Forecasting Demand of Malaysian Automotive Industry: The Case of Proton.

Nurhanani Aflizan Mohamad Rusli, and Siti Mariam Ali

***Abstract*—**Malaysia automotive industry can be considered as encouraging and attractive because the local brand manufacturer Proton is widely known and has a potential to spread to over the world. This paper investigates the correlation between inflation rate, fuel price and GDP per capita with Proton's sales revenue. The study applies rigorous empirical testing to test the validity of the model. Data derived from different sources undergo unit root tests to ensure stationarity at level or first difference. It also utilizes cointegration test, error correction model, short-run granger causality, variance decomposition and impulse response function to analyze the dominant factors will influence revenue of Proton in Malaysia.This analysis using quarterly data for the period of 2000Q1 to 2012Q4 from various sources.The estimation results indicate that there exists one co-integrating vector. Thus, it can be concluded that there is a long run equilibrium relationship among the variables.

***Keywords*—**Malaysia Automotive Industry, Proton's Revenue, Demand

I. Introduction

MALAYSIAN automotive sector is characterized by a domestically developed manufacturing structure geared towards the production of passenger vehicles. The sector has been heavily subsidized and protected to produce national champions and automobile components and parts suppliers. The history of Malaysian automotive industry can be stretched back since the 1960's. However, the manufacturing of Malaysian automotive industry was only visualized in the 1980's. It was a giant leap for the Malaysian automotive industry to manufacture the Malaysian car. The project was called the Malaysian National Car project and the company entrusted to undertake this project, Proton, was incorporated on 7 May 1983, under the name 'Perusahaan Otomobil Nasional Berhad. Established in 1983, Proton was the brain-child of Malaysia former Prime Minister, It is an ambition to turn Malaysia into Southeast Asia's new auto-making powerhouse.

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The Malaysian automobile market saw an upward trend since the economy's recovery from the prolonged recession in year 1988. The demand for automobile plummeted in 1998 due to the financial crisis but the demand picked up again as the economy recovered from the crisis by year 1999.

The purpose of this study is to investigate the long run and short run relationships between inflation rate, fuel price and GDP per capita with Proton's sales revenue in Malaysia by using time series econometric techniques i.e. the unit root test, cointegration test, error correction model, short-run granger causality, variance decomposition and impulse response function. The co-integration analysis is becoming more important in time series analysis, since it indicates the possibility of integration and co-integration among the variables in the long run relationship.

II. Literature Review

According to Shahabudin (2009) not much analytical work has been done relating to automobile sales which account for a large share of a durable goods market. Carlson and Umble (1980) were trying to determine the price of gasoline and other major factors and the sales of car. They found that the sales of compact car grew faster than other types of car. Cheng and Tan (2002) mentioned that the sharp oil price is one of the external factors which have a significant influence on Malaysian inflation in 1973 and 1974; the substantial price increases in 1973 were brought mainly by the shortages of food and raw materials arising from bad weather and increased aggregate demand. They concluded the fuel price will affect the demand of cars in countries. Higher price of fuel, lower the demand of cars in the market. People will prefer using public transportation rather than using their own cars. New car buyers will need to think more to decide buying cars, because high fuel price increase cost of driving on their own.

However, according to the empirical analysis of Callie and Omar (2010), all of their independent variables including the price of petrol variable are statistically insignificant in influencing the automobile demand in the country. Meanwhile, Mohamad Rizal & et al (2008) found in their empirical analysis the fuel prices in Malaysia have little effect on Proton sales revenue.

Furthermore, there are a number of studies on car demand investigate that the income of people will be among the main factor that affects the demand of cars in the market. Dargay (2007) continues to examine the effect of prices and income on car travel in United Kingdom. Rising income makes it easier

for household to own car. Graham and Glaister (2002) in survey about the response of motorists to fuel price changes and an assessment of the orders of magnitude of the relevant income and price effects. It means that the effect of price on fuel consumption and on motorist's demand for road travel and the demand for owning cars in heavily dependent on income.

Thus, with the reference of the above literature, this paper aims to analyze the long run and short run relationships between inflation rate, fuel price and GDP per capita with Proton's revenue in Malaysia.

III. Methodology

This analysis using quarterly data for the period of 2000Q1 to 2012Q4. The multivariate model consists of Proton revenue (REV), GDP per capita (GDP), inflation rate (INF) and fuel price (FUEL). The data are extracted from several sources, including World Development Indicators, Department of Statistics (Malaysia), Financial report of Proton Holding Berhad Malaysia. As part of the empirical design, our base estimating equation in log-linear form is specified as follows:

$$lnREV_t = \alpha + \beta_1 lnGDP_t - \beta_2 lnFUEL_t + \beta_2 INF_t + \mu_t \quad (1)$$

The error-term μ is assumed to be independently and identically distributed. The subscript (t) indexes time.

This study uses E-views software which is an interactive tool for advanced statistical and econometric analysis.The model applies unit root tests to assess stationary properties of the time series variables and avoid spurious regression. It also utilizes the co-integration test for non-stationary variables at which level they co-integrate. Thus, we can confirm that the regression of the model form is meaningful and it does not lose any valuable long-term information. With the co-integration test, if it indicates that variables are co-integrated, we can conclude that the variables have a long run relationship, and we will proceed with the estimation of the short-run dynamics of the model. In other words, it is the estimation of the error correction model.

The next test is Granger causality test which is to investigate the dynamic interactions between these variables. The test results are based on the bi-variant Granger causality analysis between the variables, we can see whether one variable can cause another variable in this analysis. Thus, aptly, Granger causality is a test of precedence or a test of predictability.

The other test is Variance Decomposition which measures the percentage of forecast error of variation that is explained by another variable within the short-run dynamics and interactions.

Lastly, Impulse Response Function can give an indication of the causal properties of the system. We can see the results are in line with the variance decomposition and the response of growth to the other variables in the system.

IV. Result And Discussion

The result of the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test; the individual lag is chosen based on Akaike criteria. Both tests are conducted with trend and intercept. Both ADF and PP tests concur that REV, GDP, FUEL and INF are stationary at first difference.

This statistical finding shows that all variables are not integrated in the first level or integrated of order 0 or I(0). This means that they are not integrated in the present period. The results indicate that GDP, INF and FUEL to Proton revenue need to be seen as a long run contribution rather than a short run. Since each of the series is stationary, we proceed to examine whether there exists long run equilibrium between revenue and the independent variables.

TABLE I
RESULTS OF JOHANSEN'S COINTEGRATION TEST

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.**
None *	0.440400	50.93266	47.85613	0.0250
At most 1	0.314737	21.90605	29.79707	0.3037
At most 2	0.058089	3.008448	15.49471	0.9665
At most 3	0.000324	0.016204	3.841466	0.8986
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value**	**Prob.****
None *	0.440400	29.02661	27.58434	0.0325
At most 1	0.314737	18.89760	21.13162	0.0999
At most 2	0.058089	2.992244	14.26460	0.9472
At most 3	0.000324	0.016204	3.841466	0.8986

*Trace and Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
*Denotes rejection of the hypothesis at the 0.05 level

Table I shows the result of Johansen Co-integration test. The result shows that the null hypothesis of no co-integrations is rejected by Trace and Maximum Eigen value. It indicates that there is one co-integrating vector exists. Thus it can be concluded that there is a long run equilibrium relationship among REV, GDP, INF and FUEL. Accordingly, these variables are tied together in the long run and their deviations from the long-run equilibrium path will be corrected. The presence of co-integration also rules out non-causality among variables. We also report the co-integrating coefficients in the long-run equation form normalized on Proton's sales revenue.

$$REV = 2.26FUEL - 2.93GDP + 0.55INF + \mu_t \quad (2)$$

Based on this long-run equation, there seem to be a positive relationship between inflation and fuel price with revenue.

Having examined that there exist a co-integration vector among the time series, the Vector Error Correction Model

(VECM) can then be applied. The short run equation under the error correction framework is computed to include an adjustment mechanism from short run to long run equilibrium. In other words, it corrects for disequilibrium. Statistically, looking at the t-statistics value for Error Correction Model (ECM) term, the figure shows that it is not significant. It may be due to methodology of collecting data at different time frames will lead to measurement bias.

TABLE II
GRANGER CAUSALITY TEST

Null Hypothesis:	F-Statistic	Prob.
LNGDP does not Granger Cause LNREV	0.03555	**0.9651**
LNREV does not Granger Cause LNGDP	0.28268	0.7551
INF does not Granger Cause LNREV	1.28157	**0.2875**
LNREV does not Granger Cause INF	0.17641	0.8388
LNFUEL does not Granger Cause LNREV	0.37633	**0.6885**
LNREV does not Granger Cause LNFUEL	0.70482	0.4996
INF does not Granger Cause LNGDP	4.82212	0.0127
LNGDP does not Granger Cause INF	1.14987	0.3258
LNFUEL does not Granger Cause LNGDP	0.31892	0.7286
LNGDP does not Granger Cause LNFUEL	4.78550	0.0131
LNFUEL does not Granger Cause INF	0.09004	0.9141
INF does not Granger Cause LNFUEL	1.07948	0.3484

Table II summarizes empirical result of Granger causality tests between four variables used in this study. The result shows there is neither unidirectional nor bidirectional causality between GDP, inflation rate and fuel price to the Proton's revenue in the short run.

Table III presents variance decomposition at 1 to 10 years horizon of each variable. Looking at the interaction between LNREV and the other variables; we find evidence suggesting the significant role of LNREV in accounting for variations in other variables. More specifically, there is an increasing trend of LNGDP forecast error variance that is attributable to innovations in LNREV at 1-year to 10-year horizons, from 0.00% to 10.58%. GDP does not have a short run impact in the variation of revenue, it only shows significant effect at year 10, counting for 10.58% of the variation. Looking at the interaction between revenue and inflation, its variation in growth at 1-year to 10-year horizons is from 0.00% to 4.11%. The result confirmed that inflation may not directly affect revenue in the short run.

TABLE III
VARIANCE DECOMPOSITION

		By innovation in (%)			
Variable explained	Period	LNREV	LNGDP	INF	LNFUEL
LNREV	1	100.0000	0.000000	0.000000	0.000000
	2	97.43974	0.241241	0.024562	2.294462
	3	90.26718	4.026737	1.875608	3.830472
	4	85.51345	6.562501	3.872628	4.051421
	5	81.51740	9.331966	4.699671	4.450965
	6	79.75321	10.73413	4.970614	4.542053
	7	79.64170	10.92223	4.745004	4.691058
	8	79.88116	10.84436	4.427072	4.847411
	9	80.15349	10.66491	4.211378	4.970224
	10	80.24371	10.57773	4.110535	5.068017

Meanwhile, the impulse response of LNREV explained that the results are in line with the variance decomposition. According to the impulse response analysis, the respond of LNREV to LNFUEL and INF is positive and it is also in line with the result of education with positive coefficient, in the long-run equation.

V. CONCLUSION

The paper examines the long run and short run relationships between inflation rate, fuel price and GDP per capita with Proton's revenue in Malaysia using a time series analysis. The results indicate that GDP, INF and FUEL to Proton revenue need to be seen as a long run contribution rather than a short run.

Based on the long-run equation, there seem to be a positive relationship between inflation and fuel price with revenue. Therefore, it is possible the fuel prices and increase in inflation rate in Malaysia have some effect on Proton sales revenue. The fuel price has only temporary effect on car purchasing. Perhaps, in other countries people will take public transportation instead of driving cars when fuel prices are high.

However, the coefficients of GDP shows negative value indicate that there is an inverse relationship with Proton revenue. Possibly, by having higher income level, consumers were open to more different option from different manufacturers. Mainly, Proton needs to alleviate the misconception of mediocre quality among its potential buyers to ensure its future product acceptance.

As a result of that, the explanation of the impact of GDP, inflation rate and fuel price on revenue would be limited to the proxies used. In addition, the data set employed for this study is from 2000Q1 to 2012Q4, and the results only represent the case of Proton, car manufacturer in Malaysia. Therefore,

analyzing data from different countries may give different outcomes and subject to future research regarding these issues.

The study formulates some suggestions for further research. First, further study may investigate the possible and potential variables which can be included or replaced the previous variables for the improvement of car manufacturing analysis. Second, future study may improve the analysis especially in the aspect of research methodology by using other research methods for example: Autoregressive Distributed Lag Model (ARDL) and Dynamic Ordinary Least Squares (DOLS). Finally, given that this study utilizes Malaysia data, the analysis can be further extended to other sectors of production or countries or grouping of countries such as Association of Southeast Asian Nation (ASEAN) and investigate if they give similar or different outcomes.

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