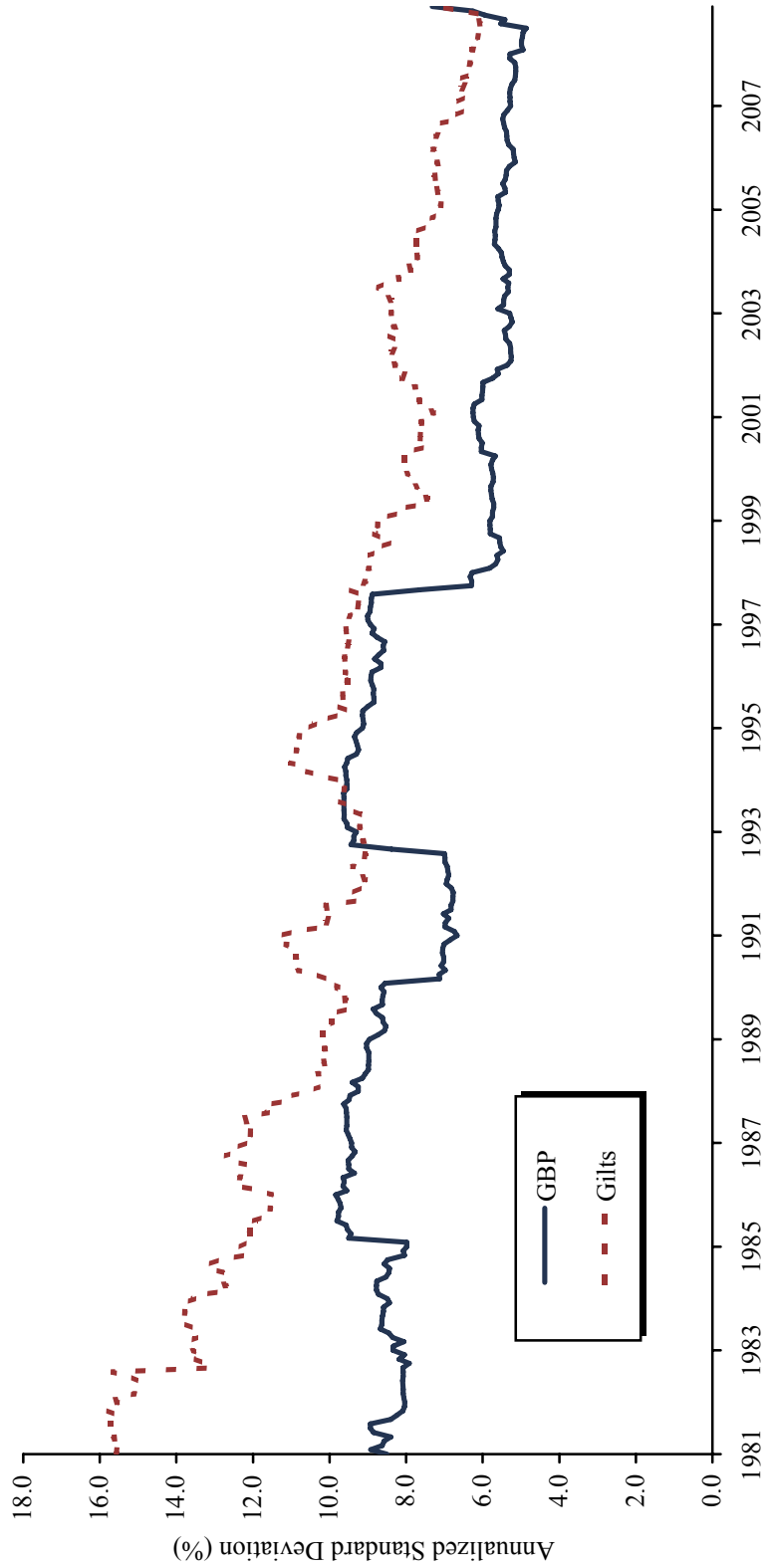
Sources: Barclays Capital, MSCI Inc., and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: Data represent the rolling five-year standard deviations of the Barclays Capital Long-Term Treasury Bond Index and of the monthly difference between MSCI EAFE Index price returns in local currency terms and in US\$ terms.

Exhibit 1b

ROLLING FIVE-YEAR VOLATILITY OF LONG-TERM U.K. GILTS AND THE EQUITY-WEIGHTED POUND STERLING

January 31, 1981 – December 31, 2008



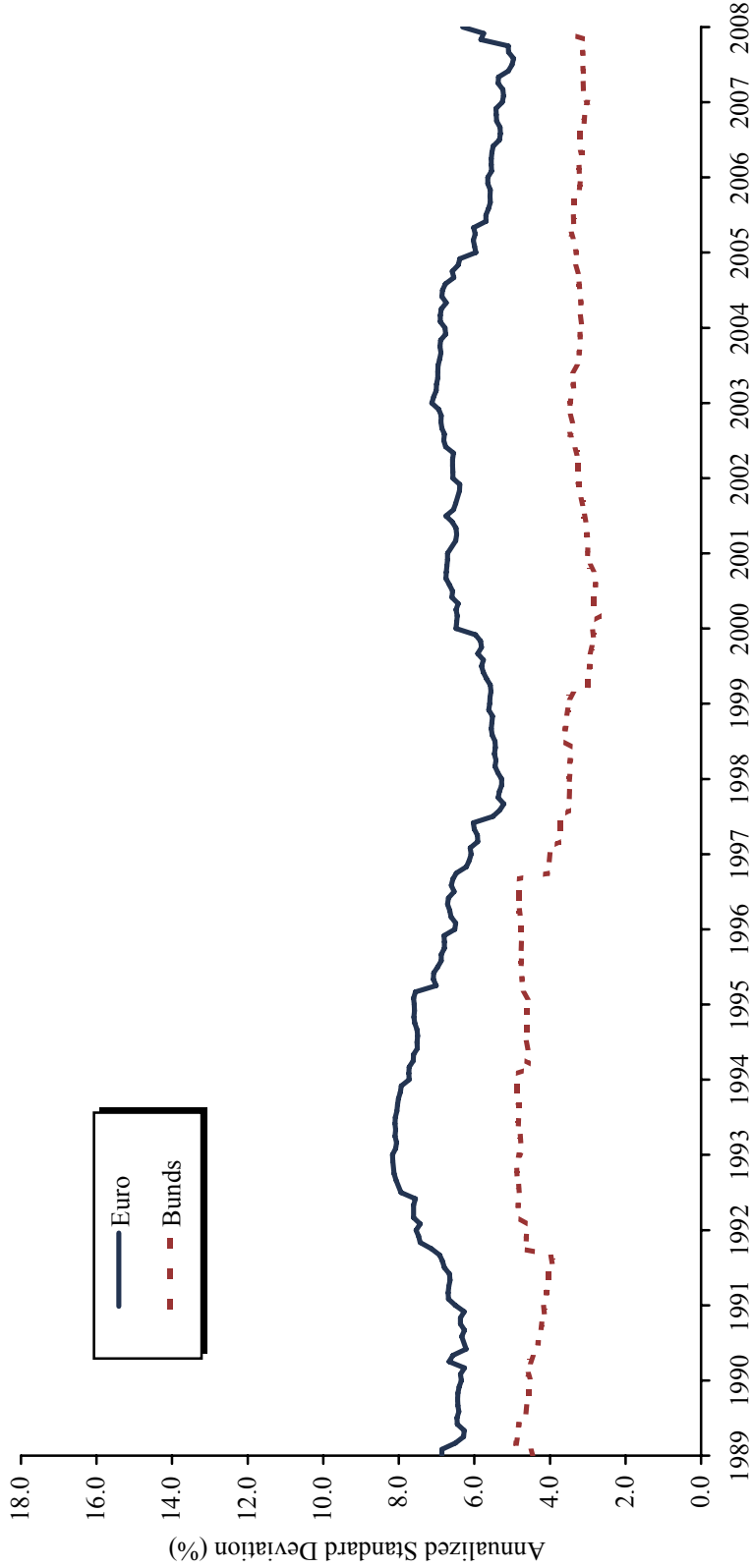
Sources: FTSE International Limited, MSCI Inc., and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: Data represent the rolling five-year standard deviations of the FTSE British Government Over 15 Years Index and of the monthly difference between MSCI World Index price returns in local currency terms and in pound terms.

Exhibit 1c

ROLLING FIVE-YEAR VOLATILITY OF LONG-TERM GERMAN BUNDS AND THE EQUITY-WEIGHTED EURO

November 30, 1989 – December 31, 2008



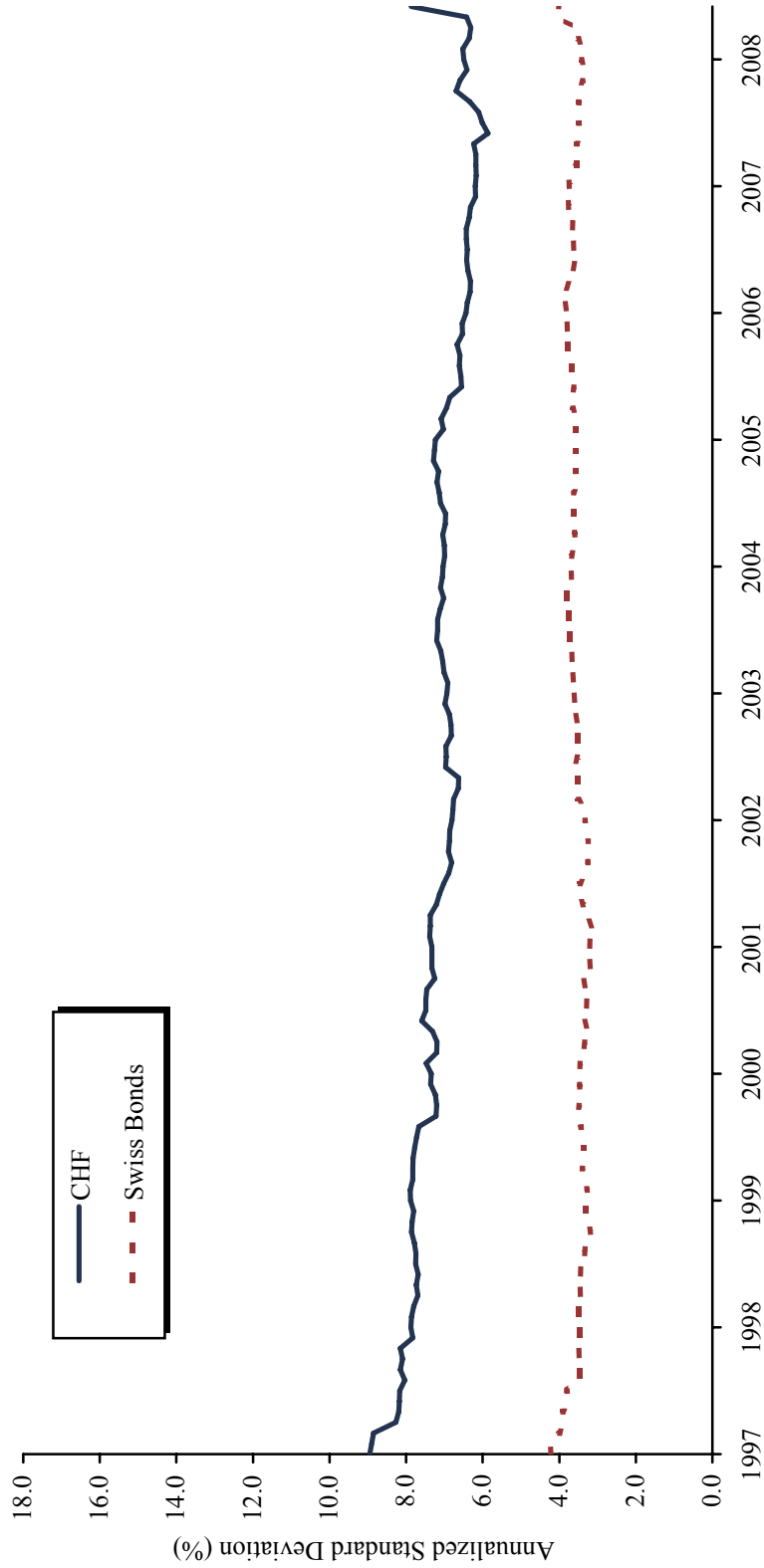
Sources: Citigroup Global Markets, MSCI Inc., and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: Data represent the rolling five-year standard deviations of the Citigroup German Government Bond Index and of the monthly difference between MSCI World Index price returns in local currency terms and in euro terms.

Exhibit 1d

ROLLING FIVE-YEAR VOLATILITY OF LONG-TERM SWISS GOVERNMENT BONDS AND THE EQUITY-WEIGHTED SWISS FRANC

July 31, 1997 – December 31, 2008



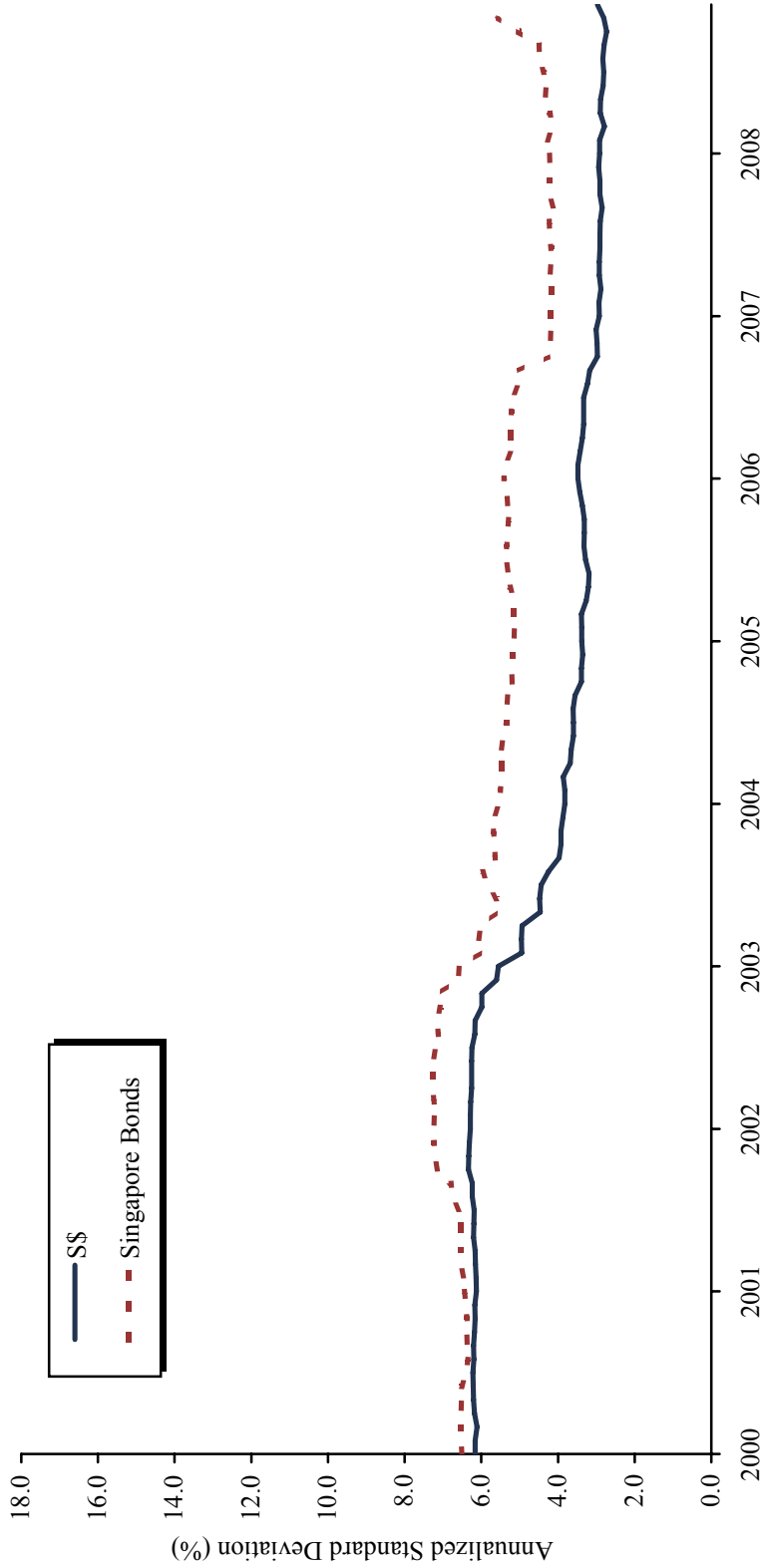
Sources: MSCI Inc., SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: Data represent the rolling five-year standard deviations of the Swiss Federal Government Bond Index and of the monthly difference between MSCI World Index price returns in local currency terms and in Swiss franc terms.

Exhibit 1e

ROLLING FIVE-YEAR VOLATILITY OF LONG-TERM SINGAPORE GOVERNMENT BONDS AND THE EQUITY-WEIGHTED SINGAPORE DOLLAR

January 31, 2000 – December 31, 2008



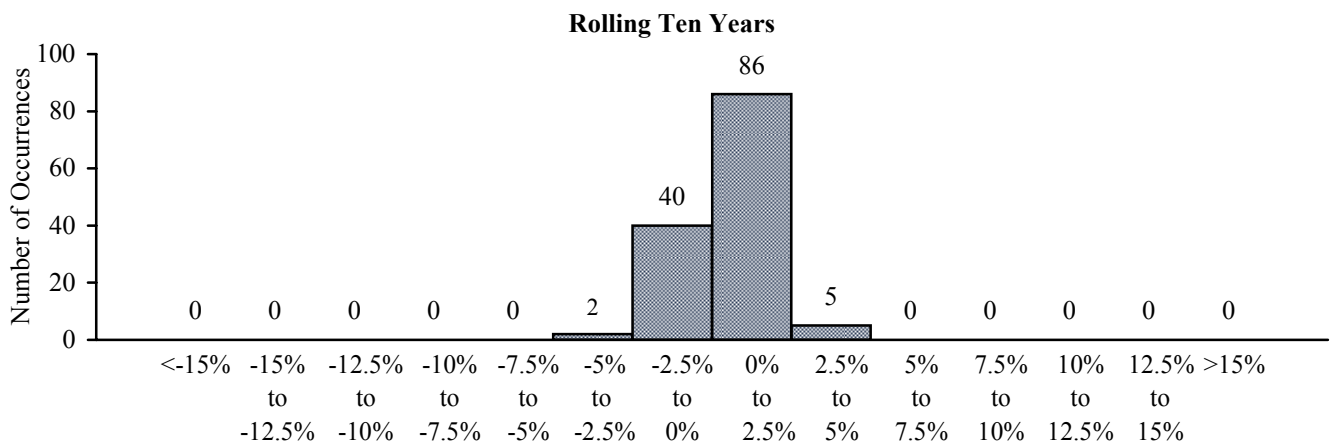
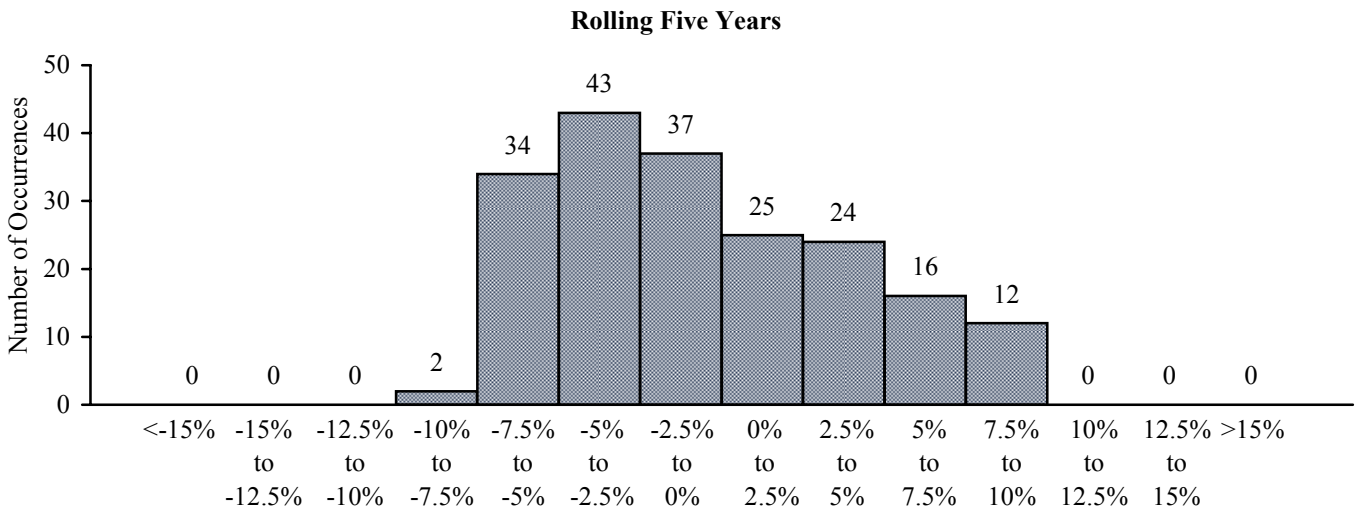
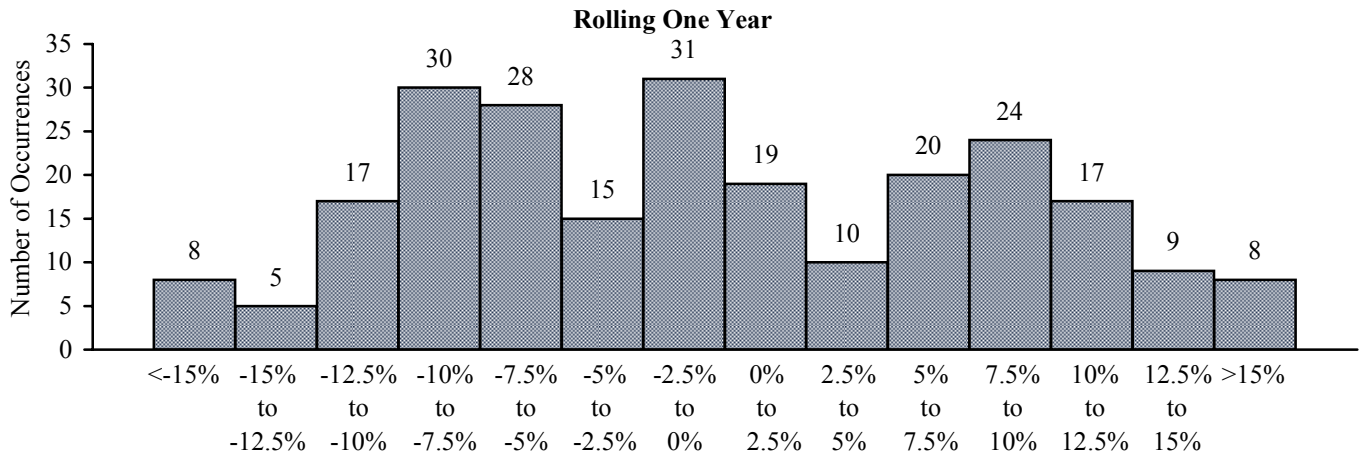
Sources: Bloomberg L.P., MSCI Inc., and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: Data represent the rolling five-year standard deviations of the Singapore Government Bond Index All UOB and of the monthly difference between MSCI World Index price returns in local currency terms and in S\$ terms.

Exhibit 2a

MSCI WORLD EX U.S. US\$-HEDGED AND UNHEDGED RETURN DIFFERENTIAL

December 31, 1988 – December 31, 2008

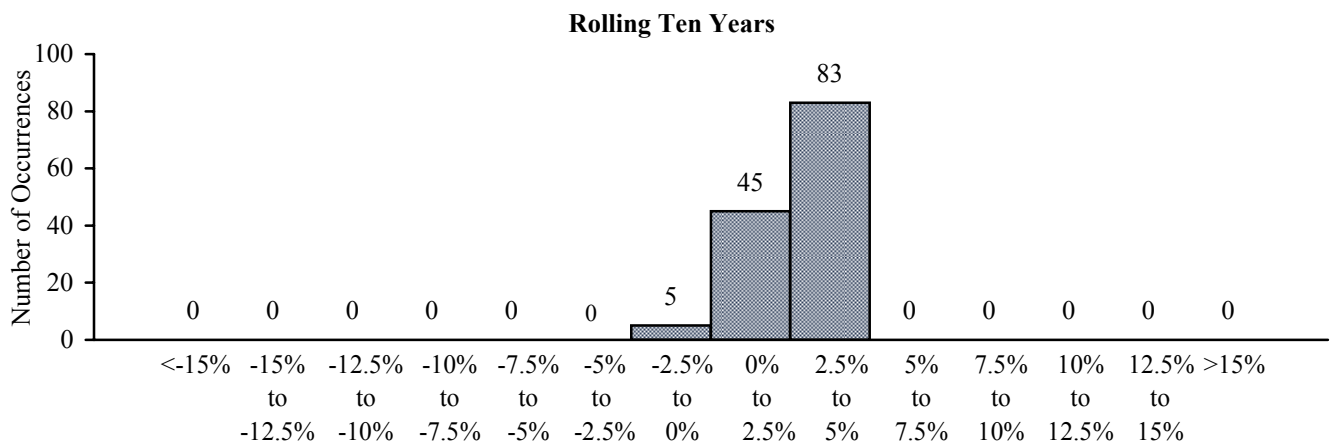
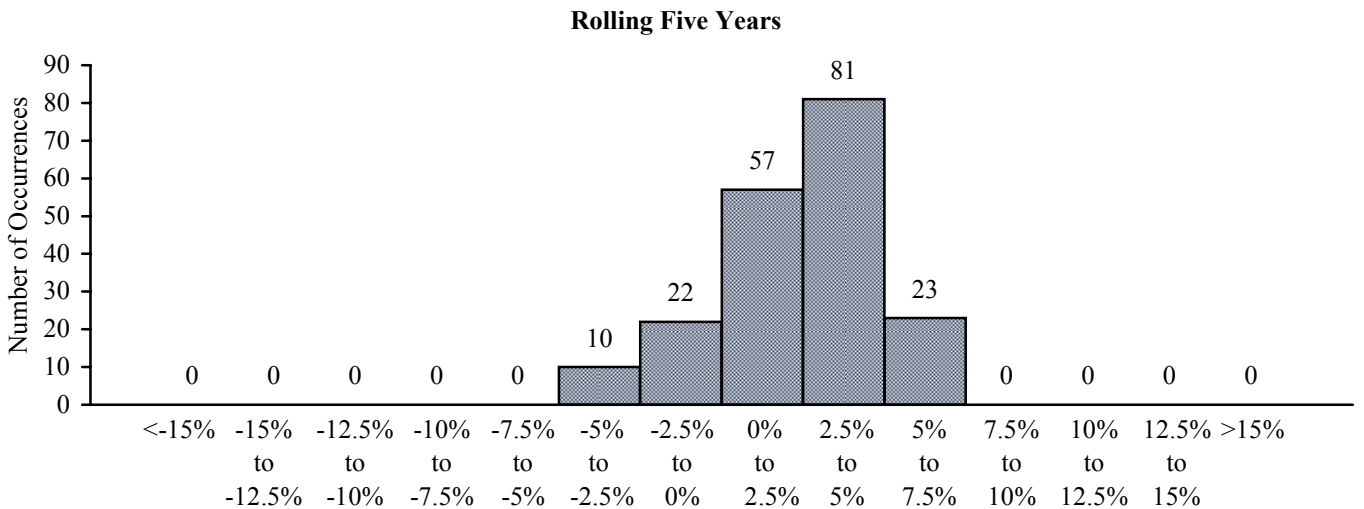
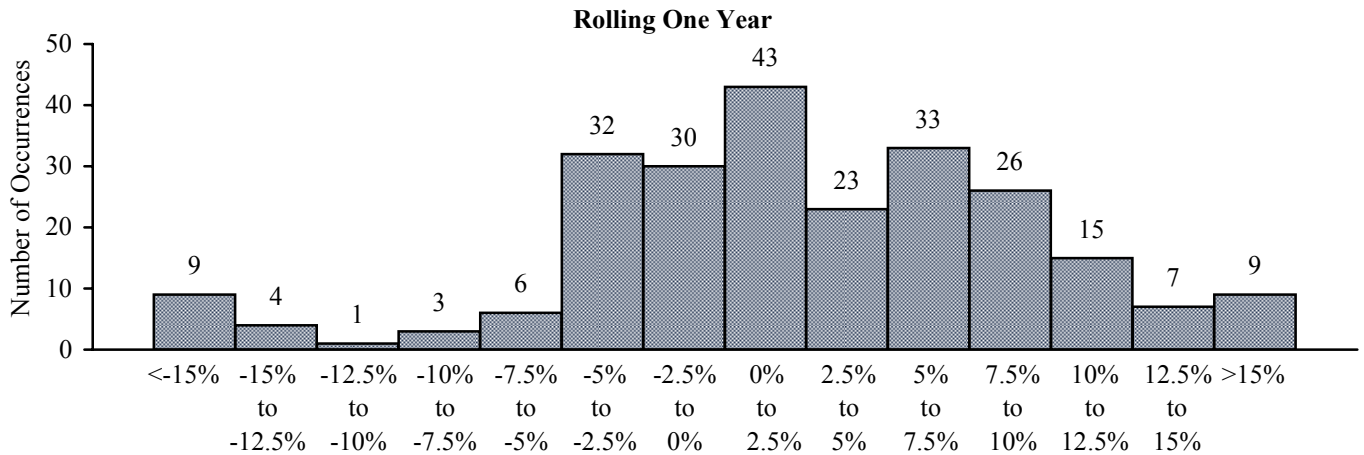


Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.
 Note: Percentages represent percentage points of returns.

Exhibit 2b

MSCI WORLD POUND STERLING–HEDGED AND UNHEDGED RETURN DIFFERENTIAL

December 31, 1988 – December 31, 2008

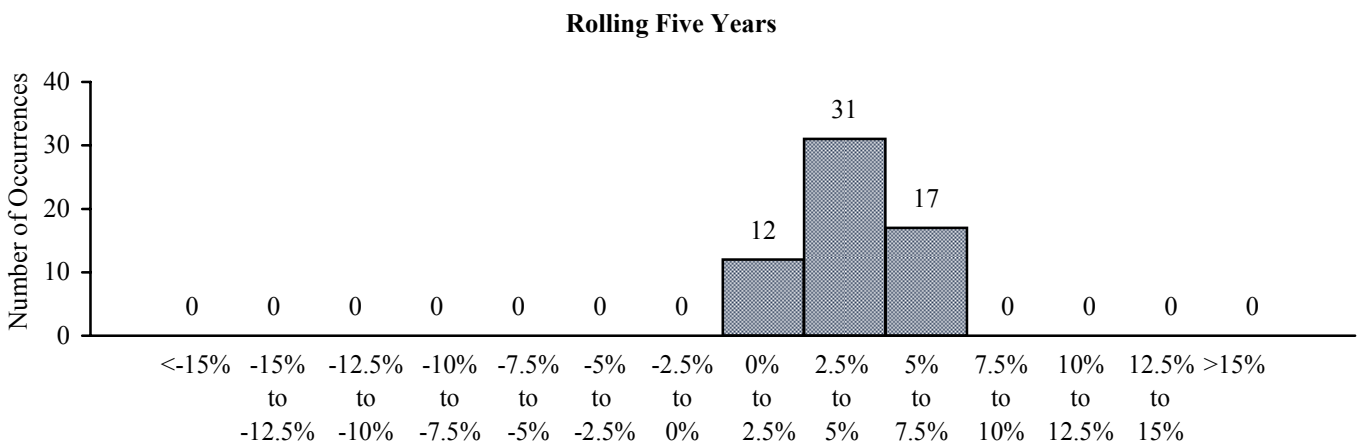
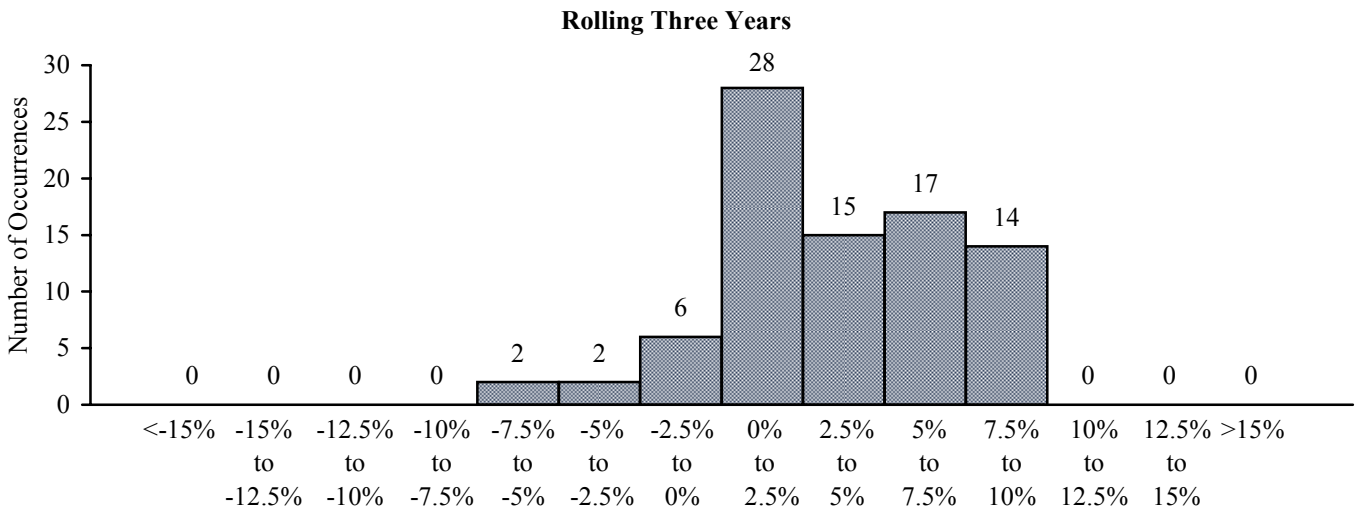
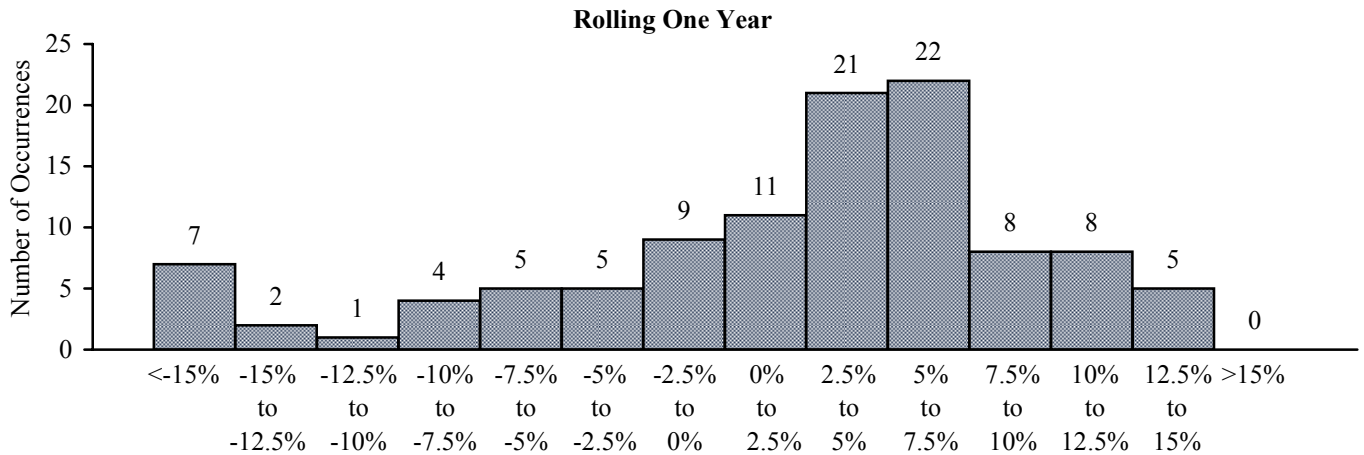


Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.
 Note: Percentages represent percentage points of returns.

Exhibit 2c

MSCI WORLD EURO-HEDGED AND UNHEDGED RETURN DIFFERENTIAL

January 31, 2000 – December 31, 2008

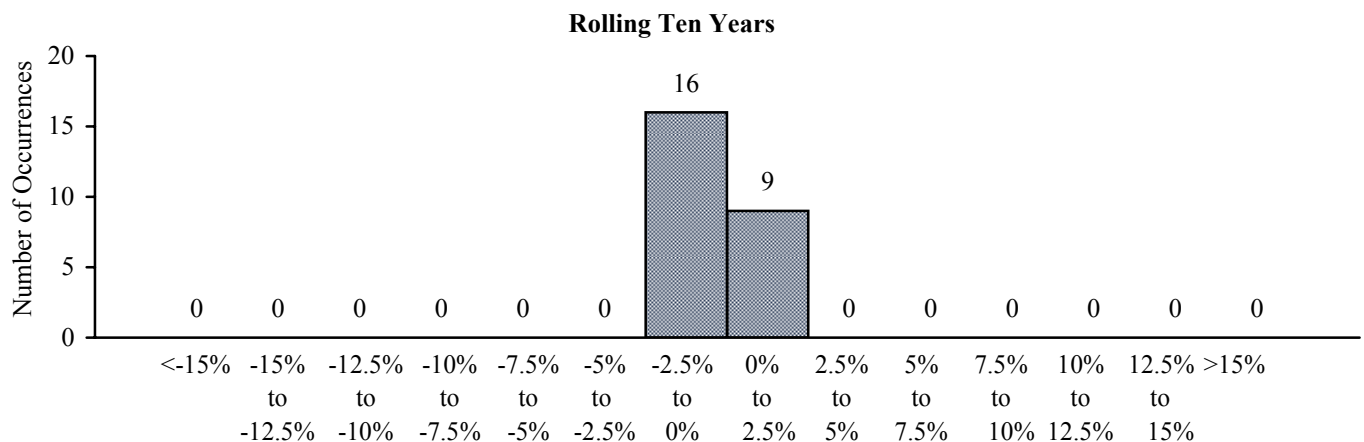
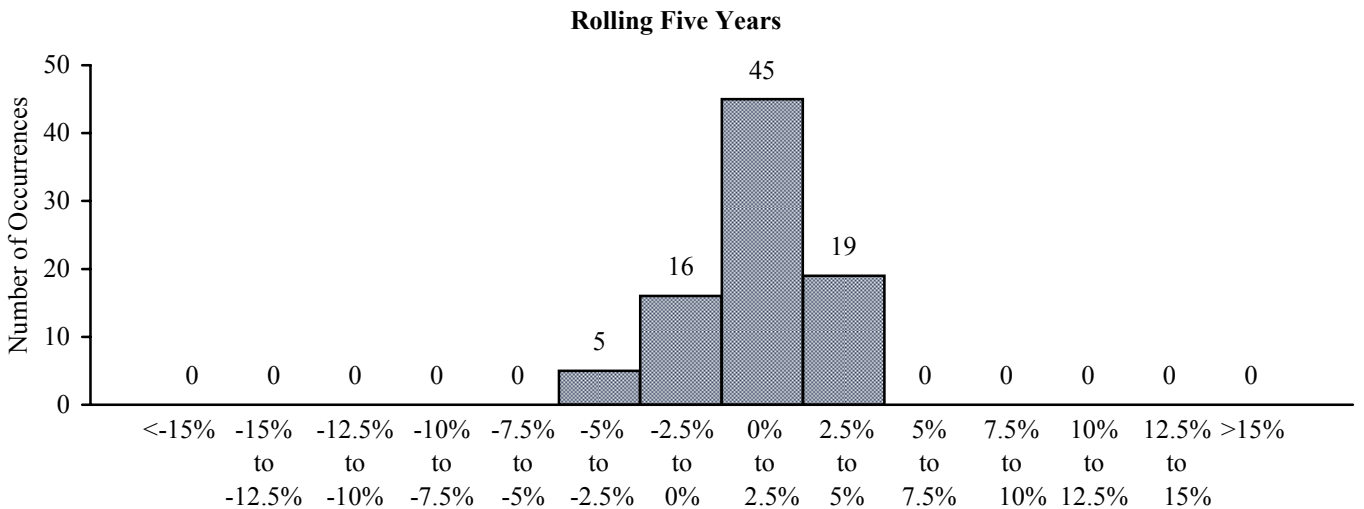
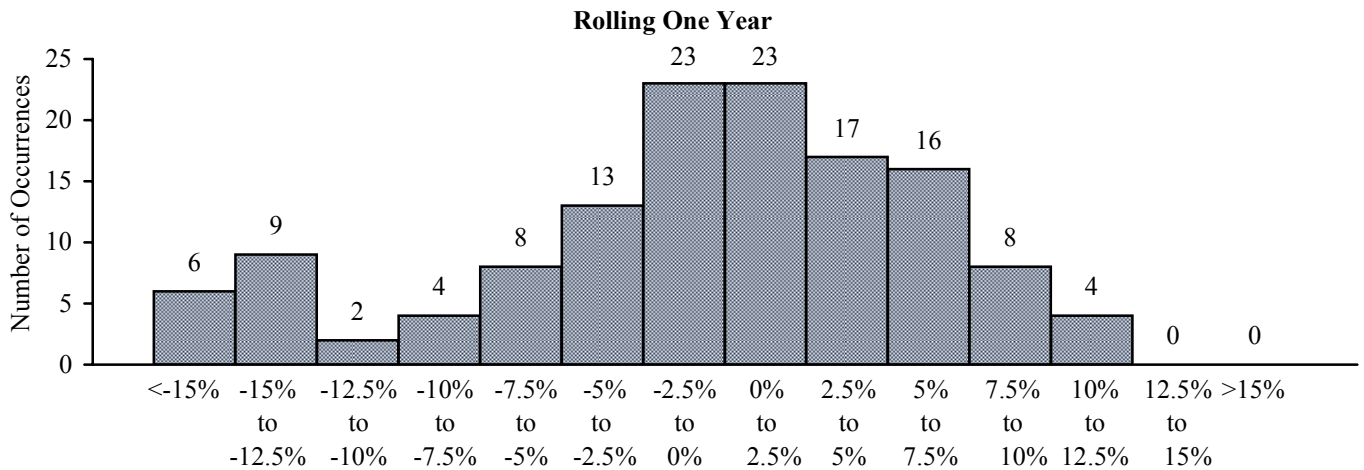


Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.
 Note: Percentages represent percentage points of returns.

Exhibit 2d

MSCI WORLD SWISS FRANC-HEDGED AND UNHEDGED RETURN DIFFERENTIAL

December 31, 1997 – December 31, 2008



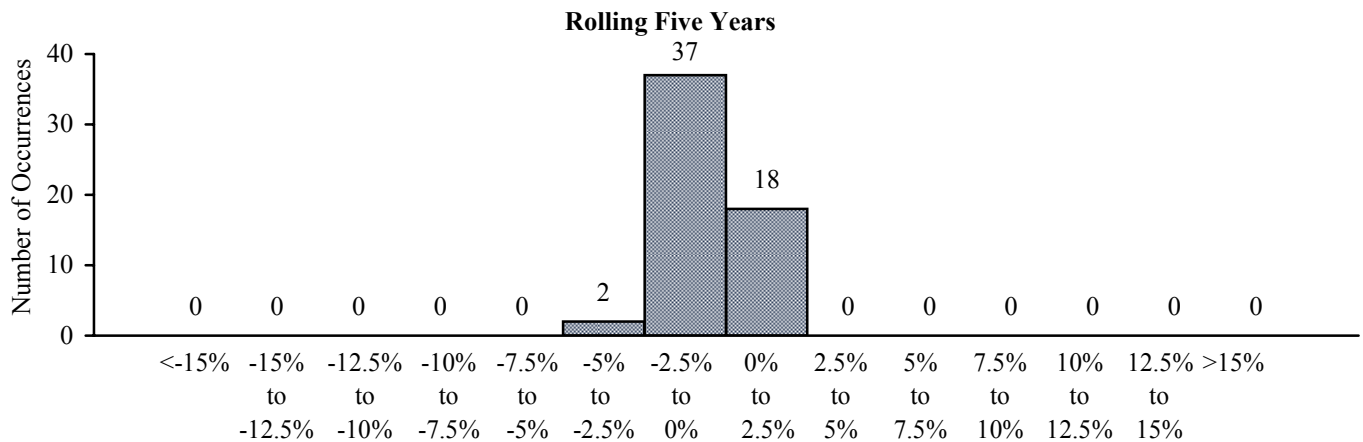
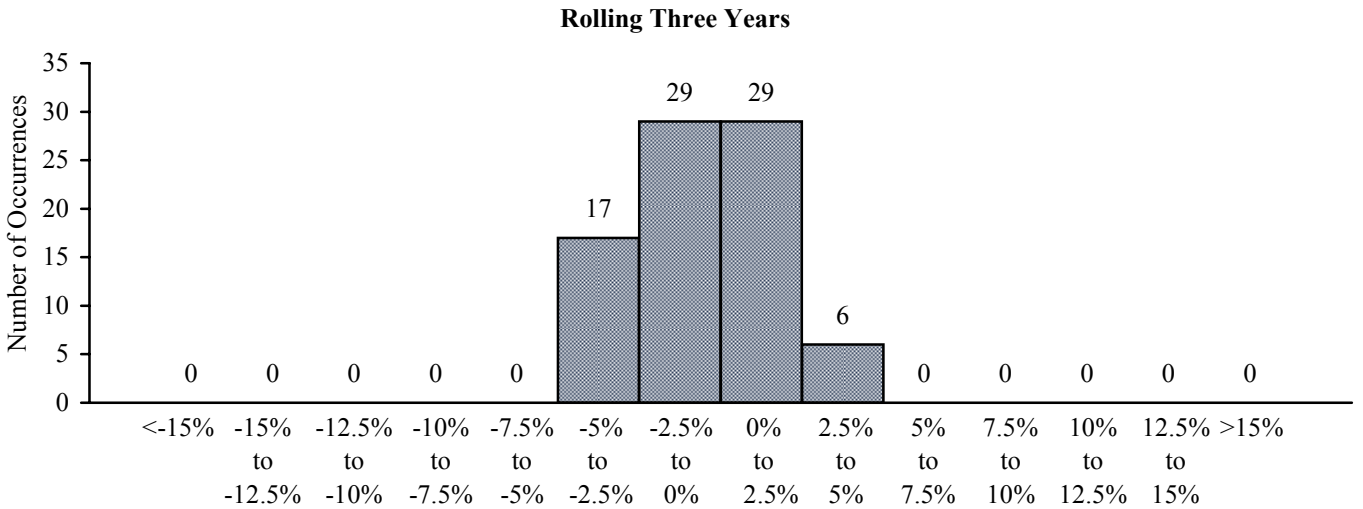
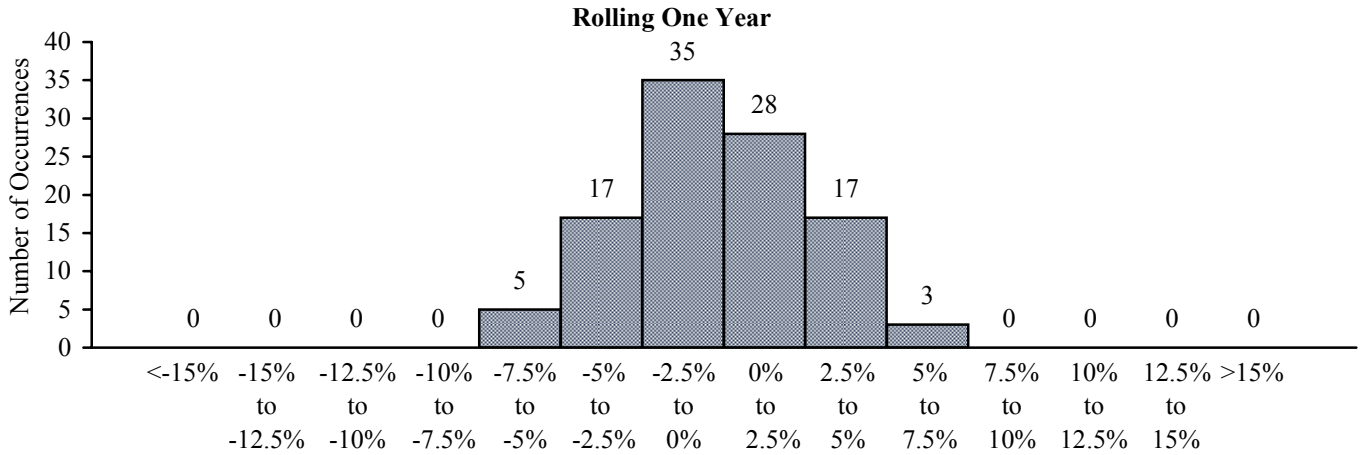
Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Notes: Percentages represent percentage points of returns. This exhibit uses Cambridge Associates' own estimate of the Swiss franc-hedged return of the MSCI World Index.

Exhibit 2e

MSCI WORLD \$\$-HEDGED AND UNHEDGED RETURN DIFFERENTIAL

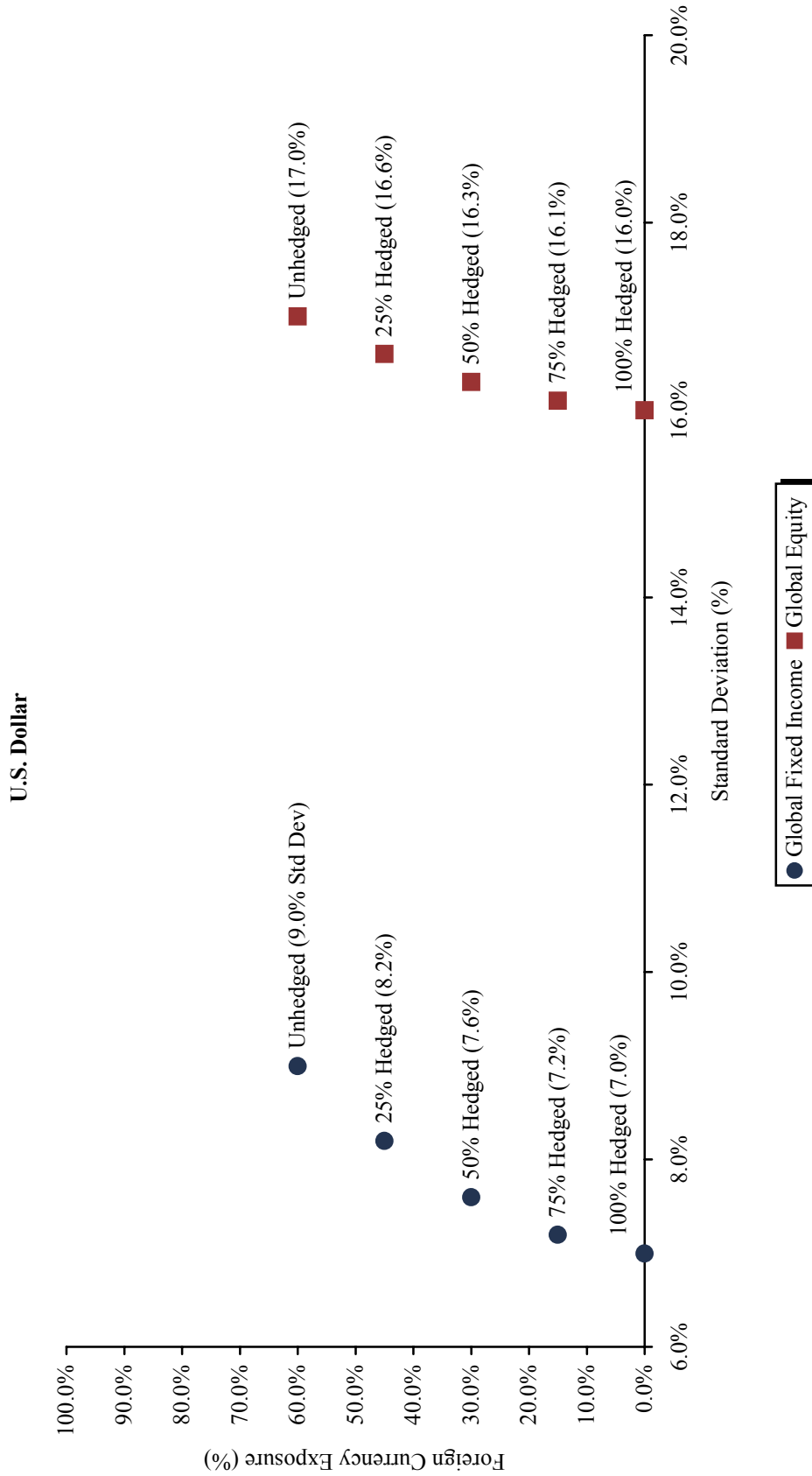
April 30, 2000 – December 31, 2008



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.
 Note: Percentages represent percentage points of returns.

Exhibit 3a

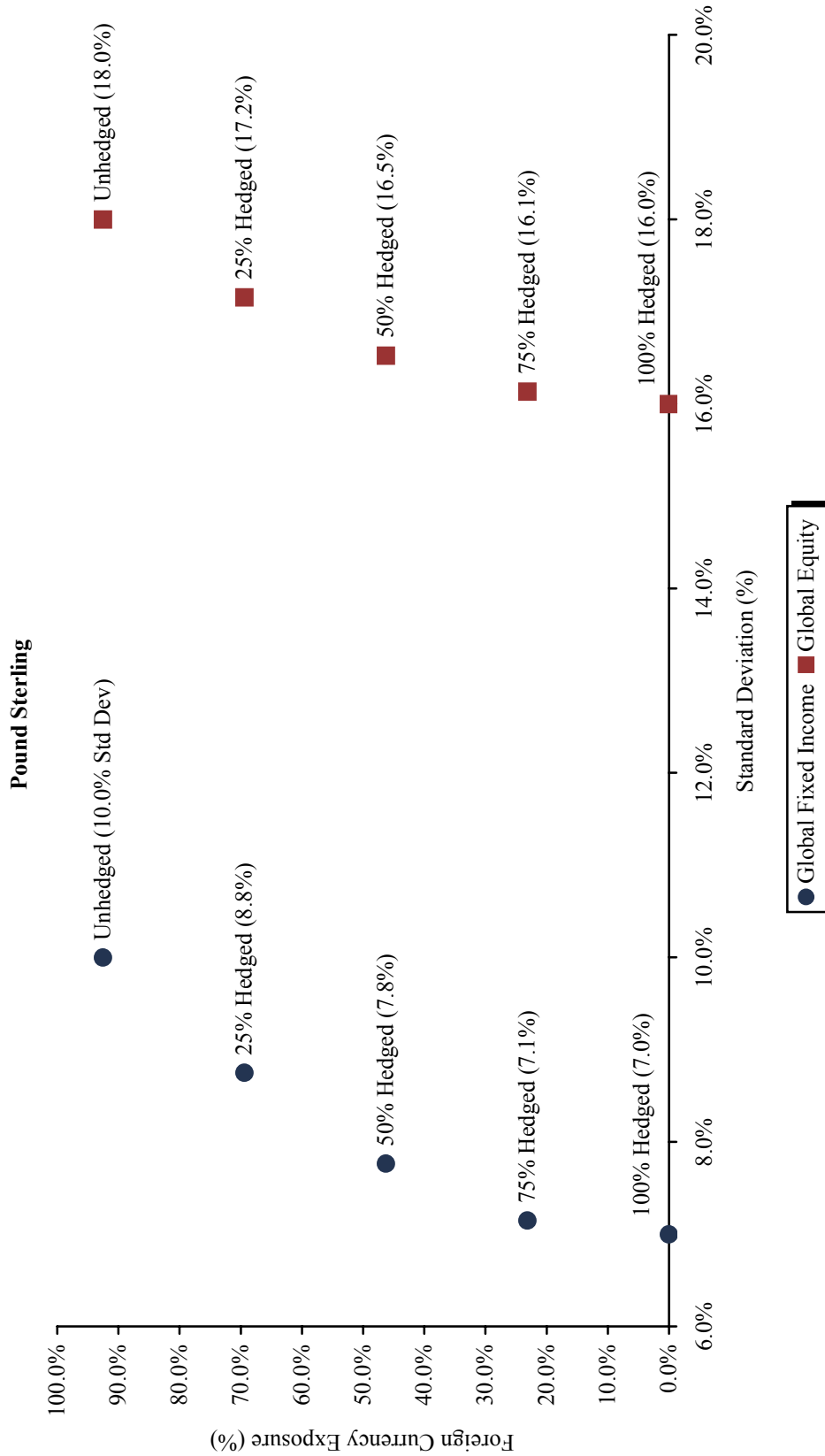
IMPACT OF CURRENCY HEDGING ON EXPECTED VOLATILITY OF GLOBAL BOND AND GLOBAL EQUITY PORTFOLIOS



Source: Cambridge Associates LLC.

Exhibit 3b

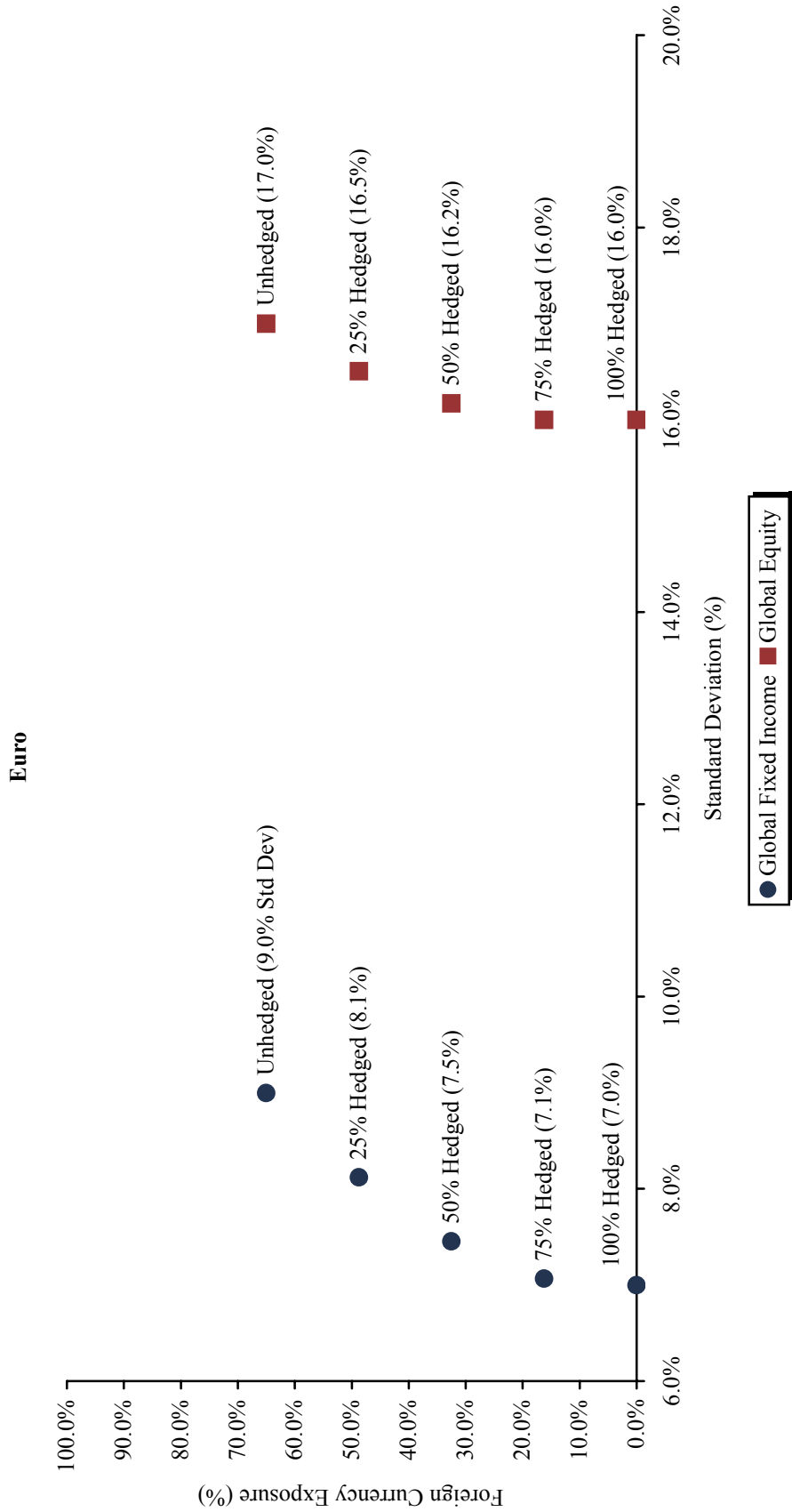
IMPACT OF CURRENCY HEDGING ON EXPECTED VOLATILITY OF GLOBAL BOND AND GLOBAL EQUITY PORTFOLIOS



Source: Cambridge Associates LLC.

Exhibit 3c

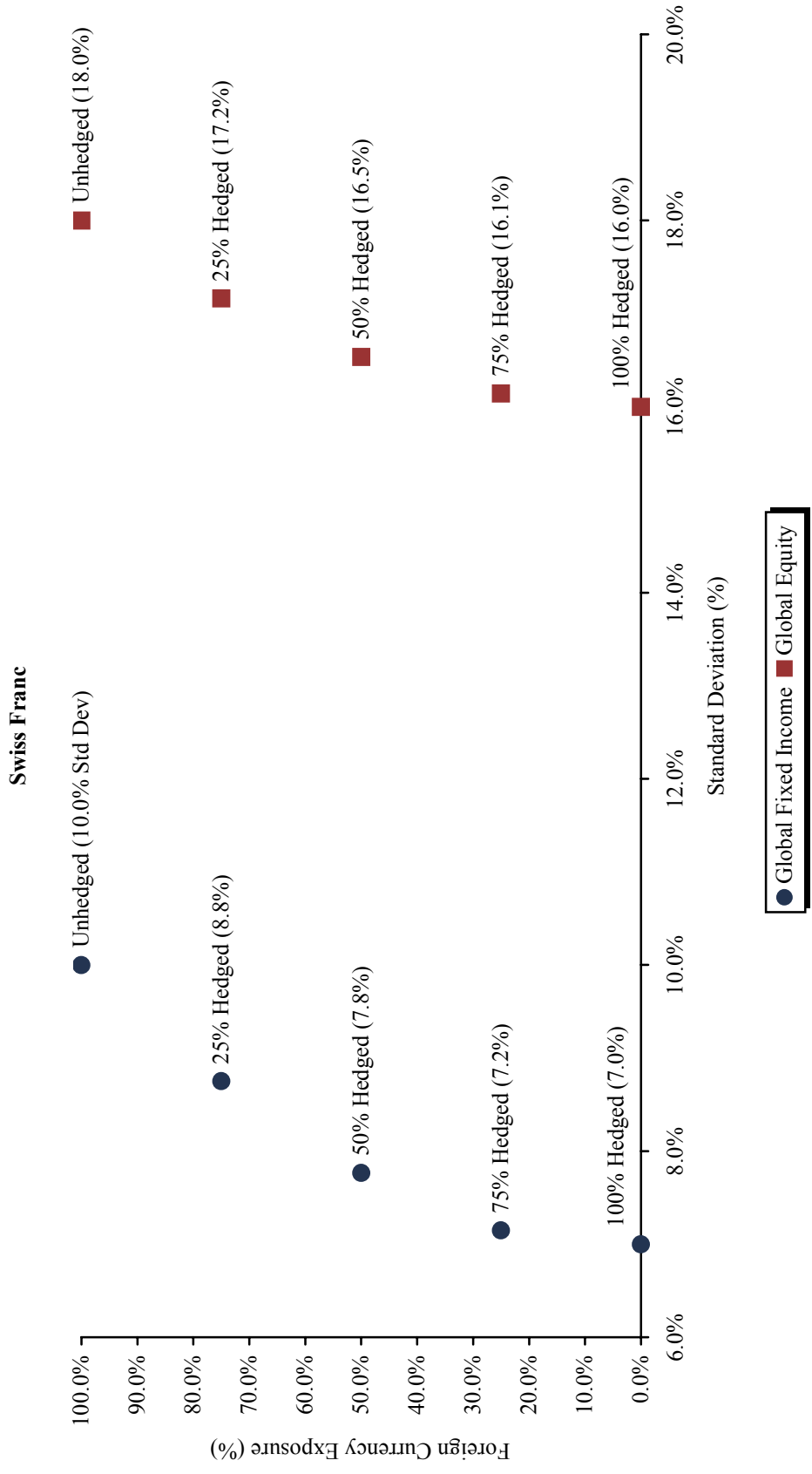
IMPACT OF CURRENCY HEDGING ON EXPECTED VOLATILITY OF GLOBAL BOND AND GLOBAL EQUITY PORTFOLIOS



Source: Cambridge Associates LLC.

Exhibit 3d

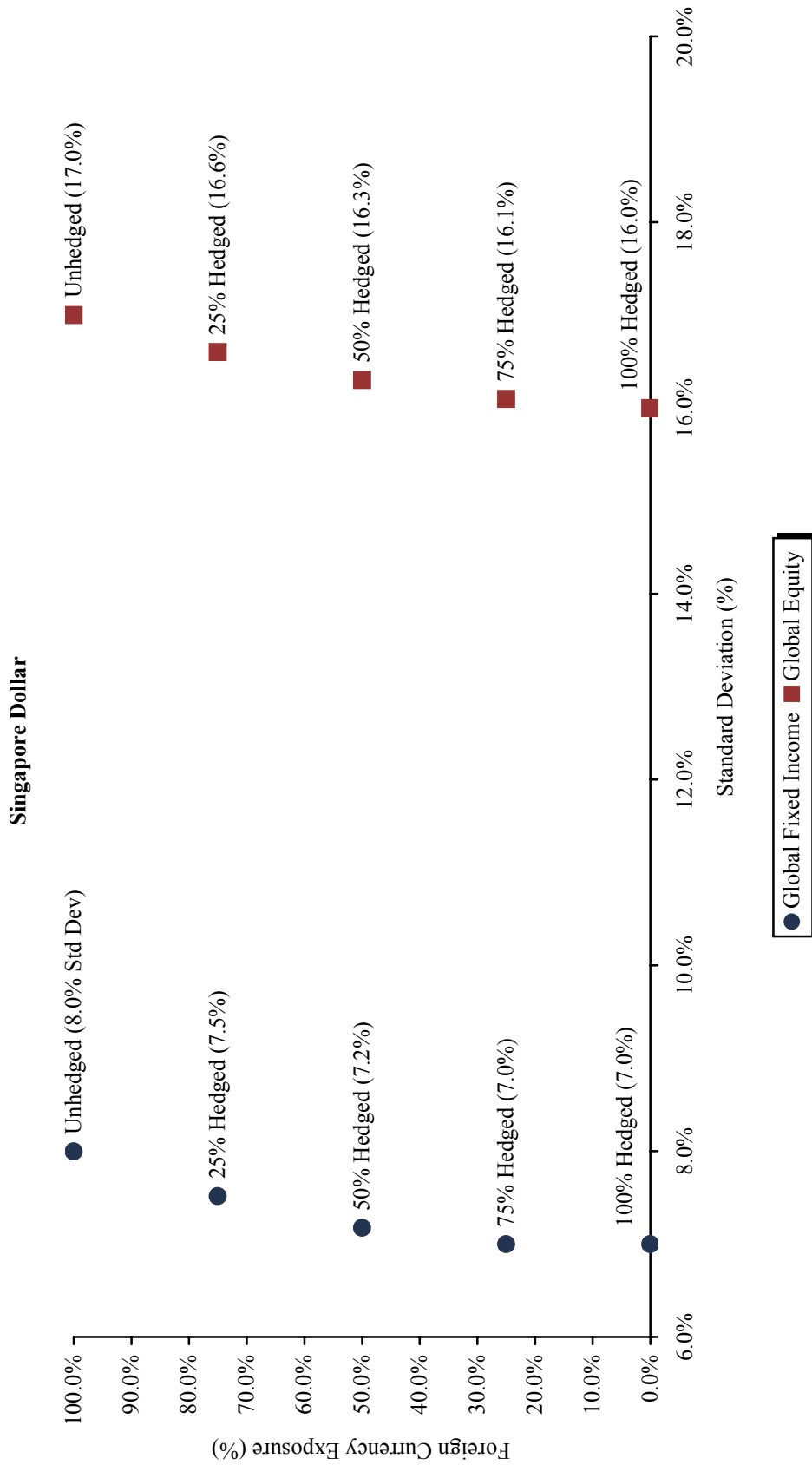
IMPACT OF CURRENCY HEDGING ON EXPECTED VOLATILITY OF GLOBAL BOND AND GLOBAL EQUITY PORTFOLIOS



Source: Cambridge Associates LLC.

Exhibit 3e

IMPACT OF CURRENCY HEDGING ON EXPECTED VOLATILITY OF GLOBAL BOND AND GLOBAL EQUITY PORTFOLIOS

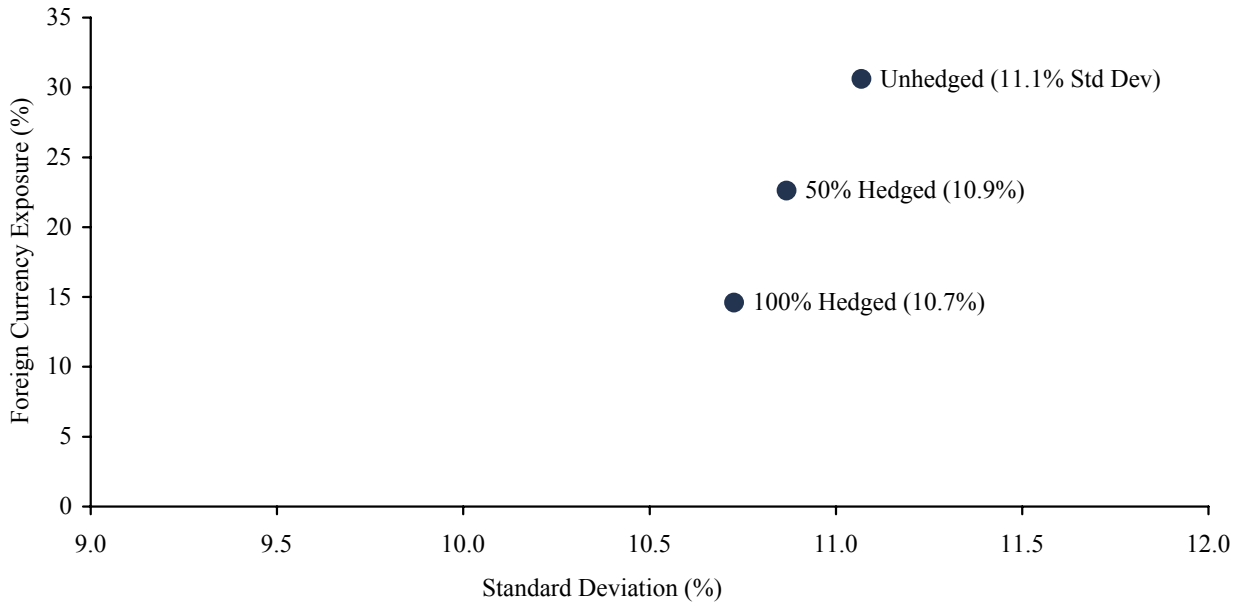


Source: Cambridge Associates LLC.

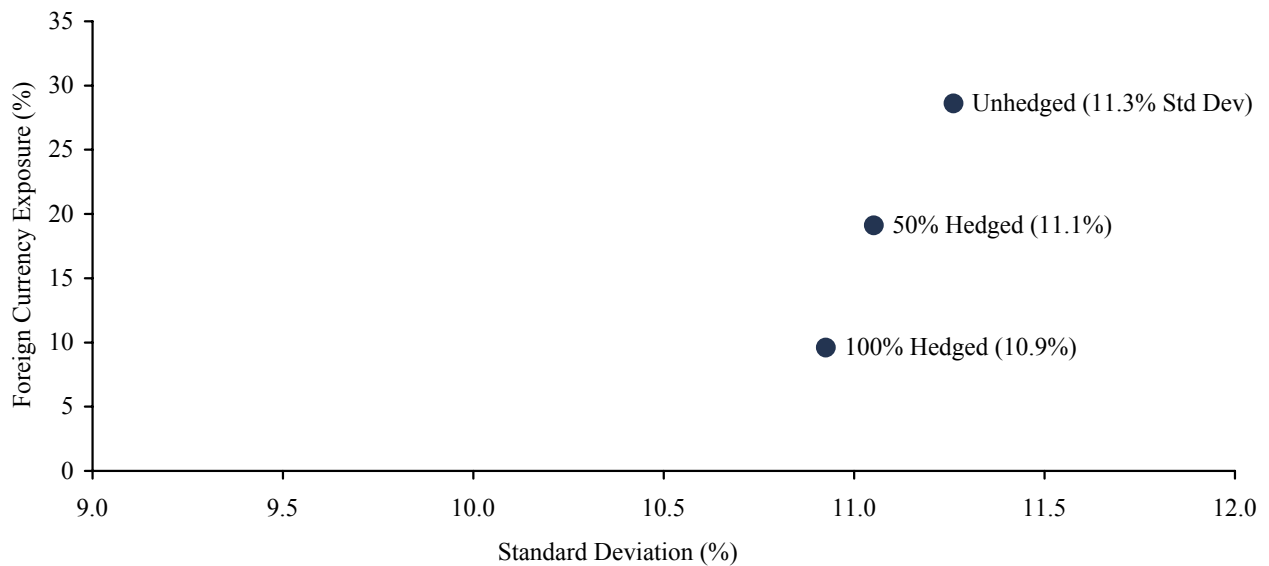
Exhibit 4a

VOLATILITY OF A US\$-BASED DIVERSIFIED PORTFOLIO AT VARIOUS CURRENCY-HEDGE RATIOS

Portfolio with Non-Marketable Alternative Assets



Marketable Asset Portfolio

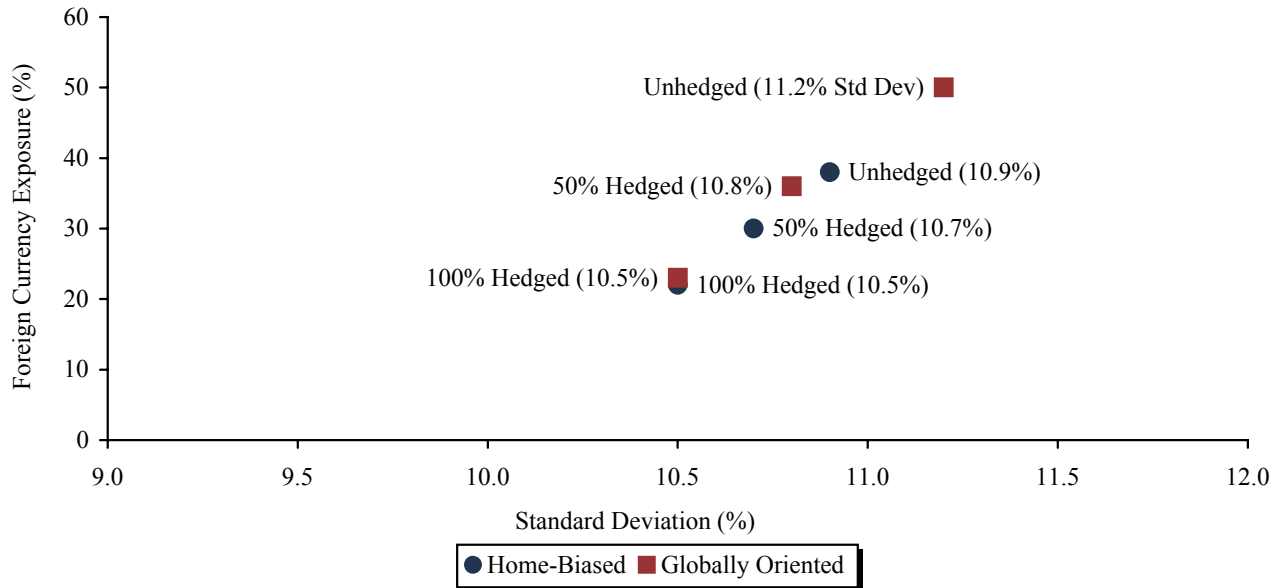


Source: Cambridge Associates LLC.

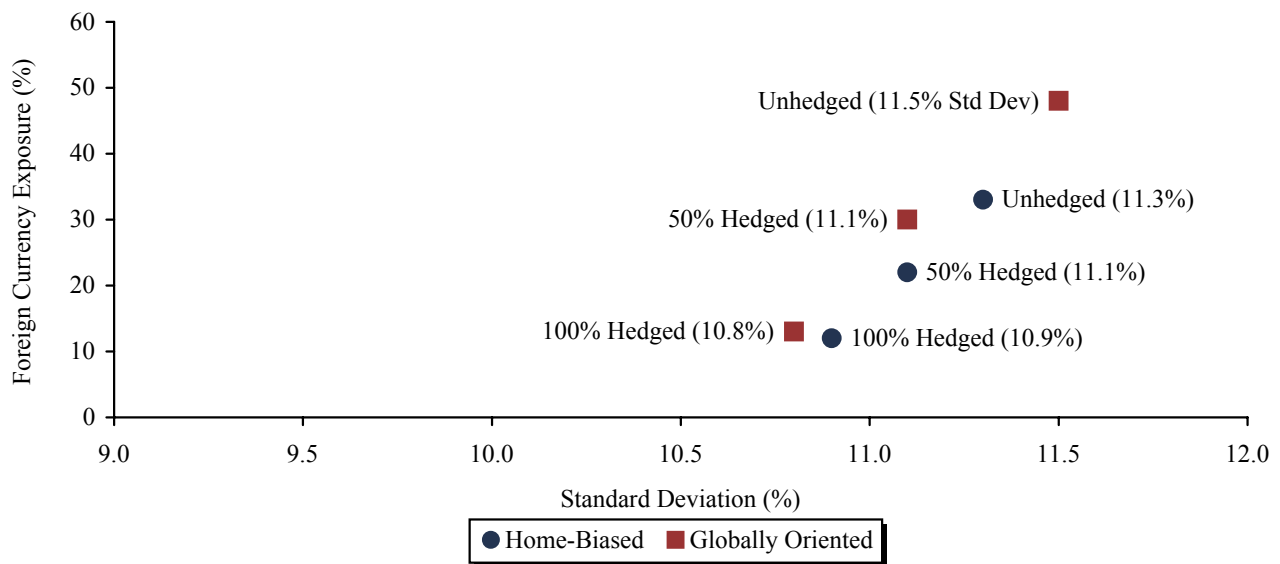
Exhibit 4b

VOLATILITY OF A POUND STERLING-BASED DIVERSIFIED PORTFOLIO AT VARIOUS CURRENCY-HEDGE RATIOS

Portfolio with Non-Marketable Alternative Assets



Marketable Asset Portfolio

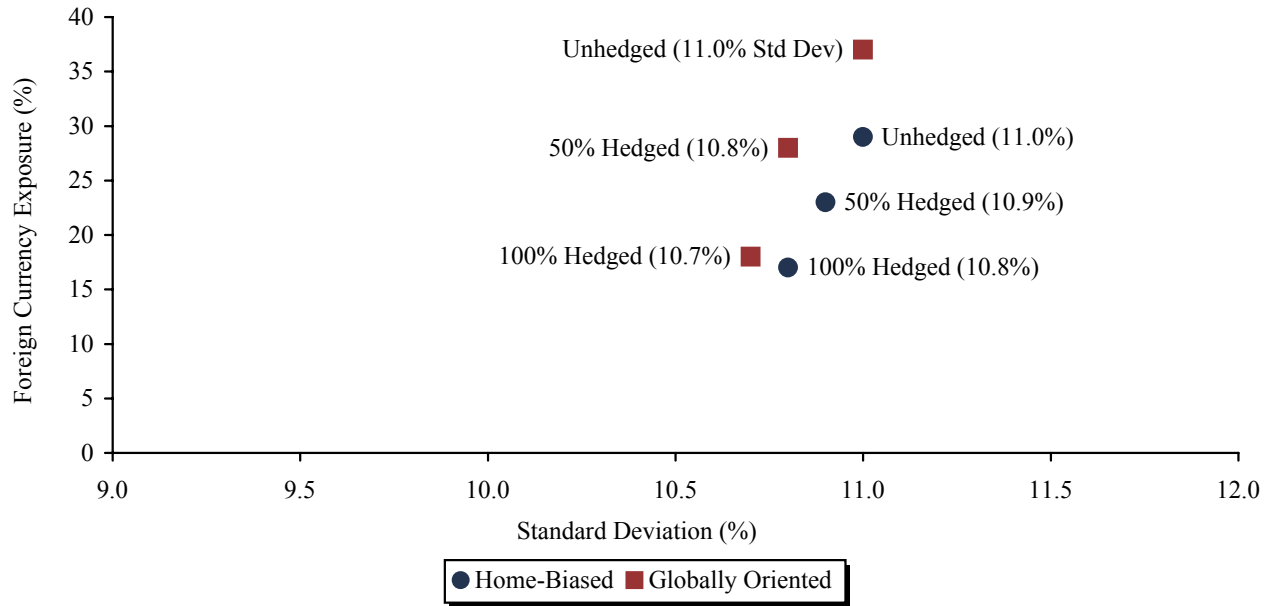


Source: Cambridge Associates LLC.

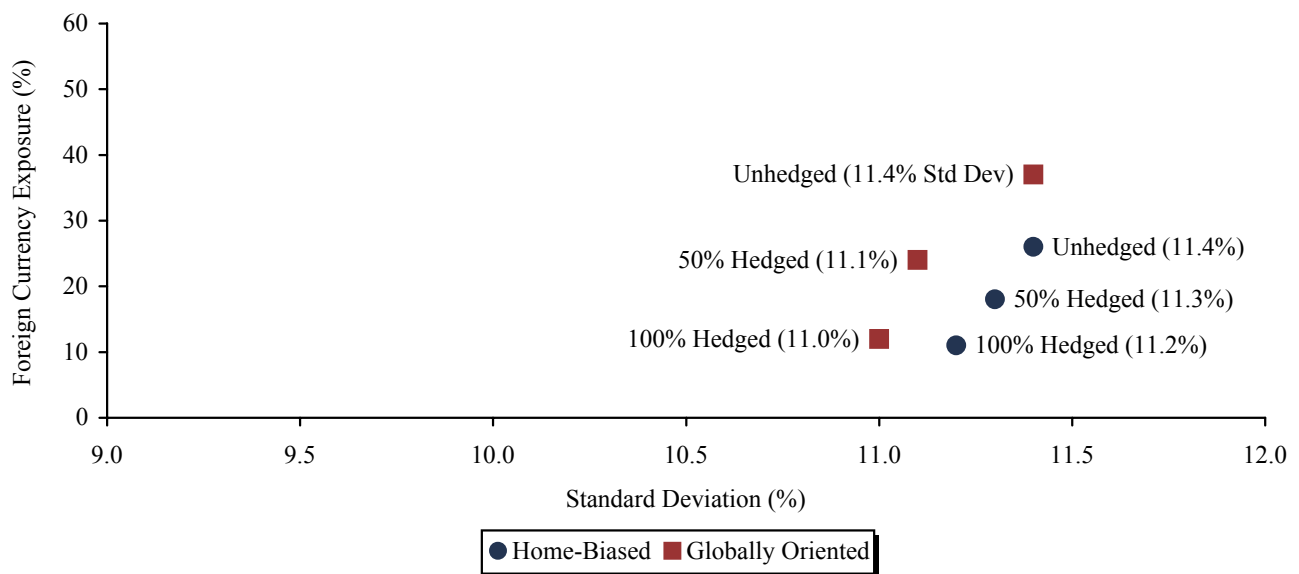
Exhibit 4c

VOLATILITY OF A EURO-BASED DIVERSIFIED PORTFOLIO AT VARIOUS CURRENCY-HEDGE RATIOS

Portfolio with Non-Marketable Alternative Assets



Marketable Asset Portfolio

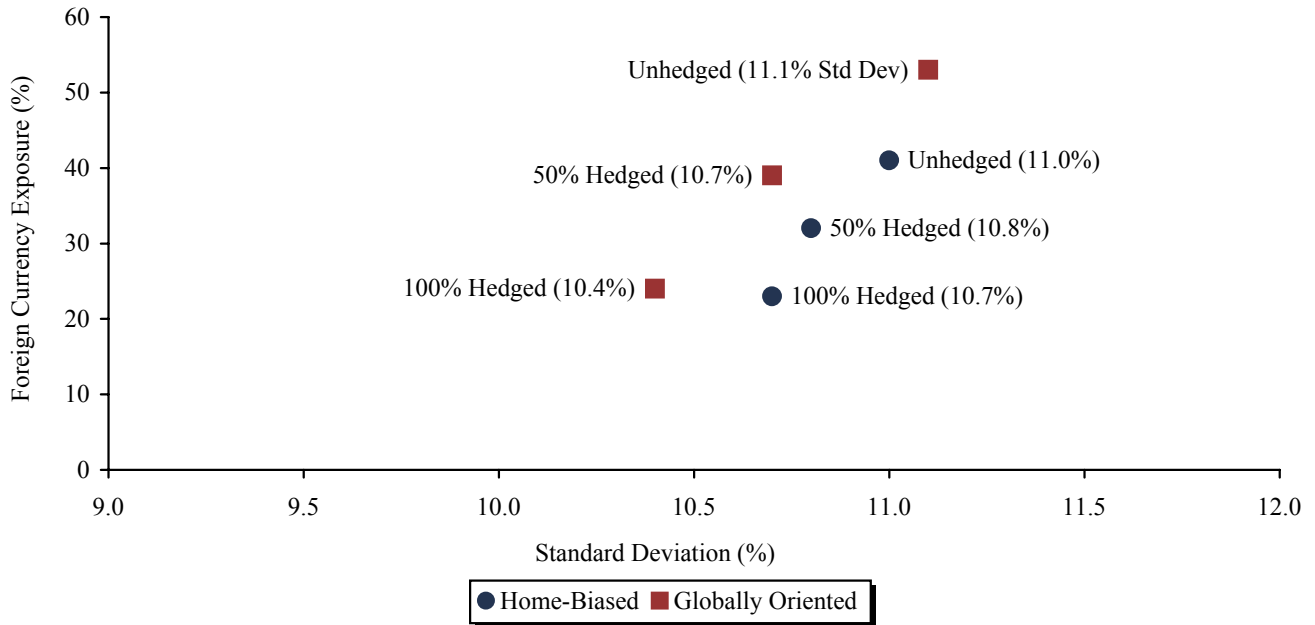


Source: Cambridge Associates LLC.

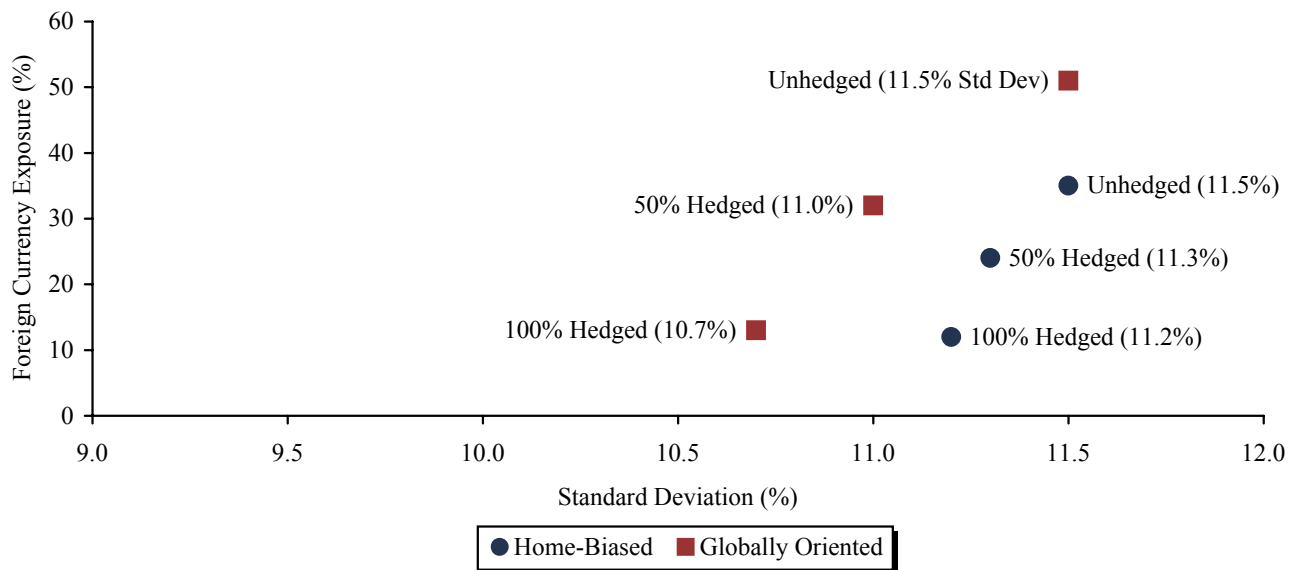
Exhibit 4d

VOLATILITY OF A SWISS FRANC-BASED DIVERSIFIED PORTFOLIO AT VARIOUS CURRENCY-HEDGE RATIOS

Portfolio with Non-Marketable Alternative Assets



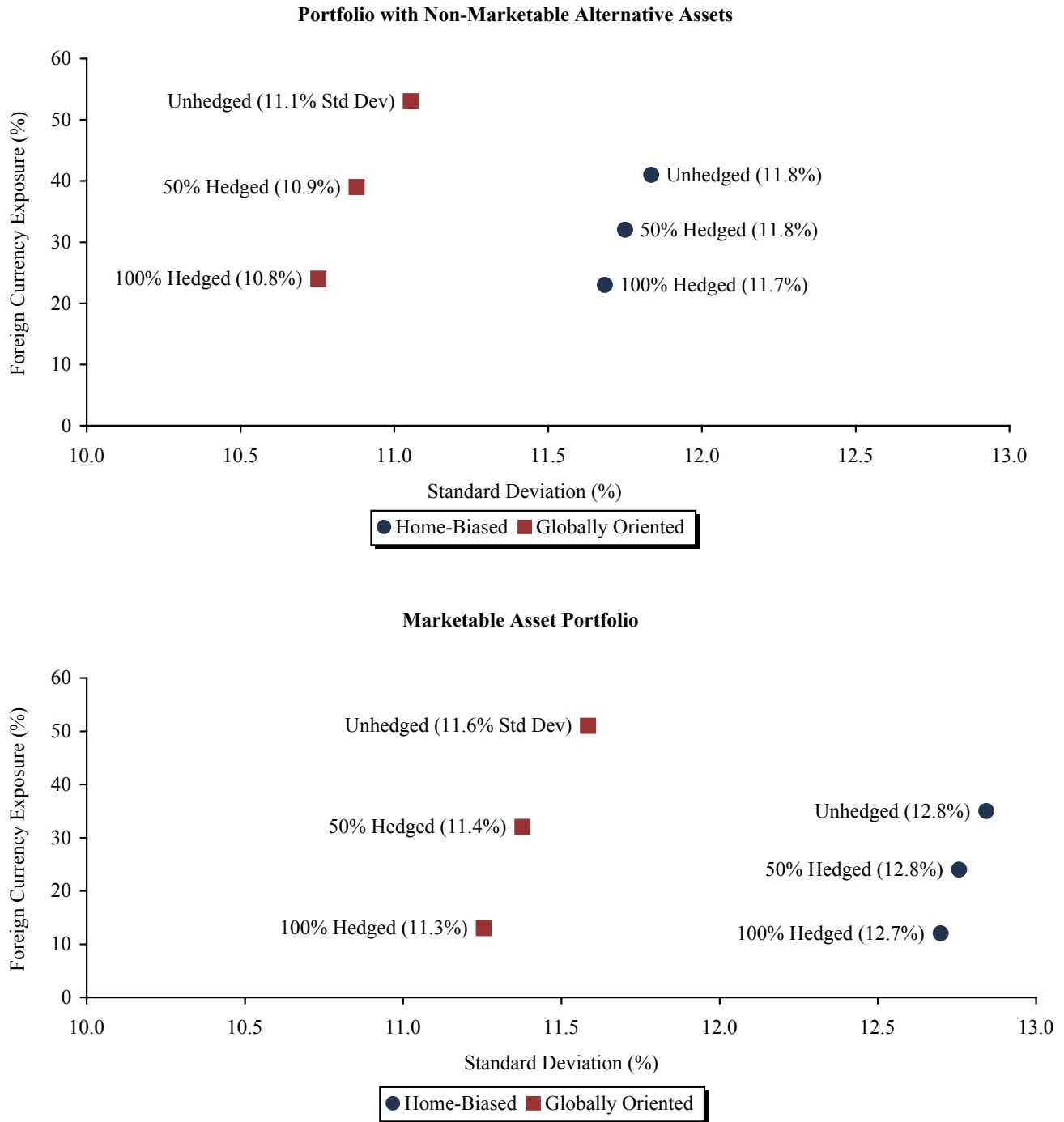
Marketable Asset Portfolio



Source: Cambridge Associates LLC.

Exhibit 4e

VOLATILITY OF A \$\$-BASED DIVERSIFIED PORTFOLIO AT VARIOUS CURRENCY-HEDGE RATIOS

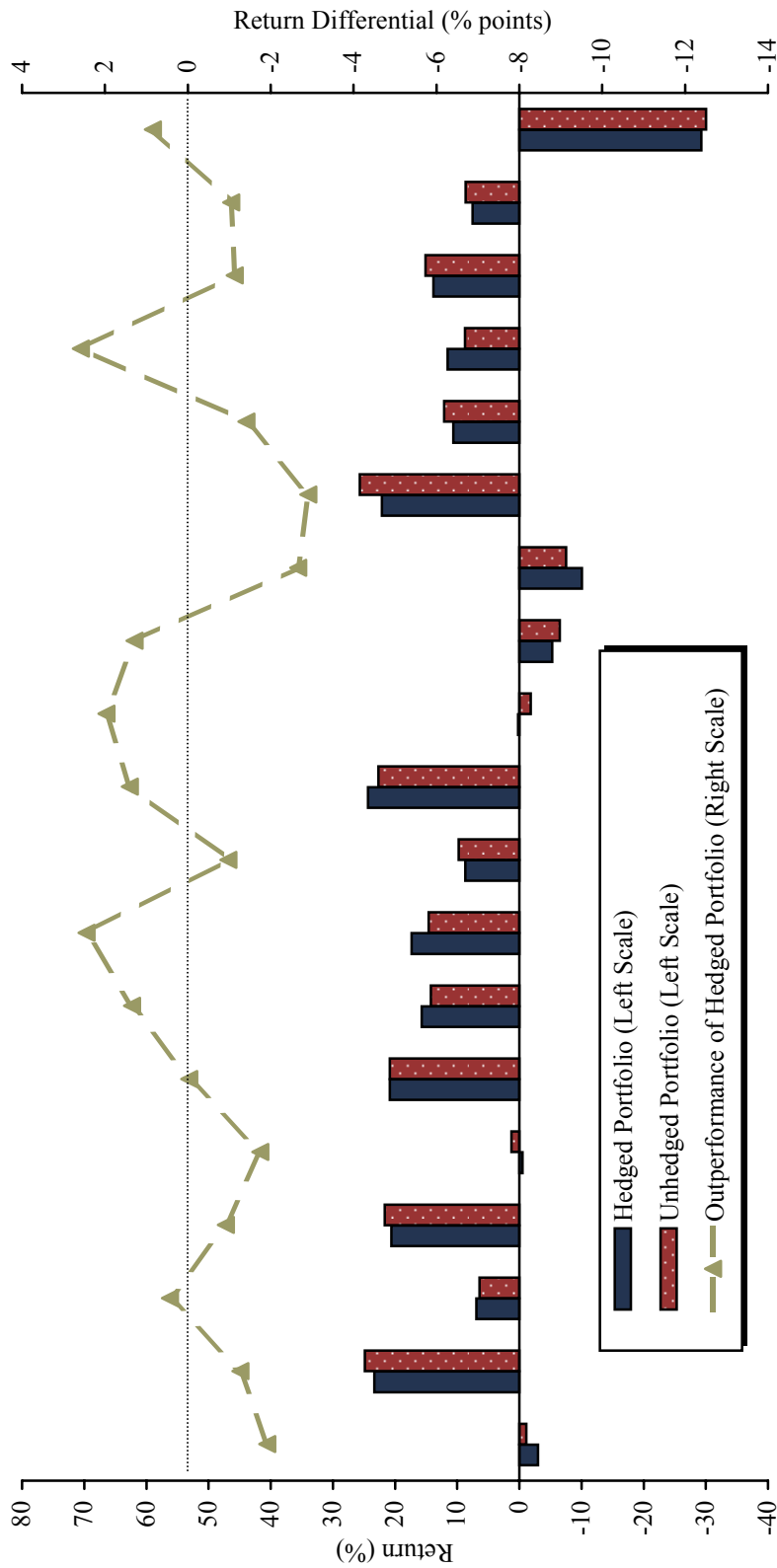


Source: Cambridge Associates LLC.

Exhibit 5a

ANNUAL RETURN OF US\$-HEDGED VERSUS UNHEDGED PORTFOLIO

January 1, 1990 – December 31, 2008



1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

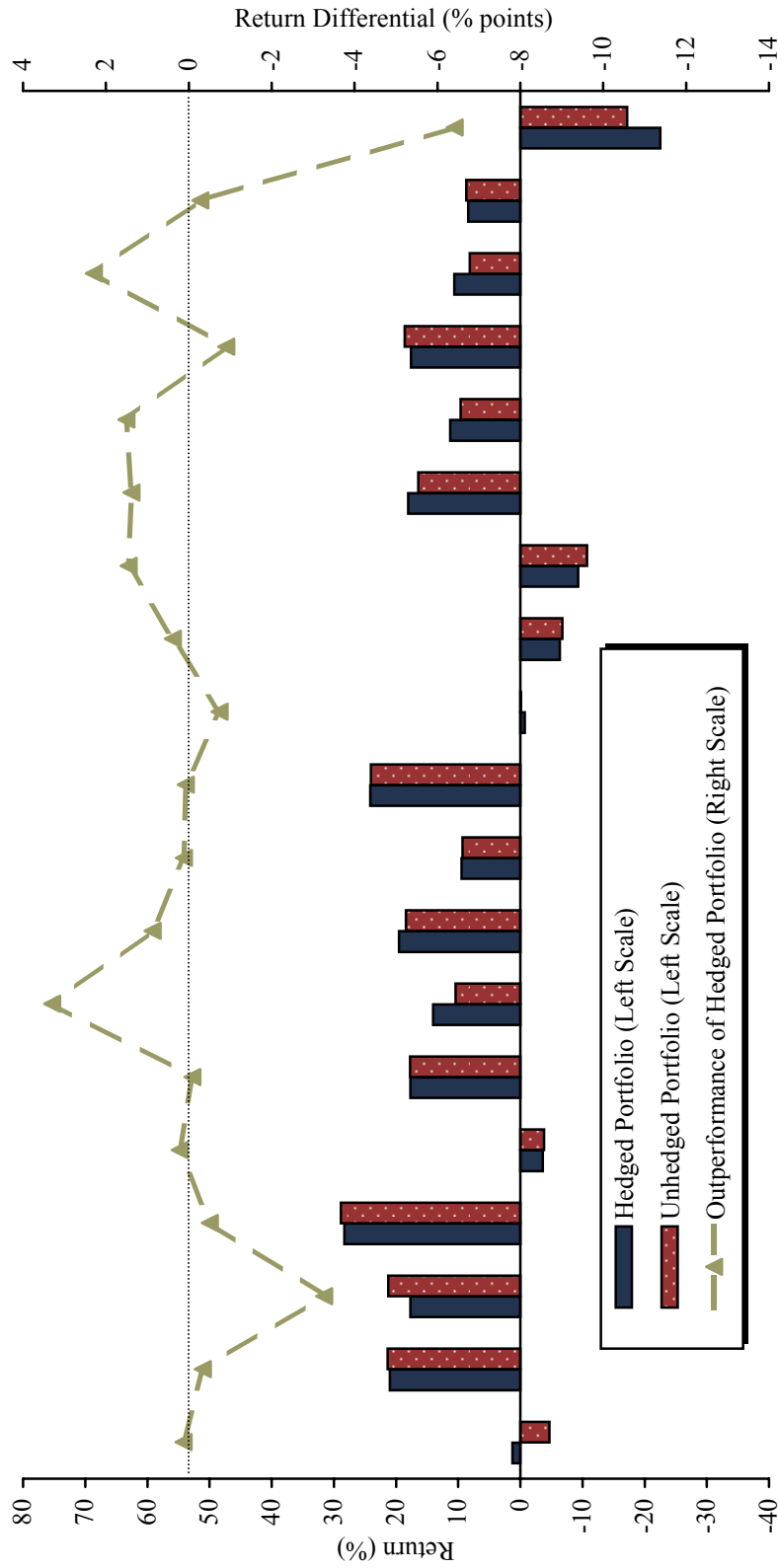
Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: This exhibit uses market indices to represent the marketable assets portfolio illustrated in Exhibit 4.

Exhibit 5b

ANNUAL RETURN OF POUND STERLING—HEDGED VERSUS UNHEDGED PORTFOLIO

January 1, 1990 – December 31, 2008



1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

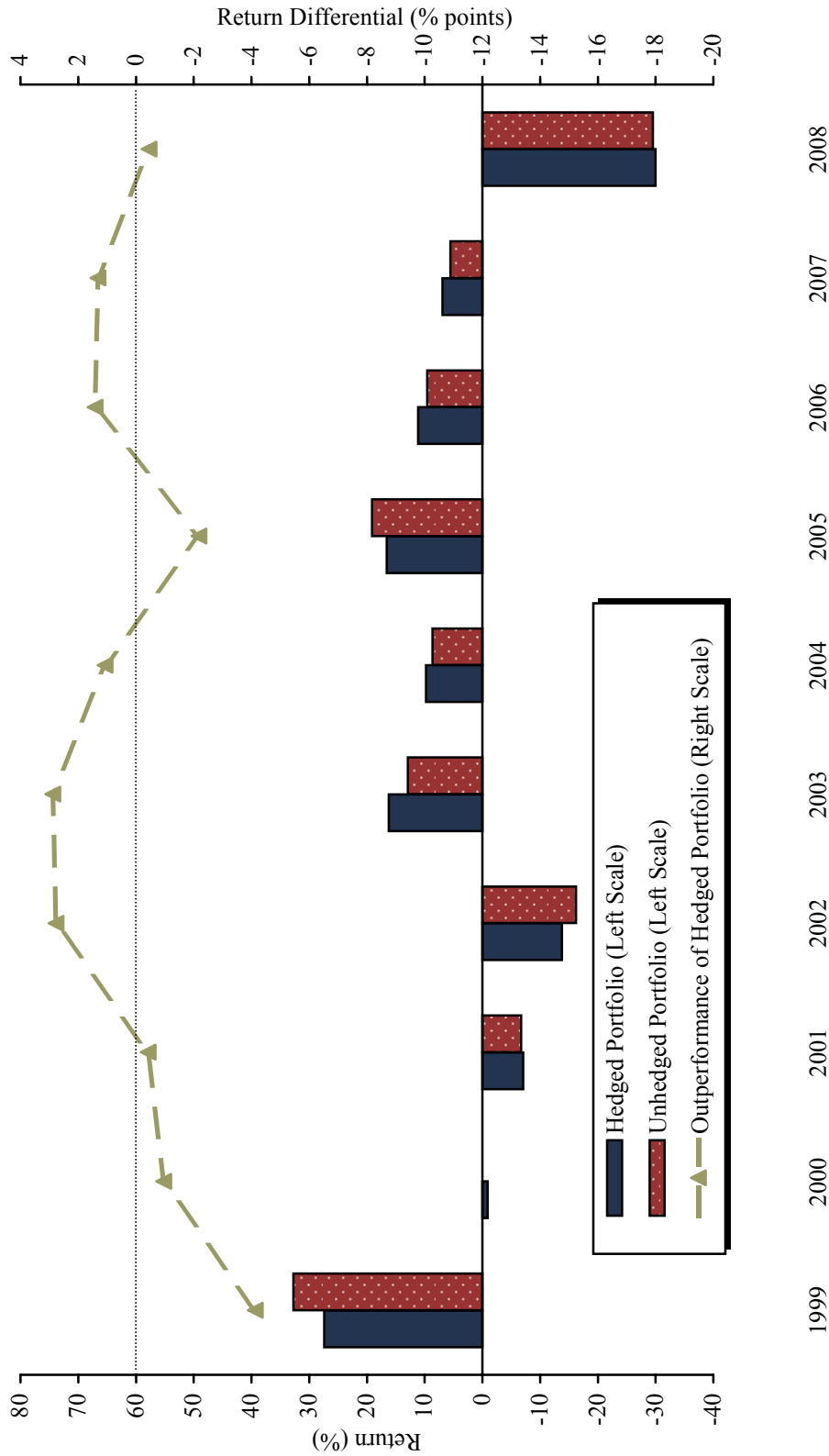
Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: This exhibit uses market indices to represent the home-biased marketable assets portfolio illustrated in Exhibit 4.

Exhibit 5c

ANNUAL RETURN OF EURO-HEDGED VERSUS UNHEDGED PORTFOLIO

January 1, 1999 – December 31, 2008



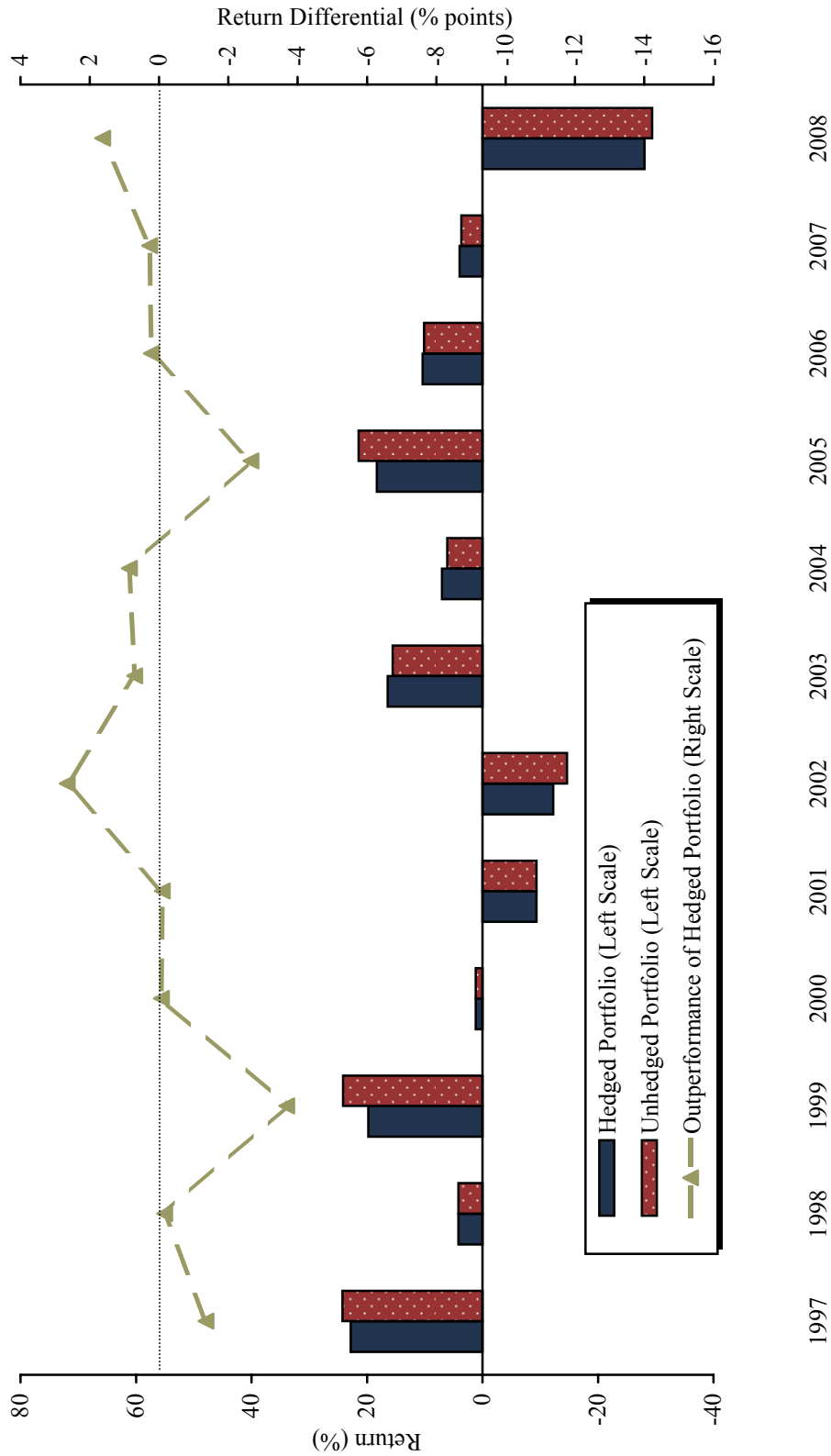
Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Note: This exhibit uses market indices to represent the home-biased marketable assets portfolio illustrated in Exhibit 4.

Exhibit 5d

ANNUAL RETURN OF SWISS FRANC-HEDGED VERSUS UNHEDGED PORTFOLIO

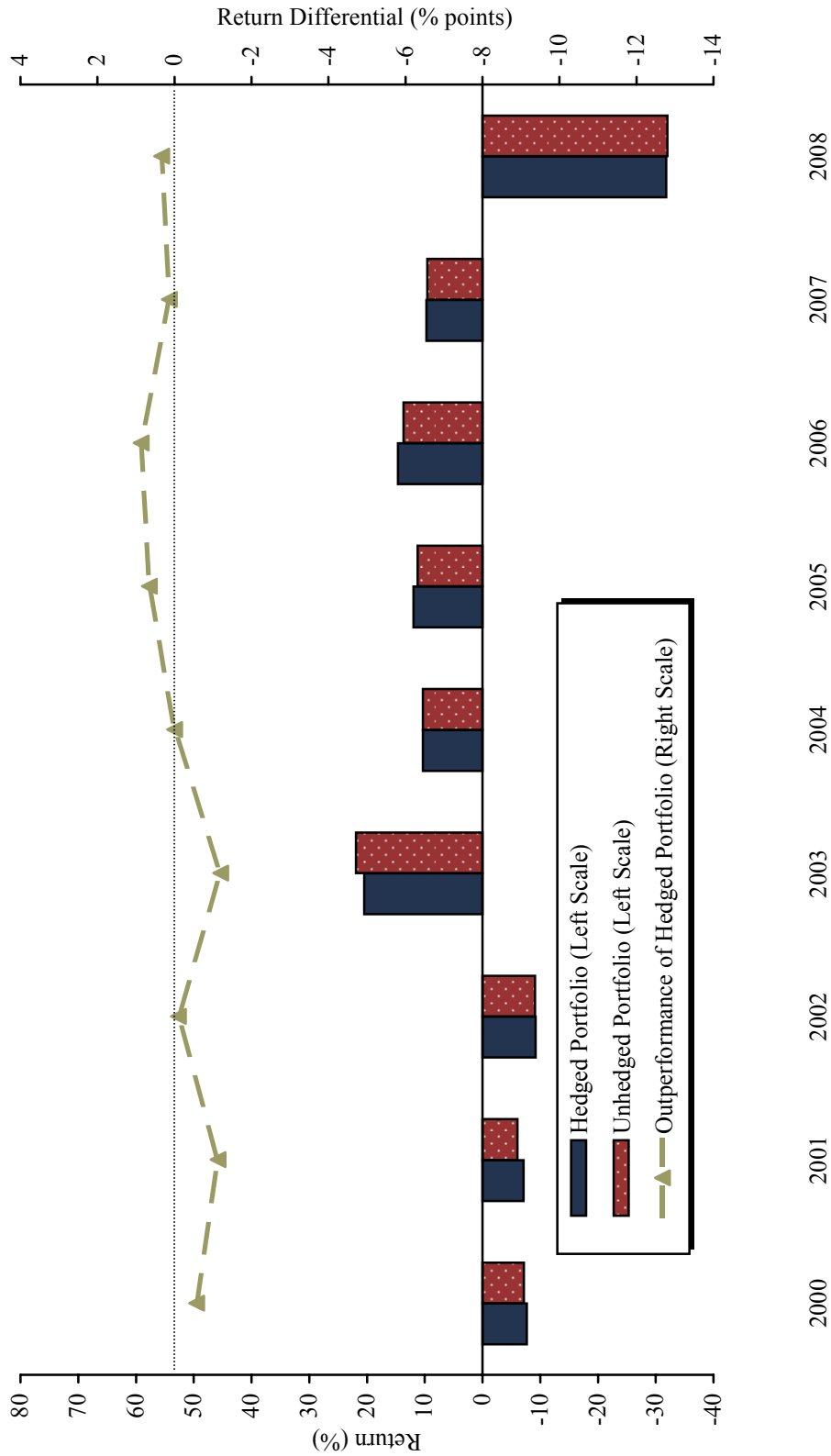
January 31, 1990 – December 31, 2008



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Notes: This exhibit uses market indices to represent the home-biased marketable assets portfolio illustrated in Exhibit 4. Global equities use Cambridge Associates' own estimate of the Swiss franc-hedged return of the MSCI World Index.

Exhibit 5e
ANNUAL RETURN OF \$\$-HEDGED VERSUS UNHEDGED PORTFOLIO
January 1, 2000 – December 31, 2008



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

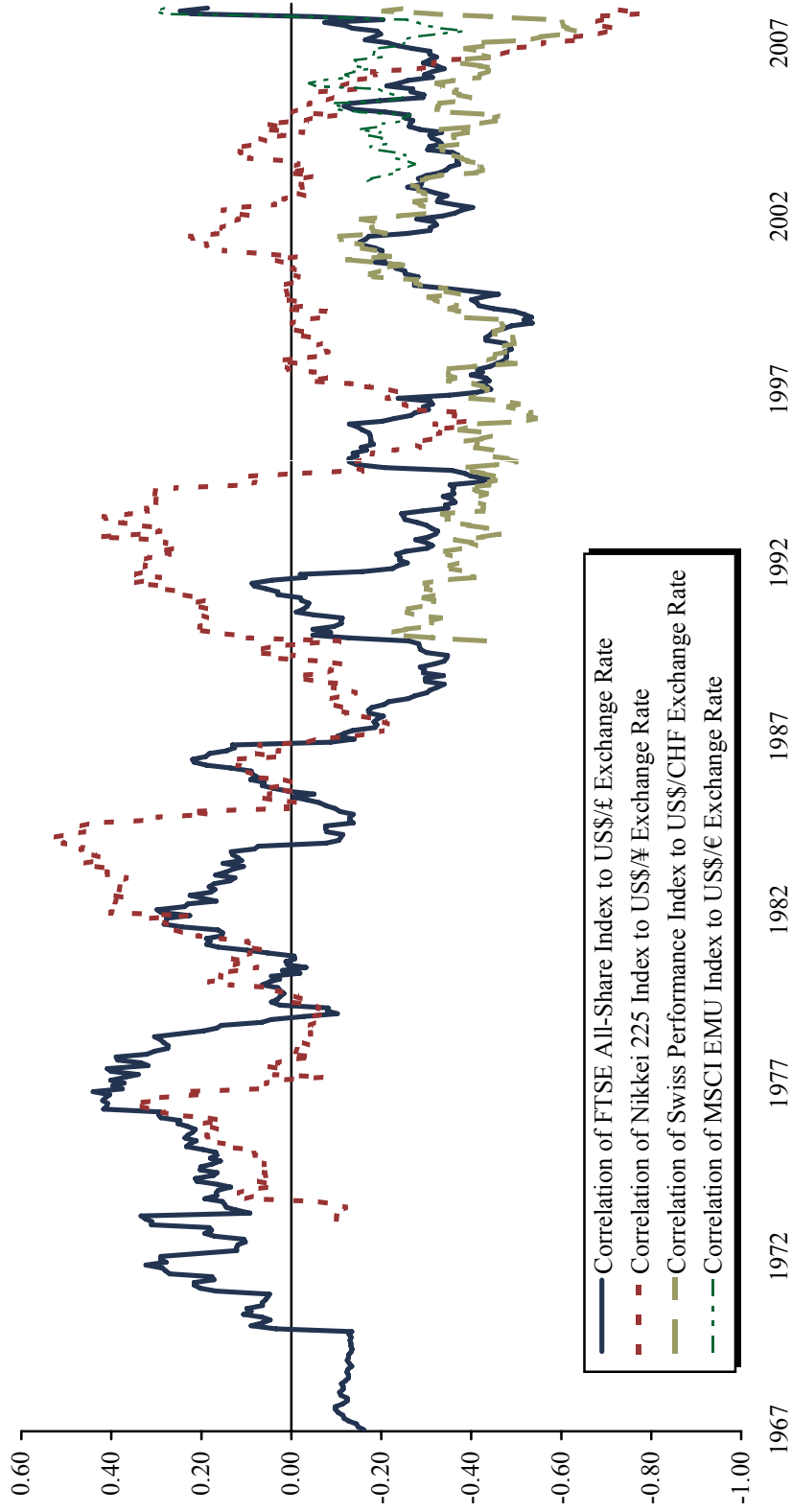
Note: This exhibit uses market indices to represent the home-biased marketable assets portfolio illustrated in Exhibit 4.

Exhibit 6a

ROLLING THREE-YEAR CORRELATION OF CURRENCY EXCHANGE RATES AND EQUITY RETURNS

US\$ Perspective

December 31, 1967 – December 31, 2008



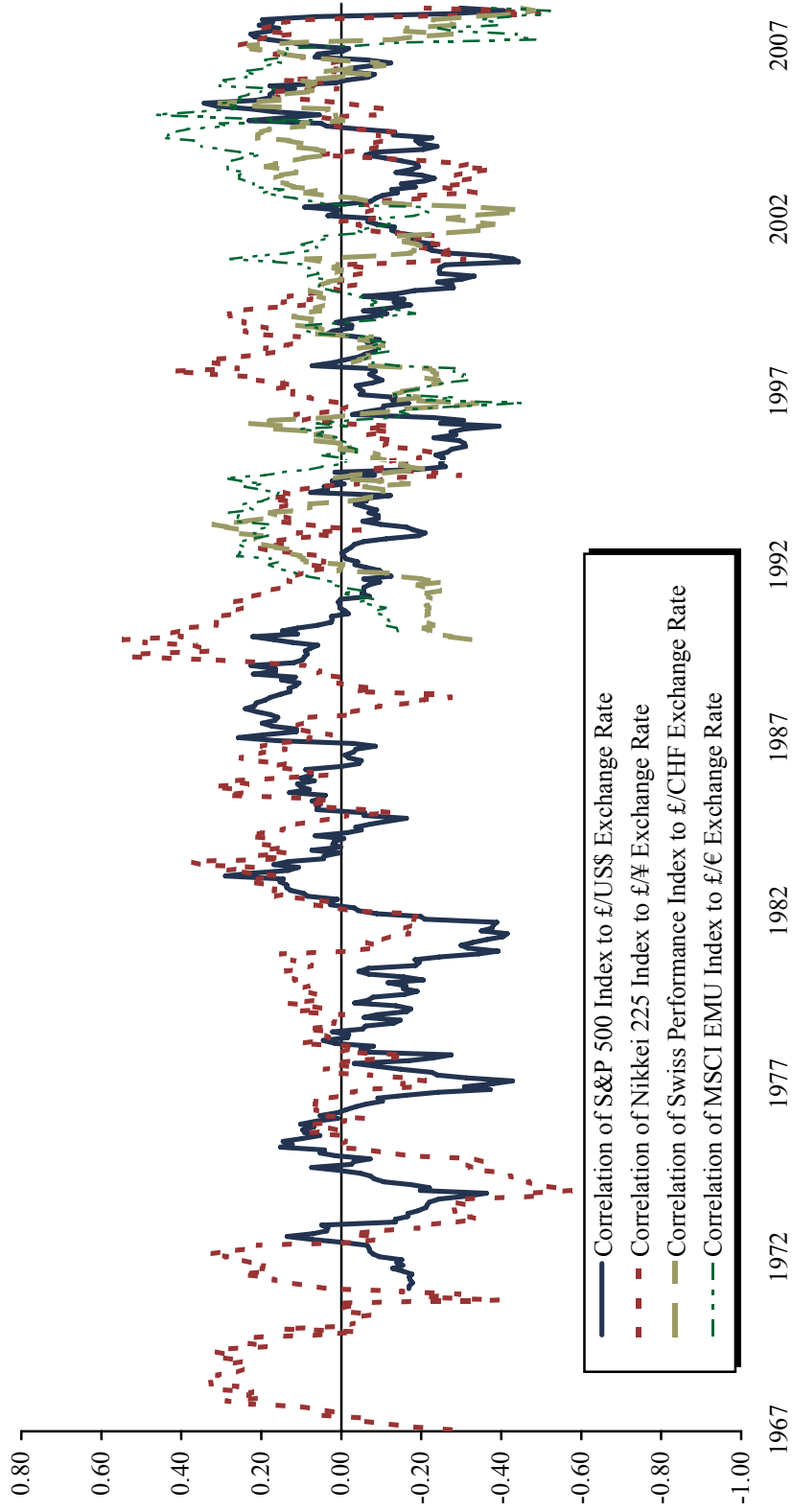
Sources: FTSE International Limited, MSCI Inc., SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Exhibit 6b

ROLLING THREE-YEAR CORRELATION OF CURRENCY EXCHANGE RATES AND EQUITY RETURNS

Pound Sterling Perspective

November 30, 1967 – December 31, 2008



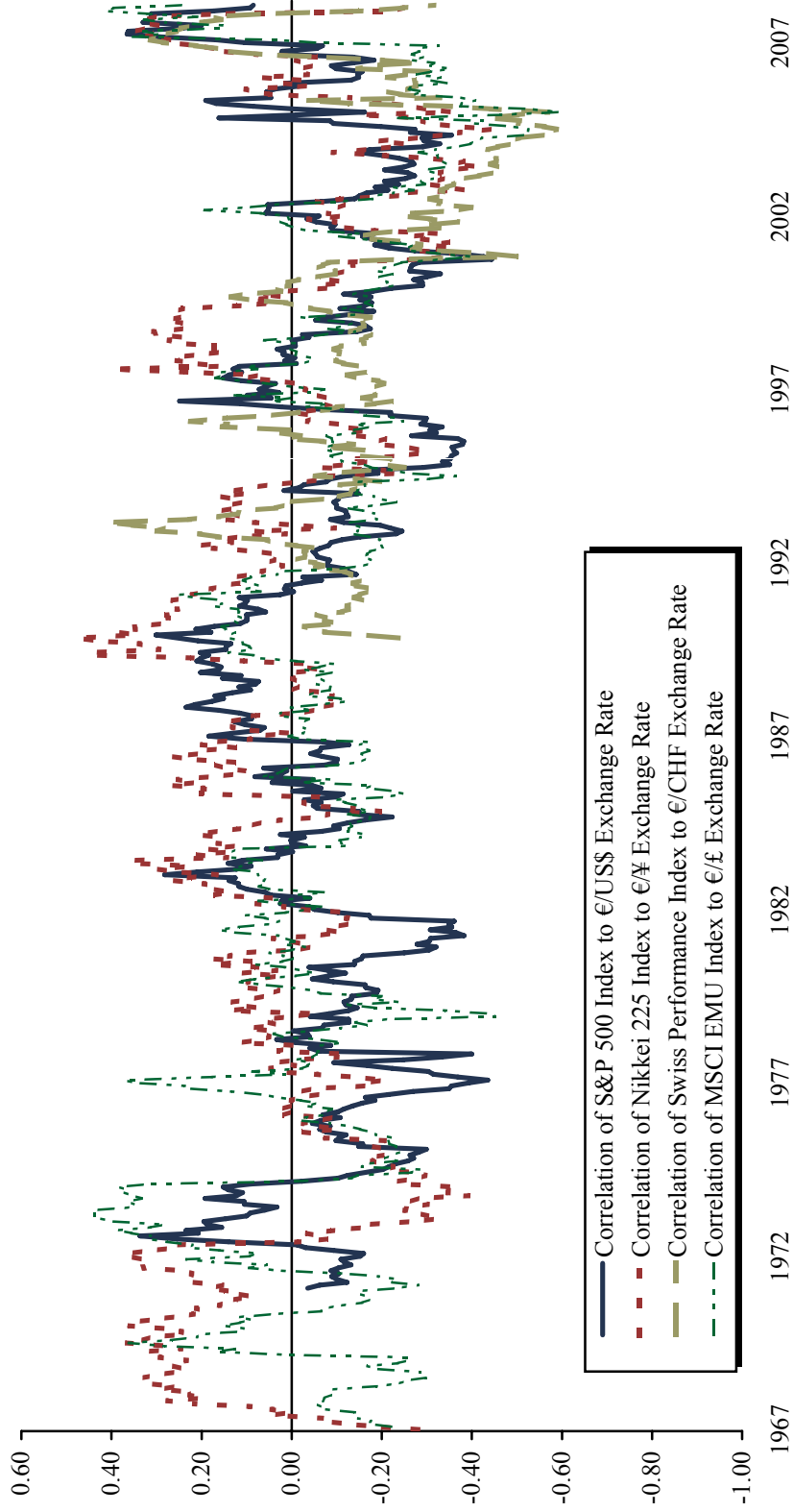
Sources: MSCI Inc., Standard & Poor's, SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Exhibit 6c

ROLLING THREE-YEAR CORRELATION OF CURRENCY EXCHANGE RATES AND EQUITY RETURNS

Euro Perspective

November 30, 1967 – December 31, 2008



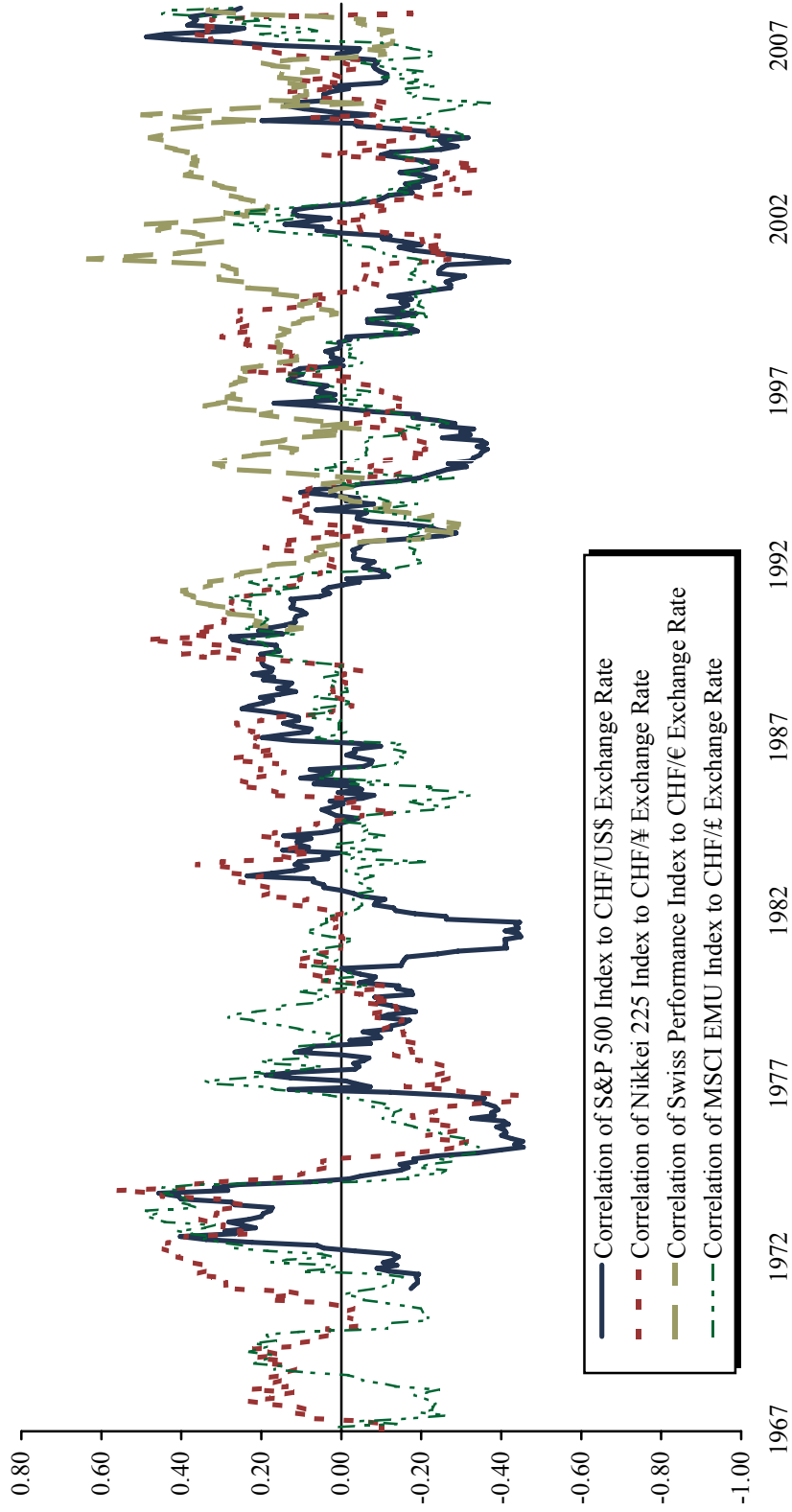
Sources: FTSE International Limited, MSCI Inc., Standard & Poor's, SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Exhibit 6d

ROLLING THREE-YEAR CORRELATION OF CURRENCY EXCHANGE RATES AND EQUITY RETURNS

Swiss Franc Perspective

November 30, 1967 – December 31, 2008



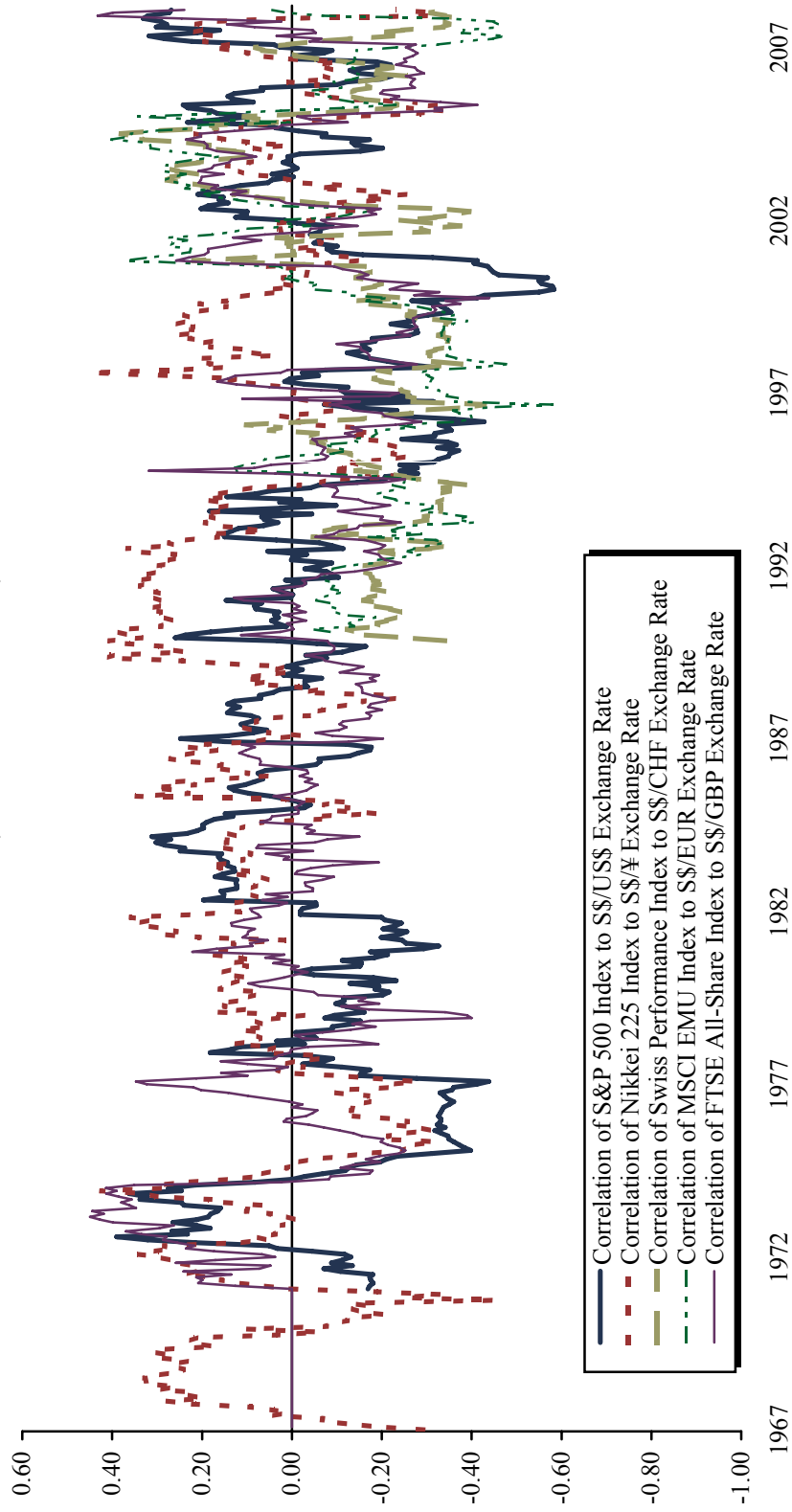
Sources: MSCI Inc., Standard & Poor's, SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Exhibit 6e

ROLLING THREE-YEAR CORRELATION OF CURRENCY EXCHANGE RATES AND EQUITY RETURNS

\$\$ Perspective

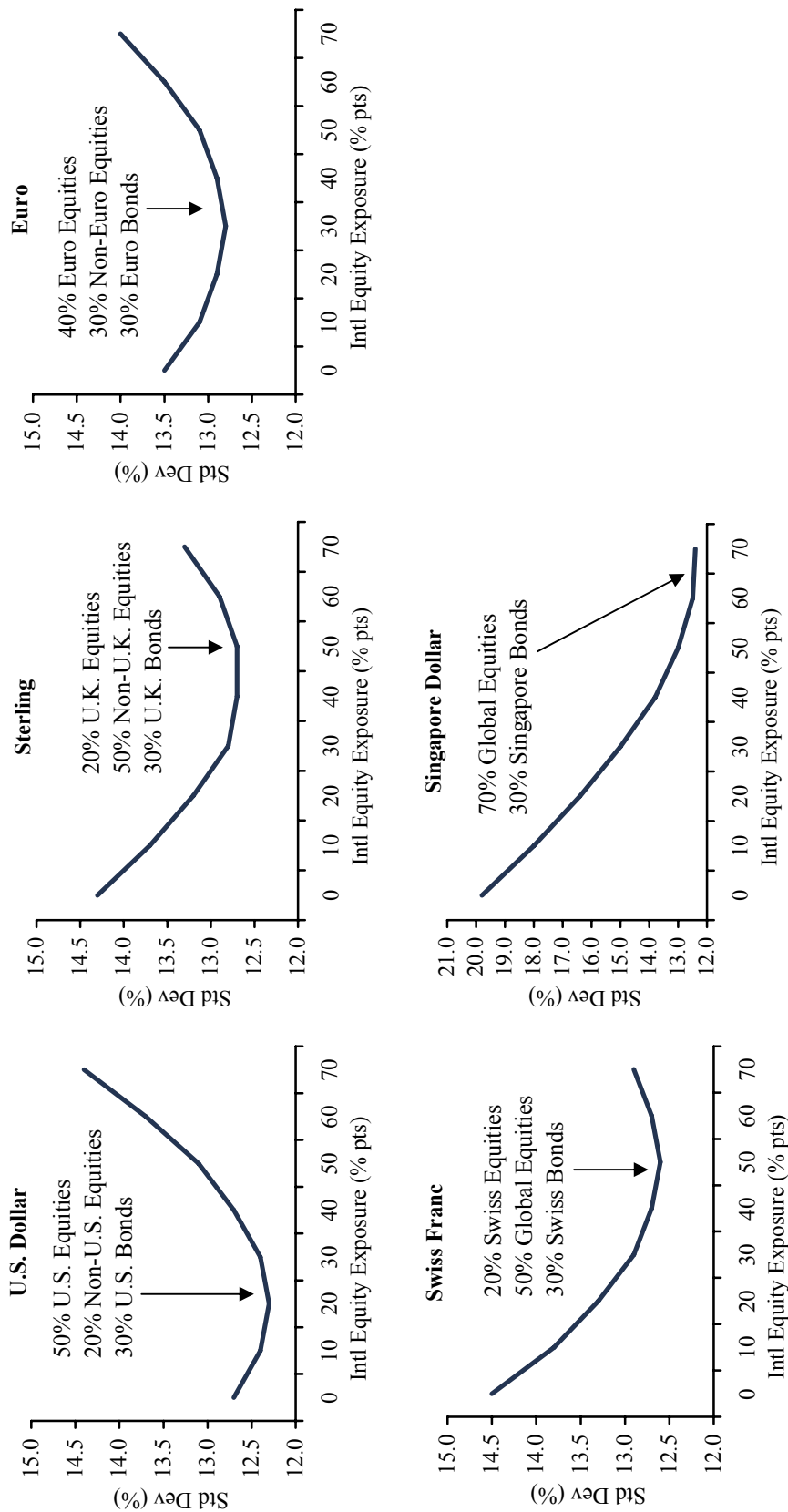
November 30, 1967 – December 31, 2008



Sources: FTSE International Limited, MSCI Inc., Standard & Poor's, SWX Swiss Exchange, and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Exhibit 7

EXPECTED VOLATILITY IMPACT OF INTRODUCING UNHEDGED INTERNATIONAL EQUITIES TO A SIMPLE PORTFOLIO OF 70% EQUITIES AND 30% LOCAL BONDS



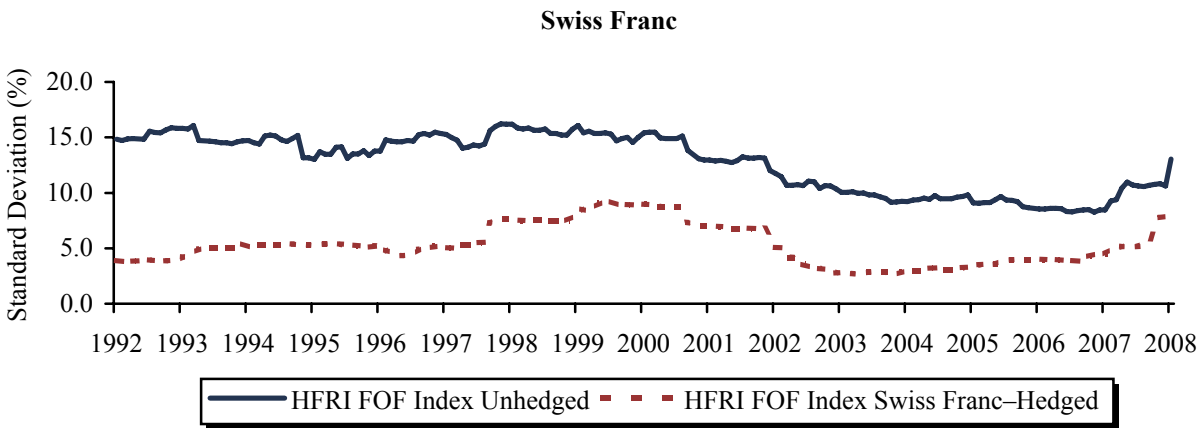
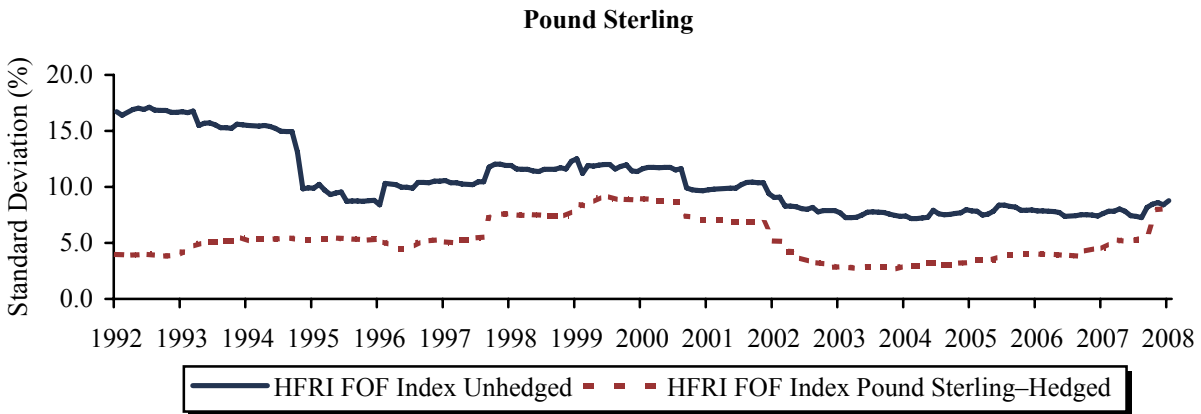
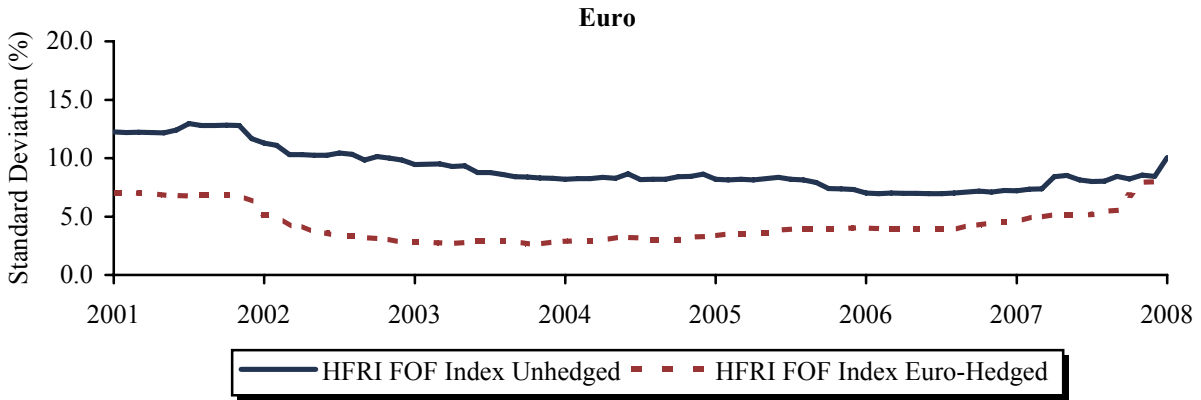
Source: Cambridge Associates LLC.

Notes: International equity exposure shown represents the percentage of the total portfolio. For example, a 20% international equity exposure represents a 50%, 20%, and 30% allocation to home-country equities, international equities, and home-country fixed income, respectively. International equity exposure for the Swiss franc and Singapore dollar is represented by global equities, which include a small portion of the home country, while that for the U.S. dollar, sterling, and euro represents global ex home-country equities.

Exhibit 8

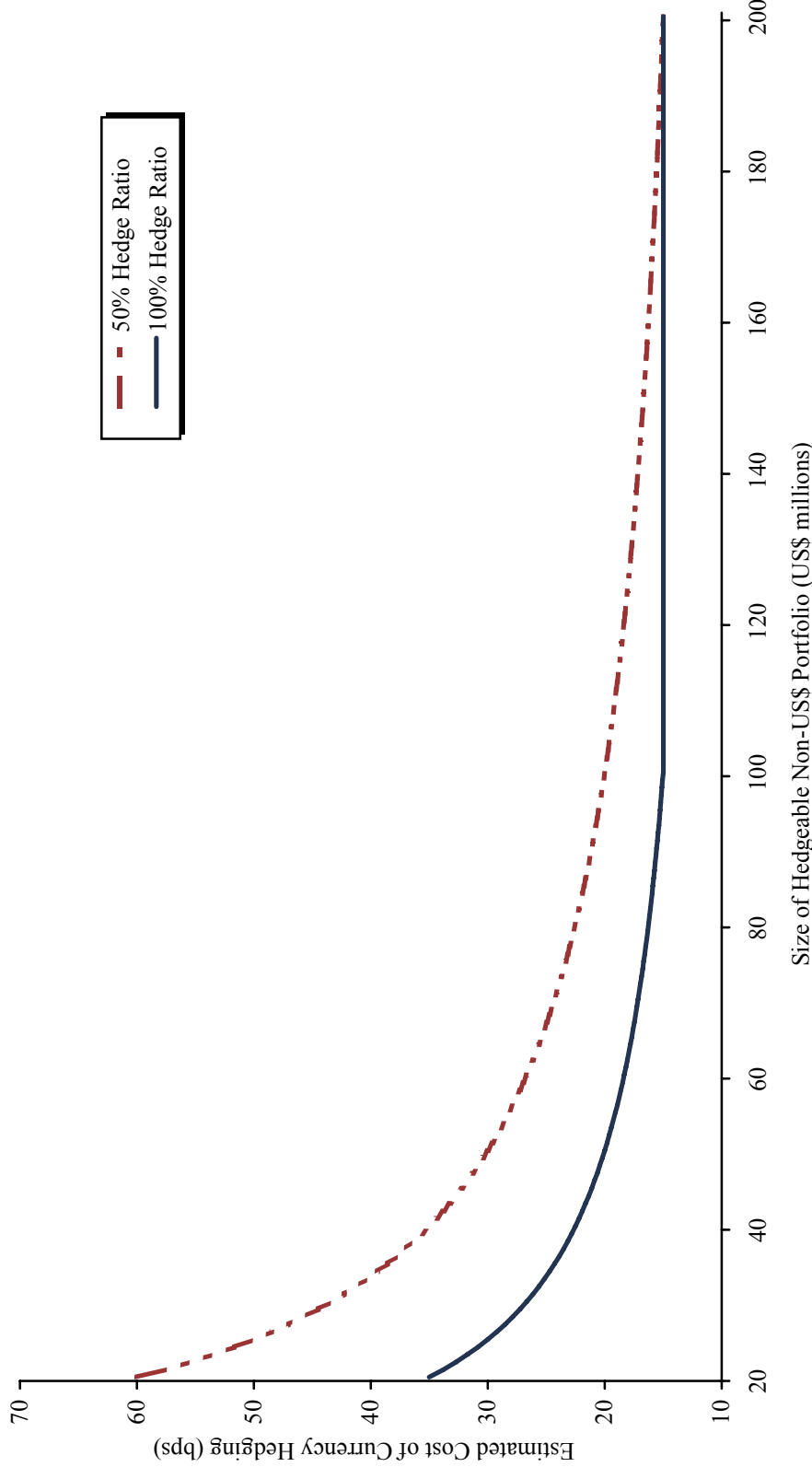
VOLATILITY OF HEDGE FUND RETURNS

Hedged vs Unhedged



Source: Hedge Fund Research, Inc.

Exhibit 9
COST RELATIVE TO HEDGED ASSET POOL



Source: Cambridge Associates LLC.

Notes: This estimate assumes annual transaction costs in the currency forwards market of 10 basis points (bps) plus an annual currency management fee of 5 bps (with a minimum annual management fee of \$50,000). This estimate does not include cash drag or transaction costs resulting from adding to or subtracting from managers to rebalance the collateral pool, nor does it include transaction costs resulting from any equitization of the collateral pool via futures.

Appendix A

A SIMPLIFIED APPROACH TO CURRENCY HEDGING

Appendix A

A SIMPLIFIED APPROACH TO CURRENCY HEDGING

In the typical approach to passive hedging using currency forwards, a US\$-based investor that is looking to apply a 50% hedge ratio to a \$200 million account benchmarked to the MSCI EAFE Index of non-U.S. developed markets equities might provide a cash pool to the currency manager (to ease the administrative burden on the investor). The amount of currency exposure to be hedged in this case is \$100 million (50% of \$200 million) and the suggested collateral pool would be in the neighborhood of \$3 million.

As the hedge nears expiration (one or three months hence), the manager determines the cost to hedge the portfolio for the next one- or three-month period and may need the investor to provide additional cash for settlement, or may permit the client to take cash out of the pool if the dollar has risen in value. For a passive overlay using forwards, interim collateral calls (“I need \$12 million by 3 p.m.!”) do not happen.¹ Still, the need to frequently top off a small cash pool can be somewhat disruptive, forcing investors to redeem funds frequently.

In the simplified approach we have developed, the cash pool is much larger than with the traditional approach (“overcollateralization”) and is then equitized so as to minimize or eliminate cash drag. In effect, the cash pool is thus being used twice: supporting transactions in the currency forwards market and providing margin for equity futures purchases.²

As Exhibits A-1a through A-1e illustrate, the frequency of expected cash flows in this hybrid approach is low; this has both administrative and behavioral benefits, minimizing both staff resources and the opportunities to second-guess a currency-hedging program when it is undergoing cash outflows (even though these outflows come when the underlying portfolio has underlying currency gains). The hybrid approach also eliminates opportunity cost (from uninvested collateral).

It is important to remember that if an investor starts out with a cash pool amounting to 20% of hedged assets and allows the pool to shrink to 3% before topping it off, it would need to add cash amounting to 17% of the hedged assets to get back to the neutral level. For that reason, investors should consider rebalancing the pool back to the target level annually or when the pool reaches a certain threshold, such as the 10% and 30% thresholds shown in Exhibits A-1a through A-1e.

This approach involves leverage, as does traditional hedging, but the level of overall economic leverage is, if anything, decreased relative to traditional overlay hedging programs (since significantly more collateral is supporting the forwards than before). If swaps are used to equitize the collateral, this introduces a second layer of counterparty risk (the first layer typically comes from the currency forwards—see

¹ Assuming no Credit Support Annex is used, there is no daily margin requirement; see Appendix D for a discussion of Credit Support Annexes. Daily margin is required when futures are used instead of forwards.

² The collateral need not be literally “equitized.” If the hedged assets are in fact global bonds, then the collateral could provide support for bond futures. Appendix E addresses this issue for hedged assets that are hedge funds.

Appendix D).³ Another potential concern is that more of the portfolio is reserved for passive management, but even investors that are adamant about maximizing active manager participation in the portfolio should be able to live with this constriction by simply allocating more of the remaining cash investment with satellite managers and less with core, benchmark-oriented managers.

We currently have a live pilot program with one overlay manager, and another manager has agreed to implement it for Cambridge Associates' clients (and has implemented it already for a pension fund that is not a Cambridge Associates client).

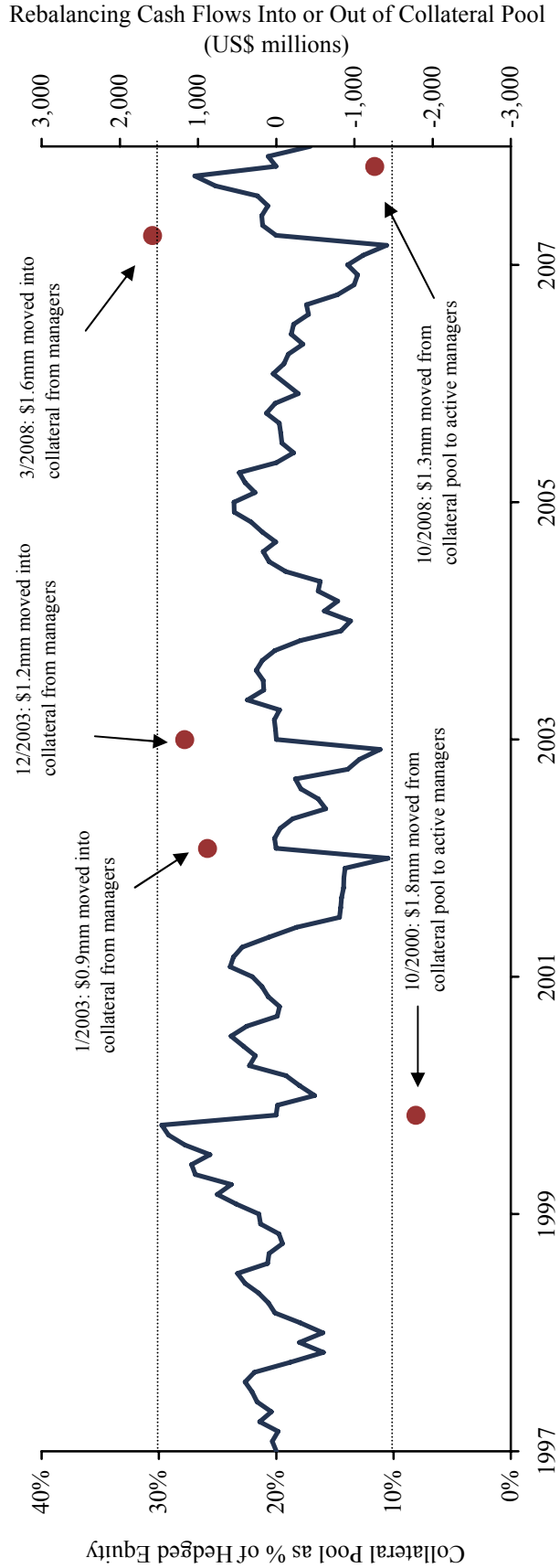
³ Exchange-traded futures theoretically introduce counterparty risk as well, but they are cleared by a highly rated clearing corporation, and daily re-margining is required; both of these aspects reduce counterparty risk compared to forwards or swaps.

Exhibit A-1a

SIMULATED CASH FLOWS TO REBALANCE US\$ CURRENCY-HEDGING COLLATERAL POOL

(Starting Portfolio Includes \$10 Million of Hedged Assets)

Collateral target is 20% of hedged assets with a 10% to 30% allowable range



— Collateral Pool as % of Hedged Equity ● Rebalancing Cash Flows Into or Out of Collateral Pool

Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

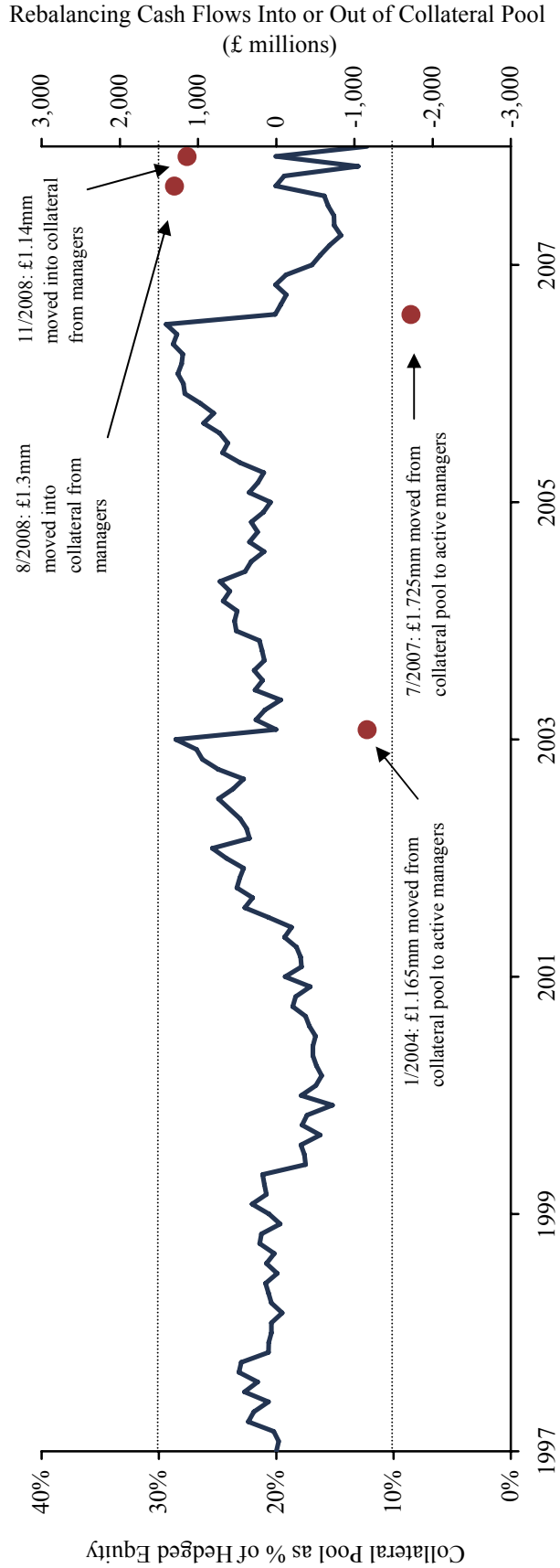
Notes: Return of currency hedge is simulated each month using the difference between the MSCI World ex U.S. (Hedged) Index and the MSCI World ex U.S. Index. Simulated return of equity futures on collateral is simulated each month using the MSCI World ex U.S. (Hedged) Index. Cash flows assume that collateral pool is rebalanced back to 20% after hitting a 10% or a 30% threshold.

Exhibit A-1b

SIMULATED CASH FLOWS TO REBALANCE POUND STERLING CURRENCY-HEDGING COLLATERAL POOL

(Starting Portfolio Includes £10 Million of Hedged Assets)

Collateral target is 20% of hedged assets with a 10% to 30% allowable range



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

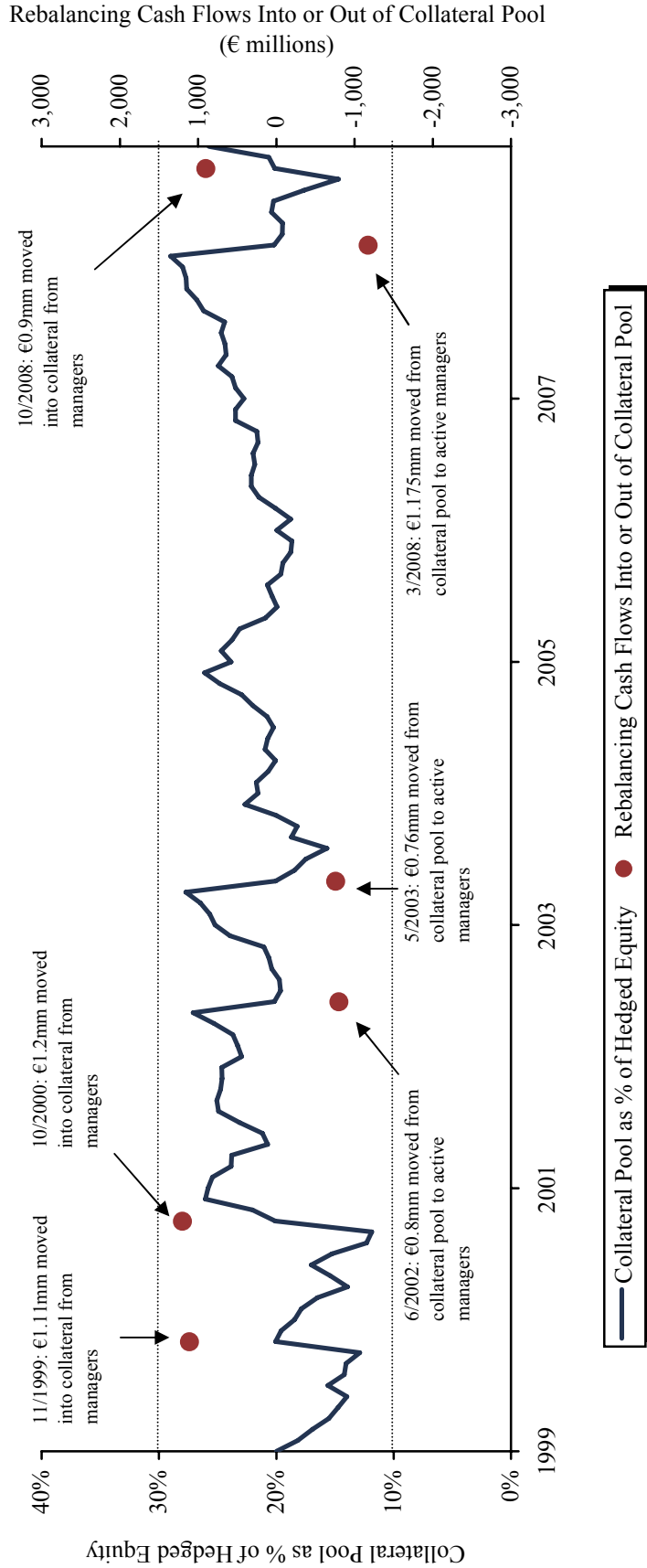
Notes: Return of currency hedge is simulated each month using the difference between the MSCI World (Hedged) Index and the MSCI World Index. Simulated return of equity futures on collateral is simulated each month using the MSCI World (Hedged) Index. Cash flows assume that collateral pool is rebalanced back to 20% after hitting a 10% or a 30% threshold.

Exhibit A-1c

SIMULATED CASH FLOWS TO REBALANCE EURO CURRENCY-HEDGING COLLATERAL POOL

(Starting Portfolio Includes €10 Million of Hedged Assets)

Collateral target is 20% of hedged assets with a 10% to 30% allowable range



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

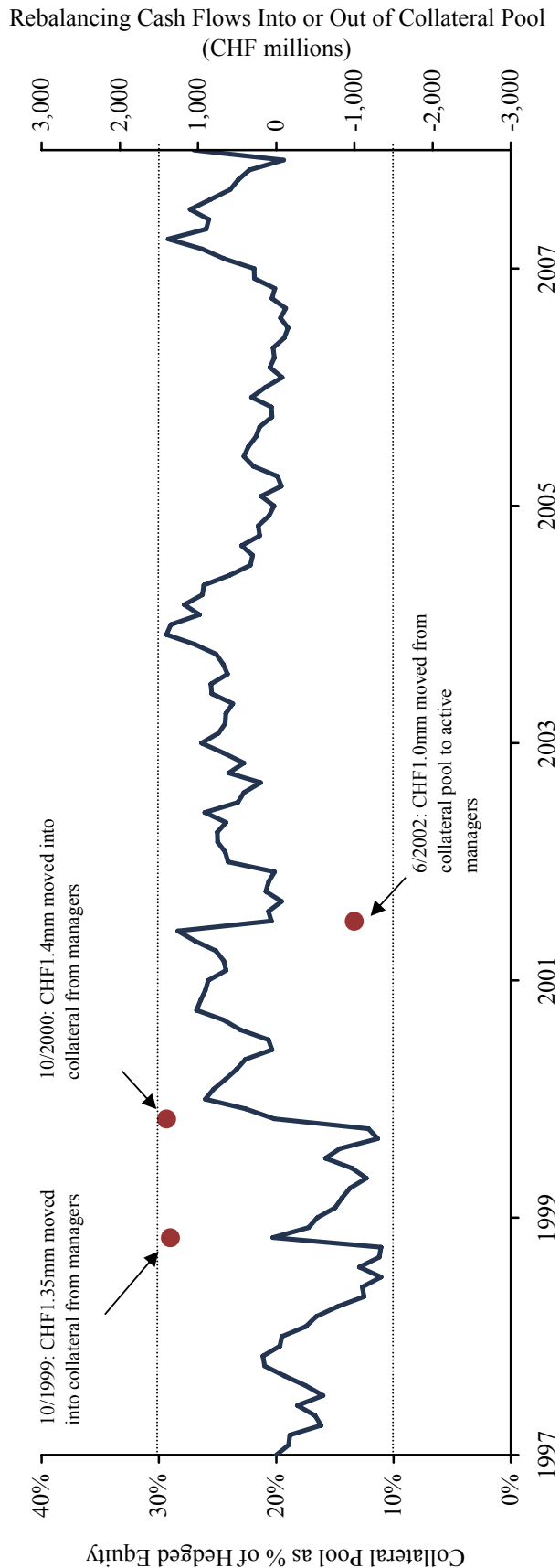
Notes: Return of currency hedge is simulated each month using the difference between the MSCI World (Hedged) Index and the MSCI World Index. Simulated return of equity futures on collateral is simulated each month using the MSCI World (Hedged) Index. Cash flows assume that collateral pool is rebalanced back to 20% after hitting a 10% or a 30% threshold.

Exhibit A-1d

SIMULATED CASH FLOWS TO REBALANCE SWISS FRANC CURRENCY-HEDGING COLLATERAL POOL

(Starting Portfolio Includes CHF10 Million of Hedged Assets)

Collateral target is 20% of hedged assets with a 10% to 30% allowable range



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

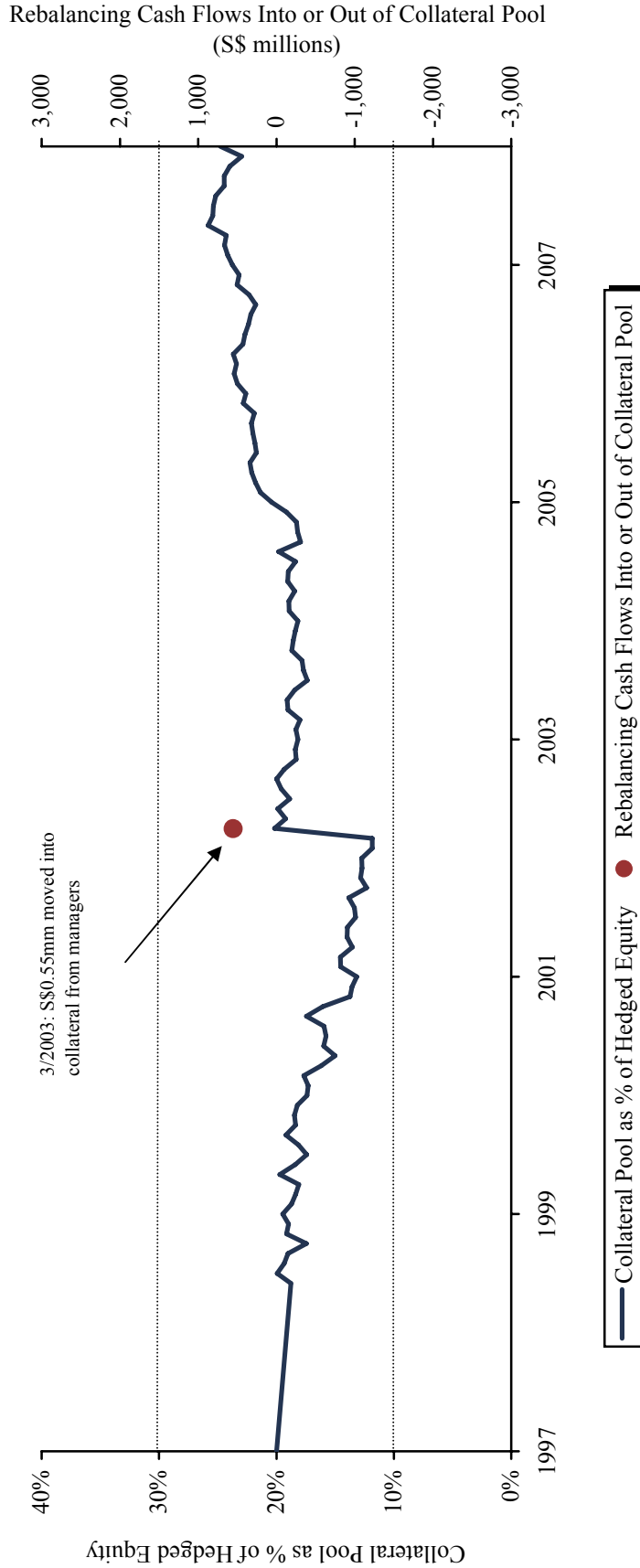
Notes: Return of currency hedge is simulated each month using the difference between the MSCI World (Hedged) Index and the MSCI World Index. Simulated return of equity futures on collateral is simulated each month using the MSCI World (Hedged) Index. Cash flows assume that collateral pool is rebalanced back to 20% after hitting a 10% or a 30% threshold. This exhibit uses Cambridge Associates' own estimate of the Swiss franc-hedged return of the MSCI World Index.

Exhibit A-1e

SIMULATED CASH FLOWS TO REBALANCE \$\$ CURRENCY-HEDGING COLLATERAL POOL

(Starting Portfolio Includes \$\$10 Million of Hedged Assets)

Collateral target is 20% of hedged assets with a 10% to 30% allowable range



Sources: MSCI Inc. and Thomson Datastream. MSCI data provided "as is" without any express or implied warranties.

Notes: Return of currency hedge is simulated each month using the difference between the MSCI World (Hedged) Index and the MSCI World Index. Simulated return of equity futures on collateral is simulated each month using the MSCI World (Hedged) Index. Cash flows assume that collateral pool is rebalanced back to 20% after hitting a 10% or a 30% threshold.

Appendix B

ACTIVE CURRENCY MANAGEMENT: CAN ACTIVE MANAGERS ADD VALUE?

Appendix B

ACTIVE CURRENCY MANAGEMENT: CAN ACTIVE MANAGERS ADD VALUE?

The purpose of hedging currency exposure is to reduce uncompensated risk. The purpose of active currency management is to earn a return. Thus, although some currency overlay managers also offer active currency services, and the two activities frequently overlap, they are not the same and the decision to hedge or not to hedge is unrelated to the question of whether some managers can add value through active management of currency exposures.

Proponents of active currency management state that the foreign exchange market has a large number of noneconomic participants (that are buying and selling currencies to hedge their exposure, and that are not differentiating between attractive and unattractive currencies). They also note that currency returns tend to be uncorrelated with those of equities, that currency transaction costs are low, and that active currency management requires little capital commitment. True statements, all. However, recent research highlights that the majority of alpha earned by active managers has actually been exotic-beta exposure in disguise, with most currency managers employing one or more of the following factors: *carry* or *forward-rate bias* (the tendency of high-yielding currencies to appreciate or at least to depreciate less than would be predicted by the theory of interest rate parity); *trend* (the tendency of currency movements, once initiated, to continue over the near term); *value* (the tendency of currencies to revert over longer periods toward purchasing power parity as valuations compress or become stretched); and *volatility* (currency options are a popular way of going long volatility). These four factors studied by Momtchil Pojarliev and Richard Levich in a December 2007 NBER Working Paper¹ accounted for about 65% of the variability in excess currency returns earned by active managers from 1990 through 2006 (nearly 77% for the subperiod 2001 to 2006). Manager returns have dwindled in recent years, yet eight of the 31 managers in the NBER sample earned a significant positive alpha (averaging 104 basis points per month from 2000 to 2006) after stripping out the four exotic-beta factors. Meanwhile, two of the four previously mentioned active management strategies have come under scrutiny. A paper in the fall 2007 edition of the *Journal of Wealth Management* noted that the effectiveness of the trend-following strategy has disappeared for major currencies (but not yet for emerging markets currencies).² And the returns from the carry trade have become highly correlated with equities, particularly during periods of deleveraging such as 2008.

We believe that there are some opportunities to add value in the foreign exchange markets. Identifying managers that can do so consistently is no mean feat, however, and prudence suggests a multi-manager approach, whether implemented through giving overlay managers some active discretion, or through stand-alone active currency products.

¹ Momtchil Pojarliev and Richard Levich, "Do Professional Currency Managers Beat the Benchmark?," NBER Working Paper No. 13714, December 2007. A version of this paper was subsequently published in the *Financial Analysts Journal* in Sept/Oct 2008.

² Kuntara Pukthuanthong-Le, Richard M. Levich, and Lee R. Thomas III, "Do Foreign Exchange Markets Still Trend?" *Journal of Portfolio Management*, Fall 2007.

Appendix C

**WHAT IS THE APPROPRIATE REFERENCE CURRENCY FOR
INVESTORS WITH VARIED SPENDING NEEDS?**

Appendix C

WHAT IS THE APPROPRIATE REFERENCE CURRENCY FOR INVESTORS WITH VARIED SPENDING NEEDS?

“It is better to be approximately right than precisely wrong.”—variously attributed to Warren Buffett and to John Maynard Keynes

The reference currency for most investors is a question with a simple answer in most cases: where will future spending take place (and what currency does that location use)? This note addresses the issue for those few investors that cannot answer that question with a simple, one-country response.

Investors Dependent on an Illiquid Currency

Investors that will be spending their assets in currencies that are not among those actively traded in world markets are faced with a dilemma. Hedging currency exposure on an ongoing basis may be very expensive, if liquid forward contracts are not available to sell dollars, sterling, euros, yen, etc., versus the investor’s primary spending currency. If the investor’s home currency is pegged to a major currency, then the investor may choose that major currency as the reference currency.

The risk, of course, is that pegs may not last forever. For investors that spend in a currency that is kept artificially cheap via a peg, if the country’s monetary authorities broke the peg and the previously pegged currency soared in value, the hedge contracts could prove to be fairly useless. If Currency X is pegged to the euro and the investor has a yen-denominated asset, the investor in Country X would customarily hedge by selling yen forward versus the euro. If, however, the peg is lifted and Currency X soars in value versus the euro, the asset hedged back to the euro will decline in value. There is no easy solution to this political/event risk, other than maintaining a home bias, which has its own problems (particularly in countries where political risk is high).

If the investor’s illiquid home currency is not pegged, then it may choose to define its reference currency as a basket of G10 currencies. In practice, this is likely to minimize the amount of hedging in the portfolio. Not an ideal solution, but there may not be an ideal solution to this problem at present.

Schools and Universities

It is rare for endowments to spend significantly in more than one country. Even universities with multiple campuses, health care joint-ventures in India or the Gulf, etc., are likely spending significantly more in their main operations than in these remote ventures. If the spending outside of the home region is not projected to be material, there is no compelling reason to include other currencies in the strategic benchmark.

Foundations

Many foundations have programs in other countries. However, U.S. foundations typically are required to spend 5% each year, and that 5% is measured in U.S. dollars. A currency mismatch that might imperil mandated spending in some periods is best avoided. Even if the foundation's sole mission is building clinics in Zimbabwe, the Zimbabwean dollar should not be part of the strategic benchmark unless the foundation is required to spend a certain amount of those Zimbabwean dollars each year.

Families

Multicurrency reference baskets are more common in the case of multigenerational families. One generation may have property in Europe and the Caribbean, another generation in Asia and the United States. Nor is it unusual for family members to change tax domiciles or citizenship over time. If the family's assets are intended to serve future generations, predicting spending by current and future family members can be rather difficult. Some family boards are tempted to throw up their hands and use the broadest possible basket of currencies, to ensure that all possible spending venues are "covered." We regard this as a well-intentioned but generally suboptimal approach. Families have explored global currency baskets weighted by GDP, GDP growth, trade, securities market capitalization, and approaches modeled on the International Monetary Fund's Special Drawing Rights program. These approaches share a common flaw. Because they are so broad and the range of countries is not chosen for family-specific purposes, they are likely to include allocations (sometimes very significant allocations) to currencies that have little likelihood of seeing material future spending by the family. Why include a benchmark exposure to the New Zealand dollar unless the family is likely to have material spending in that currency? We believe that a better approach is to instead build a custom basket that attempts to project actual future spending allocations.¹ This is unlikely to be a perfect vision of future spending, but is also less likely to include exposure to currencies that are volatile and difficult to hedge unless there is a reasonable chance that the family will spend in those currencies. Some families adopt generic basket approaches such as GDP growth weighting as a way of implicitly increasing exposures to managed currencies that may have a positive expected return. We think that a better approach for those families with the resources to make an informed bet on currency expected return is to do so explicitly, and to measure the success against a currency benchmark that is modeled on predicted future spending patterns.

¹ It may help to focus on big-ticket spending. This varies significantly by family, but may include significant charitable goals, property, business interests, and aircraft and watercraft.

Appendix D

MANAGING COUNTERPARTY RISK

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Most managers that implement currency-hedging mandates do so using forwards. These are over-the-counter instruments. As such, the two parties in the transaction are dependent on one another to settle the contracts as promised when they mature. The level of suspicion with which investors regard counterparties certainly increased during 2008 (we regard this concern as eminently reasonable and desirable). The amount of exposure to a particular counterparty can become quite large over the length of the forward contract if one's home currency appreciates significantly.

There are several steps that investors can take to limit their level of currency exposure. We hesitate, however, to refer to these as best practices, as investors' circumstances differ, and most of the steps outlined below have costs of one sort or another.

Executing an ISDA with counterparties. The International Swaps and Derivatives Association (ISDA) has developed the ISDA Master Agreement, a customizable but largely standardized legal document that can be executed by two parties to a swap or forward. Perhaps akin to a detailed prenuptial agreement, an ISDA can help lay out procedures if conditions deteriorate later. We know of one currency-hedging firm that signs ISDAs with each counterparty bank, provides a copy for review by each clients' counsel, and then adds them to the master ISDA once the client has consented. This approach should limit the legal costs for investors (although customization for each client is not permitted).

Adding a CSA to the ISDA. A Credit Support Annex (CSA) governs the posting of collateral to support a forward or swap. Without a CSA, neither the investor nor its counterparty needs to provide collateral. They simply come up with the appropriate amount of cash at settlement. With a CSA, participants can agree that collateral must be posted once the forward is a certain amount in the money, and the CSA would specify the nature of the collateral and where it must be custodied. A collateral requirement offers helpful protection when the investor's derivatives are in the money, but the protection is bilateral, and it can increase cash drag and administrative complexity for the investor. One possible substitute to a CSA is the use of an industry practice whereby the investor can unilaterally accelerate settlement of the forward at any point in time, and the counterparty must then come to settlement with the net present value of the amount owed to the investor. The investor can then open up a new forward contract to maintain the hedge, without the concern of having a large exposure to the counterparty.

Multiple vetted counterparties. We can think of no good reason for an investor to permit its service provider to engage in forward contracts with only one firm. Diversify the exposure.

Exchange-traded currency futures. Hedging is generally done via forwards, but we know of at least one reputable firm that uses exchange-listed currency futures instead. Futures contracts are available for many currencies, with solid liquidity in several contracts including the euro, pound sterling, yen, and Australian dollar. Some exposures would generally be proxy-hedged (although this is usually the case in the

forward market as well). Futures are standardized rather than customizable, with contracts on the Chicago Mercantile Exchange that mature in December, March, June, and September for the major currencies (for US\$-based hedgers). Futures are exchange traded, so there is no exposure to one counterparty. Further, they are margined daily, so the parties must post collateral, and must adjust that collateral as the value of the contract shifts, unlike in the forward market (unless a CSA is used). The collateral requirement of futures would make them undesirable for applications in which the collateral is not “equitized” as described in Appendix A.

Appendix E

**ELIMINATING FOREIGN CURRENCY EXPOSURE THAT STEMS FROM A
PORTFOLIO OF US\$-DENOMINATED HEDGE FUNDS**

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ELIMINATING FOREIGN CURRENCY EXPOSURE THAT STEMS FROM A PORTFOLIO OF US\$-DENOMINATED HEDGE FUNDS

Appendix A describes a model for currency hedging, using an oversized, equitized collateral pool that aims to reduce the number of cash flows in order to limit an investor's administrative burden. This program can work exceptionally well for a portfolio of active or passive traditional long-only equities. For non-US\$ investors that own US\$-denominated hedge funds as part of a diversified investment portfolio, however, the model requires some adaptations and compromises, and those compromises may be unattractive from both an investment point of view and an administrative point of view.¹

One required adaptation is to increase the size of the collateral pool (compared with the collateral pool that would be required to hedge traditional long-only equities), unless the investor has significant liquidity throughout the rest of the entire portfolio. A portfolio of hedge funds is not as liquid as a portfolio of marketable equities (either in separate accounts or in commingled vehicles), and if the investor's home currency appreciates suddenly, it may be impossible to liquidate sufficient hedge fund shares to settle the currency forwards when they mature. For that reason, the amount held in collateral should be quite large to provide sufficient cushion should currency move against the investor (as an example of the need for liquidity to settle hedges during volatile periods, consider that the U.S. dollar appreciated 38% versus sterling during the second half of 2008).

The manner in which the collateral is "equitized" will also differ, when the collateral is tied to hedge funds instead of to long-only equities. There are no futures contracts for generic exposure to hedge funds, of course. There are a few alternatives to consider; all are far from perfect however:

Hedge Fund Replication. Several investment banks claim to be able to replicate the performance of a fund of hedge funds, typically using a dynamic combination of exposures to equity, credit, and other factors. The basic theory behind these is that while individual hedge funds generate alpha, most of the return from a diversified portfolio of hedge funds can be attributed to generic beta exposure (such as to the S&P 500) or to "exotic beta" such as credit spreads. An investor could equitize the collateral pool using swaps that reference a bank's "hedge fund replication" index. There are several downsides to this approach. One is that we don't believe the return of a generic index of funds of hedge funds will be anything to write home about, and these products typically aim to deliver the returns of the fund-of-funds after their hefty double layer of fees. The primary attraction of hedge funds for a portfolio is that investors should be well rewarded if they can select and access the small fraction of hedge fund managers with differentiated investment skill. These

¹ Investors not denominated in U.S. dollars may want to consider whether skilled hedge fund managers offer a fund share class denominated in the investors' home currency. A number of managers offer share classes denominated in sterling and/or in euros. It will probably not be possible to fill out an entire hedge fund portfolio with these managers, but every little bit helps, provided investors are not trading convenience for manager talent. The use of additional currency share classes presents fewer operational concerns for managers that invest primarily in securities that are consistently liquid (they may occasionally need to sell large amounts of securities to settle currency forward contracts).

hedge fund replication products instead aim for the flabby middle of the industry. It is like walking into a wine store and asking for a rare bottle of Barolo, and being told, “We have wine, made with grapes from somewhere, and it has ethanol, just like Barolo. The best part is that it’s not any more expensive than Barolo and that we promise we will never be out of stock!” Another disadvantage comes from counterparty exposure underlying the swaps.² These hedge fund replication products are intriguing concepts, but currently they have short “live” track records, are often somewhat opaque, and they are generally not formally followed by the Cambridge Associates research team.

Approximating a hedge fund portfolio’s equity exposures. Another approach to providing a return overlay for the collateral pool is to assume a particular equity beta for the portfolio, and to overlay the collateral with that amount of beta using futures. Hedge fund portfolios’ exposures to the equity markets, however, are likely to be quite dynamic. Equity beta in a diversified hedge fund portfolio might have been 40% or even more in mid-2007 but quite small in early 2009, for example. Exposures to credit would have moved in the opposite direction. Assessing and adjusting these exposures in anything like real-time is likely to be difficult. Further, the equity beta is not the attraction of hedge funds, otherwise we would recommend using futures and cash instead of hedge funds in the first place, avoiding the layers of fees. The equity beta may account for part of the hedge fund portfolio’s returns, but it is ideally a residual rather than the main event.

Matching the traditional portfolio’s equity exposures. A third approach is to apply equity and bond exposures similar to those outside the boundaries of the hedge fund portfolio, but with perhaps less of an equity tilt. Let’s take a simplistic example of a portfolio that is 60% long-only global equities, 20% hedge funds, and 20% domestic bonds. If the investor chooses to set aside as collateral an amount equivalent to one-quarter of the hedge fund bucket (5% of the investor’s overall portfolio in this instance), this collateral could be overlaid using futures to add in 60% exposure to global equities and 40% exposure to bonds. The obvious downside to this approach (or the other two for that matter) is that for every dollar or euro of hedge funds within the portfolio, investors must set aside a portion of the overall portfolio as collateral, exposed to a naive mix of equities, bonds, and perhaps credit.

The overcollateralized hedging approach involves leverage, since each dollar or euro of collateral supports several dollars or euros of short currency exposure, *and* up to one dollar or euro of equity exposure. It is for this reason that we recommend equitized collateral pools be considerably larger than have proved necessary historically. Of course a traditional currency overlay program, with a small amount of cash to support currency hedges, introduces leverage as well.

Given the significant compromises that these three adaptations of the overcollateralization model described in Appendix A entail, investors may choose instead not to follow that model at all. They can simply employ traditional overlay hedging with a minimal collateral buffer, and settle forwards by selling

² Of course, actual hedge funds have underlying counterparty exposure as well. A portfolio of actual hedge funds is likely to have more diversified counterparty exposure than would hedge fund replication swaps from one or two banks, however.

liquid assets elsewhere in the portfolio.³ This requires a large degree of liquidity elsewhere in the portfolio, to ensure the investor can settle the currency forwards during times when the investor's equities have fallen in value at the same time the investor's home currency has depreciated (such as the third and fourth quarter of 2008, for investors denominated in sterling). The challenge, of course, is to deal with the portfolio distortions introduced by these liquidity-motivated (rather than rebalancing-motivated) cash flows, as well as the frequency of cash flows and the behavioral temptation to unwind a "losing" hedging program at the worst possible time.

³ This assumes that liquid assets are available outside of the hedge fund portion of the portfolio.