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Government Control in Increasing Vehicles Taxpayer Compliance

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Abstract—This study aims to determine the dynamics of taxpayer compliance from time to time by using a mathematical model. This study uses two analysis tools, namely differential equations, to create a model of taxpayer compliance and Moderated Regression Analysis to determine the effect of moderating government control on increasing taxpayer compliance. This study indicates that government control can reduce the number of non-compliant taxpayers by looking at the sensitivity index. The results of the sensitivity index of government control parameters can reduce the basic reproduction number. Statistically, it is also proven that the moderation of government control can strengthen the effect of awareness on taxpayer compliance by 82.5%.

Index Terms—Taxpayer Compliance, Government Control, Equilibrium, MRA, basic reproduction number

I. INTRODUCTION

Tax revenue is one of the State Revenue and Expenditure Budget (APBN) (Sriniyati, 2020) [11]. Taxes are contributions from the people to be given to the state treasury based on applicable laws without coercion and are used to finance state expenditures (Mardiasmo, 2009) [7]. Based on data obtained from the Ministry of Finance in 2020, it is explained that the tax contribution to the APBN is 85.65%. When viewed from the authority, taxes consist of two, namely central taxes and local taxes. Motor vehicle tax is one of the regional taxes managed by the province.

Motor Vehicle Tax (PKB) is one of the sources of regional tax that has a sizeable contribution to Original Local Government Revenue (PAD). In West Nusa Tenggara Province, the gift of PKB during 2017-2020 was an average of 23%. PKB's contribution to PAD can be seen in Figure 1.





PKB revenue is linearly correlated with the number of motor vehicles. The more the number of motorized vehicles, the PKB revenue will also increase. In 2017-2019, the

number of motorized vehicles in NTB was growing, but the number of Taxpayers (WP) who do not pay taxes is also increasing, as presented in Table 1.

Table 1. Addition of Taxpayers and the number ofTaxpayers who do not Pay Tax

City	2017		2018		2019	
	Increasin	Complian	Increasin	Complian	Increasin	Complian
	g	t	g	t	g	t
		taxpayers		taxpayers		taxpayers
Kota Mataram	20,619	132,037	20,481	145,729	21,015	161,653
Kota Bima	3,643	6,305	4,003	14,519	3,962	21,284
Kab. Sumbawa Barat	3,551	18,489	4,026	20,933	4,058	23,626
Kab. Sumbawa	8,736	47,001	9,977	55,332	10,213	62,801
Kab. Lombok Utara	5,217	19,545	5,252	24,583	7,124	26,638
Kab. Lombok Timur	21,951	116,752	25,409	130,377	26,738	146,389
Kab. Lombok Tengah	16,510	100,422	18,583	114,125	21,277	128,246
Kab. Lombok Barat	14,880	80,741	17,000	89,982	19,574	102,032
Kab. Dompu	2,861	32,639	2,890	37,361	2,958	42,580
Kab. Bima	4,788	22,943	4,874	26,130	5,005	29,755
Jumlah	102,756	576,874	112,495	659,071	121,924	

745,004

Source: Processed NTB Bappenda data

Based on the data above, an average of 87,065 additional taxpayers does not comply in making tax payments. Taxpayer compliance will affect a country's tax revenue (Chau & Leung, 2009) [5].

Taxpayer compliance is a phenomenon that occurs worldwide and is a significant problem to be solved (Sriniyati, 2020) [11]. Alink dan Kommer (2011) [2] state that as long as there are taxes, non-compliance will always exist. Seeing this phenomenon, it is necessary to make efforts or strategies to increase taxpayer compliance.



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The tax collection method or system that applies in Indonesia is the Official Assessment System, which is a tax collection system whose authority and amount are determined by the government (Widyaningsih, 2019) [12]. Thus, this system automatically relies on the volunteerism of the taxpayer in making payments (Sari & Susanti, 2015) [10]. A behavioral theory often used to describe taxpayer compliance is the TheoryTheory of planned behavior (TPB) (Lesmana et al., 2018) [6]. This TheoryTheory explains that a person's behavior will be formed with the intention, affecting the perceived attitudes, norms, and behavioral control (Lesmana et al., 2018) [6]. For this reason, this research will analyze the behavior of taxpayer compliance with government control to reduce the number of taxpayers who do not comply and are disciplined in paying taxes.

II. LITERATURE REVIEWS

Taxes are contributions given by the people to the state treasury, which are regulated by law to be imposed without receiving direct remuneration (Widyaningsih, 2019) [12]. Motor vehicle tax is a tax paid on the ownership of a motorized vehicle. Motor vehicles that are exempt from paying taxes include trains, cars used for state defense and security, and motorized vehicles owned or controlled by embassies/representatives of foreign countries using the principle of reciprocity as well as international institutions that receive tax exemption facilities from the government (Sari & Susanti, 2015) [10].

Tax compliance is a process of reporting tax obligations precisely and accurately following applicable laws (Musimenta et al., 2017) [8]. In his writing, Musimenta (2017) [8] says that tax compliance considers three aspects, namely payment compliance, filling compliance, and reporting compliance. The same thing is also explained by Antwi (2015) [4], that operationally, a taxpayer will be considered obedient if he complies with tax laws, namely reporting taxes on time, carrying out appropriate calculations, filling of tax returns on time, and paying obligations. Taxes correctly and on time.

Arisanti (2015) states that several factors can affect tax compliance, including understanding the tax collection system, service quality, education level, income level, and taxpayers' perception of tax witnesses. In addition to these factors, taxpayer compliance is also influenced by taxpayer awareness to comply [3]. Taxpayer awareness will lead to increased compliance in making payments. This is also stated in the research conducted by Anggraini (2021) [3] and Sari (2015). In his study, Sari (2015) [10] says that understanding the tax collection system and the services provided also affect taxpayer compliance. The services provided to taxpayers can be seen from the ease of payment offered by the government. Thus, in this study, government controls such as the provision of facilities for easy payments, sanctions, and others are expected to increase taxpayer compliance.

III. RESEARCH METHODOLOGY

This study models the compliance of taxpayers (obedience taxpayers) with government control. We are modeling taxpayer compliance with the provision of control from the government using a system of differential equations. This study uses secondary data to determine the values of the variables and parameters used to form the model. The use of primary data is used to strengthen the researcher's argument in knowing the correlation between variables and research parameters. Secondary data was obtained from the Regional Revenue Agency (Bappenda) of NTB. Primary data was taken on 100 of the 1,644,206 total taxpayers using the slovin formula, using a margin of error of 10%. Primary data collection was carried out using a questionnaire distributed online to all taxpayers in the Province of NTB. The data taken directly are awareness, sanctions, compliance, facilities and services, types of payments, and taxpayer compliance.

The taxpayer compliance variable was measured on a scale of 1 (Yes) and 2 (No). Taxpayer compliance is assessed from compliance in fulfilling obligations, the presence or absence of arrears, timeliness of payments, completeness of administrative data, concern about payment maturity, and consistency in enforcing tax rules. This compliance questionnaire has been tested for validity with an average significance value of 0.000, which means that the questionnaire is valid. Meanwhile, in the reliability test, Cronbach's Alpha value was obtained as large as 0.834, which means that the questionnaire questions are reliable.

The awareness variable was measured using a Likert scale of 1 to 5, namely 1 strongly disagree and 5 strongly agree. The indicator of this variable is the awareness of taxpayers about the tax function and awareness that there are funds that must be allocated for tax payments. The validity and reliability test results using SPSS were obtained below the mean significance was 0.000, and Cronbach's Alpha value was 0.841.

Tax sanctions are measured by the attitude of taxpayers to tax sanctions. This variable was measured using a Likert scale of 1 to 5. Based on the validity and reliability test results, it was found that the questionnaire was valid and reliable with an average significance value of 0.000 and Cronbach's Alpha value was 0.852.

The validity and reliability test of the facilities and service variables also states that the questions are valid and reliable with a significance value of 0.000 and Cronbach's alpha is 0.962. This variable is measured by a Likert scale of 1 to 5 to assess the services provided by tax officers and the facilities provided in making tax payments. The questionnaire also asked about the payment method used by the taxpayer. The choice of payment methods offered in the Province of NTB is to pay conventionally by coming to the Samsat office, e-Samsat, Samsat Delivery/on-call, drive-thru samsat, Village Samsat, and Mobile Samsat.

This research is divided into two stages: first, to create and analyze the differential equation model of taxpayer



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compliance with and without government control. In the next stage, it will be diagnosed the effect of awareness on taxpayer compliance. The moderating variable is government control, which is the provision of sanctions, providing comfortable facilities. The analytical tool used at this stage is MRA (Moderated Regression Analysis) regression.

Modeling motor vehicle taxpayer compliance with government control consists of several stages:

- a. Making assumptions
- b. Determining variables and parameters
- c. Forming a differential equation model
- d. Determining the equilibrium point of the system free of non-compliant taxpayers
- e. Performing numerical simulations by making trajectories and phase portraits
- f. Making simulations

The effect of government control and increasing awareness of taxpayers on the primary reproduction number and the last is to determine the sensitivity index of the government control parameter to the basic reproduction number. In this study, the basic reproduction number is the threshold of low taxpayer compliance. The higher the value of the basic reproduction number, the higher the number of taxpayers who do not comply with paying taxes.

IV. FINDINGS & DISCUSSION

This study to model the compliance of taxpayers with government control. This modeling consists of 3 compartments or subpopulations, namely motorized vehicle taxpayers who are prone to complying or not complying with tax payments denoted by S, non-compliant taxpayers denoted by I, and compliant taxpayers. Pay taxes (law-abiding taxpayers) represented by R. This model is made with an epidemiological models approach. This assumption is built because disobedience is considered to be contagious to others. Non-compliant or disobedience can influence others to do the same. This was stated by Steffano Fassini and Morselli Davide in their research entitled The Obedience-Disobedience Dynamic and The Role of Responsibility (2010). This model was created to see the dynamics of the number of compliant taxpayers from time to time.

V. MODELLING

The assumptions used in this study are:

- a. The rate of addition of motorized vehicle taxpayers is assumed to be constant and only enters the subpopulation of taxpayers.
- b. Migration rate is assumed to be the same for all compartments.
- c. Compliant taxpayers can become non-compliant taxpayers

The variables used in this study are S(t) is the number of subpopulations of taxpayers at time t, I(t) is the number of subpopulations of non-compliant taxpayers at time t, and R(t)

is the number of subpopulations of compliant taxpayers at time t. In addition to these variables, the following parameters are used in the modeling.

Table 2.	Parameters
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Parameters	Description		
Λ	Rate of addition of taxpayers,		
	$\Lambda > 0$		
α	The proportion of taxpayers who		
	choose to become compliant or		
	non-compliant taxpayers, $0 \le \alpha \le$		
	1		
β	Rate of change of non-compliant		
	taxpayer compliance, $\beta \ge 0$		
γ	Rate of change in compliance level		
	of compliant taxpayer, $\gamma \ge 0$		
	0.0		
μ	Taxpayer mutation rate, $\mu \ge 0$		

Based on these assumptions, variables, and parameters, a taxpayer compliance transfer diagram is built as follows:





Fig. 2 Transfer Diagram of the Taxpayer Compliance Model

Based on the transfer diagram above, a taxpayer compliance model is formed.

1. The subpopulation of taxpayers (S) over time

The addition of subpopulation S is influenced by the addition of the number of taxpayers on the ownership of motorized vehicles they have at an additional rate of ΛS . The reduction in this subpopulation occurs due to a mutation of taxpayers of μS . This subpopulation will be separated into two, namely non-compliant taxpayers and compliant taxpayers. The change of taxpayers to non-compliant taxpayers has a rate of αSI , while the rate of compliant taxpayers is $(1 - \alpha)SR$. Thus, the rate of change of the subpopulation S with time is

$$\frac{dS}{dt} = \Lambda S - \mu S - \alpha SI - (1 - \alpha)SR.$$



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 \mathcal{F}_i

2. The subpopulation of non-compliant taxpayers (I) over time

Subpopulation I increases with changes in taxpayer compliance from subpopulation *S* of αSI , and reduced by the awareness of taxpayers on the obligation to pay taxes into subpopulation *R* with a rate of change, namely βIR . In addition, this subpopulation also experienced an increase due to taxpayers who were originally tax-compliant (compliant taxpayers) to non-compliant taxpayers at the rate of γIR . This reduction in subpopulation also occurs due to mutations of μI . Thus, the rate of change in this subpopulation over time is

$$\frac{dI}{dt} = -\mu I + \alpha SI + \gamma IR - \beta IR$$

3. The subpopulatin of compliant taxpayers (R) over time

Taxpayer mutation rate as large as μR reduce the subpopulation of a compliant taxpayer (*R*) and change taxpayers' compliance to non-compliant taxpayers at a rate of γIR . The addition of this subpopulation occurs due to a change in compliance from the non-compliant taxpayer to the compliant taxpayer at the rate of βIR and from taxpayers who choose to become compliant taxpayers at a rate of $(1 - \alpha)SR$. Thus, the rate of change of subpopulation *R* over time is

$$\frac{dR}{dt} = (1 - \alpha)SR + \beta IR - \mu R - \gamma IR.$$

Thus, the taxpayer compliance model is as follows.

$$\frac{dS}{dt} = \Lambda S - \mu S - \alpha SI - (1 - \alpha)SR$$
$$\frac{dI}{dt} = -\mu I + \alpha SI + \gamma IR - \beta IR$$
(1)
$$\frac{dR}{dt} = (1 - \alpha)SR + \beta IR - \mu R - \gamma IR$$

Suppose control from the government is given by providing ease of facilities in paying taxes, sanctions/warning letters, and reduction of fines. In that case, it is expected to reduce the number of taxpayers who do not obey taxes by σ . The provision of facilities such as e-Samsat, Samsat delivery is done to provide convenience to taxpayers to pay taxes on time. The provision of warning letters before and after maturity by utilizing tax agents is made for reminders to the taxpayer. The reduction in fines is made to improve the compliance of taxpayers in making payments. The taxpayer compliance model with the addition of control variables is as follows:

$$\frac{dS}{dt} = \Lambda S - \mu S - \alpha SI - (1 - \alpha)SR$$
$$\frac{dI}{dt} = -\mu I + \alpha SI + \gamma IR - \beta IR - \sigma I \quad (2)$$

$$\frac{dR}{dt} = (1 - \alpha)SR + \beta IR - \mu R - \gamma IR + \sigma I$$

VI. MODEL ANALYSIS

This section will discuss the analysis of the taxpayer compliance model, including the equilibrium point and the stability analysis of the equilibrium point. The equilibrium point is free from non-compliant taxpayers, and both models are as follows.

$$E_0 = \left(\frac{\mu}{1-\alpha}, 0, \frac{\Lambda-\mu}{1-\alpha}\right)$$

Analysis of the stability of E_0 equilibrium points is done using basic reproduction numbers \Re_0 obtained using the Next Generation Matrix method [1]. In this method, for example

n = Infected compartments

m = Disease-free compartments

$$x \in \mathbb{R}^n$$
 and $y \in \mathbb{R}^m$

= The rate of addition of new infection growth that adds to the compartment i \mathcal{V}_i

= Rate of movement of individuals from infected compartmentsi

The model of the compartment can be written as follows:

$$x'_{i} = \mathcal{F}_{i}(x, y) - \mathcal{V}_{i}(x, y), \quad i = 1, 2, ..., n$$

$$y'_{j} = g_{j}(x, y), \quad j = 1, 2, ..., m$$

System (1) can be written into

$$\mathcal{F}(x, y) = (\alpha SI + \gamma IR)$$

$$\mathcal{V}(x,y) = (\mu I + \beta IR)$$
$$g(x,y) = \begin{pmatrix} \Lambda S - \mu S - \alpha SI - (1-\alpha)SR \\ (1-\alpha)SR + \beta IR - \mu R - \gamma IR \end{pmatrix}$$
$$g(0,y) = \begin{pmatrix} \Lambda S - \mu S - (1-\alpha)SR \\ (1-\alpha)SR - \mu R \end{pmatrix}$$

Based on the model, we obtained F and V, which are jacobian matrices from the matrix. $\mathcal{F}(x, y)$ and $\mathcal{V}(x, y)$ in equilibrium point E_0 are

$$F = \left(\alpha \frac{\mu}{1-\alpha} + \gamma \frac{\Lambda-\mu}{1-\alpha}\right) = \left(\frac{\alpha\mu + \gamma(\Lambda-\mu)}{1-\alpha}\right) \text{ and }$$
$$V = \left(\mu + \beta \frac{\Lambda-\mu}{1-\alpha}\right) = \left(\frac{\mu(1-\alpha) + \beta(\Lambda-\mu)}{(1-\alpha)}\right).$$

It can be proven that matrix *F* is non-negative because $0 \le \alpha \le 1$, and $\Lambda > \mu$. Likewise, matrix *V* is a non-singular matrix because the main diagonal of the matrix is non-negative. It can also be proven that the eigenvalues of the *F*-*V* matrix have a negative real part. Furthermore, the basic reproduction number is calculated, $\Re_0 = \rho(FV^{-1})$, we obtain

$$\Re_0 = \frac{\alpha \mu + \gamma (\Lambda - \mu)}{\mu (1 - \alpha) + \beta (\Lambda - \mu)} < 1$$

If given government control, the taxpayer compliance model, if given government control σ , using the Next Generation Matrix method obtained basic reproduction numbers.

$$\Re_0 = \frac{\alpha\mu + \gamma(\Lambda - \mu)}{\mu(1 - \alpha) + \beta(\Lambda - \mu) + \sigma(1 - \alpha)} < 1.$$

Based on lemma and theorem in Castillo-Chaves (2010) [1]



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we obtain the equilibrium point E_0 is stable local asymptotic.

VII. NUMERICAL SIMULATION

Numerical simulations are conducted to determine the dynamics of the number of compliant and non-compliant taxpayers making tax payments over time. The data used in this study is data obtained from the results of literature studies and data derived from Bappenda NTB. Based on data from Bappenda NTB, obtained by the proportion of taxpayers who do not obey taxes is 0.37 or 37%, while the proportion of compliant taxpayers is 0.63 or 63% of the total taxpayer. From the data, it is also obtained that the rate of increase in taxpayers is 3%. In addition, the mutation rate of motor vehicles is 0.0001. The number of non-compliant taxpayers who become compliant is assumed to be 6 out of 1000 people per year. The number of law-abiding taxpayers who become non-compliant taxpayers is 1 in 1000 people per year. In comparison, the government's control will reduce non-compliant taxpayers by 0.1% per year.

Phase portraits are made to determine the stability of the equilibrium point E_0 . Using the initial value of S = 0.001587301 million, I = 0, and R = 0.047460, it is obtained that at an initial value, the sums *S*, *I*, and *R* will go to the equilibrium point E_0 . A portrait of the system in the case of no non-compliant taxpayer ($\Re_0 < 1$) is illustrated in Figure 3.





(b)

Fig. 3 Phase portraits between S and I

Figure 3 shows one equilibrium point at the time of $\Re_0 < 1$ is (0, 00158730159864; 0; 0.04746145789). The equilibrium

point is stable locally asymptotic $\Re_0 < 1$ and $\Re_0 > 1$

Case $\Re_0 < 1$

Here is the trajectory for $\Re_0 < 1$ case, used to determine the number of subpopulations in a certain period of time.



Based on Figure 3, it can be seen that the number of non-compliant taxpayers will decrease up to a particular time, while the number of compliant taxpayers will increase. The existence of government controls can increase the number of compliant taxpayers and affect the time and number of

non-compliant taxpayers, as shown in Figure 5 and Figure 6.





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Figure 5 shows that for $t \to \infty$, the number of compliant taxpayers has increased, with the government's control will increase the number of compliant taxpayers. In contrast, the number of non-compliant taxpayers will decrease with government control, as shown by Figure 6.

Case $\Re_0 > 1$

The condition of a basic reproduction number greater than one is a system condition in which the number of non-compliant is more than the compliant in making tax payments, as seen in Fig. 7. Nevertheless, with government control, the number of disobedient taxpayers can be slightly reduced, and the number of non-compliant taxpayers can be increased even if the increase is insignificant. The illustration is depicted in Figure 8 and Figure 9.



Fig. 8 Trajectory Non-Compliant taxpayers with control government in case $\Re_0 > 1$



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Fig. 9 Trajectory Compliant taxpayers with control government in case R_0>1

The Effect of The Rate of Increase in Taxpayer Awareness (γ) and Government Control (σ) on \Re_0

This simulation is done to find out the threshold value of a system will be stable where the number of non-compliant taxpayers is not in the system. The effect of the rate of increase in taxpayer awareness is seen in the following model.

$$\Re_0 = \frac{0,000037 + 0,0299\gamma}{0,002487}$$

The stability of the taxpayer's compliance system occurs when the value of $\gamma < 0.09$, as seen in Figure 10. The effect of government control over \Re_0 is

$$\Re_0 = \frac{0,0000669}{0,001857 + 0,63\sigma}.$$

If $\sigma > 0.02$, then the number of non-compliant taxpayers will decrease as seen in Figure 11.



Fig. 10 Influence of γ against \Re_0



Fig. 11 Influence of σ against \Re_0 The influence of these two parameters to the \Re_0 is $0,000037 + 0,0299\gamma$



If $\sigma > 0.02$ and $\gamma < 0.5$, then the system will be stable i.e., the number of non-compliant taxpayers is very small or towards 0. This can be seen in Figure 12.



Fig. 12 Influence of γ and σ against \Re_0

Sensitivity analysis

This analysis is done to find out the most influential parameters in improving taxpayer compliance. The γ and σ parameter sensitivity index is

$$C_{\gamma}^{\Re_{0}} = \frac{\partial \Re_{0}}{\partial \gamma} \times \frac{\gamma}{\Re_{0}} = \frac{(\Lambda - \mu)}{\mu(1 - \alpha) + \beta(\Lambda - \mu) + \sigma(1 - \alpha)} \\ \times \frac{\gamma}{\Re_{0}} = 0.446935725 \approx 0.45$$
$$C_{\sigma}^{\Re_{0}} = \frac{\partial \Re_{0}}{\partial \sigma} \times \frac{\sigma}{\Re_{0}} = \frac{-(1 - \alpha)(\alpha\mu + \gamma(\Lambda - \mu))}{(\mu(1 - \alpha) + \beta(\Lambda - \mu) + \sigma(1 - \alpha))^{2}} \\ \times \frac{\sigma}{\Re_{0}} = -0.722145805 \approx -0.72$$

The parameter sensitivity index $\gamma = 0.45$ means that raising the γ value by 10% will increase the \Re_0 by 4.5%. Then, raising the value of σ by 10% will decrease the value of \Re_0 by 7.2%. Based on the sensitivity index, it was obtained that control from the government significantly affects the addition or addition of compliant taxpayers.

Statistically, the taxpayer compliance model is described as follows.



Fig. 13 Model of Moderating Influence Government Control on Taxpayer Compliance

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Based on the results of data processing using SPSS, it was obtained that moderate government control will strengthen the influence of awareness of taxpayer compliance in making tax payments. This is seen from the value of R Square, which increased 82.5% from 0.04 to 0.073.

VIII. CONCLUSIONS

This study was conducted to determine the dynamics of the number of taxpayers who comply with paying taxes from year to year under the control of the government. Based on the results of this study, it was found that the existence of government control can increase taxpayer compliance. This can be seen from the sensitivity index of government control parameters which can reduce the basic reproduction number by 7.2%. The smaller the basic reproduction number will lead to a stable system in which non-compliant taxpayers are close to zero. Statistically, it is also proven that the moderation of government control can strengthen the effect of awareness on taxpayer compliance by 82.5%. This means that government control will increase awareness of taxpayers.

This research is a conceptual model, so it is necessary to develop it by involving variables and parameters in increasing taxpayer compliance.

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