

GLOBAL DIVERSIFICATION
DATA MINING ONCE AGAIN

William Knapp and Daniel Bukowski

The desirability of using global investment to increase the diversification of a portfolio is widely accepted by portfolio managers and analysts. Given this acceptance, we were surprised to find no statistically robust study analyzing international asset returns at the market or sector level, since this very rudimentary information is crucial to the effectiveness of the intended diversification. Additionally, little attention is paid to the distinction between local versus dollar based returns. A U.S. investor really should be concerned with either dollar or hedged returns of their global assets.

We will attempt to overcome these issues in our investigation of market and sector returns for nine countries. These returns will be examined in local, dollar, and hedged terms. Sample trimming will be used to make the return series analysis more robust.

At the market level, our findings indicate the following: (1) Outliers must be eliminated from the return series. (2) Correlation among markets can change significantly over short periods. (3) Currency adds to diversification, given lower correlation among dollar based returns. (4) Hedging maintains return volatility but the return levels do not proxy well for local numbers given short rate risk. At the sector level there are important differences in correlation levels for each sector. In general relationships are strongest among English speaking countries and Continental Europe, while in Asia, Japan and Hong Kong tend to be unrelated.

DATA

Our sample includes market index, sector breakdown, currency, and eurodollar rate data for nine countries. The countries and their indices are shown below:

Germany	Commerzbank Index
Switzerland	Swiss Bank, General Index
Netherlands	CBS Herbeleggings Index
France	CAC General
United Kingdom	F.T. All Share
Canada	TSE Composite
United States	S&P Composite
Hong Kong	Hang Seng
Japan	Tokyo NSE Index

Index, currency, and eurodollar rates were obtained from Salomon Brothers Inc. The seven sectors used are: Basic Industry, Capital Goods, Consumer Non-Durables/Services, Energy, Interest Sensitive, Transportation, and Utilities. Sector returns were drawn from the Financial Times Actuary series. All data are monthly over the period January 1986 to February 1994. Table One provides a breakdown of each country by sector.

MARKET INDEX ANALYSIS

When looking at correlation among market indices we will try to determine the interrelationship among the various markets over time and to see how the treatment of currency affects our results. We first check the robustness of our sample in Tables Two and Three. Table Two provides correlation coefficients for all markets over the entire sample period in local currency. Three outlier months, October and November 1987 and October 1989, are deleted from the sample in Table Three. Elimination of these outlier returns causes significant reduction in the correlation among most markets.

The months in question were of course periods of extraordinary negative returns. We would argue their removal is necessary to gain a clearer picture of correlation among markets, since they represent abnormal occurrences. If one is very conservative, and anticipates future crashes, an argument can be made to retain these months in the sample. For this study we feel these outlier months present a distorted picture of the true correlation. Correlation is not a particularly efficient statistic when the data are inhabited by outliers. Therefore, they will be trimmed for the remainder of the analysis, both market and sector.

From Table Three we see high correlation among the English speaking countries(Canada, U.S., and U.K) and among continental Europe(Germany, Switzerland, Netherlands, and France). Japan and Hong Kong are relatively uncorrelated with the rest of the world and have a low correlation with each other.

Next, we examine correlation over differing time periods. Asking the question: Is the world getting larger or smaller? The sample is divided into three periods January 1986 to December 1989(Table Four), January 1990 to February 1994(Table Five), and January 1993 to February 1994(Table Six). When separating the sample roughly in two, Tables Four and Five, we can see very little change in correlation(no change in the world). Yet, if we had kept the three trimmed sample points, all occurring in the first sample period 1986 to 1989, we would have seen a substantial, but spurious, drop in correlation(recall the fall in correlation shown from Table Two to Three).

Finally, the fourteen months between January 1993 and February 1994 show some interesting short term phenomena(Table Six). Particularly the sharp increase in the relation between the U.S. and Germany and the rather sharp fall in correlation of Hong Kong with the rest of the world.

Since the U.S. based investor must eventually repatriate funds invested overseas, testing dollar and hedged returns are perhaps of greater relevance. In Tables Seven and Eight dollar based return correlation are presented. Correlation levels fall uniformly, in some cases dramatically. For instance, in the period January 1993 to February 1994 local, Germany v. U.S. is 0.65, while in dollar terms this correlation is 0.00. Presumably we can consider currency an additional asset adding to the diversifying nature of global investment.

Hedged return correlation values are given in Tables Nine and Ten. For the hedge, one month rolling swaps are assumed. Some short rate risk exists since the actual return equals the local stock return plus the short rate yield differential(U.S. minus local). Correlation levels measured over the entire sample period are reasonably close to those measured using local returns. Over the shorter time period the short rate risk comes more into play as can be seen in the relationship between the U.S. and Germany and Japan. For the U.S. and Germany we see local v. dollar v. hedged correlation of 0.65, 0.00, and 0.38 respectively, and 0.39, 0.17, and 0.27 for Japan. Over short periods hedged returns may not track as well as for longer periods.

As an ancillary question we examined aggregate returns and return volatilities for the market indices. In Table Eleven we compared local v. dollar and the whole v. trimmed sample results. Differentials exist between local and dollar volatilities and trimming seems important in that volatility levels drop on average by about 10%. As shown in Table Twelve, hedged returns levels do not always proxy well for local returns, e.g. France and the U.K. Yet, volatility levels are fairly well replicated, an important result when dealing with global derivatives and swaps.

CONCLUSIONS FROM INDEX DATA

The analysis of index returns indicates trimming outlier returns is an important statistical adjustment in order to generate robust results. Correlation levels tend to be relatively stable over longer periods of time but can fluctuate dramatically over shorter periods. Dollar based correlation is lower for global markets than local, pointing to the diversifying power of currency. Finally, hedging may not provide exact return replication but hedged volatility does proxy well for local return volatility.

SECTOR ANALYSIS

Conclusions from the analysis of the sector return data are consistent with those found from the market index data. Reported results are confined to the entire eight year sample period, trimmed data, and dollar based returns. As with market correlation, dollar based sector correlation levels were lower than local currency and there was little variation in correlation when dividing the sample period in two parts. Tables Thirteen through Twenty provide results for the sector analysis.

Looking at individual sectors, Basic Industries, Capital Goods, and Consumer Non-Durables/ Services, have similar results and are most reflective of our findings from the market data(not surprising given their dominate weight in most indices, see Table One). Restating these results: high correlation among English speaking countries, as with continental Europe, low correlation between the U.S. and Asia, and in the most recent period a significant fall in correlation between Hong Kong and the rest of the world.

With Energy, Table Sixteen, we see high correlation among the U.S., Canada, the U.K., and Netherlands. Not surprising given the global nature of the energy market. Yet, France and Japan are somewhat less related to the rest of the world. In the Interest Sensitive area the highest correlation is among European countries. In looking at Transportation and Utilities we see some of the lowest correlation, probably due to localized the nature of these sectors and greater presence of regulation.

CONCLUSIONS

This study has been a rudimentary attempt to discuss the relationship among global equity returns. Over longer periods of time, four year periods in this case, correlation levels among countries appear to be relatively stable. This result would not be so apparent had we not trimmed outlier returns from the series. Currency is a diversifying asset, given the lower level of dollar based return correlation *vis-à-vis* local returns. Asia seems to offer the greatest diversification for the U.S. investor. Finally, hedged portfolios do not always mimic return levels but do proxy well for the local volatilities.

TABLE 1

FT ACTUARIES SECTOR COMPOSITION

AS OF APRIL, 1994

MCAP \$MMM	CONS INT		CAP BASC			ENERGY TRANS		TOTAL
	GOODS	SENS	GDS	IND	UTIL			
CANADA	32.4	22.1	11.0	41.6	19.3	18.4	2.4	147.1
FRANCE	110.0	72.8	38.9	42.5	18.2	32.1	2.0	316.4
GERM	61.1	123.9	50.1	77.7	18.5	0.0	3.5	334.9
HK	38.0	111.8	2.0	0.0	25.1	0.0	7.4	184.2
JAPAN	709.5	906.9	449.6	360.4	166.8	44.6	121.0	2758.8
NETH	50.0	28.8	11.4	12.9	0.0	58.9	3.6	165.6
SWITZ	114.7	59.4	15.6	23.4	2.1	0.0	1.2	216.3
UK	333.0	187.0	70.2	99.0	112.2	73.9	21.6	897.0
US	1185.3	448.4	506.2	243.9	503.3	277.8	66.1	3230.8
TOTAL	2633.8	1961.0	1155.1	901.3	865.4	505.6	228.8	8251.1
<u>ISSUES</u>								
CANADA	22	25	8	22	9	16	4	106
FRANCE	38	29	11	13	2	4	1	98
GERM	14	14	10	15	4	0	1	58
HK	20	25	2	0	4	0	5	56
JAPAN	150	56	107	110	11	10	25	469
NETH	11	4	4	3	0	1	3	26
SWITZ	17	13	10	6	1	0	1	48
UK	66	51	26	38	14	4	6	205
US	166	79	99	63	69	26	17	519
TOTAL	504	296	277	270	114	61	63	1585

TABLE 2

MARKET INDICES
January 1986 to February 1994
(Local Currency)

United States	1.00								
Canada	0.76	1.00							
United Kingdom	0.75	0.68	1.00						
Germany	0.47	0.51	0.56	1.00					
Switzerland	0.62	0.67	0.70	0.78	1.00				
Netherlands	0.67	0.71	0.75	0.73	0.80	1.00			
France	0.55	0.53	0.55	0.70	0.60	0.59	1.00		
Hong Kong	0.45	0.56	0.58	0.45	0.51	0.52	0.36	1.00	
Japan	0.37	0.44	0.38	0.30	0.40	0.37	0.40	0.22	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 3

**MARKET INDICES
TRIMMED**

United States	1.00									
Canada	0.67	1.00								
United Kingdom	0.64	0.56	1.00							
Germany	0.28	0.37	0.39	1.00						
Switzerland	0.45	0.55	0.55	0.70	1.00					
Netherlands	0.51	0.60	0.60	0.62	0.70	1.00				
France	0.41	0.38	0.40	0.62	0.47	0.46	1.00			
Hong Kong	0.21	0.35	0.40	0.27	0.31	0.29	0.14	1.00		
Japan	0.32	0.40	0.33	0.24	0.36	0.33	0.35	0.12	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 4

**MARKET INDICES
January 1986 to December 1989
(Local Currency)**

United States	1.00									
Canada	0.70	1.00								
United Kingdom	0.64	0.57	1.00							
Germany	0.15	0.22	0.13	1.00						
Switzerland	0.32	0.41	0.26	0.70	1.00					
Netherlands	0.48	0.57	0.41	0.49	0.55	1.00				
France	0.36	0.35	0.20	0.54	0.34	0.22	1.00			
Hong Kong	0.12	0.18	0.33	-0.06	0.02	0.07	-0.01	1.00		
Japan	0.30	0.23	0.15	-0.03	0.02	0.22	-0.03	0.33	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 5

MARKET INDICES
January 1990 to February 1994
(Local Currency)

United States	1.00									
Canada	0.70	1.00								
United Kingdom	0.49	0.61	1.00							
Germany	0.18	0.27	0.17	1.00						
Switzerland	0.34	0.44	0.31	0.67	1.00					
Netherlands	0.49	0.57	0.44	0.53	-0.55	1.00				
France	0.34	0.31	0.19	0.51	0.32	0.24	1.00			
Hong Kong	0.13	0.19	0.31	-0.05	0.03	0.06	-0.04	1.00		
Japan	0.27	0.27	0.22	-0.07	0.09	0.18	0.29	-0.37	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 6

MARKET INDICES
January 1993 to February 1994
(Local Currency)

United States	1.00									
Canada	0.79	1.00								
United Kingdom	0.79	0.71	1.00							
Germany	0.65	0.09	0.38	1.00						
Switzerland	0.39	0.49	0.52	0.83	1.00					
Netherlands	0.39	0.91	0.26	0.54	0.76	1.00				
France	0.32	0.27	0.62	0.58	0.35	0.15	1.00			
Hong Kong	-0.45	-0.25	-0.33	0.13	0.13	-0.29	-0.11	1.00		
Japan	0.39	0.53	0.38	0.06	0.15	0.44	0.38	-0.61	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 7

MARKET INDICES
January 1986 to February 1994
Dollar Based Return

United States	1.00									
Canada	0.63	1.00								
United Kingdom	0.53	0.48	1.00							
Germany	0.24	0.24	0.48	1.00						
Switzerland	0.35	0.34	0.60	0.71	1.00					
Netherlands	0.48	0.47	0.69	0.75	0.74	1.00				
France	0.36	0.28	0.48	0.72	0.58	0.63	1.00			
Hong Kong	0.21	0.36	0.37	0.26	0.24	0.31	0.15	1.00		
Japan	0.24	0.32	0.50	0.34	0.49	0.47	0.45	0.10	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 8

MARKET INDICES
January 1993 to February 1994
Dollar Based Return

United States	1.00									
Canada	0.72	1.00								
United Kingdom	0.61	0.61	1.00							
Germany	0.00	-0.07	0.50	1.00						
Switzerland	0.24	0.21	0.67	0.90	1.00					
Netherlands	0.41	0.36	0.62	0.74	0.90	1.00				
France	0.24	0.15	0.66	0.72	0.70	0.61	1.00			
Hong Kong	-0.42	-0.14	-0.18	0.29	0.26	-0.03	0.26	1.00		
Japan	0.17	0.32	0.50	0.20	0.33	0.51	0.58	-0.46	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP	

TABLE 9

MARKET INDICES
January 1986 to February 1994
Hedged Return

United States	1.00								
Canada	0.63	1.00							
United Kingdom	0.61	0.64	1.00						
Germany	0.30	0.34	0.45	1.00					
Switzerland	0.46	0.55	0.66	0.78	1.00				
Netherlands	0.45	0.51	0.61	0.76	0.80	1.00			
France	0.38	0.32	0.38	0.73	0.64	0.64	1.00		
Hong Kong	0.24	0.39	0.43	0.21	0.27	0.22	0.09	1.00	
Japan	0.33	0.44	0.42	0.40	0.53	0.47	0.42	0.15	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 10

MARKET INDICES
January 1993 to February 1994
Hedged Return

United States	1.00								
Canada	0.50	1.00							
United Kingdom	0.64	0.63	1.00						
Germany	0.38	0.28	0.65	1.00					
Switzerland	0.71	0.57	0.76	0.46	1.00				
Netherlands	0.76	0.64	0.85	0.78	0.86	1.00			
France	0.40	0.38	0.57	0.70	0.57	0.76	1.00		
Hong Kong	0.21	0.40	0.56	0.61	0.40	0.44	0.19	1.00	
Japan	0.27	0.60	0.28	-0.16	0.16	0.16	-0.02	0.10	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 11

8701 - 9403	EAFE		CANADA		FRANCE		JAPAN		HONG KONG		NETH		SWITZ		UK		US	GERM	
	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	US\$	LCL	US\$
PRI RT	3.6	7.0	4.2	4.2	6.4	8.2	-0.4	5.8	19.0	19.1	8.0	10.4	8.3	10.5	9.4	9.5	8.7	4.6	2.4
SD	17.6	20.2	15.0	16.9	21.7	22.0	24.0	28.6	30.8	30.8	16.7	15.9	19.5	19.3	19.9	21.4	15.7	22.8	21.9

TRIMMED SAMPLE (OMITS 10/87, 11/87, AND 10/89)

8701 - 9403	EAFE		CANADA		FRANCE		JAPAN		HONG KONG		NETH		SWITZ		UK		US	GERM	
	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	LCL	US\$	US\$	LCL	US\$
PRI RE	7.9	10.2	8.8	8.7	12.7	12.8	1.7	7.1	30.9	30.9	15.4	15.7	15.7	15.8	17.7	16.3	14.7	10.1	9.9
SD	16.2	19.7	12.6	14.8	19.9	21.0	24.0	28.9	26.0	26.0	13.3	14.0	16.7	17.9	16.5	19.5	12.9	21.6	19.4

TABLE 12

8801 - 9403	EAFE			CANADA			FRANCE			JAPAN			HONG KONG		
	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD
PRI RET	4.79	4.67	3.87	4.08	3.09	1.43	13.59	12.44	9.51	-1.72	0.94	-0.23	23.91	23.99	24.19
SD	16.62	19.63	16.86	11.58	13.50	11.64	20.54	21.25	20.50	23.99	28.38	24.38	26.08	26.17	26.13

	NETHERLANDS			SWITZERLAND			US	UNITED KINGDOM			GERMANY		
	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD	US\$	LOCAL	US\$	HDGD	LOCAL	US\$	HDGD
PRI RET	12.48	11.51	10.21	16.10	14.29	15.01	10.00	10.34	6.33	5.03	10.52	11.49	9.82
SD	13.30	13.76	13.26	17.15	18.68	17.22	22.27	19.34	16.37	12.36	22.27	19.53	19.77

TABLE 13

BASIC INDUSTRY

United States	1.00												
Canada	0.61	1.00											
United Kingdom	0.54	0.40	1.00										
Germany	0.30	0.22	0.51	1.00									
Switzerland	0.45	0.32	0.56	0.55	1.00								
Netherlands	0.27	0.24	0.45	0.50	0.44	1.00							
France	0.37	0.22	0.51	0.65	0.47	0.51	1.00						
Japan	0.17	0.20	0.47	0.33	0.28	0.26	0.44	1.00					
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	JP					

TABLE 14

CAPITAL GOODS

United States	1.00								
Canada	0.51	1.00							
United Kingdom	0.53	0.25	1.00						
Germany	0.26	0.10	0.34	1.00					
Switzerland	0.36	0.16	0.54	0.59	1.00				
Netherlands	0.39	0.44	0.44	0.50	0.46	1.00			
France	0.39	0.16	0.49	0.68	0.59	0.49	1.00		
Hong Kong	0.18	0.26	0.26	0.19	0.28	0.35	0.24	1.00	
Japan	0.16	0.13	0.46	0.31	0.50	0.34	0.35	0.36	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 15

CONSUMER GOODS and SERVICES

United States	1.00								
Canada	0.68	1.00							
United Kingdom	0.56	0.44	1.00						
Germany	0.19	0.19	0.38	1.00					
Switzerland	0.39	0.30	0.60	0.57	1.00				
Netherlands	0.43	0.43	0.57	0.62	0.68	1.00			
France	0.38	0.34	0.52	0.65	0.55	0.62	1.00		
Hong Kong	0.25	0.28	0.38	0.25	0.25	0.35	0.27	1.00	
Japan	0.15	0.22	0.51	0.35	0.42	0.47	0.47	0.22	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 16

ENERGY

United States	1.00					
Canada	0.74	1.00				
United Kingdom	0.67	0.58	1.00			
Netherlands	0.71	0.52	0.83	1.00		
France	0.34	0.19	0.38	0.50	1.00	
Japan	0.21	0.10	0.41	0.43	0.20	1.00
	US	CAN	UK	NETH	FRAN	JP

TABLE 17

INTEREST SENSITIVE

United States	1.00								
Canada	0.44	1.00							
United Kingdom	0.38	0.45	1.00						
Germany	0.07	0.34	0.49	1.00					
Switzerland	0.32	0.44	0.62	0.69	1.00				
Netherlands	0.13	0.42	0.43	0.78	0.68	1.00			
France	0.24	0.30	0.48	0.67	0.53	0.56	1.00		
Hong Kong	0.10	0.32	0.46	0.30	0.30	0.30	0.20	1.00	
Japan	0.18	0.34	0.31	0.15	0.29	0.18	0.35	0.00	1.00
	US	CAN	UK	GERM	SWTZ	NETH	FRAN	HK	JP

TABLE 18

TRANSPORTATION

United States	1.00								
Canada	0.33	1.00							
United Kingdom	0.30	0.32	1.00						
Germany	0.26	0.11	0.46	1.00					
Switzerland	0.37	0.17	0.43	0.38	1.00				
Netherlands	0.38	0.16	0.42	0.44	0.50	1.00			
Hong Kong	0.24	0.32	0.31	0.12	0.28	0.31	1.00		
Japan	0.07	0.19	0.43	0.15	0.29	0.19	0.11	1.00	
	US	CAN	UK	GERM	SWTZ	NETH	HK	JP	

TABLE 19

UTILITIES

United States	1.00								
Canada	0.27	1.00							
United Kingdom	0.30	0.34	1.00						
Germany	0.22	0.21	0.44	1.00					
Switzerland	0.05	0.10	0.36	0.45	1.00				
France	0.30	0.22	0.37	0.68	0.35	1.00			
Hong Kong	0.06	0.26	0.25	0.21	0.05	0.09	1.00		
Japan	0.17	0.20	0.17	0.19	0.28	0.37	0.01	1.00	
	US	CAN	UK	GERM	SWTZ	FRAN	HK	JP	