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Diversification across Economic Sectors and Implication on Portfolio Investments in Malaysia

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ABSTRACT

Due to the increasing efforts towards regional and global economic integration, the effects of "country specific" factors are becoming less important in managing domestic portfolio investments. Consequently the concept of diversification across economic sectors has received attention in literature. This paper analyzes the opportunity for diversification across different economic sectors for long-term investment using sectorial indices. The findings indicate high but unstable correlation of returns between indices. This implies that investment managers should account for potential movements in sector-specific and sub-sector-specific risks. The findings imply that investment in one or two sectors of the stock market face higher total risk than in the past due to the increasing "sector" effects on portfolio investment.

Keywords: Portfolio, Diversification, Investment, Sectorial, Correlation

INTRODUCTION

Due to increasing regional and global economic integration, "country" effects are becoming less important in the management of portfolio investments. However, "sector" effects are being given more consideration when investing in emerging market portfolios. The decline in international economic differentials is the key determinant of the change in dominance from country-specific to sector-specific effects on portfolio investment risks. The launch of

several sector specific tracker funds that specialize in specific economic sectors for example, consumer goods, financials and technology stocks, is priori evidence of this phenomenon.

As business cycles converge and the process of globalization continues, correlations between country specific fundamentals will increase and consequently reduce the benefits of diversification. However, investment portfolios based on economic sectors that are relatively independent are more likely to add value and increase the opportunity to eliminate a substantial part of investment risk. The motivating factor therefore is to construct an efficient portfolio based on the different economic sectors of the economy. To achieve this objective, two important points that require focus are the correlation structures between the economic (or industries) sectors and the stability of the correlation structures over time. Knowledge of the movement of correlation structures between economic sectors will help in designing an efficient investment portfolio.

This paper examines the issues related to whether portfolio diversification across industries is more effective than portfolio investment based on naive strategy. Section 2 of the paper reviews previous studies on related issues, section 3 discusses the data and methods used to test the relevant research issues of interest, section 4 discuss the results and section 5 concludes the paper.

REVIEW OF PREVIOUS STUDIES

Harry Markowitz made the first pioneering contribution in the field of finance in the 1950s through the Markowitz portfolio model, which expressed the optimal relationship between portfolio volatility and expected return. Itshowed that under certain given conditions, an investor's portfolio choice could be reduced to balancing based on two dimensions, which are expected returns and variance of portfolio returns. Due to the possibility of reducing risk through diversification, the risk of the portfolio as measured by the variance of portfolio returns will depend not only on the individual variances of the return on different assets, but also on the pair-wise covariance (correlation) ofreturns on all assets. Therefore asset correlation structure is an importarit phenomenon of efficient diversification.

Correlations will be higher when systematic macroeconomics factors, which affect all assets in tandem, dominate sector-specific factors. Ifvariations in asset returns are driven by both systematic factors and idiosyncratic (i.e., sector specific) risks, then periods of high factor volatility will coincide with periods of high correlation. During these periods, the dominant source of variation will be market factors. There is a strong observed association between correlation and volatility (Correlation breakdown).

This argument suggests that investor$ could use simple factor models of portfolio returns to understand and predict time variation in correlations. In all these models, correlation between sectors comes from their common dependence on shocks to systematic factors while changes in correlation are driven by changes in the volatility of stocks. During periods of large macroeconomic disturbances, the common (market) factor dominates the volatility of individual sector returns and leads to higher correlations. In quieter periods, sector-specific risks may dominate, with the result that correlations are lower in these periods and diversification eliminates a greater fraction of total volatility.

Rouwenhorst (1999) proposes the mean absolute deviation (MAD) as a measure of the relative importance of industry and country factors. The findings show that industry factor returns belonging to the same sector are more highly correlated among themselves than across sectors. In the particular case of the energy sector, the component industries exhibit high volatility ofreturns (12.5 percent) and a high correlation in returns (0.55). Cavaglia et al. (2000) also find that since early 1997, opportunities for returns from industry tilts have dominated those emanating from countries' tilts and that this dominance has increased since 1997.

Beckers et al. (1996) and Solnik and Roulet (1999) have shown that there is increasing economic integration associated with a rise in the correlation of country factor returns. This would suggest that the gains from diversifying across countries are likely to be diminishing. Their similar plot for the capitalization weighted correlation of industry factor returns show that these have been relatively stable over the last decade.

Morgan Stanley (2002) documented the increasing importance of industry impact on share price performance compared to market performance. The

findings show that industry factors explain more than half of a company's share price movements. This means that a portfolio based on industry exposure might be more efficient than one based on country exposure. Diversification across industries becomes paramount in order to achieve the desired investment risk and return targets.

The evidence seems to support the notion that diversification by sectors is more effective than that based on regions. This might be also true for Malaysia, an emerging economy, implying that sectorial based diversification should be the preferred mode in managing portfolio investments.

DATA AND METHODS OF ANALYSIS

In this paper, daily sector specific returns were estimated using daily data over the period spanning September 1993 to December 2002. The data for daily stock price of 6 industry indices are sourced from Kuala Lumpur Stock Exchange (KLSE)[1]. The daily returns series are estimated as follows:

$$\ln(P_i) - \ln(P_{i-1}) \qquad (1)$$

Where, ln is natural logarithm, P denotes the price index and i represent a daily time interval. As part of our performance measurement, the excess returns are estimated by subtracting the three-month Treasury bill rate (expressed as a percentage and divided by 365) from the derived return series. The excess returns are estimated for six major sectors that represent 85 percent of the main economic sectors of the economy.

Test for Serial Correlation and Cross Correlation

The original return of each sector is tested for serial correlation. Serial correlation (auto correlation) test is adjusted by an autoregressive integrated moving average (ARIMA). The main tools for ARIMA are the autocorrelation function (ACF) and the partial autocorrelation (PACF), which are simply the plots of ACFs and PACFs against the lag length.

Cross correlation and Correlograms were derived to ascertain the exact relationship between two sectors. Cross Correlation is defined as the correlation

[1] Now known as Bursa Malaysia

between two signals in the time domain. The cross correlations between the two series x and y arc given by:

$$r_{x,y}(l) = \frac{C_{xy}(l)}{\sqrt{C_{xx(0)}} - \sqrt{C_{yy(0)}}} \quad \text{where } l = 0, 1, 2 \qquad (2)$$

Unlike the autocorrelations, cross correlations are not necessarily symmetric around lag 0.

$$\rho_{ij} = \frac{C_{ii}}{\sqrt{(C_{ii}C_{ij})}} \text{ h} \qquad \text{where } -1 \leq \rho_{ij} \leq +1$$

$$= \frac{cov(X_i, X_j)}{\sigma(X_i)\sigma(X_j)}$$

ρ_{ij} = -1 Perfect Negative Correlation

ρ_{ij} = 0 No Correlation

ρ_{ij} = +1 Perfect Positive Correlation

Test of stability Over Time

To determine the level of diversification, it is necessary to observe whether the pattern of correlations between sector indexes persists over time. The Fisher transformation procedure was applied to determine the stability of correlation coefficients over time. The Fisher transformation of rii' (the sample correlation coefficient between i and j) can be derived as follows:

$$U_{ij} = \frac{1}{2} \ln \left[\frac{1 + r_{i.j}}{1 - r_{i.j}}\right]$$

To test the stability for two consecutive periods (t and t+ 1), Z-statistic is used in the following way:

[2] Fisher, R.A. (1921) On the Probable Error of a Coefficient of Correlation Deduced from a Small Sample, *Merton,* 1.

$$Z = \frac{U_{i,j}(t) - U_{i,j}(t+1)}{\left(\frac{1}{N_t - 3} + \frac{1}{N_{t+1} - 3}\right)^{1/2}} \quad (3)$$

Where $N_1 = N,+1 = 220$

Test the Risk-return Performance of Different Industry Sectors

There are two types of evaluation measures. An Ex-Ante measure is one that is used to make an evaluation "before the fact" or before the funds are invested. An Ex-Post measure looks at how investments performed "after the fact" or after the funds are invested. This paper uses the Sharp Ratio to measure the performance or the excess returns per unit of total risk, which is considered as an ex-post measurement in which measurement deals with actualized returns and risk. The excess returns using Sharpe's Ratio is derived as follows:

$$Si = \frac{E(R_I) - R_i}{\sigma_i} \quad (4)$$

where S_i = Sharpe measure for industry index i

$E(R_I)$ = Expected return of industry index i

σ_i = Standard deviation of returns for industry index i

R_i = Risk free rate of return (3month government Treasury Bill rate)

RESULTS

Autocorrelation Results

The serial correlation results for the six selected industry indices presented in Tab!C **1.** show that autocorrelation function (ACF) and partial autocorrelation function (PACF) of the stock prices movements are stationary. There are a few significant autocorrelations at Lag 1and then an exponential dropping at Lag 2, Lag 3 and so on. The degree of correlation ranges from -0.056 to 0.198, indicating low serial correlation for each individual sector return. However,

there is significant structure in the 3rd and 7th lag, which could interpret that the series have some periods of seasonality.

Table 1 Serial Correlation by Sector, 1993 - 2002

Period	Construction	Consumer	Finance	Plantation	Property	Trading/ Service
Lag 1	0.136	0.102	0.198	0.091	0.080	0.110
Lag 2	0.076	0.009	0.082	-0.015	0.058	0.039
Lag 3	-0.028	0.017	0.026'	0.028	0.042	-0.054
Lag 4	0.032	0.058	O.o35	0.087	0.069	-0.017
Lag 5	0.020	0.014	0.007	0.085	0.047	-0.008
Lag 6	-0.026	0.004	-0.041	-0.016	-0.051	-0.037
Lag 7	-0.041	-0.049	-0.020	-0.056	-0.020	-0.017
Lag 8	-0.002	-0.021	0.005	0.027	0.004	-0.031
Lag 9	0.013	0.035	0.044	0.063	0.014	0.056
Lag 10	0.033	0.053	0.051	-0.007	0.024	0.056

Cross Correlation Results

Table 2 shows the correlation coefficients in terms oflag and lead coefficients between two-combination industry sectors which indicate high level correlation for the first one lag and one lead which gradually reduces over the period. The overall findings indicate that the sectors are not highly correlated based on the day to day return either in lag or lead condition suggesting that it will be difficult to forecast the pattern of the correlation between sectors over the analysis period.

Table 2 Cross Correlogram in Terms of Lag, 1993 - 2002

By Sector/Industry	Period Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Period Lead 0	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5
Consumer-Construction	0.7443	0.1001	0.0224	0.0025	0.0572	0.0132	0.7443	0.1622	0.0550	-0.0076	0.0351	0.0161
Construction-Finance	0.8153	0.1845	0.0826	0.0111	0.0297	0.0122	0.8153	0.1534	0.0757	-0.0013	0.0608	0.0008
Construction-Plantation	0.6704	0.0856	0.0260	0.0052	0.0516	0.0376	0.6704	0.0978	0.0020	-0.0037	0.0523	0.0343
Construction-Property	0.7847	0.0970	0.0621	0.0047	0.0341	-0.002	0.7847	0.1107	0.0677	0.0325	0.0766	0.0498
Construction-Trading	0.7968	0.1398	0.0579	0.0045	0.0267	0.0198	0.7968	0.0961	0.0350	-0.0498	-0.0003	-0.0042
Consumer-Finance	0.7706	0.1867	0.5340	0.0241	0.0348	0.0084	0.7706	0.1212	0.0440	0.0301	0.0738	0.0036
Consumer-Plantation	0.7631	0.1392	0.0332	0.0213	0.0559	0.0661	0.7631	0.0722	-0.0237	0.0347	0.0683	0.0291
Consumer-Property	0.7575	0.1326	0.0425	0.0028	0.0397	0.0234	0.7575	0.0673	0.0354	0.0559	0.0936	0.0426
Consumer-Trading	0.7846	0.1552	0.0469	0.0137	0.0266	0.0149	0.7846	0.0669	0.0084	-0.0113	0.0115	-0.0024
Finance-Plantation	0.7021	0.1155	0.0374	0.0264	0.0573	0.0370	0.7021	0.1314	0.0015	0.0191	0.0541	0.0250
Finance-Property	0.8027	0.1213	0.0636	0.0195	0.0297	-0.014	0.8027	0.1327	0.0805	0.0646	0.0653	0.0469
Finance-Trading	0.8508	0.1567	0.0603	0.0016	0.0409	0.0073	0.8508	0.1402	0.0451	-0.0321	-0.0127	-0.0151
Plantation-Property	0.7560	0.1017	-0.005	0.0028	0.0516	0.0416	0.7560	0.0562	0.0198	0.0631	0.0880	0.0673
Plantation-Trading	0.7058	0.1056	0.0118	0.0151	0.0345	0.0342	0.7058	0.0806	0.0237	-0.0104	0.0146	0.0342
Property-Trading	0.7340	0.0767	0.0489	0.0465	0.0539	0.0488	0.7340	0.0709	0.0380	-0.0209	0.0026	-0.0162

Table 3 Correlation Coefficient in Percentage, 1993 - 2002

By Sector/Industry	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Consumer-Construction	57.36	72.44	74.88	66.34	80.83	77.23	83.28	70.72	65.89	63.40
Consumer-Finance	71.77	78.53	84.12	71.11	82.57	79.37	84.85	61.65	63.19	63.76
Consumer-Plantation	62.76	75.12	88.22	73.94	81.20	83.47	83.55	64.33	61.62	59.81
Consumer-Property	66.86	76.87	89.37	72.96	84.37	68.45	82.36	75.14	72.15	64.46
Consumer-Trading	60.10	74.41	85.04	70.63	80.28	86.88	87.05	70.86	67.52	63.80
Construction-Finance	64.80	88.54	82.67	73.36	83.59	85.49	84.72	63.25	65.85	72.67
Construction-Plantation	43.47	83.63	79.10	62.69	73.84	67.93	79.31	61.58	54.74	61.97
Construction-Property	59.11	86.63	82.01	67.75	82.48	76.11	85.17	77.53	77.91	73.23
Construction-Trading	50.67	83.04	82.41	69.63	84.11	81.49	87.40	68.84	65.93	71.61
Finance-Plantation	67.24	86.25	85.55	72.49	77.70	70.89	76.67	55.57	53.89	61.67
Finance-Property	64.95	89.16	86.64	75.33	86.47	83.14	82.87	63.88	69.03	68.19
Finance-Trading	66.08	86.28	86.85	72.02	89.80	86.17	86.98	73.82	81.16	82.29
Plantation-Property	61.53	92.01	91.74	81.52	81.33	61.82	79.51	72.91	64.17	63.47
Plantation-Trading	49.80	78.47	84.91	67.44	75.51	80.57	81.69	65.00	59.71	64.42
Property-Trading	48.21	81.72	85.52	67.42	77.97	69.42	81.66	74.39	72.18	71.05

Correlation Test Results

Table 3 indicates high correlations for combination of construction and plantation sectors, with the least degree of correlation (43.47 percent) in 1993, while the plantation-property sectors had the highest degree of correlation coefficient of 92.01 percent in 1994.

If both sectors have positive and negative deviations at similar times, the covariance is a large positive number. If they have positive and negative deviations at dissimilar times, then the covariance is negative. When the return patterns of two sectors are independent, where covariance is zero, a portfolio can be found that has a lower variance (lower risk) rather than either one of the sectors being held. The findings show a high correlation coefficient for the six industry indices (degree of correlation range from 44 percent to 92 percent), which implies less opportunity to fully benefit when diversifying into these sectors.

These findings suggest that the possibility of diversification could be limited due to the high correlation between sectors for a single time horizon, whereas the changing nature of the correlation structure over the period will provide some insights into possible benefits of diversification over a longer time horizon.

Stability Test Results

Results in Table 4 show that the correlation relationships between sectors are extremely unstable overtime. For example, combination of property and trading has a correlation of 82 percent in 1994 and the correlation declines to 67 percent in 1995 indicating that both industries become diverse in opposite directions and move away from each other. The declining correlation relationship provides increasing opportunity for diversification, and investors can earn efficient returns.

Table 4 Result of Stability Test, 1994 - 2002

Z statistic test	94-95	95-96	96-97	97-98	98-99	1999 -2001	2000 -2002	2001
Consumer-Construction	0.941	0.736	0.449	0.761	0.061	0.103	0.290	0.588
Consumer-Finance	0.828	0.113	0.514	0.043	0.554	0.006	0.535	0.459
Consumer-Plantation	0.782	0.137	0.537	0.523	0.064	0.026	0.096	0.684
Consumer-Property	0.680	0.018	0.118	0.674	0.207	0.295	0.495	0.701
Consumer-Trading	0.443	0.053	0.179	0.409	0.328	0.003	0.779	0.854
Construction-Finance	0.209	0.057	0.368	0.878	0.141	0.002	0.906	0.827
Construction-Plantation	0.275	0.057	0.773	0.366	0.516	0.021	0.236	0.749
Construction-Property	0.194	0.001	0.343	0.159	0.012	0.244	0.301	0.993
Construction-Trading	0.373	0.003	0.298	0.579	0.346	0.002	0.726	0.902
Finance-Plantation	0.573	0.054	0.955	0.377	0.768	0.057	0.049	0.788
Finance-Property	0.478	0.030	0.420	0.154	0.758	0.003	0.921	0.505
Finance-Trading	0.440	0.001	0.083	0.180	0.782	0.035	0.459	0.823
Plantation-Property	0.442	0.038	0.857	0.187	0.012	0.184	0.130	0.568
Plantation-Trading	0.444	0.022	0.728	0.399	0.485	0.226	0.047	0.854
Property-Trading	0.180	0.000	0.105	0.714	0.391	0.290	0.428	0.900

This behavior suggests that there are benefits to investors who diversify their investment across these industries. As the performances of these sectors are calculated over a ten-year period, it implies that, if investors hold their portfolio investments for a longer period of time, diversification across industries and time yields some risk reduction benefits.

Performance of Different Industries

Results in Table 5 show that the plantation sector had the highest average return (0.0909) compared to other sectors for the same period. The property sector had the least return (0.0044). Overall, the average return trend for the six selected industries are similar, except that mean return was high in 1993 and linearly declined in 1997, and started recovering again before experiencing another dip in 2002.

Table 5 Mean Daily Return (%)

Indices	1993 - 2002	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Construction	0.0346	0.5415	-0.0403	0.0745	0.1330	-0.4761	-0.0700	0.2663	-0.0937	0.0650	-0.0539
Consumer	0.0437	0.4862	-0.0590	0.0114	0.1338	-0.2652	-0.0336	0.1287	-0.0179	0.0577	-0.0052
Finance	0.0624	0.7192	-0.0839	0.0537	0.1245	-0.4229	0.0330	0.2768	-0.0807	0.0126	-0.0087
Plantation	0.0909	1.0488	-0.0566	-0.0403	0.0682	-0.1647	-0.0070	-0.0107	-0.0586	0.0768	0.0529
Property	0.0044	0.6239	-0.0733	-0.0626	0.0819	-0.4657	-0.0310	0.1753	-0.1565	-0.0123	-0.0354
Trading Service	0.0294	0.5240	-0.1282	0.0138	0.0635	-0.2183	-0.0342	0.1598	-0.0694	0.0135	-0.0309

Table 6 Standard Deviation of Daily Return (%)

Indices	1993 - 2002	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Construction	1.4099	1.3853	1.3568	1.1751	0.7382	1.5566	2.5721	1.9697	1.4676	1.0344	0.8434
Consumer	0.8504	0.7994	1.3197	0.6904	0.5758	1.0002	1.3848	1.0123	0.7608	0.5110	0.4495
Finance	1.1378	1.0264	1.2071	0.9302	0.6098	1.4304	2.1853	1.5831	0.8675	0.8845	0.6536
Plantation	1.0381	1.3758	1.8713	0.9351	0.6656	1.1202	1.4729	0.9923	0.7114	0.6858	0.5506
Property	1.3444	1.5282	1.8088	1.3310	0.7229	1.2925	2.0225	2.1055	1.0476	0.9155	0.6693
Trading Service	1.1516	0.8528	1.1674	0.9133	0.6634	1.5278	2.1657	1.4759	1.0795	0.9674	0.7025

Table 7 Result of Sharpe Measure

Indices	1993 - 2002	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Construction	0.015	0.378	-0.037	0.051	0.156	-0.317	-0.035	0.130	-0.069	0.055	-0.073
Consumer	0.036	0.586	-0.052	-0.005	0.201	-0.283	-0.038	0.117	-0.034	0.097	-0.027
Finance	0.043	0.683	-0.078	0.042	0.175	-0.308	0.006	0.169	-0.102	0.005	-0.024
Plantation	0.075	0.749	-0.036	-0.059	0.075	-0.163	-0.018	-0.021	-0.094	0.100	0.083
Property	-0.006	0.396	-0.046	-0.058	0.088	-0.374	-0.025	0.079	-0.157	-0.022	-0.063
Trading Service	0.014	0.593	-0.118	-0.001	0.069	-0.155	-0.025	0.102	-0.072	0.006	-0.054

Secondly, standard deviation (variance) of each sector returns has been evaluated (see Table 6). Consumer and plantation sectors carry the least variance with their high returns, which are O.ss·percent and 1.0381 percent. On the other hand the construction sectors show high risk and declining returns over the past 10 years, thus, recording the highest variance in returns performance among the selected industries.

The Sharpe measure, which uses the standard deviation, evaluates portfolio performance on the basis of both the pofolio's returns and its diversification. Results of the Sharpe ratio test are shown in Table 7. Over the past 10 years, the best performers are Plantation (0.075), Finance (0.043) and the Consumer sector (0.036). The Property sector shows the least performance (-0.006).

CONCLUSION

The returns of different industry sectors generally tend to be highly correlated with each other. This implies limited benefits of diversification across industries. However, the findings show that despite the high correlation between indices, this correlation relationship is not stable over time. In other words, two industries whose returns are high for one period may not necessarily show the same behavior in the next period. Therefore, if the investment horizon is longer than one period, diversification across industries and time may yield some benefits in risk reduction. This behavior suggests that there are benefits to be gained from diversification across plantation, consumer and finance industries which also recorded good returns performance in the past ten years.

However, the usability of the findings is subject to the following qualifications. First, the decision to diversify across these industries must be matched by a corresponding or a least similar investment horizon. Secondly, all of the KLSE stock indices are not dividends-adjusted, therefore, unless using a speculative strategy, the performance of the industry must be differentiated from the performance of a typical stock. Therefore diversification across industries might not show benefits. However, the correlation between the returns of different industry sectors suggests that diversification across industries can only be a supplementary strategy in combination with other diversification strategies.

This finding suggests that investors who specialize in one or two economic sectors over a short period of time are likely to experience higher total risk in their investments, which implies that the effectiveness of this strategy is in the long-term investment horizon. This indicates that investment managers must account for potential movements insector-specific and sub-sector-specific risks. Portfolio managers must take note that there is no evidence of consistent performance of different sectors or industries. The performance varies over time with some industries far outperforming others, and the industry rankings are not consistent. Investors cannot be sure that industries that performed well recently will continue to do so in the near future. There are many exogenous factors that can affect industrial performance (such as economic growth, government policy, economic health of importing nations, development of new technologies etc) that were not discounted for in the analysis.

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