

Analysis of a Financial Model for Converting Industrial Waste Tires into Clean Energy for Environment Protection - A Model in Developing Countries

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Abstract: - Vietnam renewable energy industry with the involvement of many power thermal firms and energy companies have been growing recently. After the global economic crisis 2007-2011 and the recent post-low inflation 2014-2015, Viet Nam economies, its financial and stock market as well as renewable energy market experienced indirect and direct impacts on their operation, system and price. Although some economists have done researches on the relationship among macro economic factors such as: consumer price index (CPI), inflation, GDP...., this paper aims to consider the interaction between macro economic factors such as Viet Nam inflation and GDP growth rate, US inflation, exchange rate, risk free rate and other macro factors, and esp. their impacts on a big energy firm, in the context Viet Nam and the US economies receive impacts from global economic crisis. This is one main objective of this research paper. This research paper finds out firm stock price has a negative correlation with risk free rate in VN and deposit rate of VN commercial banks, but has a positive correlation with lending rate in Vietnam. And the statistical analysis will generate results which help us to suggest macro policies in favor of the local stock and financial market. Industrial risk over years has been affected much by macro economic risk, credit risk, and legal risk; therefore, government bodies need to issue proper macro economic legal, financial and credit policies in order to stimulate, develop stock market and reduce workload pressure for Vietnam bank system.

Key-Words: - inflation, stock market, risk free rate, lending rate, exchange rate, price, renewable energy industry

JEL: G12, G17, L85, M21

1 Introduction

Viet Nam economy has become active and growing recently with GDP growth rate as one of the fastest economic growth levels in South East Asia (GDP growth in 2019 expected at around 6.6% - 6.8%) and it is affected by both internal and external factors such as global economic crisis 2007-2009 and post-low (L) inflation environment 2014-2015. Esp., Vietnam renewable energy market is growing so fast with many big names energy industry such as: EVN, DVA, Power thermal companies etc. Hence, after the global crisis, the US economy has certain impacts on Viet Nam economies and financial market. Therefore, energy firms share price, so-called Firm stock price are also affected by external factors such as the inflation from US economy, S&P500 index, USD/VND exchange rate, as well as internal macro factors such as Vietnam inflation, GDP growth, VN Index, lending rate, deposit rate and risk free rate

(government bond). After the crisis time in 2008-2010 in energy industry, in recent years Vietnam energy market and firms have been growing very fast with lots of big projects in big cities in the country and even island, including but not limited to: HCM city, Ha Noi, Binh Duong, Nha Trang, Da Lat, Binh Dinh, Phu Quoc, Phan Thiet, Phan Rang, Hue, Da Nang, Can Tho, Dong Nai, Tay Nguyen, Ca Mau, etc.

The below figure shows us that Firm stock price moves in the same direction as VN Index and S&P 500 (with little fluctuation) during the period 2014-2019, and how much is the correlation between them is forecasted in the below sections.

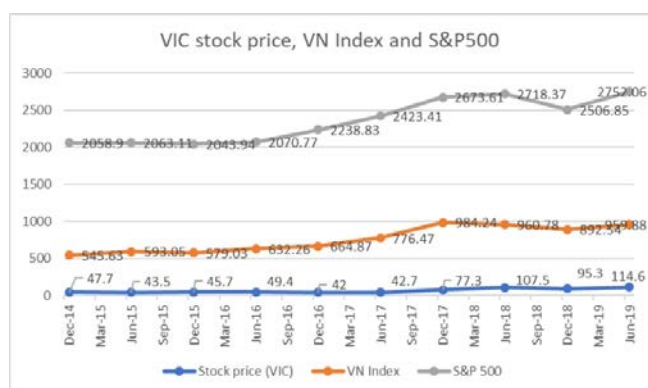


Fig.1: Firm stock price vs. VN Index and S&P500

In this research, we will consider Firm stock price in Viet Nam stock market, are affected by both external and internal factors - nine (9) major variables (inflation in USA and Viet Nam, S&P500, USD/VND exchange rate, VN GDP growth, VN Index, lending and deposit rates, and risk free rate):

$$Y (\text{firm stock price}) = f (x_1, x_2, x_3, x_4, x_5, x_6) = ax_1 + bx_2 + cx_3 + dx_4 + ex_5 + fx_6 + k$$

Note: x_1 : inflation in Viet Nam, x_2 : inflation in the US, x_3 : Vietnam GDP growth, x_4 : risk free rate, etc.

In following sections, this paper will present research issues, research methods, research results, discussion and policy suggestion.

2 Problem Formulation

The US economy factors and internal Vietnam economic factors, both of them have certain impacts on stock market and firm stock price during the post-global financial crisis period 2014-2019, this paper will find out:

Research issue 1: estimate the relationship between internal macro economic factors/variables in Viet Nam and firm stock price.

Research issue 2: estimate the relationship between external macro economic factors/variables in the US, internal macro economic factors in Viet Nam and firm stock price.

2.1 Research Method and Data

In this research, analytical method is used with data from the economy such as inflation in Vietnam and USA, GDP growth rate, lending and deposit rates, exchange rate and risk free rate. S&P 500 index and VN Index and Firm stock price data are included from 2014 -2019 with semi-annual data (10 observations in total). Beside, econometric

method is used with the software Eview. It will give us results to suggest policies for businesses and authorities.

Econometric model is established as in the introduction part. Firm stock price in Viet Nam is a function with 6 variables:

$$Y (\text{Firm stock price}) = f (x_1, x_2, x_3, x_4, x_5, x_6) = ax_1 + bx_2 + cx_3 + dx_4 + ex_5 + fx_6 + k$$

Note: x_1 : inflation in Viet Nam, x_2 : inflation in the US, x_3 : Vietnam GDP growth, x_4 : risk free rate, x_5 : exchange rate, x_6 : lending rate

2.2 Conceptual Theories

Firm stock price not only is affected by company performance, operation and dividend, but also by macro economic variables. Inflation rate may harm investment values and therefore affect negatively on stock price. During high inflation time, purchasing power and consuming decline, as well as investment decreases. Or during low inflation periods, companies revenues and profits are inflated and values decrease. That's why the US, Fed, tried in many years to keep inflation and GDP growth at low level just because real return equals to (=) nominal return minus (-) inflation. The empirical data from Vietnam stock exchange during 2007-2009 crisis showed us that inflation may harm stock market and negatively affect stock price. Other macro variables such as exchange rate might have positive and long term impact on firm stock price and later on, we will soon figure out its impact result in the below regression section. From investors viewpoint in stock exchange, knowing the relationship between stock price and various macro-economic factors is a benefit because they can predict their returns on investment and take advantages of investment opportunities in financial and stock market.

2.3 Literature Review

Nicholas (2003) revealed that among various factors, the variation of real housing prices has been affected highest by loan rate, followed by inflation and employment.

Energy market is one of the most active industrial markets and economic sectors that contribute considerably for economic and social development. It is affected by a number of macro-economic variables including but not limited to: legal, financial, credit, inflation, unemployment, salary, households, etc.

Kalitko (2012) found that Waste tires pyrolysis is well known method for their thermal recycling by

heating at near 500°C with purpose of liquid oil and carbon black by-production as near 50% and 35% yield correspondingly, including about 10% combustible off-gas residual after oil condensing and 5% wire steel cord in rest (all relatively to tire mass).

Then, Rani S., and Agnihotri R., (2014) also indicated recycling of scrap tyre pyrolysis gives comparable efficiency to diesel oil in medium to high load but it has been question on the desulfurization process. More improvement in fuel quality in term of desulfurization, reduction in viscosity is required for tyre oil as an alternate fuel for diesel engine.

Elshokary S. et all (2018) provided a lot of data about the pyrolysis of waste tires with respect to the type of reactors used associated with the experimental conditions (temperature, heating rate, type of catalyst) and its effects on the products of pyrolysis.

Then, Han J. et all (2018) mentioned that according to MS and thermogravimetric (TG) curves, tyre pyrolysis could be divided into four stages. The first stage was due to water vaporization and plasticizer decomposition at the temperature below 320 °C. The secondary stage was attributed to natural rubber decomposition at 320–400 °C, and the third stage was related to the decomposition of synthetic rubber, which took place at 400–520 °C. The fourth stage was occurred above 520 °C.

Next, Bijan et all (2016) mentioned that a distinct pattern that applies to France, Greece, Norway and Poland, where the price of observed statistically significantly associated with unemployment. Olatunji et all (2017) suggested that because macroeconomic policy could adversely affect property returns, policy-makers should understand the future implications of them.

So far, there is no researches that have been done on both internal and external macro economic variables on firm and their stock price.

3 Problem Solution

3.1 Overview on Vietnam Macro Economy and Stock market

The below graphs describe inflation in Viet Nam, credit growth rate, VN Index and Firm stock price over past years.

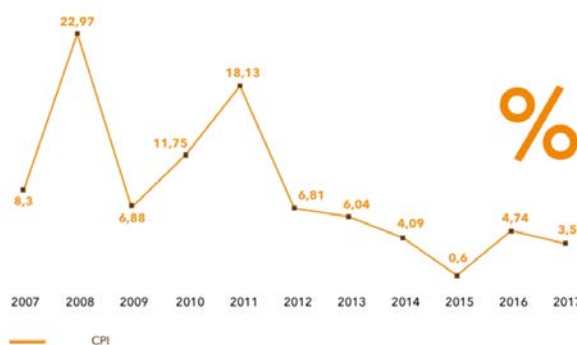


Fig.2: Inflation, CPI over past 10 years (2007-2017) in Vietnam

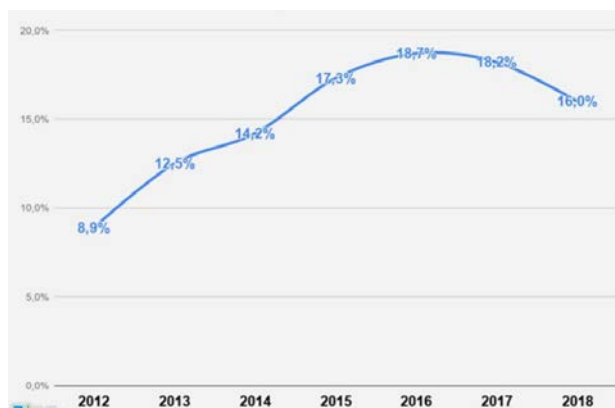


Fig.3: Loan/Credit growth rate in the past years (2012-2018) in Vietnam

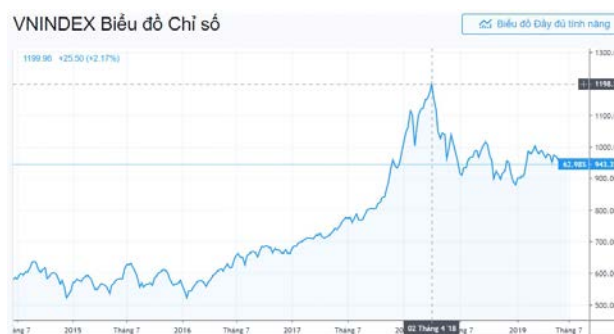


Fig.4: VNINDEX over past 5 years (2014-2019)



Fig.5: History stock price chart of Firm 2015 - 2019

The figure 2 shows us inflation in Vietnam stayed in a steady rate of about 6% from 2012-2013, then reduce in 2014-2015 (low inflation). Figure 4 tells us VN index lied in low levels from 2014-2016, then after 2016 until now the stock market has recovered. One of main reasons is shown in the figure 3 where it stated credit /loan growth rate has increased during 2014-2018 period.

We also see that in the above figure 5 from 2017-2019, investors invest in Firm stock price will receive big profits. In general, Firm stock price movement follows the same direction with VN Index.

3.2 General Data Analysis

The below figure 6 shows us that inflation in VN has a positive correlation with inflation in the US:

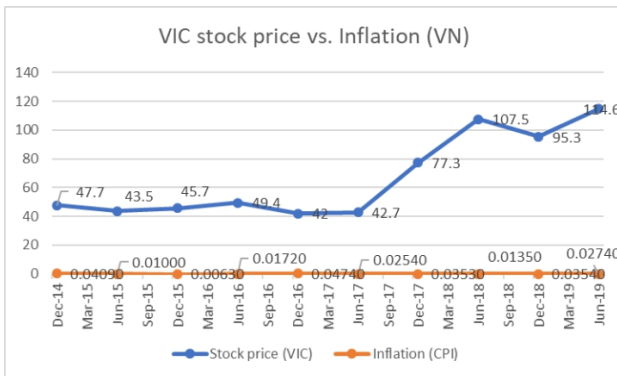


Fig.6: Inflation in Viet Nam and in the US (nguồn: Vneconomy, mof.gov.vn)

Then, we see the relationship between a set of internal macro factors including inflation, GDP growth rate, VNIndex and Firm stock price from 2014-2019. The below figure 7 shows us that Firm stock price, and then second, VN Index, have bigger volatility from June 2015 to June 2019.

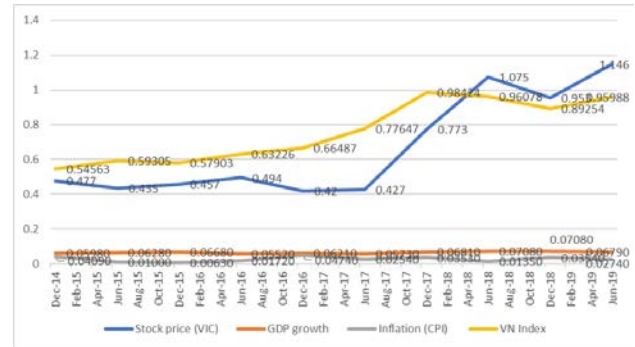


Fig.7: Inflation, VNIndex and GDP growth in Viet Nam vs. Firm stock price (Source: Vneconomy, tradingeconomic)

Another set of internal economic factors (lending rate, deposit rate and risk free rate in Vietnam) are shown in the below figure, together with Firm stock price from 2014 to 2019. The figure 8 below shows us that from June 2017 to June 2019, although there is not much fluctuation in other macro factors, Firm stock price has bigger fluctuation (increase, then decrease and increase again in June 2019).

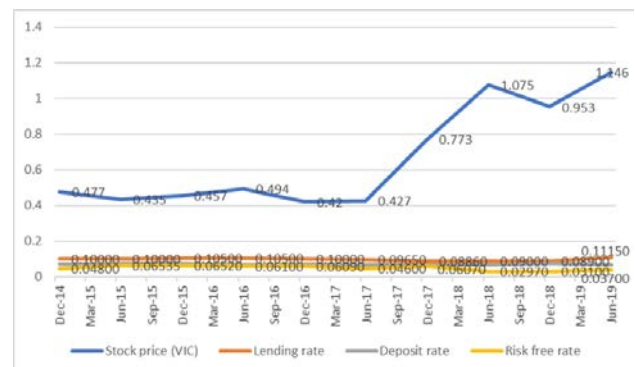


Fig.8: Viet Nam Risk free rate, lending rate and deposit rate vs. Firm stock price in Viet Nam, inflation in VN and in the US (Firm stock price unit: 100.000 VND, risk free rate: for bonds with maturity 5 years)

This research sample uses data (GDP growth, inflation, risk free rate) during 5 years from 2014 to 2019. The global crisis starting from 2007 and low-inflation period from 2014-2015 have impacts on Viet Nam economy. Therefore, we could assume Firm stock price in Viet Nam as a function depending on these macro-economic factors in the US and in VN.

Now, we see in the below figure 9 showing all above internal macro factors and Firm stock price, in Dec 2016, although VN Index increased slightly, Firm stock price decreased a little.

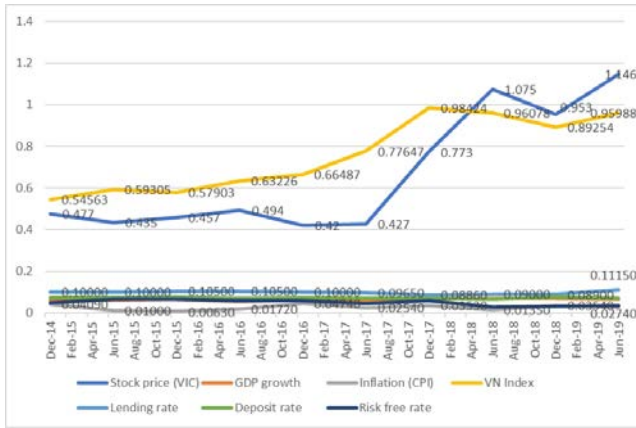


Fig.9: Inflation in Myanmar, inflation in VN and in the US (VnIndex unit: 1,000,000 VND, Firm stock price unit: 100,000 VND)

Next we see the visual relationship between external factors (macro factors in the US) and Firm stock price in the below figure 10. It shows us that, in around June 2015, Firm stock price has a little decrease.

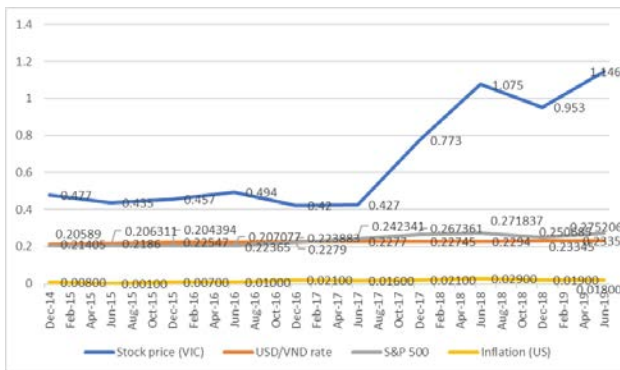


Fig.10: Exchange rate, S&P 500, Inflation in the US vs. Firm stock price (macro factors calculated at the equivalent ratio for easy comparison)

Last but not least, we see a mix of internal and external factors and their relationship to Firm stock price in the below figure 11. It shows us that, Firm stock price followed the same trend as other macro factors in VN and in USA and esp. In June 2016, and June 2018, Firm stock price has increases little much.

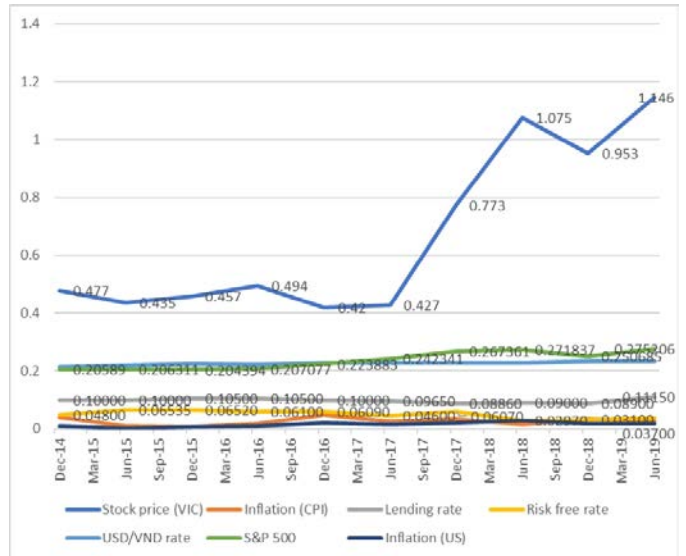


Fig.11: In the US vs. Firm stock price (macro factors calculated at the equivalent ratio for easy comparison)

On the other hand, we could see statistical results with Eview in the below table with 3 variables:

Table 1. Statistical results for internal and external macro-economic variables

	Stock price (VIC)	Inflation (CPI)	Lending rate	Risk free rate	USD/VND rate	S&P 500	Inflation (US)
Mean	0.6657	0.02588	0.09856	0.050485	0.226117	0.235499	0.015
Median	0.4855	0.0264	0.1	0.05435	0.227575	0.233112	0.017
Maximum	1.146	0.0474	0.1115	0.06535	0.2335	0.275206	0.029
Minimum	0.42	0.0063	0.0886	0.0297	0.21405	0.204394	0.001
Stand.dev	0.29278	0.013884	0.007636	0.014066	0.006102	0.029493	0.008353

The above table shows us standard deviation of Firm stock price in Vietnam is the highest (0.29), santandard deviation of S&P 500 in the US is the second highest (0.03) and standard deviation of USD/VND exchange rate is the lowest (0.006).

If we want to see correlation matrix of six(6) internal macro variabes, Eview generate the below result in table 2:

Table 2. Covariance matrix for six (6) internal macro-economic variables (GDP growth, inflation in VN, VN index, Risk free rate, lending and deposit rates)

Coefficient Covariance Matrix							
	GDPGRO...	INFLATIO...	VNINDEX	RF RATE	LENDINGR...	DEPOSIT ...	C
GDPGRO...	1605766	102734.8	-47.02845	42884.23	36204.41	-1641944	41710.68
INFLATIO...	102734.8	80715.57	-2.797794	10557.79	29443.82	-89321.24	-3603.500
VNINDEX	-47.02845	-2.797794	0.002459	4.781649	6.108154	70.05956	-4.630697
RF RATE	42884.23	10557.79	-4.781649	116345.2	517.3589	-11672.99	-11743.13
LENDINGR...	36204.41	29443.82	6.108154	517.3589	311173.8	128855.3	-47631.98
DEPOSIT ...	-1641944	-89321.24	70.05956	-11672.99	128855.3	3490767	-207295.5
C	41710.68	-3603.500	-4.630697	-11743.13	-47631.98	-207295.5	21057.59

The above table 2 shows us that correlation among six macro variables (total internal macro

economic factors). An increase in GDP growth and increase in inflation might lead to a decrease in VN Index. Whereas an increase in deposit interest rates might lead to decrease in investment and reduce GDP growth rate. Furthermore, when deposit rate increases, risk free rate tends to decline.

The below table 3 shows us that correlation among six (6) macro economic variables (both internal and external macro factors). Inflation in VN has a negative correlation with inflation in the US, lending rate in VN and risk free rate (government bond) and has a positive correlation with exchange rate and S&P 500 index. Whereas lending rate in Viet Nam has a negative correlation with inflation in VN, risk free rate and exchange rate and it has a positive correlation with inflation in the US and S&P 500. Last but not least, risk free rate has a negative correlation with inflation in VN and exchange rate and it has a positive correlation with inflation in the US and S&P 500.

Hence, a reduction in risk free rate may lead to an increase in lending rate. A reduction in risk free rate might stimulate VN inflation. And an increase in inflation may lead to a reduction in lending rate to stimulate demand and investment.

Table 3. Correlation matrix for 6 macro economic variables (inflation in VN and the US, lending rate, risk free rate, exchange rate, S&P500)

	INFLATIO...	LENDINGR...	RF_RATE	USD_VND...	SP500	INFLATIO...	C
INFLATIO...	278031.8	-13975.43	-2088.807	1.815179	2.407377	-336933.4	-47372.21
LENDINGR...	-13975.43	1109150	-13332.25	-6.211770	3.099744	731668.9	13900.69
RF_RATE	-2088.807	-13332.25	411359.6	-0.079808	10.47141	121678.5	-44080.01
USD_VND...	1.815179	-6.211770	-0.079808	0.000331	-0.000321	-11.79963	-5.981657
SP500	2.407377	3.099744	10.47141	-0.000321	0.002181	-35.90159	1.757697
INFLATIO...	-336933.4	731668.9	121678.5	-11.79963	-35.90159	2930692	237860.5
C	-47372.21	13900.69	-44080.01	-5.981657	1.757697	237860.5	129668.3

3.3 Regression Analysis and Main Results

In this section, we will find out the relationship between macro economic factors such as inflation in Viet Nam or Myanmar, inflation in USA and unemployment rates in Viet Nam or Myanmar.

3.3.1. Scenario 1

Regression model with 2 variables: Inflation (CPI) in Viet Nam and Firm stock price.

Note: inflation in Viet Nam (INFLATION_CPI), C: constant

Using Eview give us the below results:

Table 4. Regression model - 2 factors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION_CPI	36.99844	745.4686	0.049631	0.9616
C	65.61248	21.64752	3.030947	0.0163

R-squared	0.000308	Mean dependent var	66.57000
Adjusted R-squared	-0.124654	S.D. dependent var	29.27802
S.E. of regression	31.04925	Akaike info criterion	9.885883
Sum squared resid	7712.446	Schwarz criterion	9.946400
Log likelihood	-47.42941	F-statistic	0.002463
Durbin-Watson stat	0.361381	Prob(F-statistic)	0.961633

Therefore, $Stock\ price_{Firm} = 36.99 * Inflation_CPI + 65.6$, $R^2 = 0.0003$, $SER = 31.04$

(within the range of 10 observations of inflation as described in the above figures)

3.3.2. Scenario 2

Internal factors model: regression model with 3 variables: unemployment rate in Viet Nam, inflation in Viet Nam and inflation in the US:

Using Eview gives us the result:

Table 5. Regression model - 3 factors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPGROWTH	1763.682	1272.256	1.386263	0.2150
INFLATION_CPI	-126.7315	389.2463	-0.325582	0.7558
VNINDEX	0.107378	0.040383	2.658998	0.0376
C	-124.7945	67.51514	-1.848393	0.1140

R-squared	0.807532	Mean dependent var	66.57000
Adjusted R-squared	0.711298	S.D. dependent var	29.27802
S.E. of regression	15.73137	Akaike info criterion	8.638365
Sum squared resid	1484.857	Schwarz criterion	8.759399
Log likelihood	-39.19183	F-statistic	8.391335
Durbin-Watson stat	1.402457	Prob(F-statistic)	0.014423

Therefore, $Stockprice_Firm = 1763.6 * GPDgrowth - 126.7 * Inflation_CPI + 0.1 * VNindex - 124.7$, $R^2 = 0.8$, $SER = 15.7$

Hence, Firm stock price has a negative correlation with inflation in Vietnam, but has a positive correlation with GDP growth rate and VN

Index in Viet Nam. Esp., it is highly positively affected by GDP growth rate and slightly positively affected by VNindex.

3.3.3. Scenario 6

A mix of six (6) internal and external factors model: regression model with 3 internal variables: risk free rate in Vietnam (government bonds maturity 5 years), lending rate and inflation of Vietnam, together with 3 external macro variables: SP 500, inflation in the US and USD/VND rate:

Using Eview gives us the result:

Table 6. Regression model - 6 mixed factors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION_CPI	-245.1343	527.2872	-0.464897	0.6737
LENDINGRATE	437.9471	1053.162	0.415840	0.7055
RF_RATE	-815.0632	641.3732	-1.270810	0.2934
USD_VND_RATE	0.001578	0.018192	0.086754	0.9363
SP500	0.071349	0.046703	1.527738	0.2240
INFLATION_US	-372.0854	1711.926	-0.217349	0.8419
C	-127.2337	360.0949	-0.353334	0.7472

R-squared	0.849011	Mean dependent var	66.57000
Adjusted R-squared	0.547032	S.D. dependent var	29.27802
S.E. of regression	19.70496	Akaike info criterion	8.995645
Sum squared resid	1164.857	Schwarz criterion	9.207455
Log likelihood	-37.97823	F-statistic	2.811489
Durbin-Watson stat	2.030264	Prob(F-statistic)	0.212684

Hence, Stock price_{Firm} = -245.13 * Inflation_{CPI} + 437.9 * Lendingrate - 815.06*Rf_rate + 0.002*USD_VND_rate + 0.07*SP500 - 372.08*Inflation_US - 127.2, R² = 0.84, SER = 19.7

Finally, the above equation enables us to figure out that Firm stock price has a negative correlation with inflation, risk free rate in Vietnam, and inflation in the US, while it has a positive correlation with Lending rate in Vietnam, SP500 in the US and exchange rate (USD/VND) (within a range of 10 observations from 2014-2019). In an interactive global financial markets, both inflation in VN and US has negatively affect on Firm stock price. It means that high inflation might harm the investment values and may not encourage the increase in stock price of Firm, and therefore the whole stock market. Rf, Inflation in these 2 countries, and Lending rate are among factors that affect much more on Firm stock price.

4 Limitation of the Model

Eview has advantages such as: analyzing data quickly, manage it efficiently, and good for econometric and statistical analysis. On the other hand, Eview cannot give the absolutely correct correlation between variables in the model. Therefore, in this model, Eview can only provide us with results for reference.

5 Discussion for further Research

We can add one more factor into our regression model, for example, unemployment rate. Or we can add foreign investment growth rate over years into our regression model in order to see the effects of these macro factors.

6 Conclusion and Policy Suggestion

The government and authorities of Vietnam might consider controlling inflation and issuing proper policies in which risk free rate is controlled and not increasing too much in order to support stock price, in specific, and stock market in general. To do this, they need to pay attention to not only treasury bonds but also corporate bonds to create proper mechanisms and policies to attract more capital.

Macro economic and financial policies need to consider impacts of macro factors such as inflation in their countries and outside factors such as inflation in the US. Further more, lending interest rates and exchange rate need to be increased at a rational level, because stock price, and therefore stock market, has a positive correlation with lending rate and exchange rate. Hence, in credit /loan policy, bank system and relevant government companies need to control and balance the capital source to limit the using of short-term capital to finance long-term projects.

From the above regression equation, inflation in the US has a negative correlation with stock price and therefore stock market in Viet Nam, the government of Viet Nam need to implement suitable macro policies if inflation in the US increases or decreases. One lesson from company development is balancing the importance of both internal and foreign investment capital. In order to develop energy market, it needs not only bank capital, investors pre-payment, but also stock market channel, corporate bond market, and foreign investment.

Viet Nam stock market has been becoming a competitive capital channel compared to

commercial bank system and attracted more than 86,000 b VND for companies in 2018, together with 2,75 b USD from net foreign investment flow. Hence, the government and authorities in Viet Nam can issue proper policies which can protect their market economy, encourage and develop stock market to reduce pressure on bank system, increase its size to 100% GDP in period from 2020-2022 and reduce negative impacts from the global recession.

Last but not least, this study provides a regression model with its equation which helps investors to seek financial gains in the industry and stock market based on observing fluctuations in macro policies and macro economic (internal and external) variables or data as we saw in the above equations.

Acknowledgements:

I would like to take this opportunity to express my warm thanks to Board of Editors, Professors and Colleagues at Universities and companies. Lastly, thank you very much for my family, co-workers, and brother in assisting convenient conditions for my research paper.

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Annex:

1. GDP growth rate past 10 years (2007-2018) in Vietnam

