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International Diversification and Exchange Rate Risk

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Summary

The benefits arisen from international diversification are well documented with empirical evidence. Investment risk can be reduced by diversifying internationally due to the low correlations between national financial markets. Exchange rate risk however is often considered as an impediment in international investment. Total investment risk is decomposed into the volatility of the local market return, the volatility of the exchange rate change and the volatility due to the interaction between the local market return and the exchange rate change. It is shown that foreign exchange exposure in a portfolio context does not necessarily lead to higher investment risk. In some specified conditions, foreign exchange exposure can even help in risk reduction in terms of both total and systematic risks. Traditional approaches to hedge against exchange rate risk such as trading in the forward and futures markets, lending or borrowing in foreign money market should be evaluated from a portfolio rather than a single asset point of view.

Résumé

Diversification Internationale et Risque de Taux de Change

Les bénéfices de la diversification internationale sont bien documentés au moyen de résultats empiriques. Le risque de placement peut être réduit en diversifiant sur le plan international à cause des corrélations faibles entre les marchés financiers nationaux. Cependant, le risque de taux de change est souvent considéré comme une entrave au placement international. Le risque de placement total se décompose de la façon suivante: l'instabilité du rendement du marché local, l'instabilité du changement du taux de change, et l'instabilité due à l'interaction entre le rendement du marché local et le changement du taux de change. Il est démontré que l'exposition aux devises dans un contexte de portefeuille ne conduit pas nécessairement à un risque de placement plus élevé. Dans certaines conditions spécifiées l'exposition aux devises peut même contribuer à réduire le risque à la fois du point de vue des risques systématique et total. Des méthodes traditionnelles pour se protéger contre le risque de taux de change telles que l'interventiondans le marché à terme et le marché de contrats à terme (forward and futures markets), le prêt ou l'emprunt sur des marchés de devises étrangères devraient être évaluées à partir d'un portefeuille plutôt que du point de vue d'un actif unique.

INTRODUCTION

The benefits of diversifying internationally have been well documented by earlier work such as Grubel [2], Levy and Sarnat [4], and Lessard [3]. Through international diversification, investment risk could further be reduced over domestic diversification. Exchange rate risk however is an additional factor which has to be considered in international investment. Traditionally exchange rate risk is regarded as an additional risk. Various hedging strategies through the forward and money markets have been developed to reduce or to eliminate the exchange rate risk.

The purpose of this study is twofold. First, it will discuss how exchange rate risk affect investment risk in the international context. Second, it will show that foreign exchange rate risk should be considered in a portfolio context as it could be reduced simply as a result of diversification. Foreign exchange exposure does not necessarily lead to higher investment risk. On the contrary, it could even reduce investment risk if managed properly.

EXCHANGE RATE RISK AND TOTAL INVESTMENT RISK

International investment inevitably involves exchange rate risk as it requires currency conversion at the beginning and end of the investment period. In the case of investing in one single foreign market, the US dollar return from an investment in the ith market can be expressed as:

$$R_{i,US} = R_i + E_i + R_iE_i \qquad (1)$$

where $R_{i,US}$ = ith market return in US dollar

R_i = ith market return in local currency

E_i = rate of change of the exchange rate of US dollar per unit of ith country currency

The investment risk in terms of variance of the US dollar return can be expressed as:

$$VAR(R_{i,US}) = VAR(R_i) + VAR(E_i) + VAR(R_iE_i) + 2COV(R_i,E_i) + 2COV(R_i,R_iE_i) + 2COV(E_i,R_iE_i) \qquad (2)$$

where VAR(.) and COV(.) denote variance and covariance respectively.

It can be seen from Equation (2) that the volatility of the US dollar return is composed of the volatility of the local currency return, R_i, the volatility of the exchange rate change, E_i, and the volatility due to the interaction between R_i and E_i which is measured by the last four terms. For practical purposes, the product term R_iE_i is often assumed to be very small that it is negligible. Eun and Resnick [1] approximate Equations (1) and (2) by:

$$R_{i,US} = R_i + E_i \tag{3}$$

$$VAR(R_{i,US}) = VAR(R_i) + VAR(E_i) + 2COV(R_i,E_i) \tag{4}$$

The US dollar return is approximated by the local currency return plus the exchange rate return. It then follows that the volatility of the US dollar return is due to the local market volatility, the exchange rate volatility, and the covariance between local market return and exchange rate return. In an international portfolio which involves assets of more than one foreign market, the dollar return and variance of the portfolio become:

$$R_{p,US} = \Sigma\, W_iR_{i,US} \tag{5}$$

$$VAR(R_{p,US}) = \Sigma\,\Sigma\, W_iW_jCOV(R_{i,US},R_{j,US}) \tag{6}$$

where W_i respresents the weight of investment in ith market. Following the approximated definition of US dollar return as given in Equation (3), Equation (6) can be rewritten as:

$$\begin{aligned} VAR(R_{p,US}) = {} & \Sigma\,\Sigma\, W_iW_jCOV(R_i,R_j) + \\ & \Sigma\,\Sigma\, W_iW_jCOV(E_i,E_j) + \\ & 2\Sigma\,\Sigma\, W_iW_jCOV(R_i,E_j) \end{aligned} \tag{7}$$

Therefore, the overall portfolio risk depends on the covariances between the local market returns, covariances between the exchange rate changes, and cross-covariances between the local market returns and exchange rate changes. Equation (7) can further be rewritten as:

$$\begin{aligned} VAR(R_{p,US}) = {} & \Sigma\, W_i^2\, VAR(R_i) + \Sigma\, W_i^2\, VAR(E_i) + \\ & \Sigma\,\Sigma_{i\neq j}\, W_iW_jCOV(R_i,R_j) + \\ & \Sigma\,\Sigma_{i\neq j}\, W_iW_jCOV(E_i,E_j) + \\ & 2\Sigma\,\Sigma\, W_iW_jCOV(R_i,E_j) \end{aligned} \tag{8}$$

Even in the approximated forms, it can be seen from Equations (4) and (8) that the exchange rate risk affects the overall investment risk in three ways through: its own volatility, interactions between local market returns and exchange rate changes, and interactions between exchange rate changes themselves in the case of more than one market is involved.

It is obvious that volatility of exchange rate changes contributes additional risk as variance is always non-negative. The impact on overall investment risk by the interactions between local market returns and exchange rate changes and interactions between exchange rate changes themselves is less clear as covariance could be either positive or negative. First of all, to follow simple Markowitz [5] diversification principle, total investment risk could be reduced if the correlations between local market returns and exchange rate changes and the correlations between exchange rate changes themselves are less than perfectly positive. Further, the foreign exchange exposure can actually reduce portfolio risk below the local market risk level if the covariances between the exchange rate changes and cross covariances between the local market returns and exchange rate changes are negative with the following condition:

Single foreign market:

$$|2COV(R_i,E_i)| > VAR(E_i) \qquad (9)$$

Multiple foreign markets:

$$|\Sigma\ \Sigma_{i\neq j}\ W_iW_jCOV(E_i,E_j) + 2\Sigma\ \Sigma\ W_iW_jCOV(R_i,E_j)| > \Sigma\ W_i^2VAR(E_i) \qquad (10)$$

If the condition specified in either Equation (9) or (10) is true, then the foreign exchange exposure actually is beneficial in terms of risk reduction. For example, the overall investment risk in the case of a single foreign market could be reduced to zero if the local market return and exchange rate change have a perfect negative correlation.

EXCHANGE RATE RISK AND SYSTEMATIC RISK

According to the capital asset pricing model (CAPM), equilibrium return is determined by the risk-free return and risk premium as:

$$R_i = R_f + b_i\ (R_m - R_f) \qquad (11)$$

where R_i = expected return on ith asset

R_f = risk-free return

R_m = expected return on market portfolio

b_i = beta coefficient for systematic risk

In the CAPM, beta coefficient which measures the sensitivity of the asset's return to market return is the appropriate and relevant measure of risk for asset pricing. Statistically, beta coefficient can be expressed as:

$$b_i = COV(R_i,R_m)/VAR(R_m) \quad (12)$$

In an international setting, beta coefficient of US dollar returns on a foreign asset from the standpoint of a US investor, $b_{i,US}$, can be extended as:

$$b_{i,US} = COV(R_{i,US}, R_{m,US})/VAR(R_{m,US}) \quad (13)$$

Following the approximated definition of US dollar return as given in Equation (3) again, Equation (13) can be rewritten as:

$$b_{i,US} = COV(R_i,R_{m,US})/VAR(R_{m,US}) + COV(E_i,R_{m,US})/VAR(R_{m,US}) \quad (14)$$

or

$$b_{i,US} = b_{Ri} + b_{Ei} \quad (15)$$

where b_{Ri} = the beta coefficient of ith market local return against US dollar world market return

b_{Ei} = beta coefficient of the ith exchange rate change against the US dollar world market return

For the general n-market case, the beta coefficient of an international portfolio is equal to:

$$b_{p,US} = \Sigma W_i b_{i,US}$$

$$= \Sigma W_i(b_{Ri} + b_{Ei}) \quad (16)$$

$$= \Sigma W_i b_{Ri} + \Sigma W_i b_{Ei} \quad (17)$$

The overall systematic risk in the international context can be decomposed into the sensitivity of local market return to US dollar world market return and sensitivity of exchange rate change to US dollar world market return. If b_{Ei}'s have different signs among themselves or from b_{Ri}, then the overall $b_{p,US}$ could be reduced. This is similar to the previous case that foreign exchange exposure may reduce the overall investment risk as measured by variance.

EMPIRICAL EVIDENCE AND IMPLICATIONS

The ultimate effect of exchange rate risk on investment risk of course depends on the actual relationships between exchange rate changes and relationships between local market returns and exchange rate changes. In order to examine these empirical relationships, monthly closings of major stock market indices and exchange rates from October 1985 to December 1988 are used to calculate the local stock market returns as well as the exchange rate changes. The sample countries include US, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Switzerland and UK. The world index published by Morgan Stanley is used as a proxy for the world market portfolio.

First, the correlations between stock market returns are reported in Table 1 to document the benefits of international diversification due to the low correlations between different stock markets. Tables 2 and 3 then present the correlations between the exchange rates and cross correlations between stock market returns and exchange rate changes. As can be seen in Table 2, the correlations between exchange rates for Canada, Switzerland and UK are not very high. The Canadian dollar even shows negative correlations to four currencies. The cross correlations reported in Table 3 reinforce the possibility that exchange rate risk can be reduced in the portfolio context. The cross correlations in general are low. In fact over 20 percent of them are negative. The foreign currency exposure in a portfolio sense could become less significant if the choice of markets or countries is scrutinized.

The empirical effect of the foreign currency exposure on systematic risk is examined by decomposing the beta coefficient in the international setting into the stock market beta and exchange rate beta. Table 4 reports all the beta values. It clearly shows that foreign currency exposure helps in reducing the systematic risk as the beta of US dollar return is indeed less than the beta of individual market return.

From both the model and empirical evidence, it is important to consider exchange rate risk in a portfolio context. In an international setting where there is no effective foreign investment restrictions, country and exchange rate risks become unsystematic risks and are diversifiable. Traditional strategies to hedge against exchange rate risk such as trading in the forward and futures markets, lending or borrowing in foreign money market should be evaluated from a portfolio rather than a single asset or transaction point of view. Any attempt to hedge away the individual currency risk per se could actually have adverse effect on the portfolio risk.

Table 1: Correlations between Local Stock Market Returns (in Local Currency)

	BEL	CAN	FRA	GER	ITA	JAP	NET	SWI	UK
U.S.A.	0.62983	0.67495	0.56657	0.51204	0.39682	0.36837	0.73867	0.71350	0.83453
BELGIUM		0.47207	0.66486	0.63258	0.55122	0.47790	0.62317	0.65819	0.56091
CANADA			0.51711	0.32895	0.34810	0.16787	0.59240	0.60912	0.58130
FRANCE				0.68300	0.61583	0.40041	0.48158	0.61935	0.44998
GERMANY					0.45800	0.28677	0.71110	0.84701	0.45104
ITALY						0.46842	0.44067	0.46687	0.37089
JAPAN							0.45729	0.31624	0.34349
NETHERLANDS								0.82576	0.73022
SWITZERLAND									0.62514

Table 2: Correlations between Exchange Rate Changes (in US$ per Unit of Foreign Currency)

	BEL	CAN	FRA	GER	ITA	JAP	NET	SWI	UK
BELGIUM		0.01202	0.97274	0.98235	0.96137	0.81566	0.98220	0.44591	0.70952
CANADA			-0.06564	-0.05111	-0.06031	0.00229	-0.04839	0.05065	0.13949
FRANCE				0.98234	0.98065	0.83627	0.98193	0.42875	0.72563
GERMANY					0.98761	0.83509	0.99870	0.46019	0.71791
ITALY						0.85058	0.98545	0.48000	0.70716
JAPAN							0.84556	0.36570	0.77441
NETHERLANDS								0.44508	0.73474
SWITZERLAND									0.20826

Table 3: Cross Correlations between Stock Market Returns (in Local Currency) and Exchange Rate Changes (in US$ per Unit of Foreign Currency)

	BEL	CAN	FRA	GER	ITA	JAP	NET	SWI	UK
U.S.A.	0.13779	-0.19601	0.15920	0.15920	0.21388	0.18206	0.21252	0.17578	0.24446
BELGIUM	0.21277	-0.20313	0.20915	0.20915	0.22844	0.18818	0.22909	0.19836	0.16685
CANADA	-0.00959	-0.06201	-0.02140	-0.02140	0.02742	0.00725	0.02011	0.54374	-0.01831
FRANCE	-0.03834	-0.08573	-0.01936	-0.01936	-0.02455	-0.07039	-0.02101	0.09013	0.04916
GERMANY	0.20473	0.02128	0.19346	0.19346	0.18997	0.19604	0.20095	-0.06366	0.18866
ITALY	0.11813	-0.09377	0.14533	0.14533	0.11832	0.04444	0.11482	0.11662	0.08965
JAPAN	0.14508	-0.33249	0.18915	0.18915	0.17877	0.02168	0.17118	-0.07820	0.03296
NETHERLANDS	0.45377	-0.20260	0.45663	0.45663	0.78047	0.34417	0.17923	0.27509	0.31427
SWITZERLAND	0.36139	-0.05876	0.35275	0.35275	0.37171	0.41980	0.37507	0.23579	0.32884
U.K.	0.14698	-0.17612	0.14643	0.14643	0.21292	0.17910	0.20966	0.21207	0.15954

Table 4: Betas of Local Market and Exchange Rate Returns

Market	b_{Ri}	b_{Ei}	$b_{Ri,US}$
US	0.90	0.00	0.90
BELGIUM	0.95	-0.14	0.81
CANADA	0.91	-0.08	0.83
FRANCE	1.09	-0.11	0.98
GERMANY	0.76	-0.09	0.67
ITALY	0.94	-0.10	0.84
JAPAN	0.91	-0.18	0.73
NETHERLAND	0.73	-0.10	0.63
SWITZERLAND	0.69	-0.06	0.63
UK	0.91	-0.13	0.78

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