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OIL PRICE EXPOSURE TO ASSET RETURNS: A DISAGGREGATE ANALYSI

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***Abstract*—The paper analyzed oil price exposure on asset returns of eight economic sectors namely- Construction (CON), Consumer (CSU), Finance (FIN), Industrial (IND), Plantation (PLN), Property (PRP), Services (SER), and Mining (TIN). of economy. Two tests, identified as Model 1 and Model 2, were conducted via the Augmented-CAPM (A-CAPM) approach. The first was a symmetric analysis while the second was an asymmetric typed of analysis. The estimated results from Model 1 documented insignificant results in all sector analyses. These findings signified that the stock returns were not exposed to oil price shocks. The estimated results of Model 2 indicated the presence of significant finding in industrial (IND) sector, of the PW analysis. The returns of the IND sector were negatively exposed to change in PW oil price, and it was more significant during periods of oil price increased. In other word, the event of oil price increased significantly reduced the returns of the IND sector.**

Keywords: Asset returns, financial market, oil price, Augmented CAPM Model.

I. INTRODUCTION

Malaysia is an oil exporting country, and the domestic oil price is fixed by the government. The continuous increase in the world oil price in 2000s had pressured the Malaysian government to review its policy on domestic oil price setting and finally decided to adjust the retail price of oil in the domestic market in correspond to the movements in the world oil price. The change in domestic oil prices in response to changes in world oil prices has raised an important question on the impact of oil price on the Malaysian economy.

In the literatures, majority of the studies (Hamilton, 1983; Ferderer, 1996; Hamilton, 2000; and Cunado & de Garcia, 2003 and 2004) had put specific focused on the oil price impact on the macroeconomy. Majority had detected significant negative relationships. However, in the financial market analysis, only limited number of studies was conducted and the findings were relatively mixed. Studies by Chen et al. (1986), Hamao (1989) and Manning (1991) documented insignificant results, while Kaneko & Lee (1995), Hondroyiannis & Papapetrou (2001), and Sadorsky (2003) reported significant findings. Studies by Hammoudeh & Eleisa (2004) and Agusman & Derianto (2008) on the other hand documented mixed results.

In the case of Malaysia, Norasibah et al. (2009a and 2009b) had put explicit focus on the impact of oil price on the output and the stock market. Based on the findings, significant results were documented in the real market analysis only. Looking into the cases closely, the two studies were limited to aggregate type of analyses only. Therefore, the current study intended to give specific attention to financial market disaggregate analyses. The reason for the choice was because; the analysis at the aggregate level failed to detect any significant relationship, and this finding provided us a motivation to explore the issue further by conducting a detailed analysis at disaggregate level.

The paper is comprised of four sections. The next section highlights the methodology, followed by results reporting section and the final section concludes.

II. METHODOLOGY

This study used two types of oil prices; the world oil price converted into domestic currency value (PW) and the domestic oil price (PD). The PW oil price was derived from West Texas Intermediate (WTI) crude oil prices converted into Ringgit Malaysia (RM) value[1] while the PD oil price was derived from diesel oil price (in RM per liter) sold in

[1]The conversion from the USD value into the RM value is following this formula: $PW_{RM} = \frac{(PW_{USD} \times ER)}{Deflator}$

the local market.[2] The world oil price was deflated using world CPI, while the domestic oil price uses domestic CPI. Two sets of monthly data from the time-span of 1992.9 – 2005.12 [3] and 1993.9-2005.12 [4] were employed. The monthly data was employed instead of higher frequency data, such as daily or weekly data, was because higher frequencies were at risk of containing too much noise and were subject to the problem of non-synchronous and infrequent trading (Ibrahim, 2006). Two tests were conducted via the Augmented-CAPM (A-CAPM) model. The first test measured oil price exposure on asset returns (Model 1), while the second test examined the asymmetric relationship (Model 2).

The Oil Price Exposure Test: Model 1

The basic model of Jorion (1990);

$$R_{it} = \alpha + \beta MKTR_t + \theta_1 X_{it} + \sigma_t \quad (1)$$

Where R_{it}[5] is the return of the sector under consideration, $MKTR_t$ is the market return,[6] X_t is (are) the focus variable(s) and σ_t is the disturbance term. We extended the model by including oil price variable, as in equation 2, and we named it as Model 1.

$$R_{it} = \alpha + \beta MKTR_t + \theta_1 OIL_{it} + \sigma_t \quad (2)$$

Where OIL_t represents change in oil price. The returns and the oil price variable were computed using logarithmic difference. The focal coefficient was θ_1, as it measured the sensitivity of returns to changes in oil prices. If null hypothesis was rejected, the analysis was interpreted as; "change in oil price affects the returns".

The Asymmetric Test: Model 2

Model 1 assumed symmetric relationship, as it did not take into account changed in values in returns during periods of oil price increase or decrease. Following Tai (2005) and Ihrig & Prior (2005), Model 1 was extended to Model 2, as in equation (3), to incorporate changed in market conditions.

$$R_{it}=\alpha+\beta MKTR_t+\theta_1 OIL_{it}+(\theta_2 D_t X\, OIL_{it})+\sigma_t \quad (3)$$

Where D_t was an oil price dummy variable which took the value of *1* during oil price increased period and *0* otherwise. Based on equation (3), θ_1 and $(\theta_1 + \theta_2)$ respectively measured the exposure during oil price decreased and oil price increased periods. The difference in exposure values between price increase and price decrease could be tested on the null hypothesis that $\theta_2 = 0$.

[2] The reason for not considering other types of oil prices (petrol - RON97, RON92) was because, the movements in prices among diesel with other oil types tend to be parallel and the difference was not substantial.

[3] For finance, industrial, plantation and mining indices

[4] For construction, consumer, production, service indices

[5] The monthly return for the each sector considered is; $r_{it} = (p_t - p_{t-1}) / p_{t-1}$ or $r_{it} = \log(p_t) - \log(p_{t-1})$, where p_{it} is the price of the index i at time t, while p_{t-1} is the closing price for the previous period (month).

[6] Kuala Lumpur Composite Index is used to represent the market portfolio.

III. Results Reporting

Table 1 presented the descriptive statistic of the returns of each sector and their correlations with both types of oil prices.

TABLE I. DESCRIPTIVE STATISTIC RESULTS

Stats. / Sectors	Mean	Std. Dev.	Jarque-Bera (normality test)	CORRELATIONS	
				PW	PD
CON	-0.008	0.124	99.108***	-0.095	-0.054
CSU	0.000	0.077	77.282***	-0.109	-0.058
FIN	0.000	0.115	99.555***	-0.144	-0.043
IND	0.000	0.076	28.641***	-0.066	-0.032
PLN	0.001	0.093	200.927***	-0.085	-0.053
PRP	-0.012	0.110	16.690***	-0.102	-0.082
SER	-0.003	0.090	7.774**	-0.092	-0.037
MIN	-0.004	0.147	46.282***	-0.105	-0.040
MKTR	-0.002	0.086	21.362***	-0.094	-0.041
PW	0.009	0.077	5.481***	1.000	-0.001
PD	0.002	0.029	4793.279***	-0.001	1.000

Notes: The descriptive statistics are based on the returns of the indices and the changes in oil prices. *** and ** denote significant at 1% and 5% levels. Values are rounded to the nearest three decimal points.

Over the sample period, the market recorded a negative return of 0.18% per month. Out of eight indices; three sectors experienced positive average monthly returns with PLN having the highest return of 0.12% per month, followed by FIN (0.03%) and IND (0.01%). In the case of CSU; despite a positive return, the average percent was near zero. The other four sectors exhibited negative average monthly returns. The Properties (PRP) sector seemed to suffer most with a negative average monthly return of almost 1.21%, followed by CON (0.76%), MIN (0.41%) and SER (0.34%).

Column three of Table 1 displayed the value of unconditional standard deviation which measured the volatility rate. The MIN sector exhibited the highest volatility rate, followed by the CON, FIN, PRP, PLN, and SER, by the rate of 14.72%, 12.41%, and 11.48%, 11.03%, 9.29% and 8.96% respectively. Other sectors recorded the lowest volatility rate of 8%.

Focusing on the oil price variable, the results indicated that both PW and PD oil prices experience an increase throughout the sample period. On average, the PW oil price increased at an average rate of 0.89%, while the PD oil price was 0.24%.

The last two columns showed that, all returns correlated negatively with both types of oil prices. In particular; the FIN, CSU, PRP and MIN sectors of the PW analysis exhibited stronger correlation relationship than other returns as the value of the coefficient was more than 10%. In the

PD analysis, all sectors documented negative and weak correlation relationship.

Given the relative volatility of these sectors, the correlation rates were suggestive of the influence of oil price changes on their returns. However, these statements were just indicative as the computed correlations did not control for market risk. To be more precise, the analysis was extended by employing the augmented CAPM model to evaluate the degree of oil price exposure of various indices.

Estimated Results of Model 1 & Model 2

The overall results of Model 1 were presented in Table 2. Both PW and PD analyses were satisfactory as indicated by high explanatory power of adjusted-R^2. Moreover, the market beta is positive and statistically significant for all sectors indicating co-movement between returns of economic sectors and market returns. The θ_1 coefficient implied oil price exposure differed in terms of direction across sectors in all analyses. However, all coefficients were insignificant at 5% level.

We presumed the linear specification might not be able to capture the interactions between the oil price and the stock returns variables efficiently. This model was then extended into Model 2.

The overall results of Model 2 were presented in Table 3. Compares to Model 1, the beta risk estimates obtained in Model 2 in all analyses remain robust. Focusing on the θ_2 coefficient, significant result was documented in the IND sector of the PW analysis only. This finding provided evidence that the IND sector was negatively exposed to world oil price shocks (PW) and was susceptible to asymmetric type of exposure.

In particular, during oil price decrease periods, the value of exposure (θ_1) is 7.5% while during oil price increase periods; the value of exposure during oil price increase periods (θ_1+θ_2) was-8.7%. Based on the magnitude of the exposures, we may infer that IND sector was more sensitive to oil price increased than oil price decreased periods. This relationship may have connection with the characteristics of the industrial (IND) sector – which required large capital, sophisticated technology and skilled labors. The industries categorized under this sector consist of cement plant, hot steel and rod iron, national car project, small engine and engineering complexes. These industries heavily depend on oil in their operation and manufacturing processes. Therefore, the event of oil price increase caused the operating cost to go up, and reduced the profit size or the asset earnings on investment. This explanation justifies the negative asymmetric exposure of oil price shocks to the IND returns.

IV. CONCLUSION

The estimated results from Model 1 showed all sectors documented insignificant results. These findings signified that the stock returns were not exposed to oil price shocks. The estimated results of Model 2 documented one significant θ_2 coefficient in the industrial (IND) sector of the PW analysis. In particular, the returns of the IND sector were negatively exposed to change in PW oil price, and it was more significant during periods of oil price increase. This information provided indication that the IND sector was an oil dependent industry and was vulnerable to oil price shocks.

As policy recommendations, there are several alternatives. One is by reducing oil dependency level through promoting the usage of bio-fuels i.e., bio-mass oil, or other alternatives to fuel i.e. natural gas vehicle (NGV). Two is by promoting the usage of efficient and cost saving machineries. This is to ensure the higher input cost is compensated with higher production level. Third is by promoting energy a saving or conservation program. In the mission to achieve the main objective, such program also educate the public to be thrifty in their resource employment. The last alternative relating to this issue involved government's future policy implementation. In order to avoid the risk of economic downturn due to oil price increase in the future, the government may also consider restructuring or developing country's prime industry from oil dependent type to non-oil dependent type of industry.

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TABLE II. ESTIMATED RESULTS FOR MODEL 1

	CON	CSU	FIN	IND	PLN	PRP	SER	MIN
PW Analysis								
C	-0.003 (0.005)	0.003 (0.003)	0.004 (0.003)	0.004 (0.002)	0.002 (0.005)	-0.009 (0.005)	-0.002 (0.001)	-0.002 (0.009)
MKTR	1.215*** (0.054)	0.795*** (0.033)	1.184*** (0.036)	0.853*** (0.023)	0.912*** (0.055)	1.065*** (0.055)	1.040*** (0.016)	1.338*** (0.095)
PW (θ_1)	0.035 (0.062)	-0.029 (0.037)	-0.029 (0.041)	-0.007 (0.026)	-0.050 (0.062)	0.015 (0.062)	-0.013 (0.018)	-0.069 (0.108)
Adj. R^2 DW	0.817 1.958	0.827 2.332	0.905 2.376	0.915 2.455	0.672 2.207	0.769 1.921	0.971 2.078	0.604 2.176
PD Analysis								
	CON	**CSU**	**FIN**	**IND**	**PLN**	**PRP**	**SER**	**MIN**
C	-0.002 (0.005)	0.003 (0.003)	0.004 (0.003)	0.003 (0.002)	0.002 (0.005)	-0.008 (0.005)	-0.002 (0.001)	-0.003 (0.009)
MKTR	1.211*** (0.055)	0.795*** (0.033)	1.184*** (0.036)	0.854*** (0.023)	0.913*** (0.055)	1.059*** (0.054)	1.041*** (0.016)	1.340*** (0.095)
PD (θ_1)	-0.121 (0.156)	-0.068 (0.094)	-0.056 (0.104)	0.013 (0.065)	-0.040 (0.157)	-0.209 (0.155)	0.021 (0.045)	-0.028 (0.273)
Adj. R^2 DW	0.818 1.979	0.827 2.317	0.905 2.398	0.915 2.441	0.670 2.184	0.771 1.936	0.971 2.105	0.603 2.152

Notes: Numbers in parentheses are standard errors. *** significant at 1% level.

TABLE III. ESTIMATED RESULTS OF MODEL 2

	CON	CSU	FIN	IND	PLN	PRP	SER	MIN
PW Analysis								
C	0.002 (0.008)	0.002 (0.005)	0.001 (0.005)	0.009 (0.003)	-0.003 (0.008)	-0.005 (0.008)	0.001 (0.002)	0.005 (0.014)
MKTR	1.218*** (0.055)	0.795*** (0.033)	1.182*** (0.036)	0.856*** (0.023)	0.910*** (0.055)	1.067*** (0.055)	1.041*** (0.015)	1.341*** (0.096)
θ_1	0.118 (0.118)	-0.042 (0.071)	-0.081 (0.079)	0.075 (0.049)	-0.133 (0.119)	0.081 (0.119)	0.034 (0.034)	0.050 (0.207)
θ_2	-0.165 (0.200)	0.025 (0.120)	0.102 (0.133)	-0.162** (0.083)	0.166 (0.201)	-0.132 (0.200)	-0.092 (0.057)	-0.235 (0.350)
Adj. R^2 DW	0.818 1.970	0.827 2.335	0.905 2.358	0.918 2.460	0.673 2.190	0.769 1.937	0.972 2.056	0.605 2.173
PD Analysis								

	CON	CSU	FIN	IND	PLN	PRP	SER	MIN
C	-0.002	0.003	0.004	0.004	0.001	-0.009	-0.002	-0.002
	(0.005)	(0.003)	(0.003)	0.002	(0.005)	0.005	(0.001)	(0.009)
MKTR	1.212***	0.795***	1.184***	0.855***	0.912***	1.059***	1.040***	1.341***
	(0.055)	(0.033)	(0.037)	(0.023)	(0.055)	(0.055)	(0.016)	(0.096)
θ_1	0.005	-0.113	0.008	0.121	-0.266	-0.244	-0.029	0.116
	(0.382)	(0.230)	(0.255)	(0.160)	(0.384)	(0.381)	(0.109)	(0.669)
θ_2	-0.156	0.055	-0.080	-0.133	0.279	0.044	0.061	-0.178
	(0.430)	(0.259)	(0.287)	(0.180)	(0.433)	(0.429)	(0.123)	(0.753)
Adj. R^2	0.818	0.827	0.905	0.916	0.671	0.771	0.971	0.603
DW	1.989	2.316	2.405	2.437	2.185	1.934	2.106	2.153

Notes: Numbers in parentheses are standard errors. *** and ** denote significant at 1% and 5% levels.