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## **Hedging Currency Risk: Does It Have to Be so Complicated?**

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## **Hedging Currency Risk: Does It Have to Be so Complicated?**

### **Abstract**

The question of whether foreign investments should be systematically hedged against currency risk has not been clearly answered to date. Numerous theoretical and empirical studies have provided contradictory conclusions. This paper examines to what extent foreign bonds and equities are exposed to currency risk. Risk and return of different strategies are aggregated over five reference currencies for a period from 1985 to 2000. The advantage of this method is that the results do not depend much on the time period chosen. Empirical evidence confirms the hypothesis that currency hedging should be fully applied to foreign bonds, whereas foreign equities should not or only partially be hedged.

## Introduction

International diversification has now become an established practice for most investors.

However, the impact of foreign currency risks is still a debated key issue. Are there benefits from taking currency risks or should the investor avoid them? Various studies have shown<sup>1</sup> that in the long run currency risk is only rewarded to a limited extent by higher returns. In other words, the premium for currency risk is almost non-existent, or at least negligible. This has important implications for investors when they come to define their investment strategy. Unless they have predictive power, only a limited degree of currency exposure is advisable. When setting up a strategy for currency risks, investors face a number of questions:

- Are bonds and equities<sup>2</sup> exposed to currency risks to the same degree?
- How important is the impact of diversification in global portfolios – Does it compensate for the additional currency risk associated with foreign investments?
- Can the overall risk be significantly reduced by systematically hedging currency risk?
- Should the hedge ratio be less than one?
- Against which currency should the foreign investment be hedged: against the currency in which the foreign investment is denominated, or against another currency such as the US dollar, which in practice has the role of a key currency?

The drawback of most empirical studies in this field is that their results heavily depend on the observation period chosen. If, for example, they relate to a period when the US dollar was strong, the conclusion in most cases will be that US investors should hedge their foreign investments against currency fluctuations, while non-US investors would be better off not hedging their US investments at all. In this study we attempt to minimize this dependency on

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<sup>1</sup> See next section

a specific period. We do so by simultaneously considering the impacts for both investors affected by movements in the exchange rate.

Our research shows that currency risk hardly carries any risk premium. Furthermore, bonds and equities exhibit a fundamentally different currency risk exposure. As a result, diversification benefits from going international do not compensate for the extra currency risk taken in global bond portfolios. However, when the currency risks are hedged, a global bond portfolio yields a better risk/return ratio than domestic bonds. This is due to interest rate diversification. With equities, on the other hand, the diversification benefits are large enough to offset the currency risk associated with foreign investments. Therefore, currency hedging only marginally reduces the overall risk of the portfolio.

## **Literature**

The question as to whether the currency risk is rewarded by higher expected returns has produced some controversial answers in the literature. Many international asset pricing models, such as developed by Solnik (1974), Sercu (1980) and Stulz (1981) consider the currency risk as an additional risk factor; a price is therefore assigned to this risk. Dumas and Solnik (1995) examine the model developed by Adler and Dumas (1983) and conclude that in the past the currency risk for the world's four largest markets – the US, the UK, Japan and Germany – has been compensated with a premium. They do not quantify the size of this risk premium, however. De Sanits and Gerard (1998) also find evidence to support the argument that an international asset pricing model should not only include a factor for the market risk, but also a factor for the exchange rate risk. For equities, however, the premium associated

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<sup>2</sup> The empirical analyzes provided in this study are limited to these two asset classes.

with currency risk only appears to make up a small part of the overall risk premium. In addition, this premium seems to be heavily dependent on the observation period chosen.

Perold and Schulmann (1998), on the other hand, describe currency hedging as a “free lunch” over the very long run. Empirical evidence suggests that any variation in the exchange rate corresponds roughly to the forward discount or premium and is not correlated with the other variables, such as returns in local currency. Currency exposure may therefore be characterized as a game of roulette: it implies a high degree of unsystematic risk without any risk premium. When properly applied, currency hedging does not have any impact on the expected return (if transaction costs are moderate), but yields a substantial reduction in the overall risk of an international portfolio.

Glen and Jorion (1993) also conclude that the performance of optimized equity and bond portfolios is significantly improved by currency hedging. But for portfolios that are optimized on a unhedged basis, currency hedging provides virtually no extra benefit. Asset and currency allocation should therefore be simultaneously optimized.

Froot (1993) argues that “Hedge Friends” are myopic. In the short term it certainly is possible to reduce variance through currency hedging. With an investment horizon of up to five (eight) years, a hedge ratio close to 100% is therefore recommended for equities (bonds). In the medium term, however, Froot recommends a significantly lower hedge ratio of around 35%. But if an investor has an investment horizon of more than 10 years, hedging the currency risk no longer improves performance. In this case, he argues, fluctuations in real exchange rates are no longer stochastic, but follow a mean reversion. Froot therefore suggests a strategy of “going naked”, i.e. a hedge ratio that is close to zero. However, his research is restricted to the

view of a British investor investing in the US market so it is questionable whether the findings are universally valid.

It would seem that neither one extreme (100% hedging) nor the other (no hedging at all) is an ideal solution. The question of the appropriate currency hedge ratio is still not answered.

Black (1990) comes up with a universal hedge ratio which implies that in the equilibrium all investors – whatever their nationality – hold the same market portfolio and strive for the same hedge ratio. Because of Siegel's Paradox (see 2.2), this hedge ratio is significantly below 100%.

The problem is how to identify this optimal hedge ratio, as it depends on a number of parameters such as the relative preferences of different nations or risk aversion, which in reality cannot be objectively measured. Black (1989) illustrates how heavily the optimal hedge ratio is influenced by the factors used: depending on the underlying loadings of these factors, the hedge ratio varies between 30% and 80% in his research. The central conclusion remains therefore that neither one extreme (100% hedging) nor the other (no hedging at all) is optimal. Some simplification is obviously necessary to produce a feasible hedging rule.

Gastineau (1995) therefore postulates a simple 50/50 rule: 50% of the currency risk should be hedged, while the other 50% is left unhedged.

Another inevitable question is: How big is the exposure of domestic investments to fluctuations in exchange rates? Or put differently: Should an American investor hedge his holding in Coca Cola by going short in the US dollar and going long in the euro? Jorion (1990) shows that in the case of the US market, the returns on the stocks of multinational companies included in the S&P 500 are influenced by currency movements. The stronger a

company's international exposure, the greater the impact of currency swings on its share price. Diermeier and Solnik (2001) show similar results for the eight biggest capital markets.

## **Hypotheses**

**Currency risk: a zero-sum game?** We wonder whether currency risk is not simply a zero-sum game. Shouldn't the profit a Swiss investor makes on US investments when the dollar appreciates against the Swiss franc be offset by the loss that an American investor makes on Swiss investments? In theory the answer to this question is no. According to Jensen's Inequality theorem, the profit made when a currency appreciates is always greater than the loss suffered in the depreciating currency. This phenomenon is also known as Siegel's Paradox. Black (1989) argues that because this difference is always positive, hedging the entire currency risk would not be efficient.

So the question is whether this theoretical phenomenon is also materially important. To find the answer, we analyze returns and risks of money market investments, denominated in both domestic and foreign currency, experienced on average by investors in Switzerland, Germany, the UK, the US and Japan during the period 1985 to 2000. We explicitly choose money market 3-months investments in order to minimize any interest rate risk and to emphasize currency risk.<sup>3</sup>

[insert Table 1]

Siegel's Paradox would lead us to expect that foreign investments would on average yield higher returns than domestic investments. Apparently, this assumption is not true (see Table

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<sup>3</sup> Our methodology is described in the following chapter.

1). Despite the significantly higher risk, foreign money markets on average do not offer superior returns. Table 1 shows that the average return on both domestic and foreign money markets was 5.81% p.a. after aggregating across all investors and investment currencies. If we look at the third figure after the decimal point, we can see that foreign investments exhibit a premium. But the 5.814% return on the foreign money market is only marginally higher than the return achieved on the domestic money market (5.805%).

However, investing in foreign rather than domestic money market instruments increases risk (standard deviation) substantially. For instance, the risk for German investors in their home market is 0.62% p.a. compared to a volatility of between 4.13% and 11.51% p.a. in foreign money markets. As Table 1 shows, the average risk for all domestic investments of all investors comes to 0.69% p.a., which is substantially lower than the average risk for all foreign investments (10.51% p.a.).

We therefore conclude that foreign currency investments do not offer a significantly higher return. This is confirmed by the marked dominance of domestic investments over foreign investments when the return/risk ratio is examined: while domestic investments exhibit a return of 8.44% per unit of risk, this ratio is as low as 0.55% p.a. for foreign currency investments. Siegel's Paradox is apparently not very predominant in the markets we examined in this study. In what follows, we therefore consider the currency risk to be a zero-sum game.

**Foreign currency risks of bonds and equities.** Like money market instruments, foreign currency bonds are also exposed to a substantial foreign currency risk. If we only hold domestic bonds, we expect the interest rate exposure to be dominated by the currency risk

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<sup>6</sup> For example, see Denzler and Müller, 2000.

when going international. We postulate that if we hold an international portfolio, the benefits from interest rate and currency diversification are not sufficient to compensate for the additional currency risk, compared to a domestic bond portfolio.

Unlike fixed-income investments, it is questionable whether foreign equities have a higher exposure to foreign currency risk than domestic equities. A share represents a partial ownership of a company and does not embody any fixed payment rights. The share price is based on the company's expected future cash flows which, in turn, are directly or indirectly influenced by the fluctuations in exchange rates. Shares in the Swiss multinational food giant Nestlé, for example, carry a multiple currency risk even for Swiss investors, despite the company being headquartered in Switzerland and its shares being listed on the Swiss Stock Exchange. This is due to the company's multinational business activities and its resulting currency exposure. This makes it quite difficult to determine the true identity and the size of the currency risks associated with the shares. The extent to which currency risks are already hedged by the company's risk management also has to be taken into consideration. From a financial viewpoint it is therefore not clear a priori whether foreign equities carry a greater currency risk than domestic equities, and whether currency hedging helps to significantly reduce this risk.

**Hypotheses for empirical analyses.** Keeping in mind our conclusion from the previous section that taking foreign currency risk is not rewarded by significantly higher expected returns, we concentrate solely on aspects of risk in the remainder of this article. In other words, we assume that on average (and before costs) domestic and foreign investments generate the same returns.

As far as the differences in risk are concerned, we postulate the following hypotheses:

<b>Hypotheses</b>	<b>Bonds</b>	<b>Equities</b>
1. Foreign currency risk for foreign investments	<p>Foreign currency bonds are fully exposed to currency risk. Compared to domestic bonds, their overall risk is therefore higher. Yet, this currency risk can be fully eliminated through an appropriate hedging strategy.</p>	<p>Foreign equities do not necessarily carry a higher currency exposure than domestic equities. Their overall risk should therefore not be higher compared to domestic equities. Currency hedging does not reduce risk.</p>
2. Impact of international diversification	<p><u>Without currency hedging:</u> Diversification reduces a small amount of the overall risk, but the extra risk due to foreign currency exposure is not eliminated.</p> <p><u>With currency hedging:</u> Due to interest rate diversification and the absence of currency risk (thanks to hedging), a globally hedged portfolio has a lower risk than one containing domestic bonds only.</p>	<p><u>Without currency hedging:</u> Diversification substantially lowers the overall risk. A global foreign portfolio is less risky than a portfolio containing only domestic equities.</p> <p><u>With currency hedging:</u> There is no further risk reduction from hedging the currency risk of a fully diversified equity portfolio.</p>

<b>Hypotheses</b>	<b>Bonds</b>	<b>Equities</b>
3. Optimal hedge ratio	Is 100%.	Is a priori neither known nor stable.
4. Currency to be hedged	Currency in which the bonds are denominated.	Is not known a priori. It is not necessarily the currency of the company's domicile or the currency in which its shares are listed. It is possible that hedging against a key currency (e.g. USD) results in a much better risk reduction.

## **Data and methodology**

**Data.** Our analysis focuses on the five financial markets of Germany, Switzerland, the UK, the US and Japan. We concentrate on investments in equities and government bonds over the period 1985 to 2000. All our data come from Ibbotson Associates. For the money market (see section "Hypotheses") and the bonds we use Total Return Indices of Salomon Smith Barney. For the equity markets we use the MSCI total return indices. The exchange rates are also supplied by Ibbotson.

In order to capture investor's experience, we test the hypotheses formulated in the previous section by using different portfolio strategies. Throughout the paper we work with simple returns and present our results on an annualized basis. In order to produce a practicable investment strategy, continuous hedging is not applied when calculating currency-hedged strategies. Instead, the hedging positions are only adjusted on a monthly basis, with an offsetting position taken up in the foreign money market. Any changes in the value of the underlying assets are therefore exposed to currency risk. Small deviations from the targeted hedge ratio are therefore possible during the month. For mixed currency portfolios we use a buy-and-hold methodology as it has the following three advantages: First the results do not depend on any mean revision pattern in the FX market, second investors typically are benchmarked by a global index based on market capitalization and thus follow buy-and-hold rather than a frequent rebalancement, and third, less transactions costs are implied.

**Analyzed Strategies.** We will examine the following five strategies for equities and bonds:

1. Domestic Investments: investments in domestic government bonds or domestic equities.
2. Single Foreign Currency Investments: investments in bonds or equities denominated in a single foreign currency or from a single country.

3. Multi Foreign Currency Investments: investment in a global portfolio of foreign currency bonds or equities. The starting point is an original equal weighting of the four foreign markets as of December 1984, but without any rebalancing (i.e. a buy-and-hold strategy).
4. Hedged Single Foreign Currency Investments: Same as strategy 2, but fully hedged back to the respective reference currency.
5. Hedged Multi Foreign Currency Investments: Same as strategy 3, but fully hedged back to the respective reference currency.

**Particular features of the analysis method.** Because of the relatively short observation period of 72 months, there will be some reference currencies where the extra risk associated with an international strategy paid off, and others where it did not. To produce a more general statement, and one that is less dependent on a specific period, we will base our conclusions mainly on the aggregate statistics for each strategy.

For each strategy we therefore calculate the average of all the mean values and standard deviations, taking the aggregate figures for all reference currencies and investment currencies. For example, with Strategy 1 (domestic investments only) we work out the five returns and standard deviations across the five reference currencies. In the case of Strategy 2 we first take the standpoint of view of the five investors considered, and determine the average risk and return they would have achieved by investing in single currency foreign bonds or equities. In the next step we take the overall average of the five averages just calculated; this gives the average of 20 values. With this method we can obtain a “general” statement, such as whether a foreign investment was worthwhile, or whether it only incurred additional risks. Currencies which “coincidentally” performed well during a period are neutralized by the corresponding weakness in other currencies. This allows us to draw general conclusions.

However, a great deal of caution is advised when interpreting the results obtained from this method of aggregating the average returns and volatilities across different currencies. The aggregated values are not meaningful in absolute terms. They do however provide a useful comparison between the different strategies, as in the case of our aggregate statistics each reference currency has the same weighting. Furthermore, compound interest calculation implies that the average returns are not comparable between single currency and multi-currency strategies. In purely mathematical terms, the weighted average of the returns of different assets on a non-annualized basis (in our study this is equivalent to the return on domestic investments and single foreign currency investments) is the same as the return on the suitably weighted portfolio (return on multi foreign currency strategies).

But due to Jensen's Inequality theorem, the annualized portfolio return always exceeds the average value of the annualized return on single currency strategies. This is best illustrated by Table 2. As far as a Swiss investor is concerned, the return of the multi foreign country equity portfolio was 66 basis points higher on an annualized basis than the average performance of the individual markets. But the insignificance of this outperformance is confirmed by a comparison on a non-annualized basis, which shows that there is no difference in returns at all. Although this effect has been acknowledged in the literature, we do not think sufficient attention is paid to it when making empirical calculations<sup>6</sup>.

[insert Table 2]

As far as the interpretation of the results is concerned, this means that the returns in the aggregated statistics are only provided for illustration purposes. Any differences in returns are

not material but are almost exclusively attributable to the problem of compound interest. Our analysis therefore focuses purely on volatility when looking at aggregated figures. For the same reasons, we neither find it useful to calculate the Sharpe ratio nor to use different measures of risk aversions across investors.

## **Results**

**Bonds.** Table 3 shows the risks and returns of the different portfolios for investors in all five countries. For all five investors it appears that unhedged foreign currency bonds are far riskier investments than domestic bonds. While the volatility of the returns on domestic bonds was between 3.40% (in CHF) and 6.53% (in GBP), foreign currency bonds posted double-digit volatility figures, with a few exceptions. Even diversifying across several foreign currencies (instead of just one) is not enough to eliminate the additional currency risk (see “Multi foreign currency portfolio”). For investors in every country except the UK, the multi foreign currency portfolio carried a risk which was more than double that associated with domestic bonds.

[insert Table 3]

Hedging the currency risk tends to bring back the overall risk of foreign bonds to roughly the same level as that of domestic bonds. Especially for countries with volatile bond markets (i.e. the UK, the USA, and Japan) hedged foreign currency bonds were in some cases significantly less risky than domestic bonds. The pattern is very uneven as far as returns go. While Swiss and American investors would have done well by investing in foreign bonds during the period 1985 to 2000, UK investors would have fared much worse. This also clearly shows how much empirical studies are dependent on periods and currencies: while exposure to foreign currency risks would have paid off for some investors – mistakenly taken as a risk premium - foreign

bonds were a poor choice for other investors, both in terms of risk and return.

Aggregating the statistics across the various investments and reference currencies according to our investment strategies allows us to make more general statements. Table 4 shows the average risks and returns for investors from all five countries. As mentioned above, average returns are not materially different across the different strategies. In fact the difference in return within the single currency strategies is just 1 basis point, whereas the larger difference in the mean return of the multi currency strategies (up to 17 basis points) is fully explained by the compound effect of annualization.

[insert Table 4]

The results clearly show that foreign currency bonds are exposed to much higher risks than domestic bonds. Investments in single foreign currency bonds carried an average risk of 11.60%, more than double that of domestic bonds (4.54%). It is also clear that these extra risks cannot be eliminated through diversification across currencies. The risk of the multi foreign currency bond portfolio is only about one fifth below the average risk of a single currency bond investment (9.15% versus 11.60%)<sup>7</sup> and is still significantly higher than the risk of domestic bonds (4.54%).

The final question to consider is what effect currency hedging has on foreign currency bonds. Table 4 shows that fully hedging the single currency bond investments on average yields the same risk as for domestic bonds. If, however, the multi foreign currency bond portfolio is

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<sup>7</sup> The multi foreign currency strategy constructed in this study has not been optimised. However, we do not think that an optimised currency mix would produce significantly different findings.

hedged against the currencies of its constituents<sup>8</sup>, this not only fully eliminates the additional currency risk, but also offers the advantages of interest rate diversification. Compared to domestic bonds, this allowed the average risk to be reduced by well over a fifth, from 4.54% to 3.49% over the 16-year observation period.

As stated in Hypothesis 1, foreign currency bonds exhibit a substantially higher risk than domestic bonds. Currency hedging, however, entirely eliminates currency risks. Our findings also confirm Hypothesis 2, which states that currency diversification only marginally reduces the extra risk of foreign currency bonds. On the other hand, on average, a multi foreign currency bond portfolio with currency hedging is less risky than an investment in domestic bonds.

**Equities.** Table 5 shows the risks and returns for the different equity strategies from the viewpoint of the five investors. Unlike with bonds, standard deviation figures do not exhibit any clear pattern. Although it seems that domestic investments are slightly less risky than foreign investments, the difference is not as pronounced as in the case of fixed-income instruments. For German and Japanese investors, certain foreign markets (e.g. Swiss and UK equities) even had less volatility than the home markets during the observation period.

Currency hedging seems to reduce the volatility of foreign investments to a certain extent. When considering the performance of the foreign investments the benefits of hedging is less clear across the reference currencies. While a British investor could have improved the performance of his portfolio by hedging the currency risks, a hedging strategy would not have paid off for US investors, as it would have cost around 300 basis points per year.

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<sup>8</sup> Here all the currencies have a hedge ratio of 100%.

[insert Table 5]

Obviously, these results are again dependant on the arbitrarily chosen observation period. To reduce this dependency, the risks – and for purely indicative purposes also the returns – are again aggregated in Table 6. Again we point on the fact, that the shown average returns are practically the same across the different strategies. The largest difference in return arises between the single country and the multi country strategy (up to 88 basis points). However, this difference vanishes again as soon as returns are compared on a non-annualized basis. The other return differences are 8 basis points or lower.

[insert Table 6]

The analysis shows that on average an investment in foreign equities only carried a slightly higher risk (21.28%) than an investment in domestic equities (18.56%). So whereas foreign currency bond investments would have had more than twice as much risk as domestic bonds, the extra risk of foreign equities was only about a fifth more. By diversifying across different foreign countries, the volatility can be reduced from of 21.28% (for a single foreign country strategy) to 16.89% on average. With equities, the impact of diversification seems to be so strong that a globally diversified portfolio of multi foreign country investments comes off better even when compared to domestic equities. When aggregated over all investors, the risk of a global portfolio (16.89%) was almost one tenth lower than the average risk of domestic equities (18.56%). Currency hedging allowed this risk to be reduced even further (14.75%). However, the additional risk reduction is quite small compared to the elimination of almost two thirds of the overall risk with bonds.

Hypothesis 1, which postulates that foreign equities do not carry higher risks than domestic equities, is therefore not confirmed in this strict formulation. The extra risk is small, however. As a consequence, currency hedging tends to reduce the additional risk. Hypothesis 2 is confirmed to some extent. The effect of diversifying across countries reduces the overall risk. Currency hedging can in turn help to even further reduce risk, although not by very much. It follows that contrary to our hypothesis, foreign equities are apparently exposed to some currency risk of the country in which the shares are listed. On the other hand, this risk seems to be relatively small. The question of whether this extra risk is attributable to foreign currencies or to other factors, such as limited arbitrage as a result of the home country bias, is left open.

**Different hedge ratios.** So far we have either not allowed for any hedging at all, or fully (100%) hedged the securities against the currency in which they are listed. As we have shown before, it is questionable whether 100% is effectively a suitable hedge ratio. Particularly with equities, we postulate a very low and unstable correlation between the domicile currency (the currency of the country where the securities are listed) and the return of the equities.

Therefore, unlike with bonds, the optimal hedge ratio for foreign equity investments might not necessarily be 100% (Hypothesis 3). Furthermore, there is a correlation between the different currencies. In order to test for the optimal hedge ratio, we calculate the average risk and return for global foreign bond and equity portfolios with currency hedge ratios of 25%, 50%, 75% and 100%.

As shown in Tables 3 to 6 the overall risk of a portfolio of foreign investments can be reduced through currency hedging. In other words, the overall risk of an unhedged foreign investment

(hedge ratio 0%) is higher than the risk of a fully hedged investment (hedge ratio 100%). For example, an unhedged multi foreign country equity portfolio for an American investor had a volatility of 16.42%, while the risk was 15.65% when fully hedged. This phenomenon can be observed for all investors, both for bonds and equities.

Table 7 shows what happens to risk and return of multi foreign currency bond and equity portfolios when we gradually increase the hedge ratio from 0% to 100%. We also show the percentage risk reduction achieved by increasing the hedge ratio by another 25%.

[insert Table 7]

The results show that on average foreign currency bonds should be fully hedged. Compared to partial hedging, the risk is much lower. A hedge ratio of 100% also seems to be the best solution for equity investments. Focusing on the relative risk reduction, however, leads to very interesting insights. With foreign currency bonds, additional risk reduction is important for all the steps taken. Even increasing the hedge ratio from 75% to 100% reduces the risk by another 15%.

With foreign equities, however, there seems to be less of a need for full hedging. On average the risk reduction achieved is much lower than with bonds. The risk can only be reduced by between 3% and 5% with every further increase in the hedge ratio. Increasing the hedge ratio from 75% to 100% only reduces the risk by an additional 1%. This implies that full hedging is not advisable for equities, particularly taking into account the transaction costs. As expected, our Hypothesis 3 – which states that the adequate hedge ratio for bonds is 100% – is therefore

confirmed. Purely indicatively, the optimal hedge ratio for equities does not seem clear and is possibly unstable, as suggested by Hypothesis 3.

**Alternative hedge currencies.** Finally, with a view to finding an easy to implement currency hedging strategy, we analyze to what extent a strategy of hedging against a single “key currency” is appropriate.

Here the main focus lies on Hypothesis 4, which states that the currency against which securities should be hedged is clear for bonds, but not for equities. An investor might be better off hedging his equities against another currency than the one in which they are denominated. One simple idea is that such an alternative hedge currency could be the US dollar, because of its position as the world’s most important trading currency. This would imply that all equities owned by non-US investors should be hedged against the USD, while the US investor does not need currency hedging at all.

[insert Table 8]

The effects of hedging against a leading currency are shown in Table 8. There are three different hedging approaches: not hedging at all, fully hedging against the local currency (“correct” hedging), and hedging against the US dollar.

In the last case, not only the USD-investments are hedged against the USD but also all the other domestic and foreign investments. When “correctly” hedged, as much as 62% of the overall risk of bonds can be eliminated on average. On the other hand, hedging against the USD only reduced the risk by 13%. For equities, however, the two hedging approaches yield only marginally different results. While hedging against the domicile currency of the equities

in question can cut the risk by 13%, consistent hedging against the USD eliminates as much as 10% of the overall risk.

This is not actually a test for Hypothesis 4 – but it indicates that for equities, hedging against the USD yields just as good results as hedging against the “correct” currency. Bonds, however, have to be hedged against the currency in which they are denominated.

## **Conclusion**

The question of whether foreign investments should be systematically hedged against currency risk has not been clearly answered to date. Numerous theoretical and empirical studies have provided conflicting conclusions. In this article we analyze some hypotheses in the context of international diversification and the resulting foreign currency risk. We start by postulating that foreign currency risk represents a zero-sum game. Even if theoretically not true, we show that the impact of Siegel’s paradox is marginal at best. From this basic idea, we develop a simple empirical method for evaluating the risk of domestic and foreign investments. To ensure the stability and autonomy of results as far as the analysis period is concerned, the calculations are aggregated over the various reference currencies. This method allows us to draw inference regarding the risks of international investments, reducing the impact of temporary and cyclical gains or losses from the perspective of individual base currencies.

We show that bonds denominated in foreign currency are fully exposed to currency risk: on average they are almost three times as risky as domestic bonds. By fully hedging the currency risk, standard deviations are brought back to “domestic levels”. Next, we consider investments in a multi-currency bond portfolio. Compared to a single foreign currency

investment, the unhedged bond portfolios show slightly lower volatilities on average, due to international interest rate diversification. Still, this portfolio is more than twice as volatile as an investment in domestic bonds. On average, only by fully hedging the multi-currency bond portfolio against the corresponding currency basket one can achieve a lower risk than by investing solely in the domestic bond market. If the multi-currency bond portfolio is hedged against a single key currency (in our study against USD) rather than the corresponding (“correct”) currency basket, only a slight reduction in risk can be achieved.

On average, international equity investments also show a higher volatility than investments in domestic equities. Nevertheless, the extra risk for going international is much smaller than with bond investments. Furthermore, this risk can be almost completely eliminated by diversifying equities across countries. International diversification therefore plays a dominant role in investing in equity markets. Contrary to our hypothesis, hedging currency risk still helps to reduce some of the overall risk – but risk reduction is small. On the other hand, by hedging the multi-country equity portfolio solely against the US dollar, one achieves almost the same reduction in risk as by hedging against the “correct” currency basket.

Based on our empirical findings, the following rough guidelines have to be taken into account when designing an investment strategy. Unless the investor has predictive power in the currency market, currency risks must basically be eliminated, or avoided as much as possible. Focusing on foreign currency bonds, the currency risk must be fully hedged. When fully hedged, a global bond portfolio is preferable to domestic bonds.

Looking at foreign equities, some currency exposure can be identified, but it is impossible to make a definite assessment of its scale or its economic properties (optimal degree of hedging,

dynamic changes, etc.). The extra risk is relatively small compared to the overall risk of equity investments and can be eliminated through international diversification. This is the reason why we suggest broad international diversification for equities, with either no currency hedging at all or partial hedging at best.

Of course, certain reservations can be made about the methodology of our analysis. First, we examine equally weighted portfolios rather than value weighted or even optimized portfolios. Furthermore, we did not take into account potential diversification effects between the asset classes, since we only look at pure bond or pure equity portfolios. However, we do not think that this significantly affects the practical consequences we have drawn.

## References

- Adler, Michael, and Bernard Dumas. 1983. "International portfolio choice and corporate finance: A synthesis." *Journal of Finance*, vol. 38, no. 3, 925-984.
- Black, Fischer. 1989. "Universal Hedging: Optimizing Currency Risk and Reward in International Equity Portfolios." *Financial Analysts Journal*, vol. 45, no. 4 (July/August), 16-22.
- Black, Fischer. 1990. "Equilibrium Exchange Rate Hedging." *Journal of Finance* vol. 45, no. 3, 899-907.
- De Santis, Giorgio, and Bruno Gérard. 1998. "How big is the premium for currency risk?" *Journal of Financial Economics* 49, 375-412.
- Denzler, Mathias, and Heinz Müller. 2000. "A Fallacy in Performance Measurement and Risk Analysis." *Financial Markets and Portfolio Management* vol. 14, no. 2, 189-193.
- Diermeier, Jeff, and Bruno Solnik. 2001. "Global Pricing of Equity." *Financial Analyst Journal*, vol. 57, no. 4 (July/August), 37-47.
- Dumas, Bernard, and Bruno Solnik. 1995. "The World Price of Foreign Exchange Risk." *Journal of Finance* vol. 50, no. 2, 445-479.
- Froot, Kenneth A. 1993. "Currency Hedging Over Long Horizons." NBER Working Paper No. 4355.
- Gastineau, Gary L. 1995. "The Currency Hedging Decision: A Search for Synthesis in Asset Allocation." *Financial Analysts Journal*, vol. 51, no. 3 (May/June), 8-17.

Glen, Jack, and Philippe Jorion. 1993. "Currency Hedging for International Portfolios." *Journal of Finance*, vol 48, no. 5, 1865-1886.

Jorion, Philippe. 1989. "Asset allocation with hedged and unhedged foreign stocks and bonds." *Journal of Portfolio Management*, vol. 15, no. 4, 49-54.

Perold, Andre F., and Evan C. Schulman. 1988. "The Free Lunch in Currency Hedging, Implications for Investment Policy and Performance Standards." *Financial Analysts Journal*, vol. 44, no. 3 (May/June), 45-50.

Sercu, Piet. 1980. "A Generalisation of the International Asset Pricing Model." *Journal de l'Association Française de Finance* 1(1).

Solnik, Bruno. 1974. "An Equilibrium model of the international capital market." *Journal of Economic Theory* 8, 500-524.

Stulz, René M. 1981. "A model of international asset pricing." *Journal of Financial Economics*, vol. 9, no. 4, 383-406.

**Table 1. Risk and Return on Domestic and Foreign Money Market Investments (1985 – 2000)**

(in percent)

	German		Swiss		British		American		Japanese	
	Return	Risk								
Single currency										
in DEM	<b>5.56</b>	<b>0.62</b>	5.22	4.13	6.66	8.51	8.38	11.62	3.18	11.36
in CHF	4.74	4.13	<b>4.40</b>	<b>0.71</b>	5.83	9.28	7.54	12.64	2.38	11.37
in GBP	8.10	8.34	7.75	9.12	<b>9.22</b>	<b>0.87</b>	10.98	11.29	5.66	12.66
in USD	3.67	11.51	3.33	12.50	4.75	11.14	<b>6.43</b>	<b>0.49</b>	1.33	12.60
in JPY	5.81	11.33	5.47	11.33	6.91	12.68	8.63	12.71	<b>3.42</b>	<b>0.75</b>
Average of single foreign currency	5.58	8.83	5.44	9.27	6.04	10.40	8.88	12.06	3.13	12.00

Note: Broken down by different reference currencies

	Return	Risk	Ratio
Domestic money market	<b>5.81</b>	<b>0.69</b>	<b>8.44</b>
Foreign money market	5.81	10.51	<b>0.55</b>

Note: Aggregated over different reference currencies and investment currencies

**Table 2. Comparison of the Performance of a Portfolio of Foreign Equities With the Weighted Average (1985-2000)**

(in percent)

	Portfolio of multi foreign country equities	Average of four foreign country equities	Difference
Annualized	12.10	11.44	66bp
Not annualized	521.86	521.86	0bp

**Table 3. Risk and Return of Bonds for International Investments (1985 – 2000)**

(in percent)

Unhedged strategies	German		Swiss		British		American		Japanese	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk	Return	Risk
<b>Unhedged strategies</b>										
Single currency										
in DEM	<b>7.15</b>	<b>3.40</b>	6.81	5.42	8.27	9.40	10.01	12.54	4.74	11.70
in CHF	5.41	5.22	<b>5.07</b>	<b>3.30</b>	6.51	10.27	8.23	13.05	3.03	11.45
in GBP	9.82	11.45	9.47	12.02	<b>10.97</b>	<b>6.53</b>	12.75	13.59	7.34	13.84
in USD	6.34	11.79	5.99	12.76	7.44	11.72	<b>9.17</b>	<b>4.83</b>	3.94	13.09
in JPY	8.55	12.24	8.20	12.20	9.68	13.88	11.45	14.31	<b>6.10</b>	<b>4.65</b>
Average of single foreign currency	7.53	10.17	7.62	10.60	7.98	11.32	10.61	13.37	4.76	12.52
Multi foreign currency portfolio	7.74	7.11	7.74	7.71	8.07	9.04	10.80	11.34	4.96	10.53
<b>Hedged strategies</b>										
Single currency										
in DEM	<b>7.15</b>	<b>3.40</b>	5.99	3.38	10.88	3.44	8.09	3.39	4.97	3.40
in CHF	6.23	3.34	<b>5.07</b>	<b>3.30</b>	9.95	3.28	7.10	3.26	4.04	3.26
in GBP	7.35	6.51	6.18	6.46	<b>10.97</b>	<b>6.53</b>	8.20	6.48	5.04	6.46
in USD	8.17	4.86	6.99	4.87	11.95	4.91	<b>9.17</b>	<b>4.83</b>	6.03	4.87
in JPY	8.27	4.71	7.09	4.67	12.05	4.65	9.27	4.68	<b>6.10</b>	<b>4.65</b>
Average of single foreign currency	7.51	4.85	6.56	4.84	11.21	4.07	8.17	4.45	5.02	4.50
Multi foreign currency portfolio	7.55	3.60	6.58	3.72	11.26	3.14	8.21	3.43	5.06	3.56

**Table 4. Average Risk and Return for Different Bonds Strategies (1985 – 2000)**

(in percent)

	Return	Risk
Domestic bonds	<b>7.69</b>	<b>4.54</b>
Single foreign currency bonds	7.70	11.60
Multi foreign currency bonds	7.86	9.15
Hedged single foreign currency bonds	<b>7.69</b>	<b>4.54</b>
Hedged multi foreign currency bonds	<b>7.73</b>	<b>3.49</b>

**Table 5. Risk and Return of Equities for International Investments (1985 – 2000)**

(in percent)

Unhedged strategies	German		Swiss		British		American		Japanese	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk	Return	Risk
<b>Unhedged strategies</b>										
Single currency										
in DEM	<b>14.02</b>	<b>21.45</b>	13.65	23.10	15.21	21.84	17.06	21.98	11.45	23.89
in CHF	16.86	18.25	<b>16.49</b>	<b>18.51</b>	18.08	18.97	19.98	18.75	14.23	19.68
in GBP	13.40	19.20	13.03	20.10	<b>14.58</b>	<b>16.68</b>	16.42	18.74	10.84	19.81
in USD	13.95	20.28	13.58	21.46	15.13	19.41	<b>16.99</b>	<b>15.17</b>	11.37	19.88
in JPY	5.86	25.19	5.52	25.25	6.96	24.34	8.69	25.39	<b>3.47</b>	<b>20.99</b>
Average of single foreign countries	12.52	20.73	11.44	22.48	13.85	21.14	15.54	21.22	11.97	20.82
Multi foreign country portfolio	13.45	16.34	12.10	17.75	14.80	16.03	16.50	16.42	12.09	17.90
<b>Hedged strategies</b>										
Single currency										
in DEM	<b>14.02</b>	<b>21.45</b>	13.11	21.38	17.60	21.56	14.22	21.76	11.57	21.51
in CHF	17.58	18.62	<b>16.49</b>	<b>18.51</b>	21.35	18.65	17.75	18.84	14.89	18.48
in GBP	10.86	16.63	9.79	16.56	<b>14.58</b>	<b>16.68</b>	11.27	16.86	8.27	16.61
in USD	16.35	14.90	15.25	14.85	20.21	14.97	<b>16.99</b>	<b>15.17</b>	13.77	14.89
in JPY	5.92	21.03	4.81	20.96	9.21	20.99	6.61	21.18	<b>3.47</b>	<b>20.99</b>
Average of single foreign countries	12.68	17.79	10.74	18.44	17.09	19.04	12.46	19.66	12.12	17.87
Multi foreign country portfolio	13.95	14.18	11.69	14.06	18.27	14.76	13.51	15.65	12.52	15.14

**Table 6. Average Risk and Return for Different Equity Strategies (1985 – 2000)**

(in percent)

	Return	Risk
Domestic equities	<b>13.11</b>	<b>18.56</b>
Single foreign country equities	13.06	21.28
Multi foreign country equities	13.79	16.89
Hedged single foreign country equities	<b>13.02</b>	<b>18.56</b>
Hedged multi foreign country equities	<b>13.99</b>	<b>14.75</b>

**Table 7. Average Risk and Return Figures for Different Hedge Ratios****(1985 – 2000)**

(in percent)

Hedge ratio	Multi foreign currency bonds			Multi foreign country equities		
	Return	Risk	% of risk reduction	Return	Risk	% of risk reduction
<b>0</b>	7.86	9.15		13.79	16.89	
<b>25</b>	7.92	7.26	20.7	13.92	16.01	5.2
<b>50</b>	7.91	5.51	24.1	14.00	15.34	4.2
<b>75</b>	7.85	4.10	25.6	14.02	14.92	2.8
<b>100</b>	7.73	3.49	14.8	13.99	14.75	1.1

**Table 8. Comparison of Different Hedging Strategies for Global Portfolios**

**(1985 – 2000)**

(in percent)

	Unhedged		"Correctly" hedged		Hedged against USD	
	Return	Risk	Return	Risk	Return	Risk
Bonds	7.86	9.15	7.73	3.5	8.70	8.87
Equities	13.79	16.89	13.99	14.8	14.92	15.49