

International Asset Allocation Incorporating Reversals of Exchange Rate
Deviations from PPP

November 2005 draft

Mei Qiu, John Pinfeld and Lawrence C. Rose

Department of Commerce, Massey University - Albany, Auckland, New Zealand

Contact Authors:

Mei Qiu PhD candidate, Department of Commerce, Massey University
Private Bag 102 904, North Shore MSC, Auckland, New Zealand
Ph: 0064-9-414 0800 ext 9242
Fax 0064-9-441 8177
Email: M.Qiu@massey.ac.nz

John Pinfeld Associate Professor, Department of Commerce, Massey University
Private Bag 102 904, North Shore MSC, Auckland, New Zealand
Ph: 0064-9-414 0800 ext 9463
Fax 0064-9-441 8177
Email: J.F.Pinfeld@massey.ac.nz

Lawrence C. Rose
Professor, Department of Commerce, Massey University
Private Bag 102 904, North Shore MSC, Auckland, New Zealand
Ph: 0064-9-414 0800 ext 9243
Fax 0064-9-441 8177
Email: L.C.Rose@massey.ac.nz

International Asset Allocation Incorporating Reversals of Exchange Rate Deviations from PPP

By Mei Qiu, John Pinfold and Lawrence C. Rose,
Department of Commerce, Massey University-Albany, Auckland, New Zealand

(28 October 05 Draft)

Abstract

Investing internationally can provide diversification benefits. Foreign exchange rate fluctuations, however, often add risk to international portfolio investments. A new approach to managing currency risk is proposed in this study to improve international stock portfolio performance. Based on the finding of Abuaf and Jorion (1990) that exchange rate deviations from PPP are self-correcting, a selective international equity diversification strategy is proposed which requires not holding assets denominated in over-valued currencies. Examined on quarterly data of eight developed markets covering the period 1991 to 2004, the proposed portfolio strategy significantly improved portfolio returns over the naïve total diversification strategy and the MSCI world index, with statistical significance. For investment horizons of six-month, one-year and three-year, the proposed strategy achieved 0.84 to 12.86 percent (per annum) higher returns than the MSCI world index and 1.50 to 8.27 percent higher returns than the naïve diversification strategy, depending on the countries that an investment is made. The superior performance of the proposed portfolio strategy remained after adjusting for risk.

1. Introduction

As proved by Markowitz (1952), modern portfolio theory suggests that diversification can provide risk reduction benefits by holding a portfolio with assets that are not perfectly positively correlated. International asset prices, determined by different fundamental economic factors, are often less correlated and expected to be able to offer investors with greater diversification benefits.

Early studies by Grubel (1968) and Levy and Sarnat (1970) revealed that international diversification could significantly reduce risk for American investors. Saunders and Woodward (1977) reported similar evidence for UK investors. Solnik (1974) reported that international diversification could reduce almost half of the risks of well-diversified domestic stock portfolios in the U.S., Germany or Switzerland. More recently, Odier and Solnik (1993), Bugar and Maurer (1999) and Kempa and Nelles (2001) provided further evidence on risk reduction and return improvement benefits from international diversification.

Evidence has been reported that the correlations between national markets have been increasing over time due to global financial market integration. Examples include Erb, Harvey and Viskanta (1994) and Shawky, Kuenzel and Mikhail (1997). De Santis and Gerard (1997), however, reported that extra gains from international diversifications had not declined significantly over the time but continued to be significant with a 2.11 percent gain for US investors diversifying their investments in stock markets of G7 countries and Switzerland, over the period between 1970 and 1994.

Fluctuations in currency values, however, often confound diversification benefits. Eun and Resnik (1985) found that exchange rate movements mitigated international diversification benefits for investors based in some countries, but magnified the benefits to investors based in other countries. In another of their study, Eun and Resnik (1988) reported that currency fluctuations adversely affected the U.S. investors with stock investments diversified in six countries. Kaplanis and Schaefer (1991) reported that

exchange rate risk could erode part or sometimes all of the benefits from international diversifications. Odier and Solnik (1993) reported that currency risk contributed 10 to 15 percent of the risk of a world portfolio. Fluctuations in currency values may confound the diversification effects obtained from investing globally.

Currency risks of international portfolios were often handled by forward hedging in the literature, although the effectiveness of hedging is far from clear. Eun and Resnick (1988) and Gen and Jorion (1993) showed that currency hedging could enhance diversification benefits. VanderLinden, Jiang and Hu (2002) demonstrated that a “real forward hedge strategy” could improve returns of equally weighted G-5 country stock portfolios for about 1.53 percent per annum over the unhedged portfolios, for US-based investors. Kaplanis and Schaefer (1991) argued that although currency hedging with perfect prediction on hedge ratios could lead to substantial risk reductions, applying hedge ratios derived from historical data could not offer this benefit. Tezel and McManus (1998), however, found that currency hedging reduced the performance of international portfolios.

An alternative approach to reduce exchange rate risk is to avoid investing in the markets which currencies are likely to depreciate. PPP can be used to predict this depreciation. It is well established in the foreign exchange rate literature that currency exchange rate deviations from purchasing power parity are self-correcting in the long term. Abuaf and Jorion (1990) showed that approximately half of the cumulative exchange rate deviations from PPP over a five year period were reversed over the following three to five years. Coakley and Fuertes (1997) reported shorter half-life of the corrections on PPP deviations. Frankel and Rose (1996), Sarno and Taylor (1998) and Lothian and Taylor (2000) all reported supportive evidence toward the long-term validity of PPP.

Based on the Abuaf and Jorion (1990) evidence, a selective international diversification strategy is proposed in this study where only the offshore markets with local currencies not over-valued are included into the international stock portfolio. In doing so, the currency risks associated with downward corrections of currency over-valuations are expected to be reduced. The effectiveness of the proposed international diversification

strategy will be examined from the viewpoint of investors based in eight developed countries, namely Australia, Canada, Japan, New Zealand, Germany, Switzerland, U.K. and the U.S. The overall results show that portfolios constructed under the strategy outperformed the portfolios constructed under the naïve total diversification strategy, the MSCI World Index portfolio and the domestic portfolio.

This strategy, as it has been developed upon a robust empirical finding of foreign exchange market behavior, provides a unique approach to managing currency risk created by the international diversification of investments. The new approach has advantages over the traditional techniques in that it is forward-looking, is easy to calculate and is simple to carry out in practice.

2. Portfolio Strategy, Research Data and Methodology for Portfolio Performance Evaluations

In this study, an international diversifying strategy is proposed in an effort to avoid unfavorable exchange rate movements while enjoying diversification benefits from investing in international stock markets. The rationale of the strategy is that investors should avoid investing in the stock markets where the currencies of the nations are overvalued, therefore, to avoid possible loss in exchange rates. In particular, national stock markets are included in the portfolio if and only if their currencies are not overvalued relative to PPP equilibrium rate as calculated by (1).

$$PS_t = S_{t-1} * \frac{(1+i)}{(1+i^*)} \quad (1)$$

Where PS_t is the estimated PPP equilibrium rate, S_{t-1} denotes for the last term's actual exchange rate, expressed in terms of units of domestic currency per unit of foreign currency ; i and i^* are the one period inflation rate of the home and foreign countries, respectively. A five year estimation period is applied in this study¹.

¹ Comparisons using a ten-year estimation period have also been done and the results are not sensitive to the choice of different estimation periods. Results using a ten-year estimation period are available from the authors upon request.

We define an exchange rate deviation from PPP at time t as DS_t , given by:

$$DS_t = S_t - PS_t \quad (2)$$

A national market should be included into the portfolio if and only if $DS_t \leq 0$. Local markets are included in the portfolio unless all of the seven foreign currencies are undervalued against the local currencies. It is also assumed that investors' fund is split equally² among the chosen markets.

Eight markets are considered in this study, namely Australia, Canada, Germany, Japan, New Zealand, Switzerland, U.K. and the U.S., all of which are included in the MSCI developed country indices, with free-floating currencies and stock markets allowing foreign investors. To avoid possible base-country bias, the following risk-return analyses are done taking the view points of investors based in each of the eight countries of interest to this study. Quarterly data of MSCI country indices, exchange rates, CPI and MSCI World Index are collected from *Datastream* covering the period 1986:Q1³ to 2004:Q4 (inclusive). Strategies started from 1991 to allow for five-year period required by the PPP rate estimation.

For ease of expression, an international equity portfolio constructed under the proposed portfolio strategy is referred to as a *PPP-efficient portfolio* (PPPEP). The strategy is termed a *PPP-efficient strategy*. The strategy is examined for medium-term investments with one-year and three-year holding periods. Annualised average single-period returns are calculated and compared with those of the three benchmark portfolios.

The mean-variance analysis is applied to evaluate the portfolio performance. Following Eun and Resnik (1988), Sharp ratio (SHP) is applied as a measurement for risk-return trade-off, assuming a zero risk-free rate. T-tests are used to test the equality of returns

² The equal-weighting scheme is adopted in this study in an effort to avoid dominating effects of the U.S. and U.K. markets and exchange rates if market-value weighting scheme applied instead.

³ The New Zealand dollar began to float freely in 1985.

from the proposed strategy portfolio and the benchmark portfolios, with a null hypothesis of equal means.

3. Risks and Returns of International Stock Markets

Table 1 presents correlation coefficients between national market dollar returns among the eight countries during the period studied. The correlation coefficients among the eight national stock markets are ranged between 0.36 and 0.79, averaged at 0.59, indicating that investing internationally may provide diversification benefits.

Table1 Correlation Coefficients of US\$ Returns of National Stock Markets
The coefficients are estimated on quarterly stock market return data in terms of US dollar returns , realised between 1991:Q1 and 2004:Q4. All of the coefficients are significant at the 5% level.

	AUS	CAN	GERM	JAP	NZ	SW	UK
CAN	0.602						
GERM	0.622	0.722					
JAP	0.375	0.418	0.398				
NZ	0.787	0.499	0.432	0.357			
SW	0.625	0.644	0.769	0.401	0.425		
UK	0.695	0.679	0.742	0.384	0.527	0.792	
US	0.677	0.780	0.734	0.471	0.518	0.727	0.794

* All of the correlation figures in the table are significant at the 5 percent level (2-tailed).

A further examination on the relationships between foreign stock market returns (measured in local currencies) and the foreign currency fluctuations reveals that correlation coefficients between foreign market returns and the foreign currency movements are in the range between -0.54 and 0.46, averaged at -0.01 across the markets. The results are presented in Table 2, which indicate that changes in foreign currency values strengthens the returns from foreign stock market investments in some cases, while offset foreign stock market returns in other cases. This mixed overall evidence is consistent with the findings in Eun and Resnik (1985).

Table 2 Co-movements of Stock Market and Currency Returns

Correlation coefficients are calculated based on quarterly data for the period from 1991:Q1 to 2004:Q4. Local stock market returns are estimated in terms of local currency returns. Changes in currency values are measured against the US dollar.

Markets	AUS	CAD	JAP	NZ	GM	SW	UK	US
Australia Based	-	-0.04	-0.13	0.00	-0.46	-0.51	-0.40	-0.20
Canada Based	0.00	-	-0.09	0.09	-0.10	-0.14	-0.26	-0.19
Japan Based	0.22	0.12	-	0.05	0.05	-0.30	-0.01	-0.45
New Zealand Based	-0.02	0.06	-0.03	-	-0.39	-0.51	-0.37	-0.14
Germany Based	0.36	0.44	0.22	0.34	-	-0.22	0.19	0.27
Switzerland Based	0.38	0.46	0.28	0.32	0.34	-	0.27	0.32
UK Based	0.29	0.28	0.16	0.18	-0.27	-0.34	-	0.12
US Based	0.13	0.33	0.03	0.14	-0.43	-0.54	-0.27	-

4. Relative Performance of the Proposed Diversifying Strategy

The performance of the proposed PPP-efficient diversification strategy is compared with the three benchmarks. Tables 3 reports average returns obtained from adopting different diversification strategies. Table 4 presents excess returns over the benchmarks by adopting the proposed PPP-efficient portfolio strategy. Results for six-month, one-year, three-year and five-year holding periods are presented in panel A, B, C and D, respectively. Results in panels A and B suggest that, for the six-month and one-year horizon, portfolio adopting the PPP-efficient strategy provided significantly higher returns than all three benchmarks. The excess returns over the global portfolio vary between 2.49 percent and 8.75 percent (annualized single-period), from different countries' perspectives. Depending on the countries the investments were made, the PPP-efficient portfolio achieved 0.81 to 12.86 percent higher returns than the MSCI world index. Compared with the domestic-only investments, the PPP-efficient strategy achieved 2.78 to 10.01 percent higher returns. Most of the superior return performances are statistically significant at the five percent level.

Table 3 Portfolio Return Comparisons

Annualised portfolio returns are averages of portfolio returns that have been realised over the period from 1991 to 2004. Returns are presented in percentage terms. P-values from t-tests on comparing historical returns obtained under the proposed portfolio strategy against a benchmark portfolio are reported in parentheses. PPP-efficient portfolios are constructed based on five-year PPP rate estimations.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel A – Six-month Investment Horizon				
Australia	17.88	12.22 (0.000)	16.49 (0.006)	11.32 (0.007)
Canada	16.09	12.26 (0.002)	13.80 (0.025)	11.14 (0.395)
Japan	14.40	10.83 (0.031)	2.05 (0.152)	10.97 (0.001)
New Zealand	19.85	11.10 (0.000)	12.40 (0.001)	9.84 (0.004)
Germany	18.95	13.68 (0.000)	14.45 (0.028)	13.76 (0.115)
Switzerland	17.14	13.27 (0.009)	16.62 (0.204)	13.62 (0.827)
UK	15.05	12.56 (0.008)	10.76 (0.266)	12.27 (0.013)
US	14.69	11.80 (0.002)	13.88 (0.150)	11.29 (0.670)
Panel B – One-year Investment Horizon				
Australia	16.18	11.49 (0.000)	10.20 (0.002)	10.83 (0.002)
Canada	15.40	11.89 (0.002)	10.12 (0.001)	12.52 (0.156)
Japan	12.57	9.15 (0.005)	7.74 (0.004)	-0.30 (0.000)
New Zealand	18.60	10.33 (0.000)	9.28 (0.000)	10.66 (0.001)
Germany	15.60	11.41 (0.000)	10.15 (0.002)	11.15 (0.014)
Switzerland	15.52	10.82 (0.000)	9.53 (0.000)	14.68 (0.638)
UK	13.73	10.87 (0.000)	9.29 (0.000)	9.45 (0.000)
US	14.31	11.09 (0.000)	9.10 (0.000)	13.05 (0.424)

Table 3 Portfolio Return Comparisons (cont'd)

Annualised portfolio returns are averages of portfolio returns that have been realised over the period from 1991 to 2004. Returns are presented in percentage terms. P-values from t-tests on comparing historical returns obtained under the proposed portfolio strategy against a benchmark portfolio are reported in parentheses. PPP-efficient portfolios are constructed based on five-year PPP rate estimations.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel C – Three-year Investment Horizon				
Australia	12.86	10.85 (0.002)	10.24 (0.056)	10.00 (0.005)
Canada	13.42	11.02 (0.000)	10.16 (0.002)	11.07 (0.006)
Japan	10.26	8.76 (0.002)	8.01 (0.032)	-2.41 (0.000)
New Zealand	14.18	9.51 (0.000)	9.10 (0.008)	8.32 (0.006)
Germany	12.19	10.57 (0.020)	10.01 (0.065)	9.22 (0.006)
Switzerland	11.60	9.24 (0.000)	8.69 (0.012)	13.30 (0.085)
UK	11.28	9.55 (0.000)	8.70 (0.006)	8.72 (0.001)
US	11.26	9.25 (0.000)	8.32 (0.002)	11.95 (0.549)
Panel D – Five-year Investment Horizon				
Australia	12.17	12.02 (0.778)	12.66 (0.583)	10.22 (0.019)
Canada	13.14	11.32 (0.011)	11.85 (0.080)	12.77 (0.523)
Japan	9.66	9.82 (0.677)	10.40 (0.180)	-1.69 (0.000)
New Zealand	11.34	11.22 (0.863)	11.92 (0.586)	6.73 (0.008)
Germany	12.23	12.05 (0.615)	12.70 (0.474)	11.51 (0.272)
Switzerland	11.94	10.77 (0.000)	11.41 (0.439)	14.66 (0.001)
UK	10.95	9.92 (0.017)	10.43 (0.415)	9.91 (0.120)
US	11.29	9.54 (0.000)	10.03 (0.045)	13.98 (0.006)

Table 4 Excess Returns of PPP-efficient Portfolio over the Benchmarks

The excess returns are calculated as average annualised returns of a PPP-efficient portfolio minus that of a benchmark portfolio return. Average return data are from Table 3. Excess returns are presented in percentage terms. The PPP-efficient portfolios are constructed based on five-year FX deviations from PPP.

Base Country	Returns in Excess over GP	Returns in Excess over MWIP	Returns in Excess over DOP
Panel A – Six-month Investment Horizon			
Australia	5.66	1.39	6.56
Canada	3.82	2.29	4.95
Japan	3.57	12.35	3.43
New Zealand	8.75	7.45	10.01
Germany	5.28	4.50	5.19
Switzerland	3.87	0.52	3.52
UK	2.49	4.29	2.78
US	2.89	0.81	3.40
Panel B – One-year Investment Horizon			
Australia	4.68	5.34	5.98
Canada	3.50	2.87	5.28
Japan	3.42	12.86	4.83
New Zealand	8.27	7.94	9.32
Germany	4.19	4.45	5.45
Switzerland	4.70	0.84	5.99
UK	2.86	4.29	4.44
US	3.21	1.26	5.21
Panel C – Three-year Investment Horizon			
Australia	2.01	2.61	2.85
Canada	2.41	3.27	2.35
Japan	1.50	2.25	12.67
New Zealand	4.68	5.08	5.86
Germany	1.62	2.18	2.97
Switzerland	2.37	2.92	-1.70
UK	1.72	2.57	2.56
US	2.01	2.94	-0.70

Table 4 Excess Returns of PPP-efficient Portfolio over the Benchmarks (cont'd)

The excess returns are calculated as average annualised returns of a PPP-efficient portfolio minus that of a benchmark portfolio return. Average return data are from Table 3. Excess returns are presented in percentage terms. The PPP-efficient portfolios are constructed based on five-year FX deviations from PPP.

Base Country	Returns in Excess over GP	Returns in Excess over MWIP	Returns in Excess over DOP
Panel D – Five-year Investment Horizon			
Australia	0.15	-0.48	1.95
Canada	1.82	1.29	0.37
Japan	-0.15	-0.74	11.35
New Zealand	0.11	-0.58	4.60
Germany	0.18	-0.47	0.72
Switzerland	1.17	0.53	-2.72
UK	1.03	0.52	1.04
US	1.75	1.26	-2.69

For investments with three-year horizon, the PPPEP strategy provided 0.84 percent to 12.86 percent higher returns than the naïve diversification and the MSCI world index strategy, for investments made in different countries. Evidence against the domestic-only investments is mixed depending on different country's perspective. Evidence from the five-year investment horizon is mixed, showing marginal superiority of the proposed PPP-efficient portfolio strategy.

Portfolio risk statistics are reported in Table 5. The results indicate that the PPP-efficient portfolios were generally less risky than the MSCI world index. Evidence against the naïve global diversification strategy and the domestic-only portfolio strategy, however, is mixed across the origin country studied.

Risk-adjusted return performance of different portfolio strategies are reported in Table 6. For investments with six-month and one-year horizons, the proposed PPP-efficient strategy outperformed each of the three benchmark strategies at the risk-adjusted basis.

Table 5 Risk Comparison of Different Portfolio Strategies

Portfolio risks are measured by standard deviations of portfolio returns realised over the period from 1991 to 2004. Standard deviations are expressed in normal forms. The PPP-efficient portfolios are constructed on the basis of five-year cumulative FX deviations from PPP.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel A – Six-month Investment Horizon				
Australia	0.200	0.203	0.253	0.734
Canada	0.217	0.188	0.259	0.274
Japan	0.284	0.258	0.370	0.301
New Zealand	0.227	0.219	0.272	0.230
Germany	0.321	0.294	0.388	0.381
Switzerland	0.307	0.302	0.402	0.306
UK	0.251	0.243	0.338	0.212
US	0.220	0.214	0.307	0.231
Panel B – One-year Investment Horizon				
Australia	0.147	0.158	0.211	0.108
Canada	0.170	0.142	0.169	0.211
Japan	0.186	0.172	0.216	0.213
New Zealand	0.165	0.180	0.238	0.162
Germany	0.211	0.206	0.247	0.269
Switzerland	0.218	0.210	0.248	0.223
UK	0.175	0.164	0.196	0.157
US	0.170	0.163	0.170	0.188
Panel C – Three-year Investment Horizon				
Australia	0.092	0.103	0.154	0.045
Canada	0.100	0.101	0.133	0.097
Japan	0.127	0.115	0.154	0.067
New Zealand	0.109	0.121	0.179	0.096
Germany	0.135	0.114	0.165	0.172
Switzerland	0.126	0.117	0.167	0.157
UK	0.100	0.094	0.126	0.114
US	0.102	0.090	0.118	0.148

Table 5 Risk Comparison of Different Portfolio Strategies (cont'd)

Portfolio risks are measured by standard deviations of portfolio returns realised over the period from 1991 to 2004. Standard deviations are expressed in normal forms. The PPP-efficient portfolios are constructed on the basis of five-year cumulative FX deviations from PPP.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel D – Five-year Investment Horizon				
Australia	0.069	0.073	0.102	0.028
Canada	0.080	0.081	0.097	0.064
Japan	0.094	0.082	0.104	0.041
New Zealand	0.078	0.080	0.115	0.073
Germany	0.098	0.085	0.113	0.122
Switzerland	0.096	0.087	0.114	0.120
UK	0.074	0.071	0.086	0.086
US	0.075	0.070	0.083	0.108

Table 6 Sharpe Ratio of Different Portfolio Strategies

The SHP ratios are reported as the risk-adjusted return performances of each portfolio strategy, examined over the period between 1991 and 2004. The PPP-efficient portfolios are constructed on the basis of five-year cumulative FX deviations from PPP.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel A – Six-month Investment Horizon				
Australia	0.893	0.602	0.447	0.734
Canada	0.741	0.653	0.430	0.504
Japan	0.507	0.420	0.297	0.068
New Zealand	0.874	0.506	0.361	0.538
Germany	0.590	0.465	0.355	0.379
Switzerland	0.558	0.440	0.339	0.543
UK	0.599	0.518	0.363	0.507
US	0.669	0.551	0.368	0.601

Table 6 Sharpe Ratio of Different Portfolio Strategies (cont'd)

The SHP ratios are reported as the risk-adjusted return performances of each portfolio strategy, examined over the period between 1991 and 2004. The PPP-efficient portfolios are constructed on the basis of five-year cumulative FX deviations from PPP.

Base Country	PPPEP (PPP-efficient portfolio)	GP (global portfolio, equally weighted)	MWIP (MSCI world index portfolio)	DOP (domestic-only portfolio)
Panel B – One-year Investment Horizon				
Australia	1.102	0.725	0.483	1.001
Canada	0.904	0.836	0.599	0.593
Japan	0.675	0.532	0.359	-0.014
New Zealand	1.125	0.574	0.390	0.658
Germany	0.738	0.554	0.411	0.414
Switzerland	0.711	0.514	0.385	0.657
UK	0.783	0.665	0.474	0.603
US	0.841	0.681	0.534	0.693
Panel C – Three-year Investment Horizon				
Australia	1.395	1.057	0.666	2.236
Canada	1.339	1.086	0.763	1.147
Japan	0.809	0.763	0.522	-0.357
New Zealand	1.296	0.783	0.508	0.864
Germany	0.905	0.925	0.608	0.535
Switzerland	0.918	0.788	0.521	0.850
UK	1.129	1.013	0.690	0.764
US	1.100	1.023	0.705	0.810
Panel D – Five-year Investment Horizon				
Australia	1.757	1.647	1.240	3.595
Canada	1.634	1.393	1.227	2.004
Japan	1.027	1.199	1.001	-0.410
New Zealand	1.458	1.403	1.036	0.929
Germany	1.244	1.410	1.121	0.944
Switzerland	1.241	1.242	1.001	1.220
UK	1.488	1.389	1.208	1.152
US	1.505	1.371	1.203	1.293

For investments with three-year or five-year horizons, adopting the proposed PPP-efficient portfolio strategy outperformed the MSCI world index strategy in terms of the risk-adjusted single-period returns, for investments made in any of the countries studied. The strategy also outperformed the naïve diversification strategy and the domestic-only strategy for investors based in most of the eight countries studied, with some exceptions.

In general, the proposed PPP efficient selective diversification strategy is superior to the naïve international diversifying strategy, the MSCI World Index portfolio and the domestic portfolio in that the strategy was able to increase investment returns significantly. The superior return performance remains after adjusting for risk. It is worth mention that the superior performance of the proposed PPP-efficient portfolio strategy did not result from higher level of diversification. As determined by the portfolio strategy, the total number of national markets included in PPP-efficient portfolios varies from time to time, with a maximum of eight markets (the total number of markets under considerations). In fact, the portfolios held an average of 4.2 to 4.4 national markets depending on the investment horizon. In comparison, the naïve diversification strategy and the MSCI world index portfolio strategy require holdings of eight national markets at all times. This may indicate that, by incorporating directional predictions on exchange rates, diversification efficiency has improved.

5. Conclusions

This study proposes a new way to international portfolio diversification which requires that investors should only invest in assets denominated in currencies that are not over-valued against the domestic currency. Examined using empirical data of eight developed country markets over the period 1991:Q1 to 2004:Q4, the proposed PPP-efficient portfolio strategy is demonstrated to provide a better way of international equity diversification.

For the six-month, one-year and three-year horizons, the proposed PPP-efficient portfolio strategy generated superior returns over the naïve global diversification strategy and the

MSCI world index, with both economical and statistical significance. The excess returns over the MSCI world index varied between 0.84 and 12.86 percent (per annum) for investments base in different countries. The excess returns over the naïve diversification strategy were in the range of 1.50 to 8.27 across the countries studied. For investments made in any of the countries studied, the proposed PPP-efficient portfolio strategy provided the domestic investors significantly higher returns for investments with six-month or one-year holding period. Evidence against the domestic-only investment was mixed for the three-year horizon, depending on the countries of study.

Furthermore, portfolios constructed by the proposed PPP-efficient strategy were generally less risky than the MSCI world index portfolio. Risk evidence against the naïvely diversified portfolios and the domestic-only investments were mixed. Measured by risk-adjusted returns, the proposed PPP-efficient portfolio strategy significantly outperformed the three benchmark strategies for investments with a six-month or one-year horizon. For investments with three-year or five-year horizons, adopting the proposed PPP-efficient portfolio strategy outperformed the MSCI world index strategy in terms of the risk-adjusted single-period returns, for investments made in any of the countries studied. Evidence of the superior risk-adjusted performance of the proposed portfolio strategy is mixed against the naïve diversification strategy and the domestic-only portfolio strategy, for investments with a three-year or five-year holding period.

In general, the evidence indicates that the proposed selective international diversification strategy based on currency deviations from PPP equilibriums is a superior strategy than the traditional approaches to international diversifications. The superior performance mainly came from improved portfolio returns. Furthermore, the average number of holdings by the PPP-efficient portfolios was significantly less than that held by the benchmark portfolios, indicating that the superior performance resulted from avoidance of adverse exchange rate movements instead of increased degree of diversification.

The proposed PPP-efficient portfolio strategy has three major advantages over the traditional way of handling portfolio currency risk, the mean-variance efficient optimal

portfolio approach.. First, under the proposed portfolio strategy, portfolio decisions can be made by analysing one simple criterion which explicitly incorporates exchange risk. The criterion is set upon the robust economic observation of the predictive power of cumulative deviations from PPP, which is underpinned by the economic theory of PPP. Construction of mean-variance efficient models, however, relies on pure mathematic calculations which lack economic intuition. Second, mean-variance efficient portfolio estimations rely on ex post empirical data, assuming that historical relationships among national stock market returns and currency returns can be maintained into the future. As was discussed in the literature review, this assumption seems unrealistic. The proposed portfolio strategy, on the other hand, is forward-looking. Third, while the mean-variance efficient portfolio model requires intensive calculation, the proposed portfolio strategy only requires minimum calculation. Therefore, the selective portfolio strategy proposed by this study is more appealing theoretically, and also more easily applicable in practice.

The new international diversification strategy proposed in this study has significant practical implications in that it may benefit institutional investors and international funds significantly. Variations of the proposed portfolio strategy may be developed and tested for further study. The strategy may also be fine-tuned by introducing optimal weighting scheme or a filter rule to further improve its performance.

References

- Abuaf, N. and Jorion, P. (1990). Purchasing power parity in the long run. *The Journal of Finance*, XLV, 1, 157-174.
- Bugar, G. and Maurer, R. (1999). Performance of international portfolio diversification strategies: The viewpoint of German and Hungarian investors. *Kredit und Kapital*. 32, 4, 581-609
- Coakley, J., and Fuertes, A.M. (1997). New panel unit root tests of PPP. *Economics Letters*. 57, 1, 17-22.
- De Santis, G. and Gerard, B. (1997). International asset pricing and portfolio diversification with time-varying risk. *Journal of Finance*. 52, 5, 1881-1912.
- Erb, C. B., Harvey, C. R. and Viskanta, T. E. (1994). Forecasting International Equity Correlations. *Financial Analysts Journal*. 50, 6, 32-45.
- Eun, C.S. and Resnik, B.G. (1985). Currency factor in international portfolio diversification. *Columbia Journal of World Business*. 20, 2, 45-53.
- Eun, C.S. and Resnik, B.G. (1988). Exchange rate uncertainty, forward contracts, and international portfolio selection. *Journal of Finance*. 43, 1, 197-215.
- Frankel, J.A. and Rose, A.K. (1996). A panel project on Purchasing Power Parity: mean reversion within and between countries. *Journal of International Economics*. 40, 1-2, 209-24.
- Glen, J. and Jorion, P. (1993). Currency hedging for international portfolios. *The Journal of Finance*. XLVIII, 5, 1865-1886.
- Grubel, G.H. (1968). Internationally diversified portfolios: welfare gains and capital flows. *American Economic Review*. 58, 1299-1314.
- Kempa, B. and Nelles, M. (2001). International correlations and excess returns in European stock markets: Does EMU matter?. *Applied Financial Economics*. 11, 1, 69-73.
- Kaplanis, E. and Schaefer, S.M. (1991). Exchange risk and international diversification in bond and equity portfolios. *Journal of Economics and Business*. 43, 4, 287-307.
- Levy, S. and Sarnat, M. (1970). International diversification of investment portfolios. *American Economic Review*. 60, 4, 668-675.
- Markowitz, H.M. (1952). Portfolio selection. *Journal of Finance*. 7. 77-91.

Odier, P. and Solnik, B. (1993). Lessons for International Asset Allocation. *Financial Analysts Journal*. 49, 2, 63-78.

Sarno, L. and Taylor, M.P. (1998). Real exchange rates under the recent float: Unequivocal evidence of mean reversion. *Economics Letters*. 60, 2, 131-137.

Saunders, A. and Woodward, R.S. (1977). Gains from international portfolio diversification. *Journal of Business Finance and Accounting*. 4, 3, 299-310.

Solnik, B.H. (1974). Why not diversify international rather than domestically?. *Financial Analysts Journal*. 30, 4, 48-54.

Tezel, A. and McManus, G. (1998). International Diversification during the 1990s. *International Journal of Business*. 3, 2, 39-58.

Vanderlinden, D., Jiang, C.X. and Hu, M. (2002). Conditional hedging and portfolio performance. *Financial Analyst Journal*. 58, 4, 72-82.