International Portfolio Diversification Strategies and the Changes in Foreign Exchange Regimes in Singapore

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1. Introduction

International portfolio diversification has long been recommended to investors as critically important to their efforts to reduce risk without sacrificing expected returns. This diversification is especially important to investors in smaller countries, with open economies, where the industrial base is not broad. In such economies equity values are likely to be closely tied to currency and interest rate fluctuations, and more generally to investors' human capital, labor incomes, and other sources of wealth.

The most important inputs in making portfolio diversification decisions are the variances of, and the correlation between, security returns. All but the most naive diversification strategies attempt to make some use of this information. The starting point for obtaining these inputs in an international context are historical estimates of the correlation between equity indices for different countries. Accordingly, an important concern in such applications is the degree to which these historical estimates are stable.

Because returns must be translated into some base currency, one obvious potential source of instability is regime shifts in currency management policy. An investor in a particular country is typically concerned about his or her returns in that country's own currency. If the government's currency management policies change, this can alter dramatically the correlation between currencies, and hence

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the correlation between an investor's domestic portfolio and securities of other countries. It could also dramatically increase or decrease the variance of their returns. These changes, in turn, could obviate the value of historical experience in assessing the diversification potential of particular international investments.

As an example, consider the recent experience of Singapore investors. Only within the last five years have Singaporean investors been allowed to diversify internationally, and they have rushed to do so. In anticipation of greater long-term benefits Singapore has switched from a policy which pegged the Singapore dollar to a trade-weighted currency basket, in which the U.S. Dollar was of predominant importance to a policy which attempts to peg the currency to the basket of OECD currencies, with greater weights given to European currencies. One would naturally suspect that this would encourage Singaporean investors to put greater weight on U.S. stocks in their portfolios, and less weight on German stocks. The higher correlation between the Singapore dollar and the European currencies would also tend to increase the correlation between returns, measured in S$, on local equities and European equities, thus diminishing the diversification achieved through investing in Europe.

Our purpose in this paper is to find out whether such currency regime shifts have measurable effects on the correlation between equities in different countries. If this is the case, then we would expect these events to also alter international diversification strategies. We examine the question with reference to Singaporean equities, and their correlation with U.S. securities. The case of the Singapore dollar (S$) is a particularly fortuitous one, because there have been several major regime changes in the past, and these are spaced through time in a manner that provides a considerable amount of data under each regime.

We first ask what effects these changes have on the currencies themselves. We find that the volatility of the USD/S$ exchange rate shows no clear response to the policy regime shifts. The conditional volatility shows the sorts of persistence typi-

cal of exchange rates, but other sources of changing volatility appear to dominate the series. We do find, though, that the co-variability between currencies shows the impact of the regime changes and in the directions one might expect given the objectives by the policy makers. During the periods when the S$ floated freely against the dollar, more of the changes in the USD/S$ exchange rate are explained by the major European currencies' movements against the dollar than during periods when the S$ was partially pegged to the dollar.

We then ask whether the changes in the co-variability between currencies have a measurable effect on the covariance between U.S. and Singapore equities. We find that the correlation within sub-periods do not change in the directions suggested by the nature of the regime shift. This appears to be due to the fact that while the correlation between the equity returns in their own currencies have risen over time, the correlation between the exchange rate and equity return, which has always been very low, has decreased over time, thus offsetting the changes in the underlying equity indices.

The effect of changes in currency management policies on the interrelations between equity markets is but one aspect of their impact, and we hope that our results will prove informative about a broader range of issues than just portfolio management practices.

By evaluating whether exchange rate regimes are quantitatively and qualitatively important for the interrelations between national equity markets we can also gain a sense of their relative importance across a range of economic activities.

The remainder of the paper is structured as follows Section 2 discusses the predictions this history suggests for the diversification potential of foreign equities. Section 3 describes the behavior of the currencies themselves across regimes and documents the effects of the regime shifts on the correlation between currencies. In Section 4 we consider the relationship of the correlation between equity returns and the currency regimes. Section 5 summarizes our findings and concludes.

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2. Consequences for Diversification Strategies

Our interest is in the implications changes in currency management policies have for the correlation between equity indices, and whether these implications are substantial enough to materially affect diversification strategies. Simple mean-variance mathematics offers a useful benchmark, against which to assess these issues.

For a Singaporean investor the marginal contribution to the variance of portfolio return, (Rp), associated with an increase in the weight on a given asset, (xi), is proportional to the covariance between that investor's portfolio and the asset in question:

If the asset in question is U.S. stocks and the investor's home currency is S\$, then this covariance has two sources: the covariance of the U.S. market return measured in USD with the portfolio, and the covariance between the exchange rate and the portfolio

$$Cov(RS\$Sin\ RS\$Us)\ Cov(RS\$Sin\ RU\$Us) + Cov(RS\$Sin\ \varepsilon) \qquad (1)$$

where the returns above are continuously compounded, and e is the change in the log of the number of S\$ required to purchase \$1.

Note, first, that the effects of pegging the S\$ more or less closely to the USD has consequences for the above quantity that are not simple and straightforward. They depend both on the composition of the Singaporean investor's portfolio and on how the exchange rate moves with the elements of that portfolio.

If the investor in question currently holds only Singapore stocks in her/his portfolio, then our only concern is with the correlation between Singapore equities and the US index and the exchange rate, respectively:

$$Var(RS\$Us) \ Var(RU\$ \ Var \ Us) + Var(\varepsilon) + 2Cov(RUsUs, \ \varepsilon) \qquad (2)$$

First, consider the case where the S\$ is perfectly pegged to the USD. Then the change in the exchange rate, e, is always identically zero, so that the only risk the US equities contribute to the Singaporean investor's portfolio is through the correlation in the returns measured in the home country currencies. In this case a de-coupling of the S\$ and the USD can either increase or decrease the relative risk of US equities in the Singaporean investor's portfolio. This depends whether the exchange rate moves with or against the Singaporean equity market.

Note that the correlation coefficient can be misleading about the value of US equities as a diversification hedge. Assume that a reduction in the USD's weight in the target basket to which the S\$ is pegged serves to increase the fluctuation in the S\$ relative to the USD. Even if the extra movement in the exchange rate is neutral, in the sense that e is uncorrelated with the Singaporean portfolio in (1) above, the correlation coefficient may drop because of the increase in the variability. The correlation scales the covariance by the standard deviations. Since the variance is given by

$$\rho(RS\$Sin \ RS\$Us) \ Cov(RS\$Sin \ RS\$Us)/\sqrt{Var}(RS\$Us)Var(RS\$Sin) \qquad (3)$$

and the correlation is given by

$$\delta Var \ \alpha r(Rp)/\delta \chi I \quad \lambda Cov(Rp, \ Ri) \qquad (4)$$

regime shifts that only increase $Var \ (e)$, even when this variability has zero covariance with other elements of the investor's portfolio, will still reduce the correlation.

$$Cov(Rp, \ RS\$Us) = Cov(Rp, \ RU\$,Us) + Cov(Rp, \ \varepsilon) \qquad (5)$$

Of course when we consider second-order effects, or alternatively when the Singaporean investor's portfolio already includes a substantial position in dollar

denominated assets, the consequences of an increase in $Var(\varepsilon)$ are more complicated. Increases in exchange rate variability make US assets more risky simply by increasing their own variance. If the extra variability is uncorrelated with other returns, this serves to make the US investments less attractive from the perspective of a Singaporean investor.

To increase their value as a diversification hedge, the increased variability in the exchange rate must have negative correlation with other assets in the Singaporean investor's portfolio.

Thus, our empirical attention will be focused on a few central questions:

1. *Do the exchange rate regime shifts, which lower the weight on the USD in the target currency basket, induce extra variability in the exchange rate between USD and S$?*

2. *Do the correlations between currencies respond to the regime changes?*

3. *Does the correlation between equity returns change across regimes?*

4. *What are the sources of these changes?*

5. *Do changes in the relationships between currencies augment or mitigate secular trends in the relationships between the underlying equities markets themselves?*

3. Regime Shifts and Exchange Rate Behavior

The consequences of changes in currency management regimes on diversification strategies involving financial or real assets is dependent on their effects on the correlation between currencies. Thus, a first step in our inquiry is to establish whether these changes do, in fact, alter the second moments of the currencies themselves. This, after all, is what the regime changes are intended to achieve. The link between intent and results is not automatic, however, and such policies may fail to achieve their objectives to a degree that would be statistically discernable.

Other factors besides currency management policies, such as secular changes in

the underlying economies or in the currency markets in general, may well over-whelm the changes brought about by policy implementation. If this proves to be the case, then it seems highly unlikely that the currency management regime would be an important determinant of the correlation between equities.

A first question to ask is whether targeting a basket which weights the US dollar reduces the volatility of the USD/S$ exchange rate itself. Table 1 shows no clear indication that this is the case. The data are based on mid-day London quotes, from January 1980 to February 1999. The table reports standard deviations for the weekly change in the log of the exchange rate for the entire sample period, and then for each subperiod associated with a different currency management regime. During the first and last subperiods the S$ floated freely against the dollar. In the middle two subperiods it was pegged to trade weighted baskets in which the dollar was an important component.

Table 1　Standard deviations of the weekly changes in the USD/S$ exchange rate

	Free		ERM	
	Coefficient	t-statistics	Coefficient	t-statistics
intercept	−0.005	−2.0085	−0.000	−1.9451
US/DEM	0.564	11.3421	−0.675	18.9851
US/GBD	0.189	8.3612	0.965	4.3727
US/CHF	0.358	0.9861	−0.789	−2.6764
US/JPY	0.286	1.4532	−0.345	1.2398
R^2 No. obs.	0.7786 572		0.8235 419	
F-statistics Regime change			16.2098	

Time period Standard Deviation
1/79–2/99	.0129
1/75–12/83	.0111
1/74–12/86	.0102
1/87–12/96	.0127
1/95–2/99	.0178

If the volatility of the exchange rate can be said to be lower in the middle periods, this would only seem to be the case in a conditional sense. Other sources of volatility besides the currency policy appear to swamp its effects. Both figures show occasional periods of persistently high volatility, separated by longer periods of relative stability. These high and low volatility regimes, however, bear no clear relation to the currency management regimes.

The correlation between currencies, however, may show the consequences of the currency management policies even while the volatility itself does not. Table 2 suggests this is indeed the case. It reports the results of Ordinary Least Squares regressions of the weekly change in the log of the USD/S$ exchange rate against contemporaneous changes in four major currencies. The left-hand columns, labeled "Free," report the results of such a regression over the period January 1980 to December 1989, when Singapore had begun to switch its currency to a trade-weighted basket in which the dollar had a large share. The right-hand columns, labeled "ERM" report results from the same regression for pooled data from the two subperiods when Singapore switched to the basket dominated by European currencies.

This grouping was based on similar regressions run for each of the four subperiods discussed in Section 2. These regressions produced very similar coefficients for each of the two middle periods, when the S$ was allowed to float more freely against other currencies. Neither was there clear evidence of a difference

Table 2 Regressions of changes in Dollar-S$ exchange rates against major currencies in each of two currency management regimes

Time Period	Cov (RS$Sin, RS$Us)×100	δ(RS$Sin)	δ(RS$Us)
1/80-12/97	0.0133	0.267	0.0254
1/80-12/83	0.0069	0.012	0.5431
1/84-12/94	0.1344	0.332	0.0321
1/95-12/99	0.0876	0.871	0.7641
	0.6512	0.541	0.6511

between the coefficients obtained in the pre-1978 period and post-1989 period. Therefore, those periods are pooled here so that we consider only two regimes. The bottom of the table reports the results of a standard Chow test of whether the model with the coefficients restricted to be constant over the entire sample significantly under-performs the model with the coefficients estimated separately in each of the two regimes.

Notice, first, that these estimates behave across the subperiods in ways one would expect given the objectives of the currency management policies. During the "ERM" subperiods, a larger portion of the USD/S$ changes is explained by the other currencies, in particular the DEM. The R^2 in the regression is higher in this subperiod, as is the coefficient on the German Mark. Finally, there is strong evidence of a structural change across the two regimes. The F-statistic associated with the test for a change in regimes is significant at any reasonable level.

Thus, the changes in currency management policy do appear to alter the relationships between the currencies themselves, to a degree that is statistically discernable and in directions that one would expect given the stated policy objectives. In the next section we turn out attention to the question of whether these effects also appear in the relationships between equity indices.

4. Regime Shifts and the Relationships between Equity Returns

We now turn out attention to the central concern of the paper: whether the value of international equities as a diversification hedge depends on the currency management regime. We confine our attention here to the relationship between the U.S. equity markets and the Singaporean equity markets, and view the problem from the standpoint of a Singapore investor considering the purchase of U.S. stocks.

Table 3 reports estimated correlation coefficients between returns on U.S. equities, measured in S$, and returns on the Singaporean equity market measured in the home currency.

Table 3　Correlations between U.S. and Singaporean equities, both measured in S$

Time Period	Cov(RS$Sin,RU$Us)/δ(RS$Sin)$\delta$(RS$Us)	Cov(RS$Sin,$\varepsilon$)/$\delta$(RS$Sin)δ(RS$Us)
1/80–12/97	0.2081	0.0064
1/80–12/93	0.1523	0.3421
1/84–12/86	0.2234	0.0123
1/87–12/95	0.2245	0.2085
1/95–12/97	0.3452	–0.0971

Time Period　Correlation

Time Period	Correlation
1/80–12/97	*0.1996*
1/80–12/93	*0.1322*
1/84–12/86	*0.1271*
1/87–12/95	*0.2305*
1/95–12/97	*0.2559*

Recall that the two subperiods covering 1985–1984 are the periods when the USD was heavily weighted in the currency basket to which the S$ was pegged. The hypothesis of interest here is whether these closer ties between the S$ and USD reduce the value of U.S. equities as a diversification hedge. This does not appear to be the case. The correlation between the equity indices is highest in the final time period, after the Singaporean currency was re-pegged to the ECU currencies. Further, across the first two periods the correlation dropped, albeit slightly. Thus, other forces appear to be more important in determining the degree to which equity returns move together, such as general secular trends in the degree to which equities are correlated due to integration of financial markets or the underlying economies.

To evaluate further the source of the changes in the correlation between the equities, we first decompose the correlation coefficient into its numerator and denominator. The first-order effects on portfolio diversification are attributable to the covariance between the equity returns. The correlation normalizes this quantity by the standard deviation of the two indices..

From table 3 it is clear that there is a slight secular increase over time in the covariance between the two equity indices, measured in S$, which is partially off-

set by fluctuations in the volatility of the Singapore equity returns.

Evidence of general secular changes is rather more striking when we consider the components of the covariance between the equity returns as provided by the decomposition in equation (1). The correlation between the two equity indices are driven by, first, the covariance between the equity indices each denominated in their own currency, and second, by the covariance between the exchange rate changes and the Singapore equity returns. Table 3 reports values for these covariance, normalized by the standard deviations of the two equity returns in S\$. These two quantities sum to the correlation.

This table suggests the contribution of the exchange rate to the correlation between the equities is steadily dropping through time, while the underlying equity market returns, measured in their own currencies are showing closer association, perhaps because of underlying trends in financial and economic integration. These changes appear to swamp any effects associated with the currency management regime. The differences apparent as we proceed through time are more obvious than the differences we see across currency management regimes.

The low correlation between exchange rates and underlying fundamentals, have been documented extensively in the international finance literature. Adler and Dumas (1983), for example, document the low correlation between exchange rate movements and inflation. Meese (1990) provides a summary of this evidence, showing that there is little correlation between macroeconomic variables and exchange rates. In light of this type of evidence that the foreign exchange markets have ia life of their own'' it is perhaps not surprising that shifts in currency management policy, while they show up in the correlation structure of the currencies themselves, do not significantly alter the correlation between returns on equities.

5.   Conclusion

In this paper we have documented the effects of currency management policies

on the diversification potential of foreign equities. Singapore provides an interesting laboratory for such questions because of the number of regime changes it has experienced, the discreteness of the changes, and the public knowledge that these changes were to take place. We find empirically that while the regime shifts clearly alter the correlation between the currencies themselves, this does not appear to translate into significant changes in the co-variability between equity returns. This can be explained through the very low correlation between currencies movements and economic fundamentals, including equity returns.

From the standpoint of an individual investor, this suggests that changes in currency management policies, such as altering the target currency basket to which the currency is pegged, are of secondary importance in managing equity portfolios and exploiting the diversification opportunities offered by international equity investments. Similarly, companies involved in direct investment need not view these policy events as important enough to require reallocating investments across currency jurisdictions in the interest of further diversification.

The correlation between the currencies involved and the returns on the underlying assets are likely too low to make the currency risk significant in a portfolio that is reasonably well diversified to begin with. Indeed, even in a small open economy such as Singapore, where one might expect currency movements to be associated with important real changes in the economy, the correlation between exchange rates and returns in the domestic equity market are so low as to make the currency risk close to irrelevant in evaluating the potential of U.S. equities as a diversification vehicle.

References

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