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Analysis of The Influence of Premium Regulation on Motor Vehicle Insurance Premiums in Indonesia

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***Abstract*—This study analyzes the regulatory impact of Indonesian Financial Services Authority (OJK) Circular Letter No. 6/D.05/2013 on tariff/premium regulation of general insurance, with particular reference to motor vehicle insurance premiums and premium rate change factors. Using data from 44 motor vehicle insurance companies in Indonesia from 2011 to 2016, a dynamic panel data regression model with generalized method of moment (GMM) developed by Arellano and Bond was used to analyze the impact of regulation on insurance premiums in Indonesia. To analyze the impact of regulation on changes in insurance premium volatility, this study used a fixed-effect method for panel data regression. Furthermore, to analyze the determinant factors for insurance premiums in the period before and after regulation, the study used panel data regression with weighted OLS method and Newey-West corrected standard error estimator. Empirical analysis showed that regulation has a positive and significant impact on motor vehicle insurance premiums in Indonesia but does not affect the volatility of such premiums. The factors affecting change of premium differ significantly in the period before and after deregulation.**

***Index Terms*—Dynamic data panel regression, insurance premiums, motor vehicle insurance, Newey-West corrected standard error, regulation**

I. Introduction

Before the introduction of government regulations to regulate motor vehicle insurance, the insurance market in Indonesia set premiums based on the laws of supply and demand. If a company lowers its price, it increases its market share and generates higher levels of profit. This encourages other companies to try to outperform their competitors until the products traded fall to prices where no economic profit can be made, resulting in unhealthy premium conflict between insurance companies. These conditions resulted in high volatility in insurance premiums in Indonesia's motor insurance industry.

As a result, the government, in its role as regulator, needed to improve the condition of the motor vehicle insurance market in Indonesia and therefore established a policy to regulate the market through Ministry of Finance Regulation (PMK) no.74/PMK.010/2007 concerning "Implementation of Insurance Coverage in the Motor Vehicle Insurance Business Line". The regulation set out reference rates for motor vehicle insurance premiums, but was not actually implemented consistently by motor vehicle insurance businesses (Prasetyo, 2014) and this created a premium war between these businesses. The disadvantage of Regulation No.74/2007 was that it only set a single rate as a reference, whereas companies must set a full premium which includes not only the pure cost-of-cover element but also administrative and other general elements of cost. Therefore, in 2013, the Indonesian Financial Services Authority (the OJK) issued OJK Circular Letter No.6/D.05/2013 which set standard upper and lower limits for motor vehicle insurance premiums, with the intention of ending motor vehicle insurance premium rate wars and improving the underwriting cycle in the motor vehicle sector of the general insurance industry. It protects customers from high premiums and protects the ability of insurance businesses to pay claims. Thus, the government provides protection for customers from excessive insurance premium rates by setting premium limits, ensuring that regulations can guarantee that customers can access high-quality insurance services with affordable and reliable premiums. Meanwhile, the government also set a lower limit on premium rates to protect insurance businesses from unfair business competition. This provides a guarantee for insurance companies of their ability to pay customer claims and can provide space for insurance companies to focus more on providing the best service for their customers.

However, many motor vehicle insurance companies considered the implementation of these upper and lower premiums as disrupting the insurance business because it caused costs to rise. It is therefore necessary to review the effects of regulation on changes in insurance premiums and to identify the factors influencing premium growth in the periods before and after the regulation was introduced.

II. Literature Review

A. The impact of regulation on loss ratio volatility

According to D'Arcy [1], there are several theories regarding the impact of regulation on insurance premiums:

- Capture theory (protection for insurance providers): regulators are 'captured' by the insurance industry, which raises average premiums and reduces average loss ratios. In other words, the loss ratio will be lower in regulated countries than in competitive countries.
- Price suppression theory (consumer pressure): consumer pressure for low insurance premiums causes regulators to reduce insurance premiums periodically or continually. Thus, the loss ratio will be higher in regulated countries than in competitive countries.
- Alternative theories or regulatory lag and political pressure can cause fewer premium changes, but changes are

greater in countries with strict regulation. Regulatory effects will fluctuate according to market conditions, tending to increase the volatility of loss and premium rate changes in regulated countries more than in competitive countries.

- Market disruption theory: this theory suggests that the motor insurance industry does not require premium regulation. It does not make a large contribution to loss ratio volatility because insurance companies can respond to inadequate premium levels by rejecting unfavorable businesses, reducing the level of services provided to reduce costs, or withdrawing from the market if necessary.

III. Research Methodology

Data in this study comprises panel data drawn from insurance statistics including the financial statements of motor vehicle insurance companies in Indonesia from 2011 until 2016, sourced from the official website of the OJK, and other data sourced from the Indonesia Stock Exchange. The three elements analyzed in the study were whether OJK regulations applied from 2013 caused insurance premium changes and volatility, and differences in the determinants of motor vehicle insurance business in Indonesia before and after the application of the regulation.

A. Loss ratio analysis ($LossRatio_{i,t}$)

To test structural changes in insurance premiums, loss ratio is used as an inverse measurement of price profitability. Loss ratio (or claim expense ratio) is obtained by comparing the value of claim expenses with premium income. In conducting research into changes in premiums in the two different regulatory periods (pre- and post-regulation), time-series and cross-sectional data must be used. Thus, the method used in this study is dynamic panel data regression with generalized method of moment (GMM) estimation, as developed by Arellano and Bond [2].

B. Regression model of dynamic panel data

Dynamic panel data regression is characterized by two sources of persistence over time. Autocorrelation occurs because of a lag in the dependent variables between regression and individual effects, characterizing heterogeneity among individuals for cross-sections. Autocorrelation, also known as serial correlation, is the correlation between errors generally occurring in time-series data.

The general form of the dynamic panel data model is as follows:

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + \mu_i + \nu_{it}$$

where:
$u_{it} = \mu_i + \nu_{it}$
with
$\mu_i \sim IID(0, \sigma^2_\omega)$
$\nu_i \sim IID(0, \delta^2_\pi)$
Thus:

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + \mu_i + \nu_{it}$$

where:
y_{it} = dependent variable for individual data to i and timing data to t
$y_{i,t-1}$= independent variable for individual data to i and timing data to t
δ = scalar
x'_{it} = free variable for individual unit to i and timing data to t matrix with size of 1 x k
β = free variable parameter matrix with size of k x 1
μ_{it} = Error for individual unit to -i and timing data to -t

C. DMM estimation from Arellano and Bond method for dynamic panel data

To analyze the effects of regulation on insurance premiums, this study used dynamic panel regression with the GMM estimation method suggested by Arellano-Bond [2]. The GMM method was chosen because of the possibility that the value of motor vehicle insurance premiums measured through loss ratio is influenced by other variables and loss ratio variables at different time periods. Arellano and Bond [2] argued that additional instruments can be obtained in dynamic panel data models by using the orthogonality conditions that exist between lag values from y_{it} and y_{it} interference. The estimation parameter with one-step estimator of GMM Arellano and Bond is as follows:

$$\hat{\delta}=\left[\left(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1},\Delta X_i)'Z_i\right)\hat{W}\left(N^{-1}\sum_{i=1}^{N}Z'_t(\Delta y_{i,t-1},\Delta X_i)\right)\right]^{-1}$$
$$\left[\left(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1},\Delta X_i)'Z_i\right)\hat{W}\left(N^{-1}\sum_{i=1}^{N}Z'_t(\Delta y_{i,t-1},\Delta X_i)\right)\right]$$

where:
Z_i = valid instrument of ordo matrix (T-2) x $\frac{(T-2)(T-1)}{2}$
$\Delta y_{i,t-1}$= ordo 1 x (T-2)
$\hat{W}$ = consistent estimation for W_{LxL} with L being the amount of instrument variable with ordo $(\frac{(T-2)(T-1)}{2})$ x $(\frac{(T-2)(T-1)}{2})$

Estimation results for the two-step estimator is achieved through distributing the weight of $\hat{W}_{optimal}$ with $\hat{\Lambda}^{-1}$, as follows:

$$\hat{\Lambda}^{-1} = N^{-1}\sum_{t=1}^{N} Z'_i\Delta V_i \times \Delta V'_i Z_i$$

Thus, the estimation result parameter with one-step estimator of GMM Arellano and Bond becomes:

$$\hat{\delta}_2=\left[\left(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1})'Z_i\right)\hat{\Lambda}^{-1}\left(N^{-1}\sum_{i=1}^{N}Z'_t(\Delta y_{i,t-1})\right)\right]^{-1}$$
$$\left[\left(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1})'Z_i\right)\hat{\Lambda}^{-1}\left(N^{-1}\sum_{i=1}^{N}Z'_t(\Delta y_{i,t-1})\right)\right]$$

The model specifications for loss ratio analysis are as follows:

$$\begin{aligned} LossRatio_{i,t} =& \alpha + \beta_1 Regulasi + \beta'_2 X_2 + \beta'_3 X_3 + \beta'_4 X_4 \\ &+ \beta'_5 X_5 + \beta'_6 X_6 + \beta'_7 X_7 + \beta'_8 X_8 + e_{it} \end{aligned} \quad (1)$$

where $LossRatio_{i,t}$ is the loss ratio for company i in year t, regulation is a dummy variable encoded as 1 for 2011 to 2013 and 0 for 2014 to 2016.

TABLE I: Chow Test Results

Effects test	Statistic	Difference	Probability
Cross-section F	2.49997	-48.208	0
Cross-section Chi-square	120.244384	48	0

TABLE II: Hausman Test Results

Test Summary	Chi-sq. statistic	Chi-sq. difference	Probability
Cross-section random	10.363866	7	0.01689

Interest rates can affect insurance premiums ([3]) where premiums reflect discounting from estimated losses. To control this effect, the remaining $IntRate_{t-1}$ variables are included in this model. The amount of surplus owned by an insurance company can affect premium determination decisions, which in turn impacts on premium changes. If external financing is expensive, shock-affected insurance companies can choose to restore their financial strength by raising premiums rather than by acquiring additional capital from the capital markets [4], [**?**]. If the insurance company's surplus is depleted, it needs to adjust the premium rate charged. To control the inverse relationship between surplus and premium, changes in surplus to asset ratios ($\Delta Surplus2A_{i,t-1}$) are included as control variables in this model. Claim reserves are reserves held against potential disaster losses. Their purpose is to spread the impact of irregular events that affect insurance premiums over several years and thus support the income of insurance companies. Without such reserves, insurance companies' surpluses will absorb fluctuations in losses. To reflect this, claim-on-asset ratio ($\Delta CR2A_{i,t-1}$) is one of the control variables used in this model. Claim growth standard deviation ($CondStdDev_{i,t-1}$) is the growth rate standard deviation of the loss ratio included in this model as a control variable to control for changes in future losses. Thus, the company can more quickly respond to changes before regulation than after it. To take into account such interaction effects, the variable standard deviation of claim x regulation growth ($CondStdDev_{i,t-1}\times$Regulation) is included as a control variable. One-year lag ($LossRatio_{i,t-1}$) and 2-year lag ($LossRatio_{i,t-2}$) dependent variables were included in the regression model since a number of studies have documented cycle patterns in industrial loss ratios as well as loss ratios in individual companies or lines of business [6], [7].

In this study, the first test was performed on the unit root of each variable to justify the model specification. Table I presents the results of the Dickey-Fuller test for loss ratios, interest rate variables, surplus ratio to assets, claim growth standard deviation, claim x regulation standard deviation growth, and 1-year and 2-year variable lags for the dependent variable.

D. Loss ratio volatility analysis [$\sigma^2(LossRatio_{i,t})$]

To analyze the volatility of insurance premiums measured through the volatility of the loss ratio, the data used is time-series data and cross section. To determine the best model for analyzing loss ratio volatility, model conformity testing procedure will be carried out consisting of the Chow test and the Hausman test. Based on the results of the Chow test in Table I, the probability values of the F and chi-square tests are smaller than α at a confidence level of 5%. In other words, the fixed-effect model is better than the common-effect model. The Hausman test results in Table II show that probability value in the random cross section is 0.01689 smaller than α at a confidence level of 5%, so the fixed-effect model is better than the random effect model.

These tests show that the best model for analyzing loss ratio volatility is the fixed-effect model, thus the model used in Equation 2 is fixed-effect model regression with panel data with the following model specifications:

$$\begin{aligned}\sigma^2(lossRatio)_{i,t} =&(e_{i,t}-e_i)^2\alpha+\beta_1 Regulasi+\beta_2' X_2+\\ &\beta_3' X_3+\beta_4' X_4+\beta_5' X_5+\beta_6' X_6+\\ &\beta_7' X_7+\nu_{it}\end{aligned} \tag{2}$$

where $e_{i,t}$ is the residual from Equation 1, e_i is the mean of $e_{i,t}$ for t years throughout company i, X_n is the vector of control variables, and v_{it} is the term for random error.

Eight control variables are included in Equation 2, not including 1-year and 2-year lags from the loss ratio and with one additional variable, being $Premi_{i,t}^{1\backslash 2}$. This latter variable represents the square root of the premium obtained in firm i in year t, used to identify differences in premium volatility among insurance companies. This is included to allow for lower volatility, because the size of the company is assumed to increase over time. These seven variables become the control variables of Equation 2.

E. Analysis factors that affect changes in premiums ($\Delta Premium_{i,t}$)

Analysis of the factors that influence premium changes in two different regulatory periods was based on the data panel regression model. To produce a better estimation value with an unbiased standard error by including a lag of three independent variables, Equation 3 is estimated using the weighted OLS procedure with Newey-West corrected standard error that allows for heteroscedasticity and autocorrelation throughout the company in relation to three lags, used in this study in order to see premium changes clearly.

F. Newey-West corrected standard error

OLS regression often fails to meet the basic assumptions needed to produce the best parameter estimates. The most common failure in regression analysis is for heteroscedasticity, occurring when the variance of the error regression model is not constant. Another problem that occurs in regression analysis is autocorrelation, encountered when there is a correlation between one error and another error. Estimation of weighted least square accompanied by an estimate of the Newey-West covariance matrix can be carried out to overcome this problem. The method developed by Newey and West (1987) known as the Newey-West corrected standard error method can correct heteroscedasticity and autocorrelation problems [8]. Newey and West proposed covariance estimators that are consistent with the presence of heteroscedasticity and autocorrelation (HAC) in unknown forms, assuming that autocorrelation between remote observations is lost. The HAC coefficient covariance estimator is consistently given throughout as follows:

$$s\hat{u}m_{NW} = \frac{T}{T_k}(X'X)^{-1}T\hat{\Omega}(X'X)^{-1}$$

where $\hat{\Omega}$ is a long-run covariance estimator:

$$\hat{\Omega} = \frac{T}{T-k}\{\sum_{t=1}^{T} u_t^2 X_t x_t' + \sum_{v}^{q} = 1$$
$$\left((1-\frac{v}{q+1})\sum_{t=v+1}^{T}(x_t u_t u_{t-v} x_{t-v}' + x_{t-v}u_{t-v}u_t x_t')\right)\}$$

where q is lag from truncation which is the parameter representing the amount of autocorrelation used to evaluate the residual dynamics of OLS u_t:

$$q = floor(4(\frac{T}{100})^{\frac{2}{n}})$$

The model specifications used to analyze the factors that affect changes in premium are as follows:

Pre-regulation and post-regulation:

$$\begin{aligned}\Delta Premi_{i,t} =& \alpha + \beta_1 X_1 + \beta_2' X_2 + \beta_3' X_3 + \beta_4' X_4 + \\ & \beta_5' X_5 + \beta_6' X_6 + \beta_7' X_7 + \beta_8' X_8 + \\ & \beta_9' X_9 + \beta_1 0' X_1 0 + \beta_1 1' X_1 1 + u_{it}\end{aligned} \quad (3)$$

Premium is a function of past loss experience [7]. Differences due to regulations, data reporting and internal accrual accounting will affect premiums through their impact on previous losses [6]. In determining the insurance premium, all harmful factors which exist based on past experience should be more strongly considered. Level of risk will affect decisions about changes in insurance premiums and affecting the growth of the insurance premium, thus delta losses $(\Delta Losses((\Delta Losses_{i,t-1})(\Delta Losses_{i,t-2})(\Delta Losses_{i,t-3}))$ are included as independent variables in Equation 3.

Interest rates can affect insurance premiums [3], in that premiums reflect discounts from estimated losses and interest rate rises can therefore lead to decreases in insurance premiums. In addition, insurance premiums create substantial investment funds. Funds invested can generate significant investment income so that varying interest rates need to be considered in setting premiums. Therefore, the interest rate becomes one of the explanatory variables in Equation 3. In addition, if the overall market is performing well, higher investment returns can allow insurance companies to reduce insurance premiums to remain competitive or to seek greater market share. Thus, higher investment returns are associated with lower underwriting profits [9]. High investment income in a period of high capital market returns is related to lower returns because premiums are lower ([10]. To find out this relationship, variable changes in the composite stock price index ($\Delta IHSG_t$) are included as a control variable in Equation 3. Changes in surplus level at 1 year, 2 years, and 3 years ($\Delta Surplus_{i,t-1}$) ($\Delta Surplus_{i,t-2}$) ($\Delta Surplus_{i,t-3}$) are included as independent variables to test whether the change in surplus is directly related to changes in premiums [4], [5]. Likewise, companies must take into account that there are likely contingencies beyond their control which involve responsibility for paying claims at some time in the future. Thus, changes for 1-year, 2 year, and 3-year claim reserves (($\Delta CR_{i,t-1}$) ($\Delta CR_{i,t-2}$) ($\Delta CR_{i,t-3}$)) are included in Equation 3. To analyze the factors that influence premium changes in two different regulatory periods, testing is carried out separately for the pre- and post-deregulation periods.

IV. Findings

To analyze the impact of regulation on motor insurance premiums in Indonesia, the independent variable involves a lag of the dependent variable, allowing for stochastic trends. Therefore it is necessary to carry out unit-root tests at the beginning of the study to examine the assumption that panel data is not stationary. Research conducted by [11] proves that the strength of panel-based unit-root tests can be dramatically higher than achieved by performing separate unit-root tests for each individual time series. As the first step, a test for unit roots in crucial variables is conducted to justify the model specification, using the augmented Dickey-Fuller (ADF) method. The reported test statistics are based on data for the years 2011 to 2016. The results are presented in Table III.

Based on Table III it can be seen that the statistical value of t for each variable is greater than the value of t in the table of critical values at confidence levels of 1%, 5%, and 10% and that the probability value of each variable is smaller than 0.05. Thus, the data is stationary at the differentiation level of the first stage. Thus, the data can be used in dynamic panel data testing.

A. Regression results for dynamic panel data for loss ratio analysis ($LossRatio_{i,t}$)

GMM (Arellano-Bond) results from Equation 1 are presented in Table IV. From the analysis carried out, the regulation dummy variable gives a positive and significant coefficient. This shows that there is a significant relationship between regulatory variables and losses. The influence of regulation on loss ratio indicates that any changes in regulations

TABLE III: ADF unit-root test

Variable	Level	Difference
LossRatio	-16,814***	-30,400***
	(0,000)	(0,000)
IntRate	-13,430***	-20,114***
	(0,000)	(0,000)
Surplus2A	-21,683***	-32,622***
	(0,000)	(0,000)
CondStdDev	-28,521***	-40,899***
	(0,000)	(0,0001)

Note: * $>$ critical MacKinnon value α = 1%, ** $>$ critical MacKinnon value α = 5%, *** $>$ critical MacKinnon value α =10%.

TABLE IV: Dynamic panel data results tests

Variable	Coefficient	Std. error	t-statistic	Probability
Regulation	0.824891	0.287855	2.865649	0.0049
IntRate	0.190452	0.231074	0.824203	0.4114
ΔSurplus2A	-0.364828	0.481377	-0.757884	0.45
ΔCR2A	-3.343043	4.552421	-0.734344	0.4641
CondStdDev	0.038324	0.017987	2.130661	0.0351
CondStdDev x Regulation	-0.046315	0.019239	-2.407327	0.0175
1-year lag LossRatio	-0.783183	0.105355	-7.433757	0
2-year lag LossRatio	-0.634892	0.110102	-5.766414	0

TABLE V: Results of fixed-effect model regression estimates

Variable	Coefficient	t-count	Probability
C	4.363107	17.98443	0
Regulation	-1.949826	-6.778054	0.4562
$IntRate_{t-1}$	-0.093062	-0.759633	0.4483
$\Delta Surplus2A_{i,t-1}$	0.401313	0.574258	0.5664
$\Delta CR2A_{i,t-1}$	-24.16595	-0.393274	0.6945
$CondStdDev_i, t-1$	-0.000163	-2.286173	0.0233
$CondStdDev_{i,t-1}$ x Regulation	0.000151	1.789964	0.0749
$Premium_{i,t}^{\frac{1}{2}}$	2.05E-07	0.26472	0.7915
R^2			0.472858
F-statistic		3.392375	0
Durbin-Watson statistic			1.91156

regarding insurance in Indonesia, especially in motor vehicle insurance, will cause changes in losses incurred and costs of adjusting losses to premiums obtained by the company, thus affecting changes in insurance premiums.

B. Regression result of fixed-effect model panel data for volatility loss ratio analysis

The results for panel data regression for the volatility of the loss ratio for regulatory variables and the control variables are presented in Table V. The initial step is to apply some classic assumption tests to ensure that the regression equation obtained has accuracy of estimation and is unbiased and consistent. From the analysis conducted, the regulation dummy variable gives negative and insignificant coefficients. These results indicate that the regulations imposed by the government do not have a strong or significant impact on the volatility of changes in losses incurred and the costs of adjusting losses to premiums obtained by companies. This can be interpreted as the regulations imposed by the government having no significant contribution for the volatility of insurance premiums.

C. Regression results for weighted OLS with Newey-West corrected standard error for factors influential on premium changes ($\Delta Premium_{i,t}$)

As a first step, classical assumption tests are carried out to ensure that the regression equation obtained has accuracy in estimation. The test results show that heteroscedasticity and autocorrelation problems occurred in the regression equation, so the regression analysis is performed using weighted OLS estimation with Newey-West corrected standard error to overcome these problems. The estimations of Equation 3 with weighted OLS with Newey-West corrected standard error were conducted separately for pre- and post-regulation stages and are presented in Table VI. It can be seen that the significance of $\Delta Loses_{t-1}$, and $\Delta IntRate$ for $\Delta Premiums$ both before and after regulation increased by 5%. Yet $\Delta_I HSG$ and $\Delta Surplus_{t-3}$ significance for $\Delta Premiums$ before regulation was also 5% and the significance of ΔCR_{t-1} for $\Delta Premiums$ after regulation rose to 10

V. Discussion

The results of testing Equation 1 as shown in Table 4 reveal that regulation has a significant effect on the loss ratio of

TABLE VI: Results of weighted OLS regression estimates

Dependent variables: DPremiums			
Variable	Expected sign	Pre-regulation: 2011–2013	Post-regulation: 2014–2016
C	N/A	-11.33553 (0.0000)	1.331786 (0.1855)
DLosest-1	+	2.031611*** (0.0444)	2.223062*** (0.0281)
DLosest-2	+	1.234515 (0.2194)	1.461703 (0.1464)
DLosest-3	+	-0.719851 (0.4730)	-1.4013 (0.1637)
DIntRate	-	9.869992*** (0.0000)	-4.079336*** (0.0001)
DIHSG	+	9.230936*** (0.0000)	1.049584 (0.2960)
DSurplust-1	-	-0.576218 (0.5655)	0.035997 (0.9713)
DSurplust-2	-	-0.654525 (0.5140)	1.604119 (0.1113)
DSurplust-3	-	2.079286*** (0.0397)	-1.124863 (0.2629)
DCRt-1	-	1.409465 (0.1613)	1.721270** (0.0878)
DCRt-2	-	-0.193898 (0.8466)	1.618663 (0.1081)
DCRt-3	-	-0.302839 (0.7625)	0.621132 (0.5357)
R2		0.80098	0.301387
Adj. R2		0.782737	0.237347
N		132	132

motor vehicle insurance companies registered with the OJK from 2011 to 2016. It is indicates that there is unhealthy premium competition in the vehicle insurance market before regulation. The results of this study are supported by the equilibrium hypothesis described by [12], which states that there is premium competition in the insurance market before despite the incentives for collusion created by the insurance regulatory system.

The results of Equation 2 as shown in Table V indicate that regulation has no significant effect on loss ratio volatility as a variant of the amount of claim payments paid from premiums received by motor insurance companies registered with the OJK from 2011–2016. This result is in line with the results of research by [12], which state that regulation does not affect the volatility of insurance loss ratios. The shift from one competitive equilibrium to another competitive equilibrium due to regulation should not affect the volatility level of insurance premiums.

The insurance market has high levels of volatility for its loss ratios. Before regulation, this high volatility is due to insufficient premiums being received to pay for expected claims. However, after the implementation of upper and lower limits for insurance premiums by the OJK, such regulation proved not to affect the volatility of the loss ratio as an inverse measure of insurance premiums. The results of this study are supported by the market friction theory, which explains that regulation does not affect the volatility of insurance premiums seen from the aspect of volatility of the loss ratio because the volatility of the loss ratio itself is more influenced by internal factors in risk management and calculation than by external factors such as regulation. In addition, insurance companies can respond to inadequate premium levels by rejecting unfavorable business, reducing the level of services provided to reduce costs, or even withdrawing from the market if necessary.

Furthermore, the results of Equation 3 (shown in Table VI) show conditions before regulation indicating that $\Delta Loses_{t-1}$, $\Delta IntRate$, $\Delta IHSG$, and $\Delta Surplus_{t-3}$ significantly influence the growth of motor vehicle insurance premiums in Indonesia. Meanwhile, conditions before regulation indicate that, in contrast, $\Delta Losest_{t-2}$, $\Delta Losest_{t-3}$, $\Delta Surplus_{t-1}$, $\Delta Surplus_{t-2}$, ΔCR_{t-1}, ΔCR_{t-2}, and ΔCR_{t-3} do not have significant effects on the growth of motor vehicle insurance premiums in the country.

Similarly, $\Delta IntRate$ and $\Delta IHSG$ significantly and positively influenced growth of motor vehicle insurance premiums before the implementation of regulation by the OJK. The results of this study are in line with the theory put forward by Doherty and Kang [3] that suggests economic factors such as interest rates and the stock prices can also affect insurance premiums because they can affect the present value of estimated losses. In addition, these positive and significant results are also in line with the cash-flow underwriting theory that states that maximizing cash flows creates funds that can be invested in place of underwriting profits. On the other hand, $\Delta Surplus_{t-3}$ had a significant influence on the growth of motor vehicle insurance premiums before the implementation of premium regulations by OJK. The results of this study reinforce the theory that in competitive industries changes in surpluses will affect change in insurance premiums. Hence,

this study is also in line with the results of research conducted by Berry-Stölzle and Born [12] that prove lags in surplus changes are important determinants of changes in premiums after deregulation but not at the level of regulation.

The results of subsequent studies into post-regulation conditions indicate that $\Delta Loses_{t-1}$, $\Delta IntRate$, and ΔCR_{t-1} with a significance level of 10% have a significant influence on the growth of motor vehicle insurance premiums in Indonesia. In contrast, post-regulation conditions indicate that increase in $\Delta Loses_{t-2}$, $\Delta Loses_{t-3}$, $\Delta Surplus_{t-1}$, $\Delta Surplus_{t-2}$, $\Delta IHSG$, ΔCR_{t-2}, and ΔCR_{t-3} do not significantly influence the growth of motor vehicle insurance premiums in Indonesia.

By observing post-regulation conditions, it can be proved that $\Delta Loses_{t-1}$ has a significant and positive effect on the increase in net premium income in the current period compared to the previous year. Based on the theory mentioned in Cummins' book Restoring competition and increasing market efficiency [13], regulations concerning insurance rates tend to increase premiums, reflecting the increase in claims costs. Indeed, since the enactment of regulations concerning insurance premiums issued by the OJK in 2013, insurance premiums were raised to protect insurers from inadequate premiums, and this subsequently led to an increase in the growth rate of motor vehicle insurance premiums in Indonesia.

In contrast, $\Delta IntRate$ has a significant and negative effect on premium growth, indicating that insurance premiums increased significantly when interest rates fell. This is because the amount of the premium is calculated in terms of the present value based on discounted interest rates. This indicates that regulation improves the underwriting cycle. Under regulations regarding the limits of insurance premium rates, insurers are required to set insurance premiums in accordance with expected risk or loss, and this improved underwriting increases the growth rate of premiums.

In addition, ΔCR_{t-} has a significant and positive effect on premium growth with a significance level of 10%. The regulation requires additional loss reserves to be held to cover claims that have been reported but have not been paid and claims that have not yet been reported. Again, with good underwriting processes the value of premium income will reflect actual premium growth.

VI. Conclusion

This study examines the impact of premium regulation on insurance premiums and the factors that affected insurance premiums before and after the enactment of regulations. By using data from 44 vehicle insurance companies registered with the OJK and using complete and consistent financial reports from 2011 to 2016, this study seeks to provide information to regulators regarding the effects of regulations, for use in evaluating regulations for maintaining the stability of the insurance climate in Indonesia. Aspects of the regulator's role are to evaluate the setting of upper and lower premium limits periodically and to ensure that the results of implementing regulations do not disrupt the condition of insurance businesses, and in this, regulators must focus on monitoring prices and profits effectively [14]. In addition, this study seeks to provide information to insurance companies regarding the factors that influence changes in insurance premiums before and after regulations are implemented, to aid them in driving premium growth toward underwriting profitability.

The insurance premium regulations issued by the OJK have changed the vehicle insurance market from a being a excessively competitive to a healthily competitive. By maintaining market openness, insurance companies will be encouraged to be more efficient and to have high levels of market competitiveness. Regulation increases insurance premiums in order to provide protection to insurance companies' ability to pay claims, so that they tend to increase the price of insurance premiums accordingly. This can be seen from the results obtained from Equation 1, which indicate that regulation has a positive and significant effect on insurance premiums as measured through loss ratio as an inverse measure of insurance premiums.

However, this increase in insurance prices is considered burdensome to customers. Determination of lower-limit rates is a problem for insurance companies that are able to offer more competitive rates and may be able to charge below the lower limit of the regulated premium range. Although insurance companies can indeed be protected in their ability to pay claims, consumers will be disadvantaged because they do not have access to more competitive premium rates. Because insurance premiums become more expensive, consumers tend to reduce their purchases of insurance products. In other cases, consumers prefer large insurance companies when their premium rates are the same as small insurance companies, and so small insurance companies become less competitive. Given these problems, the government needs to review its policy on vehicle insurance premiums in Indonesia. These issues are also of concern to insurance companies, requiring them to adjust their behavior and service quality in order to gain the trust of consumers. Following regulation, the premium offered is no longer the main factor for insurance companies in offering their products to customers, with quality and service becoming a major factor in customer choice. The results obtained from Equation 2 show that regulation does not have a significant effect on the volatility of loss ratio. Volatility of loss ratio is more strongly influenced by internal factors in business behavior, such as risk management and calculation. This is normal, given that companies need time to adapt to new regulations. In this case, the government has taken steps to regulate insurance agents in carrying out regulations, such as by conducting audits of insurance companies and interviewing directors of general insurance companies and insurance brokers. If there are violations, sanctions can be imposed to revoke a company's authorization.

The factors that influence changes in premiums differ significantly in the period before and after regulation, indicating that the regulatory environment affects the determination of insurance premiums. In the insurance cycle, there are soft and hard markets. Soft insurance market conditions tend to apply

if financial markets are running well due to achieving a large part of their profits from investment, thus insurance premiums are often dependent on the performance of the investment markets, including the stock market. When companies become profitable, they begin to apply softer underwriting criteria and lower their premiums to gain greater market share. The insurance premium regulation issued by the OJK moves the vehicle insurance market from being at a soft position in the market cycle, where standard underwriting is more lax and premiums are lower, to a hard insurance market position where premium prices are higher and underwriting standards are more stringent. This can be seen from the results of Equation 3, which show that in the years before the regulation was implemented, $IHSG$ and $IntRate$ had a significant and positive effect on insurance premiums whereas after the regulation was implemented $IHSG$ no longer had a significant influence on insurance premiums. The premium rate regulation affects the amount of premium obtained and will affect the loss ratio; regulations also include minimum claim reserve requirements and interest rates that affect premium decisions in accordance with estimated future losses, all of which are factors that influence the growth of motor vehicle insurance premiums in Indonesia and which will therefore be the main focus for companies in driving premium growth toward underwriting profitability.

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