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EXAMINING THE DETERMINANTS FOR ASYMMETRIC INDUSTRIAL CORRELATION IN BULL AND BEAR PERIODS IN BURSA MALAYSIA

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ABSTRACT

This paper investigates the asymmetric behavior and the influence of determinants on pair wise industrial correlations in Malaysian stock market over 1990 until 2010 period. We find that most of the pair-wise industrial correlations are highly correlated during bear market. The regression analysis shows that only market volatility significantly explains the pair-wise industrial correlations during both bull and bear periods while the other explanatory variables including the Malaysian market returns, the US market returns and market liquidity do not show any impact on industrial correlations across both bull and bear periods.

Keywords: Asymmetric Industrial Correlation; Bull Market; Bear Market.

1. INTRODUCTION

Technology advancement and financial liberalization amplify both positive and negative effects to economic development. With the advanced technology, investors can carry the information faster and efficiently across the market, while the deregulation and flexibility in financial markets decrease investment barrier. In the 1990s, capital market has become deregulated and more open to foreign investors. It provides the opportunity for domestic investors to transact across foreign equity markets. The effect of this financial liberalization is debatable among researchers. Fundamentally, financial liberalization is generally believed to improve the performances in finance sector and promote economic growth. However, some researchers argue that it has increased the risk to investors. The combined effect of technology advancement and the expansion of liberalization increase market integration. The integration of stock market is generally followed by increasing market liquidity, market volatility, market correlations and economic growth. The increase in market integration generally causes a

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reduction in the benefit of international diversification strategy. Recently, several researchers argue that the benefits of diversification have been reduced owing to the increase of correlations among international equity markets (Longin and Solnik, 1995; Errunza, Hogan and Hung, 1999; Solnik and Roulet, 2000; Driessen and Laeven, 2007). An alternative diversification strategy has been advocated to support the decreasing benefits in international diversification. This is known as industry diversification.

Based on the above arguments, the purpose of this study is to examine the importance of industrial diversification by taking into consideration the issue of asymmetric correlations in order to avoid the overvaluation and undervaluation in industry diversification. We focuses on several potential variables that might explain the asymmetric industrial correlations, comprising of both local and US market returns, local market liquidity and local market volatility. To our knowledge, previous findings of asymmetric correlation are limited to developed markets such as the US stock market. This study attempts to fill up the gap in the literature by emphasizing on the asymmetric industrial correlations in an emerging market namely Malaysia. The objectives of the study are twofold: (1) to analyze the existence of asymmetric industrial correlations during bull and bear markets and (2) to investigate the impact of market returns, market liquidity and market volatility on industrial correlations during bull and bear markets.

The remaining of this paper is organized as follows. The next section reviews past literature on industrial correlations. Section three discusses the methodology and data employed in the study. The empirical results are presented in Section 4. The final section concludes the paper.

2. LITERATURE REVIEW

International investment has become one of the hottest discussions among the researchers and investors. International diversification has been introduced in order to protect investors against market crash. Traditionally, international portfolio diversification is analyzed by mean-variance framework where pair-wise correlations of the assets are used to gauge the extent of international diversification. However, empirical findings from Longin and Solnik (1995), Solnik, Boucrelle and Le (1996), Solnik and Roulet (2000), Goetzmann and Rouwenhorst (2005), Yang, Tapon and Sun (2006), Ferreira and Gama (2010), and Syllignakis and Kouretas (2011) document that correlations of stock return are not constant over time, implying that the behavior of investors tends to change according to the movement of correlation between financial assets.

Previous empirical findings in the 1970s until 1990s indicate that country diversification is beneficial to investors when cross country correlations are low (Grubel, 1968; Levy and Sarnat, 1970; Solnik, 1974, 1982; Jorion, 1985; Black and Litterman, 1992; Jankus, 1998). Several empirical findings by Lessard (1974), Solnik (1974), Heston and Rouwenhorst (1994, 1995) Griffin and Karolyi (1998) Serra (2000) and Denis et al (2002) indicate that country effects are dominated by industry effects.

Recently, technology advancement and financial liberalization have reduced trading barriers in order to provide investment opportunity to foreign investors. With the changes of economic

structure, it is not surprising to find that country based diversification has become less important while correlation among international stock markets have increased. Several researchers have provide empirical evidence on this claim, see for example Longin and Solnik (1995); Errunza, Hogan and Hung (1999); Solnik and Roulet (2000); Driessen and Laeven (2007).

In view of the decreasing benefit in international diversification, industry diversification has been advocated with the back of solid empirical ground, see for example Cavaglia, Brightman and Aked (2000), Galati and Tsatsaronis (2001), Baca, Garbe and Weiss (2000), Wang, Lee and Huang (2003), Brooks and Del Negro (2004a), Isakov and Sonney (2004), and Bai and Green (2010). These studies highlight that industry factor become more important than country factor. This is supported by Flavin (2004) who indicates that low industrial correlations are actually the reason of the shift interest of investors towards industry diversification. Ferreira and Gama (2005) argue that industry correlations remain low within a market, therefore industry diversification is preferable than international diversification. Later, Bai and Green (2010) add that increasing of liberalization has changed a time pattern of both country and industry effects in emerging market. As a result, industry effects become more important than country effects. This is evident by Ferreira and Gama (2010), who document that industry correlation show a systematic increase in the late 1990s, thus industry correlations are considered as an alternative strategy to investors because the correlations among industries are low.

Since stock prices are sensitive to economic fluctuation, the bull and bear markets need to be considered in the portfolio allocation. Asymmetric correlation is a concept of differentiating correlation measurement during falling and rising markets. Previously, the asymmetric correlation was measured by skewness and co-skewness. A study by Longin and Solnik (2001) applies an exceedance correlation between positive and negative returns in measuring asymmetric correlation. In addition, Ang and Chen (2002) employ the H statistic and find that smaller, recent loser stocks may have greater asymmetric correlations, while higher beta stocks might have a lower asymmetric correlation. Ang and Bakaert (2002) argue that high volatility and correlation tend to exist during bear market. Recently, Kearney and Poti (2006) report that asymmetric correlations tend to react to both positive and negative news. A free model has been proposed by Hong, Tu and Zhou (2007) to test asymmetric correlation in the US stock market. The result shows strong asymmetry for beta sorted portfolio and slightly significant in size sorted portfolio. Later, empirical findings by Kunovac (2011) conclude that correlation is rapidly increased in European countries during bear markets.

3. DATA AND METHODOLOGY

3.1. Data Sources

This study uses daily industry indices of the Malaysian stock market from January 1990 to December 2010. The industries indices are classified following the Financial Times Actuaries Standards. The industries are basic materials, consumer goods, consumer services, finance, healthcare, industrial products, oil and gas, technology, telecommunication and utilities. In addition, Malaysian market returns, the US market returns, market liquidity and market volatility are included as determinants in the model. All indices are collected from Datastream

and the series are quoted in local currency. The return indices have been converted into natural logarithm.

3.2. Methodology

The dependent variable in the model is the pair-wise industrial correlations between the Malaysian industries. We follow the study by Ferreira and Gama (2010) to construct the monthly industrial correlations by using daily stock returns based on the following standard formula:

$$COR_{ij,t} = \frac{COV_{ij,t}}{\sqrt{VAR_{i,t} \times VAR_{j,t}}}$$

where *i* and *j* denote industry *i* and *j* and the time subscript *t* refers to trading day in the month. *COV* and *VAR* denote the covariance and variance, respectively.

3.3. Examining Asymmetric Bull and Bear Effects on Industrial Correlations

To investigate the influence of market trends (rising and falling markets) on the Malaysian industrial correlations, the following regression model is estimated:

$$COR_{ij,t} = \beta^{+}_{1,ij} I^{+} + \beta^{-}_{2,ij} I^{-} + \gamma_{ij} COR_{ij,t-1} + \varepsilon_{ij,t} \quad (2)$$

where I^{+} is the bull dummy taking value of one when the average monthly market returns show a positive value and zero otherwise. I^{-} is the bear dummy with a value of one when the average market returns is in negative values and zero otherwise. The lagged dependent variable is included in the model to pick up serial correlations in the dependent variable. Wald test is used to test the equality between the coefficients of the bull dummy and bear dummy.

3.4. Determinants of Industrial Correlations

To test the possible determinants of the pair-wise industrial correlations, we introduce four explanatory variables, the Malaysian market returns, the US market returns, the Malaysian market liquidity and Malaysian market volatility.

Recently, Ferreira and Gama (2010) report that the influence of market returns have been foundon asymmetric industrial correlations. Meanwhile, Patel (2011) argues that emerging markets of Asia have become integrated with the US stock market. Thus the development in the US market might also influence industrial correlations in the Asian markets like Malaysia.

The effect of market liquidity on market returns in emerging countries have been highlighted in the studies by Brennan et al. (1998), Datar et al. (1998), Chordia et al. (2001), Amihud

(2002), Jones (2002), Jun, Marathe and Shawky (2003). While studies by Maheu and McCurdy (2000), Edwards et al. (2003), Gomez and Gracia (2004), Guidolin and Timmerman (2005), and Taamouti and Tsafack (2009) have taken into account the effect of market volatility on correlations of stock returns. Based on these arguments, the Malaysian market returns, the US market returns, Malaysian market liquidity and Malaysian market volatility are included as explanatory variables in the empirical model.

The empirical model is:

$$\begin{aligned} COR_{ij,t} = {} & \alpha_{ij} + \delta^{+}_{1,ij} I^{+} \left| r_{m,t} \right| + \delta^{-}_{2,ij} I^{-} \left| r_{m,t} \right| + \delta^{+}_{3,ij} I^{+} \left| r_{us,t} \right| + \delta^{-}_{4,ij} I^{-} \left| r_{us,t} \right| + \delta^{+}_{5,ij} I^{+} \left| LIQ_{m,t} \right| \\ & + \delta^{-}_{6,ij} I^{-} \left| LIQ_{m,t} \right| + \delta^{+}_{7,ij} I^{+} \left| VOL_{m,t} \right| + \delta^{-}_{8,ij} I^{-} \left| VOL_{m,t} \right| + \gamma_{ij} COR_{ij,t-1} + \pi_{ij} r_{m,t-1} \\ & + \pi_{ij} r_{us,t-1} + \pi_{ij} LIQ_{m,t-1} + \pi_{ij} VOL_{m,t-1} + \varepsilon_{ij,t} \end{aligned} \tag{3}$$

where $r_{m,t}$ is the Malaysian market returns, $r_{us,t}$ is the US market returns, $LIQ_{m,t}$ is the liquidity series which is measured by using the stock turnover volume and $VOL_{m,t}$ is the market volatility series calculated by the standard deviation of the daily market returns in month *t*. In the model, the sign dummies are allowed to interact with the absolute value of the determinants to examine the effect of each determinant during bull and bear markets.

4. EMPIRICAL RESULTS

Table 1 panel 1 depicts basic descriptive statistics for ten Malaysian industries from January 1990 to December 2010. Panel 2 of Table 1 reports the basic descriptive statistic for Malaysian market returns, US market returns, market liquidity and market volatility. The range of the stock returns for the ten industries are from -0.2426 to 0.1047. Most of the industries show positive returns except for the technology industry with return of -0.2426. Healthcare has the highest mean value of 0.1047 while technology has the lowest mean value of -0.2426. Standard deviation measures the volatility level of the stocks range from 0.3408 to 0.6531. Industry with the highest volatility is healthcare with standard deviation of 0.6531 while the lowest volatility industry is oil and gas industry with standard deviation of 0.3408. The results show that the changes in stock returns in the healthcare industry are higher than other industries. Jarque-Beras significant for all industries, implying the non-normality of the series.

Table 1: Descriptive Statistics for Malaysian Industries and the Determinants of Industrial Correlation

Variable	Mean	Median	Maximum	Minimum	Standard Deviation	Jarque-Bera
Panel 1: Industries						
Basic material	0.0161	0.0108	1.7956	-1.8825	0.4478	101.7991***
Consumer goods	0.0340	0.0358	2.5960	-1.9969	0.4634	341.0675***
Consumer services	0.0347	0.0584	1.1377	-1.3014	0.3465	50.6966***
Finance	0.0443	0.0673	2.6134	-1.7566	0.4526	434.9907***
Healthcare	0.1047	0.0853	1.7792	-4.9848	0.6531	4659.2340***
Industrial products	0.0185	0.0520	1.7693	-2.0835	0.3983	360.7540***
Oil and gas	0.0336	0.0550	1.8202	-2.2717	0.3408	1156.5360***
Telecommunication	0.0433	0.0540	1.7880	-1.4249	0.4222	52.6919***
Technology	-0.2426	-0.3181	0.8859	-1.1996	0.6028	0.2176
Utilities	0.0043	0.0151	1.6423	-2.8914	0.4137	1603.2800***
Panel 2: Determinants						
Market returns	0.7268	1.2653	28.7142	-29.5756	7.4080	90.8235***
US market returns	0.7467	1.3032	11.1012	-18.8649	4.5100	55.2434***
Market Liquidity	1.0356	-0.8492	105.4893	-83.2176	38.3187	4.3864
Market Volatility	1.0430	0.8143	8.6161	0.2408	0.8474	8685.3170***

Notes: *, **, and *** indicate statistical significance at 10%, 5% and 1% level, respectively.

Table 2 illustrates the estimated results of industrial correlations during bull and bear markets. From the results, thirty six out of the forty five industrial correlations which are about 80% of the results show that both bull and bear dummies are statistically significant. This indicates that industrial correlations do not behave the same during bull and bear markets. Looking at the coefficient of the dummy variables, the bear dummy shows highly positive coefficients which imply that industrial correlations tend to move together during bear sentiment. This estimationis consistent with the empirical finding by Ferreira and Gama (2010), except for consumer goods-telecommunication, which is the only pair that shows contrary result, where industrial correlations are higher during bull market. The high growth of the telecommunication industry could be associated with the growth of online purchase activities for consumer goods. Thus, investors may believe the growth of telecommunication industry is correlated with the performance of consumer goods industry.

Table 2: Industrial Correlations during Bull and Bear Markets

$COR_{ij,t}$ is the pair-wise industrial correlations in month t for industry group i and j. I^+ is the average monthly market returns with positive values during bull markets, while I^- is the average monthly market returns with negative values during bear markets. They are sign dummies. To construct sign dummies, I^+ equals to one if the market returns is positive otherwise zero and I^- equals to one if the market returns is negative otherwise zero. $COR^{ij,t-1}$ is the lagged correlation included to pick up serial correlation in the correlation series.

The model estimated is: $COR_{ij,t} = \beta^{+}_{1,ij} I^{+}_{my} + \beta^{-}_{2,ij} I^{-}_{my} + \gamma_{ij} COR_{ij,t-1} + \varepsilon_{ij,t}$

Industries	$\beta^{+}_{1,ij}$	$\beta^{-}_{2,ij}$	γ_{ij}	**F-statistic**	**Results**
Basic material -Consumer goods	0.3432***	0.3936***	0.1953***	65.4459***	Bear>Bull
	(0.0000)	(0.0000)	(0.0018)	(0.0000)	
Basic material -Consumer services	0.3120***	0.4115***	0.3766***	55.5006***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Basic material –Finance	0.3339***	0.4331***	0.3722***	55.5990***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Basic material -Healthcare	0.2116***	0.2749***	-0.1108	34.0184***	Bear>Bull
	(0.0000)	(0.0000)	(0.2319)	(0.0000)	
Basic material –Industrial products	0.3187***	0.4143***	0.3086***	56.8528***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Basic material -Telecommunication	0.2614***	0.3175***	0.2764***	50.1439***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Basic material -Technology	0.1057	0.2299	-0.0348	1.0679	None
	(0.3594)	(0.2270)	(0.9391)	(0.4011)	
Basic material –Utilities	0.2234***	0.3327***	0.3302***	47.8303***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Consumer goods-Consumer services	0.3572***	0.3896***	0.2151***	64.3769***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Consumer goods-Finance	0.3972***	0.4078***	0.1990***	67.7662***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Consumer goods-Healthcare	0.1613***	0.2370***	0.1128	23.1936***	Bear>Bull
	(0.0000)	(0.0000)	(0.2064)	(0.0000)	
Consumer goods-Telecommunication	0.3212***	0.2621***	0.1188*	63.0989***	Bull>Bear
	(0.0000)	(0.0000)	(0.0594)	(0.0000)	
Consumer goods-Technology	0.3170	0.4900*	-0.1457	3.3060	None
	(0.1547)	(0.0500)	(0.7523)	(0.1077)	
Consumer goods-Utilities	0.3188***	0.3248***	0.1907***	54.3219***	Bear>Bull
	(0.0000)	(0.0000)	(0.0046)	(0.0000)	
Consumer services-Finance	0.4896***	0.5460***	0.2224***	77.1491***	Bear>Bull
	(0.0000)	(0.0000)	(0.0003)	(0.0000)	
Consumer services-Telecommunication	0.3470***	0.3547***	0.2602***	57.5905**	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Consumer services-Technology	0.1659	0.6085***	0.0183	10.9105***	None
	(0.1540)	(0.0035)	(0.9462)	(0.0100)	
Consumer services-Utilities	0.3531***	0.4259***	0.2180***	67.1706***	Bear>Bull
	(0.0000)	(0.0000)	(0.0009)	(0.0000)	
Finance-Technology	0.1196	0.5378**	0.2150	5.2207**	None
	(0.4926)	(0.0179)	(0.5827)	(0.0486)	
Healthcare-Consumer services	0.1476***	0.3117***	0.0580	30.1322***	Bear>Bull
	(0.0000)	(0.0000)	(0.4996)	(0.0000)	
Healthcare-Finance	0.1865***	0.3033***	0.0548	31.2852***	Bear>Bull
	(0.0000)	(0.0000)	(0.5525)	(0.0000)	
Healthcare-Telecommunication	0.1432***	0.2148***	0.0477	21.5074***	Bear>Bull
	(0.0000)	(0.0000)	(0.6083)	(0.0000)	
Healthcare-Technology	0.2369	0.3662	0.1157	1.7060	None
	(0.1873)	(0.1403)	(0.7856)	(0.2591)	

Industries	$\beta^{+}_{1,ij}$	$\beta^{-}_{2,ij}$	γ_{ij}	F-statistic	Results
Healthcare-Utilities	0.1230***	0.2224***	-0.0652	23.4072***	Bear>Bull
	(0.0001)	(0.0000)	(0.4699)	(0.0000)	
Industrial products-Consumer goods	0.2846***	0.3117***	0.3430***	45.7438***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Industrial products-Consumer services	0.3741***	0.4207***	0.2859***	60.8570***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Industrial products-Finance	0.3749***	0.4544***	0.3043***	61.9478***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Industrial products-Healthcare	0.1290***	0.2244***	0.1335	17.2764***	Bear>Bull
	(0.0006)	(0.0000)	(0.1504)	(0.0000)	
Industrial products-Telecommunication	0.2778***	0.3073***	0.2700***	51.8571***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Industrial products-Technology	0.1677	0.4449	0.0149	1.5684	None
	(0.3478)	(0.1358)	(0.9732)	(0.2832)	
Industrial products-Utilities	0.2497***	0.3495***	0.3159***	49.8102***	Bear>Bull
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Oil and gas-Basic material	0.3054***	0.3913***	0.1995***	68.6121***	Bear>Bull
	(0.0000)	(0.0000)	(0.0013)	(0.0000)	
Oil and gas-Consumer goods	0.3103***	0.3545***	0.0945	70.5656***	Bear>Bull
	(0.0000)	(0.0000)	(0.1348)	(0.0000)	
Oil and gas-Consumer services	0.3302***	0.3662***	0.2123***	63.1246***	Bear>Bull
	(0.0000)	(0.0000)	(0.0007)	(0.0000)	
Oil and gas-Finance	0.3955***	0.4149***	0.1284**	74.8333***	Bear>Bull
	(0.0000)	(0.0000)	(0.0425)	(0.0000)	
Oil and gas-Healthcare	0.1404***	0.2449***	0.0651	27.2014***	Bear>Bull
	(0.0001)	(0.0000)	(0.4545)	(0.0000)	
Oil and gas-Industrial products	0.3119***	0.3644***	0.1792***	65.9809***	Bear>Bull
	(0.0000)	(0.0000)	(0.0043)	(0.0000)	
Oil and gas-Telecommunication	0.2642***	0.3132***	0.0937	61.7805***	Bear>Bull
	(0.0000)	(0.0000)	(0.1385)	(0.0000)	
Oil and gas-Technology	0.0280	0.4511*	0.1766	2.7302	None
	(0.9194)	(0.0669)	(0.8142)	(0.1435)	
Oil and gas-Utilities	0.2821***	0.3396***	0.1002	62.1645***	Bear>Bull
	(0.0000)	(0.0000)	(0.1336)	(0.0000)	
Telecommunication-Finance	0.3821***	0.4189***	0.1946***	69.9423***	Bear>Bull
	(0.0000)	(0.0000)	(0.0019)	(0.0000)	
Telecommunication-Technology	0.1548	0.5948**	0.1331	3.3703	None
	(0.4422)	(0.0436)	(0.7531)	(0.1044)	
Telecommunication-Utilities	0.3316***	0.3756***	0.2171***	56.3978***	Bear>Bull
	(0.0000)	(0.0000)	(0.0012)	(0.0000)	
Utilities-Finance	0.3999***	0.4615***	0.2036***	68.8499***	Bear>Bull
	(0.0000)	(0.0000)	(0.0019)	(0.0000)	
Utilities-Technology	0.3555	0.4099**	-0.4001	4.9650*	None
	(0.1375)	(0.0379)	(0.4765)	(0.0534)	

Notes: $\beta^{+}_{1,ij}$ and $\beta^{-}_{2,ij}$ denote the estimated coefficient with positive sign dummy and negative sign dummy, respectively. γ_{ij} is the estimated coefficient for lagged correlation and F-statistic is from Wald test. Figure in the parentheses are probability values. The *, **, and *** indicate significant at 10%, 5% and 1% level, respectively.

Table 3 presents the estimated results of the four determinants, Malaysian market returns, the US market returns, market liquidity and market volatility during bull and bear markets. Out of forty five pair-wise correlations, market return is statistically significant for oil and gas-utilities with bull and bear dummies. The coefficient of market return is negatively related to oil and gas and high during bear market which means an increase in market returns decreases the pair-wise correlation of oil and gas-utilities. The oil and gas-utilities indicate low standard deviation which means they can be considered as defensive sectors that are not much affected by ups and downs of the markets. From forty five pair wise correlations, the US market returns and market liquidity show insignificant results. In other words, the increase or decrease in the US market returns and market liquidity has no impact on the performance of industrial correlations.

Market volatility is statistically significant in thirty two out of forty five regressions. Out of thirty two regressions, market volatility is statistically significant in twenty eight pair-wise industrial correlations during bear market while market volatility is statistically significant in four pair-wise industrial correlations during bull market. Therefore, we can conclude that market volatility tend to influence Malaysian industrial correlations during bear market rather than bull market which is in line with a number of studies such as Ang and Bekaert (1999), Maheu and McCurdy (2000), Gomez and Gracia (2004), Guidolin and Timmerman (2005), Taamouti and Tsafack (2009).[1]

Overall, the estimated results show that the majority of industrial correlations are statistically higher during bear market which is consistent with the finding of Ferreira and Gama (2010). In addition, the empirical results show that market volatility has significant effect on industrial correlations during bear sentiment. Therefore, investors need to be alert when the market starts to become volatile in order to minimize their investment risk.

Table 3: Asymmetric Industrial Correlations and Its Determinants during Bull and Bear Markets

$COR_{ij,t-1}$ is the pair-wise industrial correlations in month t for industry group i and j. I^+ is the average monthly market returns with positive values during bull markets, while I^- is the average monthly market returns with negative values during bear markets. They are sign dummies. To construct sign dummies, I^+ equals to one if the market returns are positive otherwise zero and I^- equals to one if the market returns are negative otherwise zero. $COR_{ij,t-1}$ is the lagged correlation included to pick up serial correlation in the correlation series.

[1] We conducted a two-sample t-test on the estimated coefficients of the bull and bear interaction terms of the regression reported in Table 4. The results only support for a significant impact of market volatility, but not the rest.

Industries	Malaysian Market Return		US Market Return		Market Liquidity		Market Volatility	
	$\delta^{+}_{1,ij}$	$\delta^{-}_{2,ij}$	$\delta^{+}_{3,ij}$	$\delta^{-}_{4,ij}$	$\delta^{+}_{5,ij}$	$\delta^{-}_{6,ij}$	$\delta^{+}_{7,ij}$	$\delta^{-}_{8,ij}$
Basic material - Consumer goods	-0.0099** (0.0371)	-0.0002 (0.9722)	0.0143* (0.0586)	0.0091 (0.1961)	0.0008 (0.3051)	0.0010 (0.3004)	0.1520*** (0.0000)	0.1539*** (0.0001)
Basic material - Consumer services	-0.0052 (0.2092)	-0.0046 (0.3786)	0.0026 (0.6916)	0.0050 (0.4148)	0.0011 (0.1156)	0.0015* (0.0973)	0.1271*** (0.0000)	0.1642*** (0.0000)
Basic material - Finance	-0.0023 (0.6055)	-0.0054 (0.3268)	-0.0064 (0.3608)	0.0064 (0.3286)	0.0009 (0.2294)	0.0003 (0.7593)	0.1264*** (0.0000)	0.1766*** (0.0000)
Basic material - Healthcare	0.0034 (0.7819)	-0.0111 (0.5446)	-0.0038 (0.7479)	0.0020 (0.8729)	0.0016 (0.3701)	0.0001 (0.9570)	0.0423 (0.7266)	0.2100** (0.0184)
Basic material - Industrial products	-0.0058 (0.2255)	0.0004 (0.9442)	0.0063 (0.4076)	0.0074 (0.2927)	-0.0004 (0.5819)	0.0010 (0.3086)	0.1708*** (0.0000)	0.1518*** (0.0002)
Basic material - Telecommunication	-0.0040 (0.4150)	0.0002 (0.9693)	-0.0084 (0.2805)	-0.0124* (0.0905)	0.0006 (0.4820)	0.0014 (0.1852)	0.1345*** (0.0000)	0.1485*** (0.0003)
Basic material - Technology	- -	- -	- -	- -	- -	- -	- -	- -
Basic material - Utilities	0.0012 (0.8105)	0.0041 (0.5164)	0.0035 (0.6690)	-0.0013 (0.8603)	-0.0005 (0.5691)	0.0010 (0.3868)	0.1074*** (0.0003)	0.1217*** (0.0047)
Consumer goods- Consumer services	-0.0099** (0.0342)	-0.0034 (0.5596)	0.0096 (0.2025)	0.0069 (0.3204)	0.0010 (0.1975)	-0.0001 (0.9114)	0.1326*** (0.0000)	0.1584*** (0.0001)
Consumer goods- Finance	-0.0120*** (0.0087)	-0.0029 (0.6098)	0.0093 (0.2070)	0.0073 (0.2793)	0.0018** (0.0167)	-0.0008 (0.4095)	0.1272*** (0.0000)	0.1683*** (0.0000)
Consumer goods- Healthcare	-0.0143 (0.2472)	-0.0123 (0.5040)	0.0015 (0.9013)	0.0083 (0.4993)	-0.0008 (0.6262)	0.0017 (0.3612)	0.4093*** (0.0016)	0.3165*** (0.0005)
Consumer goods- Telecommunication	-0.0096* (0.0593)	-0.0014 (0.8312)	0.0146* (0.0748)	-0.0090 (0.2351)	0.0015* (0.0755)	-0.0001 (0.9022)	0.1379*** (0.0000)	0.1764*** (0.0000)

Notes: $\delta^{+}_{1,ij}$ and $\delta^{-}_{2,ij}$ denote the estimated coefficient positive sign dummy interacts with absolute market returns and negative sign dummy interacts with absolute market returns, respectively. $\delta^{+}_{3,ij}$ and $\delta^{-}_{4,ij}$ denote the estimated coefficient positive sign dummy interacts with absolute US market returns and negative sign dummy interacts with absolute US market returns, respectively. $\delta^{+}_{5,ij}$ and $\delta^{-}_{6,ij}$ denote the estimated coefficient positive sign dummy interacts with absolute liquidity and negative sign dummy interacts with absolute liquidity, respectively. $\delta^{+}_{7,ij}$ and $\delta^{-}_{8,ij}$ denote the estimated coefficient positive sign dummy interacts with absolute volatility and negative sign dummy interacts with absolute volatility, respectively. Figure in the parenthesis are probability value. The *, **, and *** indicate statistical significance at 10%, 5% and 1% level, respectively.

Table 3: Asymmetric Industrial Correlations and Its Determinants during Bull and Bear Markets *(continued)*

Industries	Malaysian Market Return		US Market Return		Market Liquidity		Market Volatility	
	$\delta^{+}_{1,ij}$	$\delta^{-}_{2,ij}$	$\delta^{+}_{3,ij}$	$\delta^{-}_{4,ij}$	$\delta^{+}_{5,ij}$	$\delta^{-}_{6,ij}$	$\delta^{+}_{7,ij}$	$\delta^{-}_{8,ij}$
Consumer goods-Technology	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Consumer goods-Utilities	-0.0107**	-0.0024	0.0183**	-0.0041	0.0005	0.0004	0.1415***	0.1695***
	(0.0269)	(0.7066)	(0.0253)	(0.5668)	(0.5116)	(0.7207)	(0.0000)	(0.0001)
Consumer services-Finance	-0.0032	-0.0073*	0.0036	0.0058	0.0010*	-0.0003	0.0786***	0.1543***
	(0.3414)	(0.0806)	(0.4938)	(0.2366)	(0.0808)	(0.6795)	(0.0001)	(0.0000)
Consumer services-Telecommunication	-0.0034	-0.0024	0.0058	-0.0084	0.0015**	0.0006	0.0980***	0.1620***
	(0.4588)	(0.6670)	(0.4216)	(0.2079)	(0.0470)	(0.5667)	(0.0003)	(0.0000)
Consumer services-Technology	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Consumer services-Utilities	-0.0082**	0.0036	0.0049	0.0001	0.0015**	-0.0001	0.1138***	0.1395***
	(0.0472)	(0.4972)	(0.4747)	(0.9921)	(0.0330)	(0.9083)	(0.0000)	(0.0001)
Finance-Technology	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Healthcare-Consumer services	-0.0019	-0.0196	-0.0124	0.0040	0.0000	-0.0007	0.0830	0.2623***
	(0.8799)	(0.2944)	(0.2976)	(0.7460)	(0.9922)	(0.7127)	(0.5020)	(0.0040)
Healthcare-Finance	-0.0068	-0.0098	-0.0026	0.0034	-0.0010	0.0032	0.2504*	0.2348**
	(0.5934)	(0.6064)	(0.8350)	(0.7875)	(0.5727)	(0.1143)	(0.0615)	(0.0125)
Healthcare-Telecommunication	0.0181	-0.0180	0.0001	-0.0015	-0.0016	0.0026	0.1616	0.2512***
	(0.1273)	(0.2986)	(0.9920)	(0.8981)	(0.3382)	(0.1432)	(0.1592)	(0.0031)
Healthcare-Technology	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Healthcare-Utilities	0.0020	-0.0232	-0.0012	-0.0009	-0.0014	0.0005	0.1639	0.2764***
	(0.8626)	(0.1771)	(0.9146)	(0.9398)	(0.3834)	(0.7954)	(0.1537)	(0.0011)
Industrial-Consumer goods	-0.0056	-0.0014	0.0167**	0.0004	-0.0002	0.0000	0.1287***	0.1635***
	(0.2604)	(0.8208)	(0.0386)	(0.9546)	(0.8423)	(0.9756)	(0.0000)	(0.0001)
Industrial-Consumer services	0.0004	-0.0048	-0.0026	0.0082	0.0011*	-0.0011	0.1022***	0.1744***
	(0.9119)	(0.3398)	(0.6882)	(0.1695)	(0.0844)	(0.2020)	(0.0000)	(0.0000)
Industrial products-Finance	-0.0076*	-0.0041	-0.0041	0.0028	0.0000	-0.0012	0.1288***	0.1679***
	(0.0672)	(0.4305)	(0.5367)	(0.6481)	(0.9425)	(0.1673)	(0.0000)	(0.0000)
Industrial products-Healthcare	-0.0074	0.0091	0.0051	-0.0074	-0.0021	0.0007	0.2600*	0.2279**
	(0.5890)	(0.6545)	(0.6977)	(0.5896)	(0.2719)	(0.7254)	(0.0631)	(0.0209)

Table 3: Asymmetric Industrial Correlations and Its Determinants during Bull and Bear Markets *(continued)*

Industries	Malaysian Market Return		US Market Return		Market Liquidity		Market Volatility	
	$\delta^{+}_{1,ij}$	$\delta^{-}_{2,ij}$	$\delta^{+}_{3,ij}$	$\delta^{-}_{4,ij}$	$\delta^{+}_{5,ij}$	$\delta^{-}_{6,ij}$	$\delta^{+}_{7,ij}$	$\delta^{-}_{8,ij}$
Industrial products-Telecommunication	-0.0011 (0.8146)	-0.0050 (0.3836)	0.0015 (0.8404)	-0.0118* (0.0850)	0.0003 (0.6572)	0.0003 (0.7288)	0.1134*** (0.0000)	0.1946*** (0.0000)
Industrial products-Technology	- -	- -	- -	- -	- -	- -	- -	- -
Industrial products-Utilities	-0.0041 (0.3907)	0.0038 (0.5372)	0.0145* (0.0733)	-0.0031 (0.6623)	-0.0004 (0.6572)	0.0010 (0.3490)	0.1349*** (0.0000)	0.1600*** (0.0002)
Oil and gas-Basic material	-0.0001 (0.9825)	0.0003 (0.9634)	0.0029 (0.7001)	-0.0076 (0.2721)	0.0000 (0.9534)	0.0024** (0.0176)	0.1346*** (0.0000)	0.1558*** (0.0001)
Oil and gas-Consumer goods	-0.0057 (0.2448)	0.0002 (0.9704)	0.0214*** (0.0064)	-0.0094 (0.1920)	0.0009 (0.2487)	0.0020* (0.0510)	0.1294*** (0.0000)	0.1841*** (0.0000)
Oil and gas-Consumer services	-0.0031 (0.4855)	-0.0146*** (0.0099)	0.0053 (0.4533)	-0.0028 (0.6723)	0.0017** (0.0233)	0.0010 (0.3035)	0.1214*** (0.0000)	0.2370*** (0.0000)
Oil and gas-Finance	-0.0004 (0.9289)	-0.0080 (0.1942)	0.0089 (0.2599)	-0.0056 (0.4407)	0.0003 (0.7217)	0.0007 (0.5073)	0.1234*** (0.0000)	0.1924*** (0.0000)
Oil and gas-Healthcare	-0.0042 (0.7296)	-0.0270 (0.1339)	0.0084 (0.4672)	0.0049 (0.6814)	-0.0008 (0.6252)	0.0041** (0.0264)	0.2494** (0.0388)	0.2780*** (0.0019)
Oil and gas-Industrial products	-0.0039 (0.3969)	-0.0031 (0.5951)	0.0036 (0.6244)	-0.0061 (0.3741)	-0.0005 (0.4707)	0.0006 (0.5086)	0.1657*** (0.0000)	0.1856*** (0.0000)
Oil and gas-Telecommunication	-0.0073 (0.1556)	-0.0151 (0.0191)	0.0095 (0.2499)	-0.0026 (0.7299)	0.0008 (0.3220)	0.0016 (0.1404)	0.1404*** (0.0000)	0.2333*** (0.0000)
Oil and gas-Technology	- -	- -	- -	- -	- -	- -	- -	- -
Oil and gas-Utilities	-0.0137*** (0.0068)	-0.0116* (0.0736)	0.0142* (0.0917)	0.0001 (0.9899)	0.0014* (0.0895)	0.0011 (0.3320)	0.1475*** (0.0000)	0.2163*** (0.0000)
Telecommunication-Finance	-0.0054 (0.2228)	-0.0016 (0.7678)	0.0032 (0.6460)	-0.0089 (0.1700)	0.0009 (0.2074)	0.0012 (0.1844)	0.1042*** (0.0001)	0.1445*** (0.0001)
Telecommunication-Technology	- -	- -	- -	- -	- -	- -	- -	- -
Telecommunication-Utilities	-0.0049 (0.2782)	-0.0012 (0.8331)	0.0116 (0.1274)	-0.0067 (0.3150)	0.0003 (0.6725)	0.0000 (0.9853)	0.1237*** (0.0000)	0.1871*** (0.0000)
Utilities-Finance	-0.0092** (0.0290)	0.0042 (0.4411)	0.0166** (0.0193)	-0.0059 (0.3434)	0.0002 (0.7568)	0.0000 (0.9793)	0.0902*** (0.0004)	0.1184*** (0.0015)
Utilities-Technology	- -	- -	- -	- -	- -	- -	- -	- -

5. CONCLUSION

This paper investigates the asymmetric behavior and the influence of determinants on pair-wise industrial correlations in the Malaysian stock market during 1990 to 2010 period. We find that most of the pair-wise industrial correlations are highly correlated during bear market. The empirical evidence indicates that industry diversification is not preferable for Malaysians stock market when the market is in bear sentiment. However, Malaysian investors can minimize investment risk with the different proposed pair-wise industrial correlations during bull and bear markets. The regression analysis shows that only market volatility significantly explains the pair-wise industrial correlations in both bull and bear periods while the other explanatory variables including Malaysian market returns, the US market returns and market liquidity do not show any impact on industrial correlations across both bull and bear periods. Therefore, Malaysian investors need to be alert when market is volatile as the risk is going to be higher over the period. The results provide important policy implications for domestic investors and international investors. The main idea shows that the investors are more productive when they diversify their portfolio in bull market rather than bear market. It is suggestible that investors should stay away from bear market as this analysis has shown that most industries are moving together during falling market or bear market. Therefore, diversification benefits are minimal during bear market. However, the results are applicable to the Malaysian industries only. Future research may consider several other possible issues by including industrial correlations with other countries such as the pair of Malaysia-US, Malaysia-China, Malaysia-India and others. With this approach, Malaysian investors can construct their portfolio of firms from foreign industries.

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