The Robust Impact of Macroeconomic Factors Towards Market Valuation Among Energy Sector Across Countries

NORIZA MOHD SAAD[1]

[1]Fakulti Pengurusan dan Perniagaan, UniversitiTeknologi MARA, Cawangan Kelantan, 18500 Machang, Malaysia
Email ID: norizajasaad78@gmail.com

Abstract: This paper investigated the significant mean difference in market valuation by companies across countries. Further, it investigated the impact of macroeconomic factors proxies by Gross Domestic Product (GDP growth), Consumer Price Index (CPI), and Interest Rate (IR) towards the energy firms' market valuation proxy by Tobins' Q ratio. Secondary data were utilized for an unbalanced panel which consisted of eight countries. A total of 747 listed companies was the sample size that spanned through ten years (from 2010 to 2020). Data were gathered from Bloomberg. The study employed Scheffe method for comparison analysis and multivariate regression for impact analysis that was modelled into ordinary least square, random effect, fixed effect, and random effect robust. The best-fit model was chosen based on the results of the Bruesh Pagan Langragian Multiple (BP-LM) effect besides checking on heterokedasticity problem. The results obtained rectify that there is no multicolinearity issue and no heterokedasticity problem in data analysis. Therefore, the reported findings confirm that there are positive relationships and impact of GDP and CPI on Tobins'Q as well as a significant inverse relationship with interest rate factor across the countries.

Keywords: Tobin's Q, Gross Domestic Product (GDP growth), Consumer Price Index (CPI), Interest Rate (IR), Energy Sector.

INTRODUCTION

The listed companies' performance was also affected by external factors like macroeconomic indicators (Chinedu Francis Egbunike, 2018). These indicators include the inflation rate that normally proxy by Consumer Price Index (CPI), unemployment, gross domestic product (GDP), interest rates, and others (World Bank Group, 2015; Broadstock et al., 2011). According to them, these external factors can influence the listed performance either in positive or negative ways, which becomes systematic risks or uncontrollable factors that influence the movement of the company's share price around the globe. Even though these factors are uncontrollable, most countries have realized the importance of stabilizing economic factors because it can jeopardize investors' confidence level, especially foreign investors who might have an interest in investing in a company in a country. Thus, good indicators of these economic variables on energy firm's performance, in general, include high GDP, low or moderate CPI.

The effect of macroeconomic factors on market valuation through financial performance as a dependent variable in the energy sector is required to explore further since the impact might differ due to different macroeconomics factors states. The significant positive impact is significant to the potential investor in future investment, especially at high Tobin's Q ratio that promotes the higher market value of equity due to good performance of share price formerly lead to stable market valuation conditions. Even though the macroeconomics factor-like GDP, CPI, and IR are dynamic and quite different across the countries, the overall market valuation's impact should be considered this when making investment decision. In companies' business performance, there are systematic factors that influence performance globally. Again, this implies that the impact of macroeconomics indicators on firm market valuation across countries needs to investigate further since the company's performance across countries is different, affecting the business in different ways.

In addition to the above statement about Tobin's Q, the elements embedded in the market valuation measures such as the market value of equity, preferred stock, and debt become essential factors involved in financing issues in the firms' capital structure. Relevant to the issue discussed, the latest study conducted by Yang and Gan (2021) examined the impact of debt financing on a firm's Tobin's Q reported the impact of this financing structure on the company's investment strategy planning towards their capital structure setting. This means that they are essential tools that ensure that the financing issues embedded in Tobins' Q formulation can influence the business performance, besides looking into detail on the business strategy's macro factors during investment decision making.

The remaining part of the paper is structured as follows. Discussion of past studies on the relationship between macroeconomics factors in general and specific towards firm performance, market valuation by Tobin's Q. This paper further explained the data collection and methodology used. The multivariate regression results analysis follows this. Lastly, this paper concludes and highlights policy recommendations.

DATA AND METHODOLOGY

Secondary data were utilized for the unbalanced panel. Eight (8) countries were selected among the Asian region for energy companies with 747 observations from 2010 to 2020. The countries are Malaysia, Singapore, Taiwan, Hong Kong, Japan, the Philippines, Thailand, and Vietnam. This study considered the Tobins' Q as a dependent variables proxy to represent a firm's market valuation, whereas Gross Domestic Product (GDP) growth rate, Consumer Price Index (CPI), and Interest Rate (IR) are independent or explanatory variables. To collect information on the dependent and independent variables, this study obtained data from Bloomberg, where sufficient data are available to obtain Tobins' Q, GDP, CPI, and IR for all companies across the countries.

The study considered firm performance from the perspective of market valuation as measured by Tobins' Q. The formula equation of the Tobins' Q model is derived from the studies conducted by Tobin (1982), Bauer et al., (2003), Klapper and Love (2004), Yu Hsing (2011), Misbah et al., (2020), and Mari et al., (2020). Therefore, the operational definition of Tobins' Q in this study refers to the total market value of companies from the equity plus preferred stock plus short-term and long-term debt and bond over the company's total asset for each of the countries. As a general principle in finance philosophy, if the market valuation is at a high level, companies can sell their equity at a higher price to increase cash and invest either locally or foreign investment, depending on the potential and opportunities. However, if the market valuation is at a low level, then the inverse associate can be translated where firms do not get much for their equities compared to the cost of physical capital, so they do not sell equity to increase capital in macroeconomics factors, for instance, GDP, CPI as well as IR. In the mathematical equation, Tobin's Q is presented as follows:

$$Tobin'sQ_i = \frac{MV_{CS_i} + PS_i + D_i}{TA_i} \qquad (1)$$

where $MVCS$ = the market value of common stock of the ith company = $Pi \times NOSHi$,
  Pi = the average monthly price of the *ith* company's common stock,
  $NOSHi$ = the number of shares outstanding for the *ith* company,
  PSi= the book value of company *ith* preferred stocks,
  Di = the book value of company *ith* long-term liabilities, and
  TAi = the total assets of the *ith* company.

Scheffé's method or approach was applied to the set of estimates of all possible contrasts among the factor level means to achieve the objective of mean comparison analysis. Technically, there is an infinite number of contrasts. The simultaneous confidence coefficient is exactly $1-\alpha$, whether the factor level sample sizes are equal or unequal. The Scheffé confidence interval procedure that generates simultaneous intervals for all contrasts is considerably wider. In the general case when many or all contrasts might be of interest, the Scheffé method tends to give narrower confidence limits. Therefore, Scheffe's test is one of the most stringent adjustments that can be used to decrease experiment wise error rates when testing multiple comparisons. This means that each pairwise comparison has to have the same significance as the variance for all comparisons when using Scheffe's testis shown below:

Scheffé: The analysis in this study considered that the mean value (μ) of sample groups in between 1 and 2 should be in between 0.95 to 5.49(2). Where; μ= refers to the set of estimates of all possible contrasts among the factor level means of Tobins' Q across countries.

Then, to achieve the second objective, the relationship between the macroeconomics factors and market valuation was estimated using the following multivariate regression equations:

$MVit= α+b1GDPit +b2CPIit+ b3IRit+ εit(3)$ *OLS Model*
  $MVit= α+b1GDPit +b2CPIit+ b3IRit+ εit, re$ *(4) RE Model*
$MVit= α+b1GDPit +b2CPIit+ b3IRit+ εit, fe (5) FE Model$
$MVit= α+b1GDPit +b2CPIit+ b3IRit+ εit, re robust$ *(6) RE Robust Model*

where, MV is market valuation poxy by Tobins' Q, the time period is denoted by the subscript t (t=11,T=2010….2020), then the companies for each country subscript by i , (i=1…747,n=8 category where 1=Malaysia, 2= Singapore, 3= Taiwan, 4=Hong Kong, 5= Japan, 6= Philipines, 7= Thailand and 8= Vietnam, total of N=747 observations); α represents constant term; and εit is the random error term.

After that, to select the best-fit model of the relationship between dependent, MV, and independent, GDP, CPI, and IR, Hausman Test was performed. This is an essential step in identifying the most appropriate model in

concluding remarks and explaining the relationship between both types of bonds. It was followed by a diagnostic check test on the model selection whereby the modified Wald-chi test for group-wise heteroskedasticity is tested whether the variances are constant or not. The probability chi-squared result's significance concluded that there is a heteroskedasticity (variances are not constant) problem. Hence, the most appropriate model was determined based on the significant level of heterokedasticity results. If the chi-squared shows a significant result, then robust multiple regression estimations are required to perform the selected model, and if insignificant, the robustness is not required to that level. The regression model runs using robust standard error estimation to overcome or rectify the problem in this situation. As a benefit of using the Stata, a robustness check and test were performed to resolve the problem.

This study developed the hypothesis based on the past studies discussed in the literature to outfit for the pooling regression model as shown below:

H1: There is a significant mean difference of MV for companies and macroeconomics variables across the countries.

H2: GDP impact positively on market valuation.

H3: CPI impact positively on market valuation.

H4: IR impact negatively on market valuation.

The decision rules is to accept the hypotheses if $P > 0.05$ or $P > 0.01$, and reject hypotheses if $P < 0.05$ or $P > 0.05$.

RESULTS AND DISCUSSION

Table 1 reveals the overall performance of the dependent, Tobins'Q, and the independent variables, GDP, CPI, and IR, for all the datasets. Amidst the study period, the minimum value indicates that Tobin's Q is at 0.24 percent only with a negative value of macroeconomic factor at -6.1 percent, -1.14 percent, and -0.07 percent for GDP, CPI, and IR, respectively. However, the maximum value shows a quite encourage value not only to the market valuation or firm value but also to the macroeconomic factors representing almost 15 percent and above all the variables. The market and economic growth above 10 percent are considered stable and suitable indicators for business planning and investment. Even though the maximum value of descriptive statistics results is on top, as revealed by the mean value, it shows that the variables' performance is still low at a positive value. It can still mitigate a specific systematic risk involved since the standard deviation results are close to the mean value. This also implies that the economic performance in Asian region countries is quite similar across the countries (this will be further explained in Scheffe's analysis of mean comparison across the countries).

Table 1: Descriptive Statistic Results

Variable	Mean	Std. Dev.	Min	Max
Tobin's Q	1.22	1.21	0.24	22.73
GDP Growth	3.43	3.78	-6.1	14.53
CPI	1.87	2.59	-1.14	18.63
Interest Rate	1.96	2.39	-0.07	15

Table 2 reports that the p-value of correlation are relatively low (correlations value less than 0.8) which justifies the fact that no multicollinearity problems exist among dependent and independent variables as mentioned by Gujarati (1995). The results obtained show that Tobins' Q has a positive significant correlation with the independent variables, GDP and CPI but had a negative significant correlation with IR.

Table 2: Pairwise Correlation Results.

Variable	Tobin's Q	GDP Growth	CPI	Interest Rate
Tobin's Q	1			
GDP Growth	0.089	1		
CPI	0.085	0.4036	1	
Interest Rate	-0.025	0.404	0.709	1

From Table 3, the results obtained show that there is a significant mean difference between Tobins' Q across the countries with macroeconomics factors at 99 percent confidence level with an F value of 16.13 generated by Scheffe tabulation. The results, therefore, postulate that market valuation performance for countries have a different pattern even though their macroeconomic factors in the Asian region countries is quite similar; even when traded at different stock exchange of capital market place. Therefore, it can be concluded that the first objective of the study shows that there is a significant mean difference of market valuation performance across the countries. Thus, H1 is accepted.

Table 3: Scheffe Results for Variance.

Source	SS	df	MS	F value
Between groups	144.43	7	20.63	16.13***
Within groups	945.45	739	1.28	

As reported in Table 3, overall, there is a significant mean difference in market valuation across the countries. However, for interclass comparison by Scheffe method, it showed that most of the countries, except Taiwan, are significantly correlated with Hong Kong at a 99 percent confidence level with all negative associations. As for Malaysia, the results show a negative correlation with other countries except for Taiwan. From Table 4, it can be seen that there are mixed results with significant and insignificant correlations, respectively.

Table 4: Comparison of Market Valuation (Tobin's Q) by Country

Mean Value	Hong Kong	Japan	Malaysia	Philipines	Singapore	Taiwan
Japan	-1.39***					
Malaysia	-0.83***	0.56				
Philipines	-1.01***	0.38	-0.18			
Singapore	-1.24***	0.15	-0.41	-0.23		
Taiwan	-0.29	1.11**	0.54	0.72	0.95*	
Thailand	-0.91***	0.48	-0.08	0.1	0.33	-0.62
Vietnam	-1.30***	0.09	-0.47	-0.29	-0.06	-1.01*

Based on the results presented in Table 5, unbalanced panel data was applied for the tests since the data retrieved for all countries indicate an unequal number of observations and covered the ordinary least square (OLS), fixed effects (FE), and random effects (RE), and random effects robust (RE Robust) models. The diagnostic check test was performed on the model selection whereby the modified Wald-chi test for group-wise heteroskedasticity was tested whether the variances are constant or not. The probability chi-squared result's significance concluded that there is a heteroskedasticity (variances are not constant) problem. Hence, the most appropriate model is determined based on the significant level of heterokedasticity results. If the chi-squared shows a significant result (in this case, the result shows that all models indicate a significant at 99 percent confidence level except for RE robust, which is at 95 percent confidence level), then robust multiple regression estimations are required to perform the selected model. If it is insignificant, the robustness is not required to that level. The regression model will run using robust standard error estimation to overcome or rectify the problem in this situation. As a benefit of using the Stata, a robustness check and the test was performed to resolve the problem. The study also revalidates the result with Bruesh Pagan-Lagrarian Multiplier (BP-LM) diagnostic tests to determine which models, i.e., RE or FE, are the best-fit and most appropriate model for explaining the relationship between the yield and its facets as well as control variables with heterokedasticity problem. The BP-LM test results reported a significant result that showed that OLS and FE were the most appropriate models to explain such a relationship. However, since the wild-chi for RE model showed a significant value, then the robust effect can also be further analyzed to identify the impact of macroeconomics on Tobins' Q,

Also, R-square was reported for the model estimation of regression to investigate the percentage of the relationship between the macroeconomic factors as an explanatory variable in explaining the market valuation. The result also revealed only a low value of about 2 percent to 3 percent for all the models developed. This implies that, for instance, Tobins' Q of energy companies under the most appropriate model, OLS has about a 2.91 percent effect on the GDP, CPI, and IR.

Overall, the finding shows that Tobins' Q for companies under the energy sectors in the Asian region is significant at 99 percent and 95 percent confidence levels in the OLS model with a positive impact on GDP and CPI and a negative impact on IR. The result also reported that the association is consistent among all the models tested and validated, OLS, FE, RE, and RE Robust. Therefore, the study accepts the H2 and H4.

Table 5: Multivariate Regression Results

	OLS	RE	FE	RE Robust
Constant	17.44***	10.71***	11.82***	11.53***
GDP Growth	2.30**	2.99***	2.76***	2.93***
CPI	3.58***	2.32**	2.01**	1.33
Interest Rate	-3.74***	-2.68***	-2.23**	-1.43
Observations	747	747	747	747
R-Square	2.91%	2.81%	2.87%	2.81%
Wald chi2		20.85***	-	10.17**
F-Value	10.571***	-	6.64***	-

BP-LM	388.50***		
RE Effect	Yes		Yes
FE effect	-	Yes	

CONCLUSION

Even though the macroeconomics factor-like GDP, CPI, and IR are dynamic and quite different across the countries, the overall market valuation's impact should be considered this when making investment decision. In companies' business performance, there are systematic factors that influence performance globally. However, this study was only focused on the external factors like GDP, CPI, and IR that all countries are dealing with. Overall, the study confirmed that all these four hypotheses developed are accepted. Thus, there is a significant mean difference in market valuation across the countries. Even though they are different for market valuation performance. However, the macroeconomics factors significantly impacted the performance of the companies. The impact is reported in different ways, where GDP and CPI had a positive impact, and IR had a negative impact on the market valuation among the countries' energy sector. However, for future research, other factors of macroeconomics like foreign direct investment and employment rate should be considered and the internal factors to increase the overall impact. Thus, this study can provide signal information to investors and companies when they are planning a long-term investment in their capital structures.

Declaration of Conflicts of Interest/Ethical Declaration (if possible): No conflict of interest.

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