Comparison of Macro Factors' Influences on Energy Stocks and Alternative Energy Stocks

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Abstract:

This research investigates macro factors' influence on energy and alternative energy stocks. The market risk premium, industry risk premium, and the percentage change in oil price from January 2003 to December 2019 are examined for their impact on energy stocks' risk premium by applying the multifactor model analysis. The results suggested that market sentiment plays an important role on both fossil and alternative energy stocks' return but at unequal level. The impact of oil price change is rather low. Surprisingly, the industry risk premium is not statistically significant in this study. The results suggest that fossil energy stocks and alternative energy stocks are not integrated. Investors could gain diversification benefit from holding these two sub-sectors together. The unexplained part is still high, accordingly, the uncounted variables in this study should be further explored.

Keywords: alternative energy; market risk premium; industry risk premium; multifactor model; energy stock; integrated.

JEL Classification: G10; G12.

Introduction

The energy development is always the interesting and important issue in both real and financial sectors, since energy is the major part in production and in profits and losses of companies. The rising oil prices make profits to energy producers and traders, but cause losses to energy-consumed businesses. The abrupt surges in oil prices since the first decade of the millennium and all time high in 2008 have changed the landscape of global economy and business sectors. The rising oil prices fuel up not only the growth and enlargement of the traditional petroleum-related energy companies, but also the development and attention toward alternative energy companies, and increase the financial performance, as well as stock prices, of both energy and alternative energy companies.

Higher energy prices in decades of 2000 reflect the rapidly increasing global demand for oil, especially from emerging market economies like China and India. Coupled with increased concern about the worsening environment and climate like the global warming, the research and development of renewable energy that is less harmful to environment helps spur the demand for alternatives, such as wind and solar, to the traditional energy that relies on fossil fuels. Therefore, increasing demand for energy and environmental concerns are driving factors for rising oil prices and the financial performance of both traditional and alternative energy companies and their stock prices.

Since the rising oil prices in the first decade of 2000 have trigger the attention toward demand of both traditional and alternative energy, this study will explore empirically the relationship between oil price changes and stock returns of those companies.

1. Literature review

Since the energy industry is one of the major industries in every country, and other industries mostly are energy-demanding, the companies in the energy industry are normally big and powerful in terms of economic, political, and social impacts. Therefore, the energy companies' stocks are often the targets for both local and international

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investment. The recent development in the energy industry is due to the fluctuation in oil prices, the scarcity of fossil-fuel reserves, and the environmental concern on the global warming. The effort to decrease the dependency on fossil fuels; namely, oil, coal, and natural gas, has shifted the energy-developers' attention toward "green" or "alternative" energy fuels; *i.e.,* hydro, solar, wind, and biofuel, *etc*. The large demand of energy with the diversity of petroleum and renewable energy sources not only changes the industrial landscape, but also gives directions of the investment strategies in the financial markets.

Several studies explore the relationship between oil price fluctuations and stock market performance, both the aggregate returns and the stock returns of energy companies. (Kaneko and Lee 1995) use a vector autoregressive (VAR) model to analyze macroeconomic factors that influence the returns of stock markets in US and Japan. They find that international factors, such as changes in oil prices, are most significant in Japanese stock market returns. (Sadorsky 1999) also employs a VAR analysis to study the effect of oil prices and oil price volatility on real stock returns and find that oil price changes have more influence on real stock returns than do interest rates. For the effect of macro factors on energy companies' stock returns (Sadorsky 2001) finds that exchange rates, crude oil prices and interest rates have significant impacts on stock price returns in the Canadian oil and gas industry.

Hammoudeh and Huimin (2004) study the relationship between oil sensitivity and systematic risk in oil - sensitive stock indices, and find that the growth in oil price has a positive effect on the stock returns of the oil-exporting countries and the US oil-sensitive industries. However, investors view the systematic risk more importantly than the oil sensitivity in pricing the oil-sensitive stocks. Ewing and Thompson (2007) studies the empirical relationship between crude oil prices and several key macroeconomic variables including output, consumer prices, unemployment, and the aggregate stock market returns. They find the leading influence of oil prices on consumer prices.

For the studies on alternative energy stock performance, Henriques and Sadorsky (2007) explore the relationship between alternative energy stock prices, technology stock prices, oil prices, and interest rates. They find that technology stock prices and oil prices has an effect on stock prices of alternative energy companies, and a shock to technology stock prices has a larger impact on alternative energy stock prices than does a shock to oil prices. Huang, Cheng, Hu, and Chen (2011) explore the relationship between crude oil prices and stock prices of alternative energy companies and find that oil prices lead the stock performance of alternative energy companies after 2006.

Gormus, Soytas, and Diltz (2015) analyze the relationship between the fossil-fuel and alternative energy stock returns and the changes in oil prices, currency, aggregate market index, and gold prices, and find that changes in oil prices and exchange rates do not have any effect on petroleum companies' stock returns while there is a significant relationship between oil price changes and most energy sub-industry stock returns in the long run. Lee and Baek (2018) use the nonlinear autoregressive distributed lag (ARDL) approach and find that oil prices have a positive effect on the stock prices of renewable energy companies only in the short-run, and the relationship does not last in the long-run.

This study uses the case of the energy industry in the Stock Exchange of Thailand (SET) since the energy industry is one of the major industries in the SET, and the stocks in the energy industry are always get the market attention. This industry in the SET has the market capitalization more than 20% of the total market value. The changes in value or return of the stocks in this industry would have a major effect on the overall market. In addition, it is a popular industry not only for the domestic investors but also for the international investors. The research is questioning whether the stock market investors of both fossil-fuel and alternative-energy companies incorporate any macroeconomic factors into their trading decisions. The factors, such as the aggregate market returns, energy industry returns, interest rates, and changes in oil prices (incorporating exchange rates), are explored in this study. Market return and risk-free rate from government bonds' return are considered as important variables in the Capital Asset Pricing Model suggested by Sharpe (1964) while industry risk premium is also an important variable in many studies, for example, the study of (Sun and Zhou 2017).

2. Methodology

This research paper collects monthly data of Dubai crude oil price (in US dollars/barrel), US dollar value in Baht (Baht per US dollar), and the total return indices of SET index, SET Energy Industry index, and 51 listed companies under energy industry of the Stock Exchange of Thailand (SET) from Reuter database from January 2003 to December 2019. The data are grouped into fossil energy group and alternative energy group. The first group is composed of 34 companies and the later includes the remainder. Also, the data of total return index of Thai government bond is collected from The Thai Bond Market Association (ThaiBMA) during the same period. The

Dubai crude oil price is converted into Baht by multiplying the price by the US dollar value in Baht (Baht per US dollar) before the investigation begins to match the other indices which are in Baht value.

The research starts from converting the data into log return (Rt) for further analysis as follows:

$$R_t = \ln(I_t/I_{t-1}) \quad (1)$$

where: I_t is the index at time *t*, and I_{t-1} is the index at time *t-1.*

The study's investigation is based on panel data analysis. Initially, the modified indices are built. The values of SET Index, SET Energy Index, Dubai crude oil price, and Thailand Government Bond Index are reset at 100 in January 2003 and the indices would be adjusted to move at the same percentage as their calculated returns. The graphs drawn on these new indices would be initially used to show their association. Then, the related variables Risk Premium for Fossil Energy Stock (RFOSSIL, t - RGOV, t), Risk Premium for Alternative Energy Stock (RALTER, t - RGOV, t), Market Risk Premium (RSET, t - RGOV, t), Energy Industry's Risk Premium (RENE, t - RGOV, t), and Percentage Change in Oil Price (ROIL, *t*) are calculated where RFOSSIL, *t* is the fossil energy stocks' return at period *t*, RALTER, *t* is the alternative energy stocks' return at period *t*, RGOV, *t* is the Thai government bond's return, RSET, *t* is the SET index return at period t, RENER, *t* is the SET energy index's return at period *t,* and ROIL, *t* is the percentage change in crude oil price at period *t*. These new data would be examined to deliver their distribution information before they would be further explored in the next part.

To obtain the impact of market, energy industry, and oil price movement on the return of fossil energy group and the return of alternative energy group, this research adapts the multifactor model under multiple regression analysis for the investigation. The model is widely used in financial research since it could count the impact factors beyond market risk as suggested by (Ross 1976). The model is explained in the equation as follows:

$$(R_{i,t} - R_{GOV,t}) = \beta_{i,0} + \beta_{i,1}(R_{SET,t} - R_{GOV,t}) + \beta_{i,2}(R_{ENER,t} - R_{GOV,t}) + \beta_{i,3} R_{OIL,t} + e_{i,} \quad (2)$$

where: $\beta_{i,0}$ is the y-intercept; β_i is beta coefficient which show the influence of each factor on the stock *i*'s risk premium; $R_{i,t}$ is stock *i*'s return at period *t*.

The difference between the stock return and the government bond's return (Ri,t - RGOV,t) represents investors' risk premium for the stock investment, the difference between the SET index return and the government bond's return (RSET,t - RGOV,t) represents the market risk premium, and the difference between SET energy index's return and the government bond's return (RENER,t - RGOV,t) represents the energy industry's risk premium. As a result, the impact of these risk premiums together with the impact of oil price change would be total in the model.

3. Result

The Figure 1 shows the comparison of the modified indices of SET return, SET Energy Industry return, Thai Government Bond return and Dubai Crude Oil return during Jan 2003 to Jan 2019. The indices are made to be 100 at the end of January 2003 and adjusted with their returns. Except the index of Thai Government Bond return, other modified indices show some positive relation of the movement. Accordingly, the movement of the stock market, energy industry stock in overall, and crude oil price might have some impact on the energy stocks' return. The separate testing for fossil energy and alternative energy stocks should provide profound evidences for the influences of these factors. Additionally, the steadiness of the movement in government bond return index implies that there might be no association on its movement and other variables' movement. The testing on the impact of the market premium and energy industry risk premium might reasonably provide more precise results than the testing on the impact of the straight market return and the straight industry return.

Table 1 provides the information of the distribution of the studied data. The risk premium for fossil energy stock at the average of 0.11% is obviously higher than the risk premium for alternative stock market of 0.03%. Market risk premium and energy industry risk premium average at the first and the second ranks of 0.41% and 0.23%, consecutively. The lowest average is the percentage change in oil price of -0.22%.

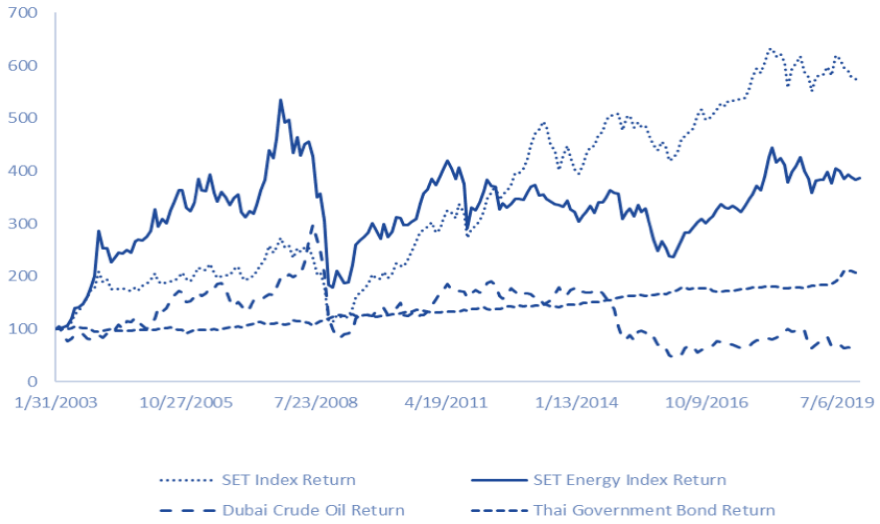
The fluctuation of all of these variables are very high, comparing to their averages. The first rank is the standard deviation of the risk premium for alternative energy stock at 12.30%, followed by the standard deviation of risk premium for fossil energy stock, the percentage change in oil price, energy industry risk premium, and market risk premium of 11.46%, 9.20%, 7.17%, and 5.59%, respectively.

For the skewness, though risk premiums for fossil energy stock and alternative stock are skewed to the right, the independent variables including market risk premium, energy industry risk premium, and percentage change in oil price are skewed to the left. However, all degrees of skewness are not very high. The highest

skewness belongs to the market risk premium at -1.68 and the lowest skewness belong to the risk premium of fossil energy at 0.41.

Lastly, all of these data are highly leptokurtic. The highest kurtosis belongs to the market risk premium of 13.70 and the lowest belongs to the percentage change in oil price of 5.39.

Figure 1. Modified indices of SET return, SET Energy Industry return, Thai Government Bond return and Dubai Crude Oil return during Jan 2003 to Jan 2019. The indices are made to be 100 at the end of January 2003



Source: Reuter Database and the Thai Bond Market Association

Table 1. Descriptive Statistics of Risk Premium for Fossil Energy Stock ($R_{FOSSIL,t} - R_{GOV,t}$), Risk Premium for Alternative Energy Stock ($R_{ALTER,t} - R_{GOV,t}$), Market Risk Premium ($R_{SET,t} - R_{GOV,t}$), Energy Industry Risk Premium ($R_{ENER,t} - R_{GOV,t}$), and Percentage Change in Oil Price ($R_{OIL,t}$).

	Risk Premium for Fossil Energy Stock ($R_{FOSSIL,t} - R_{GOV,t}$)	Risk Premium for Alternative Energy Stock ($R_{ALTER,t} - R_{GOV,t}$)	Market Risk Premium ($R_{SET,t} - R_{GOV,t}$)	Energy Industry Risk Premium ($R_{ENER,t} - R_{GOV,t}$)	Percentage Change in Oil Price ($R_{OIL,t}$).
Mean	0.11%	0.03%	0.41%	0.23%	-0.22%
Median	0.00%	-0.31%	0.91%	1.13%	1.38%
Maximum	100.92%	86.12%	17.68%	42.52%	28.64%
Minimum	-84.83%	-85.54%	-39.32%	-43.31%	-44.22%
Std. Dev.	11.46%	12.30%	5.59%	7.17%	9.20%
Skewness	0.41	0.60	-1.68	-0.64	-0.87
Kurtosis	12.47	9.78	13.79	11.37	5.39
Observations	4,717	1,419	6,150	6,150	6,150

Note: * Significant at 0.10; ** Significant at 0.05; *** Significant at 0.01

Table 2 shows the comparison of multifactor model's coefficients for all energy industry stocks, fossil energy stocks, and alternative energy stocks. The OLS multiple regression analysis reports many similar results. The risk premiums of all energy industry stocks, fossil energy stocks, and alternative energy stocks are statistically significantly influenced by market risk premium and the percentage change in crude oil price. In addition, these impacts are positive at the significant level of 1%. The energy industry's risk premium is not statistically significant to both fossil energy stocks and alternative energy stocks.

The impact of stock market on the energy stocks is higher than the impact of oil price. For all energy industry stocks, every 1% changes in market risk premium would make the stocks' risk premium increases by 1.059%. The impact is stronger for the alternative energy stocks. 1% changes in market risk premium would cause up to 1.596% change in these stocks' risk premium. For the fossil energy stocks, the impact of stock market is less. 1% changes in market risk premium would cause 0.940% change in the stocks' risk premium.

Oppositely, the influence from the change in oil price is very limited. In overall, 1% changes in oil price would cause only 0.044% change in energy stocks' risk premium. In details, the impact is stronger for fossil energy stocks. 1% changes in oil price would cause only 0.063% change in these stocks' risk premium while 1% changes in oil price would cause only 0.011% change in the alternative energy stocks' risk premium.

Overall, the model could explain the risk premium by 24.06%. In particular, the three independent variables could explain the risk premium of fossil energy stocks better than the risk premium of alternative energy stocks at 26.29% and 19.36%, consecutively.

Table 2. Comparison between the Multifactor Models of ALL Energy Stocks, the Multifactor Model of Fossil Energy Stocks and the Multifactor Model of Alternative Energy Stocks

	$R_{ALLEN,t} - R_{GOV,t}$	$R_{FOSSIL,t} - R_{GOV,}$	$R_{ALTER,t} - R_{GOV,}$
$R_{SET,t} - R_{GOV,t}$	1.059***	0.940***	1.596***
$R_{ENER,t} - R_{GOV,t}$	-0.061	0.036	-0.518
$R_{OIL,t}$	0.044***	0.063***	0.011***
Constant	-0.003**	-0.003**	-0.003**
Adjusted R-Squared	0.2406	0.2629	0.1936

Note: * Significant at 0.10; ** Significant at 0.05; *** Significant at 0.01; $R_{ALLEN,t}$ is Energy Stocks' Return, $R_{FOSSIL,t}$ is Fossil Energy Stocks' Return, $R_{ALTER,t}$ is Alternative Energy Stocks' Return, $R_{GOV,t}$ is Thailand Government Bond Index's Return, and $R_{OIL,t}$ is Dubai Crude Oil's Return.

Conclusion

This study investigates the macro factors' influences on fossil energy stocks and alternative energy stocks in Thailand during January 2003 to December 2019. The association of the movements in energy stock return, market return, and the percentage change in crude oil price suggests that these macro variables might have some contribution to the return of energy stocks and alternative energy stocks. The research applies multifactor models under OLS multiple regression to verify the truth and finds that stock market and oil price could statistically significantly influence the energy stocks' return but the impact from stock market is stronger than the impact from the crude oil price. In details, these two variables positively influence the risk premium of both fossil energy and alternative energy stocks. However, the impact from stock market is rather strong, especially, for alternative energy stocks. The results suggest that market sentiment plays an important role on the energy stocks' return.

The impact of oil price change on fossil energy firms is unsurprisingly more than on alternative energy. Interestingly, the impact from oil price change is very small for both fossil and alternative energy stocks' risk premium. In other words, the role of oil price on the energy industry stocks is quite limited. This result might be due to several possible reasons. The energy firms might be able to deal with the fluctuation of oil price effectively through the available hedging instruments such as futures or forward contracts or these firms might diversify their business into other less related business, for example, the launching of grocery stores in many gas stations.

Additionally, the different coefficients of the multifactor models from this study also advocate that fossil energy stocks and alternative energy stocks are not quite integrated. Investors could still gain some diversification benefit from putting both fossil and alternative energy stocks in their portfolio.

Lastly, the low adjusted R-squared value for the model suggests that there are still many independent variables affecting the energy stocks' return. Accordingly, further studies should be done to explore the uncounted variables.

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