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Optimal Control Application in Mathematical Model of Indonesian Coffee Export Tax

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ABSTRACT

Coffee is one of Indonesia's major non-oil and gas agricultural export commodities, with around 67% of its production exported and 33% consumed domestically. To optimize economic variables such as production, demand, export volume, and export tax revenue, a dynamic model was developed. Two simulations were conducted: one where the government controls with set economic targets and another without target controls on export tax. The model used the Two-Stage Least Squares (TSLS) method to estimate equations, which were incorporated into an optimal control framework. The objective was to minimize a quadratic function representing deviations from target values and control values. Simulation showed that export tax changes had limited effects, likely due to the high export tax rate applied. To achieve export tax values closer to desired targets, it is recommended that the government reduce the export tax rate, which would also encourage increased export volume.

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1. INTRODUCTION

A country's economy and development are greatly influenced by its involvement in international trade, given the competition between countries in the global market [1]. Indonesia is one of the countries that engages in international trade activities, including the export of goods and services. Coffee represents one of the most significant non-oil and gas export agricultural products in Indonesia. As one of the world's leading coffee producers, Indonesia has the potential to influence the growth of global coffee exports. Moreover, coffee can exert an influence on non-oil and gas sources of state income in numerous developing countries [2]. According to data from Central Bureau of Statistics (BPS), Indonesian coffee exports to foreign countries in 2022 reached USD 1.13 billion. The

primary destinations for Indonesian coffee exports included the United States, Egypt, Japan, Spain, and Malaysia. Approximately 67% of the total coffee production in Indonesia is exported, while the remaining 33% is utilized for domestic consumption [3]. A number of factors can influence the volume of Indonesian coffee exports, including the level of production, global coffee prices, and the price of chocolate in Indonesia. In research [4] indicates that inflation and exchange rates affect the volume of Indonesian exports in both the long and short term, nevertheless the exchange rate does not exert a considerable influence on the volume of Indonesian coffee exports. A multitude of factors can impact Indonesian coffee exports, including production factors and global coffee prices [5]. It can be observed that the volume of exports is not influenced by the quantity of coffee produced [6]. Coffee production in Indonesia experienced growth from 1965 to 2024, which was influenced by the increasing demand of the international export market as well as the expansion of coffee plantation areas. [7]. In [8] forecasting the future volume of Indonesian and Colombian coffee exports found that Indonesian coffee exports tend to increase stagnantly and considered low compared to the increase in Colombian coffee exports, and [9] using the Almost Ideal Demand System (AIDS) model to measure the elasticity of demand for Indonesian, Vietnamese, Brazilian, and Colombian coffee in the U.S. market.

The extent of coffee plantations is a factor that can affect coffee production. Over the past twenty-two years, the area of coffee plantations has demonstrated a pattern of instability, exhibiting both increases and decreases [10]. In 2002, Indonesia had the largest amount of coffee plantation land in the country, with 1.321.421 hectares. However, in subsequent years, the area decreased, reaching 1.210.365 hectares in 2010 [11]. The expansion of coffee plantations in Indonesia has been accompanied by an increase in coffee production. The conversion of land previously utilized for coffee plantations into other agricultural uses has contributed to a reduction in the overall land area available for coffee production. The highest recorded coffee production was 793.193 tons in 2022, while the lowest production was 554.574 tons in 2000 [12], [13]. Coffee productivity in Indonesia can increase with the development of agricultural land, farmer capacity and the agribusiness sector implemented strategically [14]. Meanwhile, according to [15], coffee production is influenced by the regional minimum wage (UMR) and the price of Indonesian chocolate, which is used as a substitute commodity for coffee. This is modelled by a simultaneous equation. Whereas in [16] examines a simultaneous equation model using a panel data approach to evaluate the mutual influence between financial inclusion, economic growth, and poverty in 33 Indonesian provinces during 2011-2021.

The strategy to increase coffee production productivity can be carried out by improving human resources, managing crop resources effectively, and utilizing agricultural technology through appropriate investment modeling [17]. According to [18], the factors affecting Indonesian coffee demand depend to tea prices and Indonesia's GDP. Previous studies have employed various methods to forecast price and demand trends. For instance, [19] utilized comparing moving average, single exponential smoothing, and double exponential smoothing methods for forecasting the demand of LPG cylinders at PT Petrogas Prima Services. In [20], the autoregressive integrated moving average (ARIMA) method was employed to forecast fiscal policy variables in the Indonesian economy, namely budget deficits, consumption, investment, exports, imports, and gross domestic product (GDP). Furthermore, the optimal control on fiscal policy through budget deficit is determined.

There has been many research in optimal control such as [21] which analyze stochastic control for dynamic fiscal policy formulation under uncertainty, including comparisons between open-loop, feedback, and dual control. Similarly, [22] explored optimal control problems in autonomous and nonautonomous linear systems with discrete time. Four easier optimal control problems, classified as “bang-bang type solutions”, were identified. The use of bang-bang type solutions facilitates the achievement of optimal control solutions and apply optimal stochastic control to production and inventory models with constant demand [23], and developing optimal control methods for discrete-time nonlinear systems, with direct application to automated guided vehicles (AGVs), such as industrial robots that move along a specific path [24]. In contrast, [25] the spread of the COVID-19 pandemic was analyzed dynamically by including control variables in the form of lockdown policies. The application of optimal control can significantly reduce the number of cases, although its effectiveness depends on the conditions of the region.

Based on previous research, this study will focus on economic problems related to coffee, which are reviewed based on coffee production, coffee demand and Indonesian coffee exports, which will then be formed into a mathematical model based on economic theory. This study uses a mathematical model in the form of three interrelated equations, namely coffee production, demand and exports. The model uses a simultaneous approach because the three variables affect each other directly. The new contribution of this model is to include economic factors such as coffee area, sugar price, international coffee price, and coffee export tax variables together in one model. In addition, this study uses the previous year's data (lag) to capture the effect of time. The model estimation is conducted using the 2SLS method to overcome potential bias due to endogeneity between variables Thus, this model not only explains the structural relationships within the coffee sector, but can also be used to simulate the impact of economic policies on Indonesia's coffee market equilibrium. One important result of this study shows that export taxes have a major influence on Indonesian coffee exports. Therefore, government involvement is necessary to control Indonesia's coffee export tax in order to achieve economic stability. With the right policy, export taxes can effectively optimize the balance between domestic and international markets, thereby supporting the sustainable growth of the coffee sector.

2. RESEARCH METHOD

This study employs the exponential smoothing method to perform forecasting, specifically with a two-times weighting approach. A forecasting model was constructed to predict the production, demand, and export variables of Indonesian coffee for the period spanning 2023 to 2027. The initial stage of this research is a comprehensive literature review, which involves the collection of relevant sources, including academic journals, books, and other pertinent materials, to serve as the theoretical foundation and reference points for the development of the mathematical model. The model constructed is an econometric model in the form of simultaneous equations, specifically those pertaining to production, demand, and coffee exports. The subsequent phase is the identification of simultaneous equations, based on order conditions as a necessary condition and rank conditions as a sufficient condition. The results of the identification demonstrate that the model constructed can be concluded to be an overidentified model. Moreover, the econometric model was estimated using the two-stage least squares (2SLS) method, with statistical criteria employed to assess the model's fit, including the coefficient of determination (R^2), the overall F-test, and the Durbin–Watson statistic test. To measure the extent to which the model can explain the actual conditions using Root Means Square Error (RMSE), Root Means Square Percent Error (RMSPE) and Mean Absolute Percentage Error (MAPE).

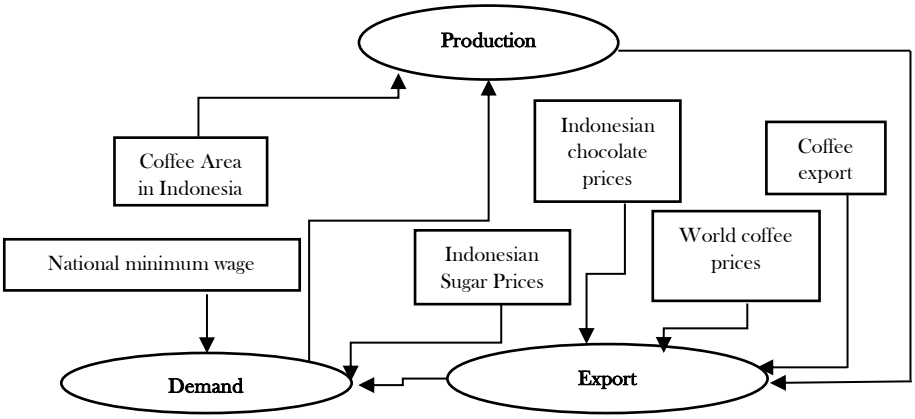


Figure 1. Diagram of the relationship between variables in an econometric model.

The econometric model employed in this study is constructed in the form of simultaneous equations. In the construction of an econometric model, three stages must be followed: specification, estimation, and parameter evaluation. The econometric model has been formed as illustrated in Figure 1. Based on Figure 1, the simultaneous equation model can be formed as follows:

1. Coffee Production

$$QS_t = a_{11} + a_{12}QD_t + a_{13}LAK_t + a_{14}QS_{t-1} + U_{1t}. \quad (1)$$

where:

QS_t : Indonesian coffee production for time t (Ton)
QD_t : Indonesian coffee demand for time t (Ton)
LAK_t : Coffee Area in Indonesia for time t (Ha)
QS_{t-1} : Indonesian coffee production for time $t-1$ (Ton)
$a_{11}, \dots, a_{14}$: Parameter Value
U_{1t} : Disturbance variable

2. Coffee Demand

$$QD_t = b_{21} + b_{22}EX_t + b_{23}UMR_t + b_{24}HGI_t + QD_{t-1} + U_{2t}. \quad (2)$$

where:

QD_t : Indonesian coffee demand for time t (Ton)
EX_t : Indonesian coffee exports for time t (Ton)
UMR_t : National minimum wage for time t (Rp)
HGI_t : Indonesian sugar prices for time t (Rp/Ton) (Rp)
QD_{t-1} : Indonesian coffee demand for time $t-1$ (Ton)
$b_{21}, \dots, b_{24}$: Parameter Value
U_{2t} : Disturbance variable

3. Coffee Exports

$$EX_t = c_{31} + c_{32}QS_t + a_{33}HCI_t + a_{34}HKD_t + c_{35}PE_t + U_{3t.} \quad (3)$$

where:

EX_t : Indonesian coffee exports for time t (Ton)
QS_t : Indonesian coffee production for time t (Ton)
HCI_t : Indonesian chocolate prices for time t (Ton)
HKD_t : World coffee prices for time t (Ton)
PE_t : Exports tax for time t (Rp)
$c_{31}, \dots, c_{35}$: Parameter Value
U_{3t} : Disturbance variable

4. Identity Equation

$$EX_t = QS_t - QD_t. \tag{4}$$

where:

EX_t : Indonesian coffee exports for time t (Ton)
QS_t : Indonesian coffee production for time t (Ton)
QD_t : Indonesian coffee demand for time t (Ton)

The next step is to form an optimal control model presented in the form of a dynamic model involving control variables to change the system from its current condition that is not following the target desired by policymakers during a certain period. In this study, the selection of this model is based on the model obtained in the form of a time series. The optimal control model used in this study is a modified form of the basic form of optimal control, wherein in the general equation of optimal control there is no target value, which means that all control variable values and state variables are considered unlimited. In the application world (real world), even though it has been calculated mathematically at the correct control variable value, in taking it, it may be impossible to achieve what is obtained. To apply optimal control in real problems such as economics, it is necessary to provide a limit value in the form of a target value so that the resulting solution is not too far from reality.

In this study, the problem taken is related to coffee export tax control in an economic context, while the dynamic system described by the constraint model is a simultaneous model covering production, demand and exports of Indonesian coffee. The following objective function has been described and the constraints of the econometric model:

Objective function:

$$\min J = \frac{1}{2}\sum_{t=0}^{N} \begin{bmatrix} x_t - \bar{x}_t \\ u_t - \bar{u}_t \end{bmatrix}^T W_t \begin{bmatrix} x_t - \bar{x}_t \\ u_t - \bar{u}_t \end{bmatrix}. \tag{5}$$

Against constraints:

$$x_t = \boldsymbol{A}x_{t-1} + \boldsymbol{B}u_t + \boldsymbol{C}e_t, \qquad t = 1, 2, \dots, T \tag{6}$$
$$x_{t_0} = x_0,$$
$$u_{t_0} = u_0.$$

where:

x_t : The n −dimensional state variable vector for time t
u_t : The m −dimensional control variable vector for time t
$\bar{x}_t$: The target value in the state variable for time t
$\bar{u}_t$: The target value for the control variable for time t
W_t : A matrix that contains the weight of the deviation on state variables and variables control over its target value for time t
e_t : A vector of exogenous (non-control) variable for time t
x_{t_0} : Initial value in state variable for time t_0
u_{t_0} : Initial value in control variable for time t_0
A : The parameter matrix of the lag variables
B : The parameter matrix of the control variable
C : The parameter matrix of endogenous (non-control) variables
T : The final time period of the specified time horizon

The variables used in the model econometric in this study consists of:

Endogenous Variable (State):

$x(1) : QS_t$: Indonesian coffee production for time t
$x(2) : QD_t$: Indonesian coffee demand for time t
$x(3) : EX_t$: Indonesian coffee export for time t

Lag Variable $t-1$:

$x_{t-1}(1) : QS_{t-1}$: Indonesian coffee production for time $t-1$
$x_{t-1}(2) : QD_{t-1}$:Indonesian coffee demand for time $t-1$

Control Variables:

$u(1) : PE$: Exports tax

Exogenous variables (non-control):

$e(1)$: LAK : Coffee Area in Indonesia
$e(2)$: UMR: National minimum wage
$e(3)$: HKD : World coffee price
$e(4)$: HCI : Indonesian chocolate price
$e(5)$: HGI : Indonesian sugar price

In this study, the simulation was conducted on two occasions. The first simulation was conducted under the assumption that the government does not control policies through export taxes, and the second simulation was conducted under the assumption that the government controls policies through export taxes. In order to obtain the optimal solution, the simulations carried out between 2023 and 2027 were conducted by replacing the weights.

3. RESULT AND ANALYSIS

3.1 Forecasting Exponential Smoothing

This study employs a forecasting approach to examine the variables of production, demand, and export of coffee from 2022 to 2027 as shown in Table 1. The selection of parameters was conducted through a trial-and-error process with the objective of minimizing forecast error. The technique for measuring forecasting error is based on the values of RMSE, MAE, and MAPE.

Table 1. Result of forecasting Exponential Smoothing

Year	Coffee Production (Ton)	Coffee Demand (Ton)	Coffee Export (Ton)	Export Tax (Rupiah)
2023	809082.1	323881.8	451888.1	1.55483E+12
2024	822989.1	332729.7	478017.9	1.61892E+12
2025	836896	341577.7	504147.7	1.68301E+12
2026	850803	350425.6	530277.4	1.7471E+12
2027	864710	359273.6	556407.2	1.81119E+12

3.2 Econometric model

The econometric model estimation in this study uses two stage least square (2SLS). The following model was derived from the estimation results and can be statistically validated.

$$QS_t = -15.2637 + 0.1469\ QD_t + 1.44\ LAK_t + 0.4972\ QS_{t-1} \quad (7)$$

Tabel 2. Result of 2SLS Coffee Production (QS)

Statistical Test	Value
R-Squared	0.839401
Adj R-Squared	0.814043
F-Stat	33.88155
Durbin Watson	2.252252
Instrument Rank	9

The results of the estimation of coffee production indicate that coffee production depends on the coffee area. If the area is getting bigger, coffee production will also increase, this shows that coffee area has a positive and significant effect. Additionally, the coffee production area is subject to influence from the demand for coffee and the preceding year's coffee production. The table 2 shows that 83.94% of the variability in the dependent variable can be explained by the independent variables in the model. The Adjusted R-Squared value is that 81.4% of the variability in the dependent variable can still be explained after considering the number of independent variables in the model. The model shows statistical significance as indicated by high f-stat values and no autocorrelation in the model based on the results of the Durbin Watson test. Instrument Rank in a simultaneous model indicates the number of instruments used to address the endogeneity problem.

$$QD_t = 1.0422 + 0.1442\ EX_t + 0.1916\ UMR_t + 0.1907\ HGI_t + 0.2973\ QD_{t-1} \quad (8)$$

Tabel 3. Result of 2SLS Coffee Demand (QD)

Statistical Test	Value
R-Squared	0.984089
Adj R-Squared	0.980554
F-Stat	277.7881
Durbin Watson	1.406084
Instrument Rank	9

The demand for coffee is subject to a number of factors, including the volume of coffee exports, national minimum wage levels, the price of sugar in Indonesia, and the level of coffee consumption in the previous year. The coefficients of exports, regional minimum wage, Indonesian sugar price, and last year's coffee demand demonstrate a positive and statistically significant. The table 3 shows that 98.4% of the variability in the dependent variable can be explained by the independent variables in the model. The Adjusted R-Squared value is that 98.05% of the variability in the dependent variable can still be explained after considering the number of independent variables in the model. The model shows statistical significance as indicated by the high f-stat value but based on the Durbin Watson test 1.406 is slightly lower than 1.5, which indicates there is potential positive autocorrelation in the residuals. Instrument Rank in a simultaneous model indicates the number of instruments used to address the endogeneity problem.

$$EX_t = 17.641 - 1.7832\ QS_t + 0.8113\ PE_t - 0.5793\ HKD_t + 0.4155\ HCI_t \tag{9}$$

Tabel 4. Result of 2SLS Coffee Export (EX)

Statistical Test	Value
R-Squared	0.862916
Adj R-Squared	0.832453
F-Stat	27.95059
Durbin Watson	1.899126
Instrument Rank	9

The regression results of Indonesian coffee exports have a significant effect on coffee production, export taxes, world coffee prices, and Indonesian chocolate prices. The table 4 shows that 86.29% of the variability in the dependent variable can be explained by the independent variables in the model. The Adjusted R-Squared value is that 83.24% of the variability in the dependent variable can still be explained after considering the number of independent variables in the model. The model shows statistical significance as indicated by high f-stat values and no autocorrelation in the model based on the results of the Durbin Watson test which is close to the value of 2. Instrument Rank in a simultaneous model indicates the number of instruments used to address the endogeneity problem. Furthermore, the reduce from form is carried out where the left segment only contains state variables while the right segment contains variables in the year (t-1) or lag variables, exogenous (non-control) variables and control variables. Then the reduce from form is as follows:

$$\begin{aligned} &QS_t - 0{,}1469\ QD_t = -15.2637 + 1.44\ LAK_t + 0.4972\ QS_{t-1} \\ &QD_t - 0.1442\ EX_t = 1.0422 + 0.1916\ UMR_t + 0.1907\ HGI_t + 0.2973\ QD_{t-1} \\ &EX_t + 1.7832\ QS_t = 17.641 + 0.8113\ PE_t - 0.5793\ HKD_t + 0.4155\ HCI_t \\ &EX_t - QS_t + QD_t = 0 \end{aligned} \tag{10}$$

Then the econometric model above is represented in the form of a multiplication matrix, so that the reduced from is obtained:

$$\begin{bmatrix} 1 & -0.1469 & 0 \\ 0 & 1 & -0.1442 \\ 1.7832 & 0 & 1 \\ -1 & 1 & 1 \end{bmatrix} \begin{bmatrix} QS_t \\ QD_t \\ EX_t \end{bmatrix}$$

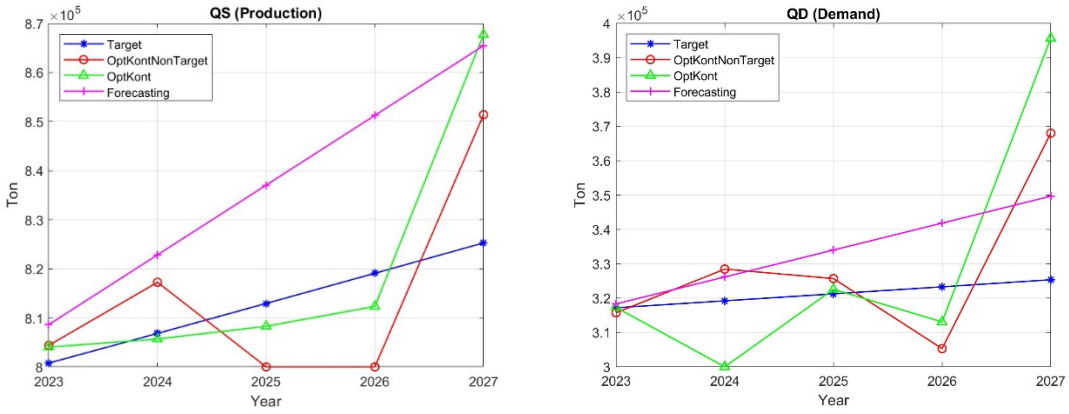
$$= \begin{bmatrix} -15.2637 & 1.44 & 0 & 0 & 0 & 0 & 0.4972 & 0 \\ 1.0422 & 0 & 0.1916 & 0.1907 & 0 & 0 & 0 & 0.2973 \\ 17.641 & 0 & 0 & 0 & -0.5793 & 0.4155 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} C \\ LAK_t \\ UMR_t \\ HGI_t \\ HKD_t \\ HCI_t \\ QS_{t-1} \\ QD_{t-1} \end{bmatrix} \tag{11}$$

$$+ \begin{bmatrix} 0 \\ 0 \\ 0.8113 \\ 0 \end{bmatrix} PE_t$$

3.3 Optimal control simulation results

In this study there are two simulations, namely Optimal Control without a target (OptKontNonTarget) on the control variable and Optimal Control (OptKont) by looking at the target on the control variable, where both conditions are equally given control, but in Optimal control without a target shows that only the *state* variables, namely the production, demand and export variables of Indonesian coffee are given a government target, while the control variable in the form of an export tax the government does not give a target with the aim of determining the most optimal value on the control value and also to see if the policy can be implemented. The target value represents the desired outcome of the government, expressed as a growth rate (%) relative to the final observation

point within the specified time horizon. The OptKontNonTarget value is derived from the initial simulation, whereas the OptKont value is derived from the subsequent simulation. The forecasting value is the result of the predicted value obtained through. The application of the exponential smoothing method. From the calculation results using the "fmincon () function" feature in MATLAB, the production and demand are illustrated as in Figure 2.



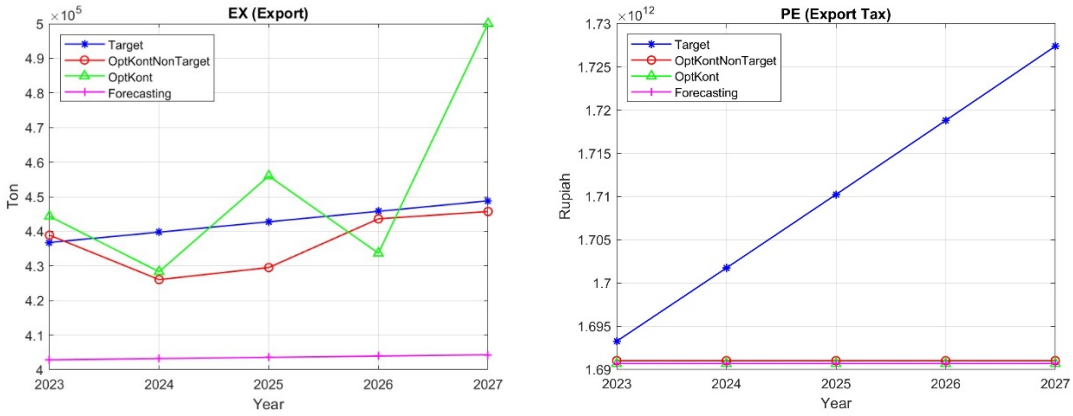
(a) (b)

Figure 2. (a) The production values of OptKontNonTarget, OptKont, and the forecast, (b) The demand value of OptKontNonTarget, OptKont, and the forecasting

The figure 2 illustrates the simulation results for the period between 2023 and 2027. Figure 2(a) shows that in 2023, the production values for OptKontNonTarget and OptKont slightly exceeded the target. However, their trajectories differ: OptKontNonTarget shows sharp fluctuations-including a significant decline in 2025-while OptKont follows a more stable growth path. The production forecast continues to rise above the target line every year. The volatile production of OptKontNonTarget suggests that its planning is risky and difficult to predict. In contrast, OptKont has a more stable pattern, making it more reliable for maintaining market stability and planning investments in the long term.

Figure 2(b) the graph shows that coffee demand tends to increase, but the no-target value (OptKontNonTarget) produces fluctuations that risk the stability of the market. OptKont, despite its decline, provides a more planned direction and eventually reaches high demand. If production is not adjusted to this increase in demand, it causes market imbalances, supply shortages, and price increases.

Production and demand values optimized without a target (OptKontNonTarget) experience quite sharp fluctuations over the period 2023-2027. Meanwhile, the approach with a target (OptKont) shows a more stable growth although in some years it is below the target. A gradual increase can support supply stability and price control in the market. Therefore, target-controlled production provides a better impact for long-term planning, market control, and sustainability of the national coffee sector.



(a) (b)

Figure 3. (a) The export target values of OptKontNonTarget, OptKont, and the forecast, (b) The export tax value of OptKontNonTarget, OptKont, and the forecasting.

Figure 3(a) the graph shows that exports increase more significantly when controlled with a target (OptKont). In contrast, when given a control without a target (OptKontNonTarget), the value of exports tends to be below the target value. Meanwhile, the forecasting only shows a flat and conservative trend, indicating that the implementation

of controls with a target can improve a country's export performance. An increase in exports means an increase in foreign exchange, strengthens the trade balance, and generally boosts national economic growth.

In 3(b) The graph shows that the export tax value under Target increases consistently from 2023 to 2027, while the values under OptKontNonTarget, OptKont, and Forecasting appear to stagnate at around IDR 1.690 trillion for five years, showing no significant upward trend. The significant discrepancy between the targeted export tax value and the results of OptKontNonTarget, OptKont, and Forecasting suggests that the country could lose revenue if coffee production and exports are not properly managed. Although coffee production and demand had increased, it did not automatically increase the export tax. This may be because the amount of coffee exported is still small or the tax rate is too low. Therefore, it is necessary to adopt an adjusted tax policy so that increased production and demand can also increase state revenue. This means that production, export, and tax strategies must support each other so that the coffee sector can provide maximum benefits to the economy.

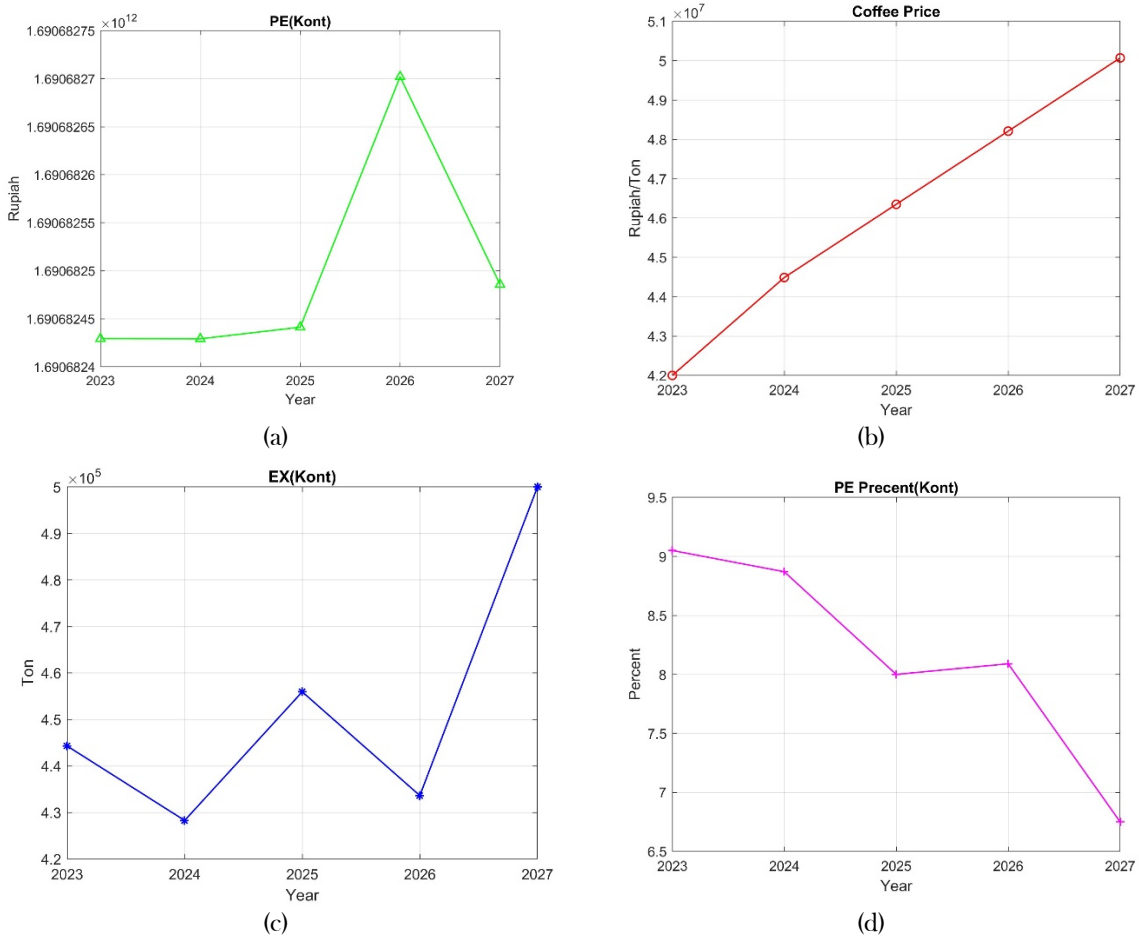


Figure 4. (a) Export tax, (b) coffee price, (c) export, and (d) percent export tax.

Figure 4(a) illustrates that the export tax value in the period spanning 2023 to 2026 continues to increase. In 2026, the export tax value reaches its highest point over the course of the five-year simulation period. The increasing export tax value is influenced by three factors: an increase in coffee prices, an increase in the volume of coffee exports, and a government policy that increases the value of the export tax rate. The value of the tax imposed is directly proportional to the value of the export tax rate. Figure 4(b) illustrates that the price of coffee will continue to increase throughout the period spanning 2023 to 2027. In 2023, the price of coffee is 42000000, while in 2027, it reaches 50070800, representing a growth rate of 3.9%. The price of coffee continues to increase due to an increase in coffee consumption, both domestically and internationally. Figure 4(c) illustrates the significant fluctuations in the volume of coffee exports. There was an increase in export volume in both 2025 and 2027, while in 2024 and 2026, the export volume decreased compared to the previous year. An increase in demand for coffee on the international market, coupled with elevated coffee prices on the international market, can also result in an uptick in export volumes. Figure 4(d) illustrates the final result, derived from the export tax value, Indonesian coffee price, and coffee export volume. This result is expressed as the percentage of the export tax rate. It can be seen in the figure that the percent value of export tax continues to decline in the simulation period of 2023-2027. From the simulation results that have been carried out, the amount of export volume can increase when the percent value of export tax decreases.

Following the completion of several simulations, it was determined that the value of the state variables, specifically production, demand, coffee exports, and control variables, namely export taxes, exhibited notable alterations when different weights were applied. Conversely, the export tax control variable demonstrated minimal to no impact on the final result. In this study, the export tax value is anticipated to attain its target value; however, the optimal value of export tax control remains distant from its target value, resulting in a considerable discrepancy between the control and target values. In order to achieve an export tax value that is close to the target value, it is recommended that the government implement a reduction in the percentage value of the export tax, which should be followed by an increase in the volume of coffee exports.

4. CONCLUSION

The simulation results using control with target (OptKont) over export tax or control without target (OptKontNonTarget) show that the average optimal value of production and demand is greater than its target value. On the other hand, the average value of export tax as a control is smaller than the average value of its target. The average value of exports without control is smaller than its target value, but on the other hand, the average value of exports with control is greater than its target value. By giving different weights to government control or without control over export tax, it is found that only a little can affect the final result, this can be caused by depending on the amount of tax percentage set. To achieve an export tax value that is close to the target value based on this study, it is recommended that the government take a policy on export tariffs, namely by reducing the percentage value of the export tax, which is also followed by a policy of increasing export volume. For further research, it is necessary to study the problem in the imports to obtain optimum results.

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