

ANALYSIS OF INDONESIA'S PEPPER IN THE SUPPLY AND DEMAND

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ABSTRACT

Indonesia is second biggest producer and exportir of pepper commodity in the world. The purposes of this research are: (1) to analyze of Indonesian pepper in the supply and demand; (2) to analyze the impact of exchange rate, price of world pepper, and combination among its to Indonesian pepper in the supply and demand. Analysis method used simultaneous equation with time series data from 1990 till 2013. The results showed that determinant coefficient (R2) of every equations are 0,51 till 0,86 and F value are 4,67 till 20,16. Indonesian pepper production significantly influenced by real price of Indonesian pepper, Indonesian pepper export, real interest rate of Indonesia, and Indonesian pepper production last year. Indonesian pepper demand significantly influenced by Indonesian population. Indonesian pepper export significantly influenced by growth of Indonesian pepper demand and Indonesian pepper export last year. Indonesian pepper price significantly influenced by Indonesian pepper production, real exchange rate of IDR to USD, inflation rate of Indonesia, and Indonesian pepper price last year. Real price of Indonesian pepper isn't responsive to Indonesian pepper production in short run and responsive in long run. Indonesian population is responsive to Indonesian pepper demand in short run and long run. Other exogenous variables aren't responsive to endogenous variable in short run and long run. The exchange rate depreciation, the increase price of world pepper, and combination among its impact to increase of Indonesian pepper price, export, and production and degradation of Indonesian pepper demand. Development of pepper agroindustry must intensively to improve domestic demand and give economic value to pepper commodity.

Keywords: *Pepper, supply and demand response, simultaneous equation*

INTRODUCTION

Background

Pepper (*Piper nigrum* Linn.) is one of the important spices type in world trade since formerly. Therefore, pepper become one of Indonesian prominent exporting commodity in plantation subsector, where pepper residing in sixth export position in 2012 equal to 1.30% with value equal to US\$ 423.48 million (Direktorat Jenderal Perkebunan, 2013). Based on data from Food Agriculture Organisation (2014), at period 1990-2013 Indonesian pepper export value increase equal to 3.35%. This improvement indicate that Indonesian pepper commodity in world market have high sell value and become stock-exchange resource of Indonesian income from plantation subsector. Indonesian pepper production can to meet domestic demand as raw material for food industry, cosmetic and pharmaceuticals, and also as domestic direct



consumption. However surplus of Indonesian pepper production still high, this condition become potency for Indonesia to add national income with export activities to international market (Food Agriculture Organisation, 2014). Pepper is an export commodity that cultivate by smallholders. Based on its role in the international trade, Indonesian government promote intensively to the world market (Malian, 2004).

Pepper commodity confronted with problems that related to degradation of production which because of production farm conversion into tin mining area, pepper plants in the old phase and no replanting, and attack of pests and diseases. Another problem is the agribusiness system of Indonesian pepper in undeveloped condition, because pepper cultivation dominated by smallholder plantations, so that the modernity process of cultivation and processing technology difficult to distributed to pepper farmers (Kemala, 2006). Analysis to Indonesian pepper in the supply and demand must be done to push the development of Indonesian pepper. The purposes of this research are: (1) to analyze of Indonesian pepper in the supply and demand; (2) to analyze the impact of exchange rate, price of world pepper, and combination among its to Indonesian pepper in the supply and demand.

RESEARCH METHOD

Data and Data Source

Data used in this research are secondary data with time series data from 1990 till 2013. Data obtained from various sources such as: Food and Agriculture Organisation (FAO), *Badan Pusat Statistik Indonesia* (BPS), *Bank Indonesia* (BI), and International Labour Organisation (ILO). Model estimate with Two Stages Least Squares (2SLS) method by using computer program Statistical Analysis System/ Econometric Time Series (SAS/ETS) version 9.00.

Data Analysis

Model Specification

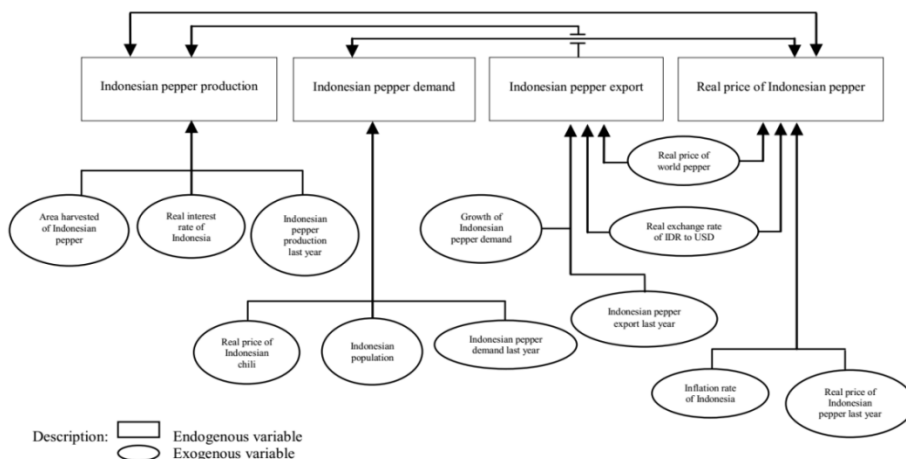


Figure 1. Intervariable relevance framework of Indonesian pepper in the supply and demand

$$QPL_t = a_0 + a_1LP_t + a_2QXLI + a_3HLIR_t + a_4IRR_t + a_5QPL_{t-1} + U_1 \dots\dots\dots (1)$$

$$QDL_t = b_0 + b_1HLIR_t + b_2HCIR_t + b_3POPI_t + b_4QDL_{t-1} + U_2 \dots\dots\dots (2)$$

$$QXLI_t = c_0 + c_1ERR_t + c_2HLWR_t + c_3GQDL_t + c_4QXLI_{t-1} + U_3 \dots\dots\dots (3)$$

$$HLIR_t = d_0 + d_1QPL_t + d_2QDLI_t + d_3ERR_t + d_4HLWR_t + d_5IN + d_6HLIR_{t-1} + U_4 \dots\dots\dots (4)$$

Statistical hypothesis:

- a₁, a₂, a₃ > 0; a₄ < 0; and 0 < a₅ > 1
- b₁ < 0; b₂, b₃ > 0; and 0 < b₄ > 1
- c₁, c₂ > 0; c₃ < 0; and 0 < c₄ > 1
- d₁ < 0; d₂, d₃, d₄, d₅ > 0; and 0 < d₆ > 1

Description:

- QPL = Indonesian pepper production (ton)
- LP = Area harvested of Indonesian pepper (ha)
- QXLI = Indonesian pepper export (ton)
- HLIR = Real price of Indonesian pepper (Rp/kg)
- IRR = Real interest rate of Indonesia (%)
- QDLI = Indonesian pepper demand (ton)
- HCIR = Real price of Indonesian chili (Rp/kg)
- POPI = Indonesian population (thousand people)
- ERR = Real exchange rate of IDR to USD (Rp/US\$)
- HLWR = Real price of world pepper (US\$/kg)
- GQDLI = Growth of Indonesian pepper demand (ton)
- IN = Inflation rate of Indonesia (%)
- U = Disturbance variable
- Subscript t = Year to-t
- Subscript t-1 = Last year (t-1)

Model Identification

Identification formula of the structural model according to order condition is (Gujarati, 2011):

$$(K-M) > \text{or} = \text{or} < (G-1) \dots\dots\dots (5)$$

Description:

- K = Total variable in simultaneous model
- M = Total variable in certain equation
- G = Total equation in simultaneous model
- If, a. K-M > G-1, then over identified
- b. K-M = G-1, then exactly identified
- c. K-M < G-1, then under identified

Table 1. Model Identification with order condition test

Variable Label	K-M	Sip	G-1	Cothike
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Indonesian pepper production	16 - 6 = 10	>	4 - 1 = 3	over identified
Indonesian pepper demand	16 - 5 = 11	>	4 - 1 = 3	over identified
Indonesian pepper export	16 - 5 = 11	>	4 - 1 = 3	over identified
Real price of Indonesian pepper	16 - 7 = 9	>	4 - 1 = 3	over identified

Based on model identification formula with order condition criteria, so structural equation in this research have over identified character, so that parameter estimate using the Two Square Least Stage (2SLS) method.

Model Estimation

Calculation of parameter estimate using computer program SAS/ETS version 9.00. Correlation test use Durbin-h Statistics test with formula (Pindyck and Rubinfeld, 1991 in Tety, 2002):

$$dh = (1 - \frac{1}{2}dw) \sqrt{\frac{n}{1-n[(var \beta)]}} \dots\dots\dots (6)$$

Description:

- dh = Durbin-h statistics value
- dw = Durbin watson statistics value
- n = Number of observation
- var(β) = Square of standar error of lagged endogen variable

Model Validation

Model Validation aim to see how far a model can represent real world. Validation test indicator use RMSPE (Root Mean Square Percent Error) and U-Theil with formula (Theil, 1965 in Tety, 2002):

$$RMSPE = (1/n \sum (Yp - Ya)^2)^{0,5} \times 100\% \dots\dots\dots (7)$$

$$U = (1/n \sum (Yp - Ya)^2)^{0,5} / ((1/n \sum Yp^2)^{0,5} + ((1/n \sum Ya^2)^{0,5}) \dots\dots\dots (8)$$

$$UM + UR + UD = 1 \dots\dots\dots (9)$$

$$UM + US + UC = 1 \dots\dots\dots (10)$$

Description:

- Yp = Model prediction value
- Ya = Observation value
- N = Number of observation year
- UM = Bias proportion
- UR = Regression proportion
- UD = Distribution proportion
- US = Varians proportion
- UC = Covarians proportion

Model Simulation

Model simulation is one of approach that can be used for policy evaluation. Simulation limited in period 1990-2013 with some simulation alternative. There are:

exchange rate depreciation of IDR to USD equal to 8.05%, increase price of world pepper equal to 3.04%, and combination among its.

RESULTS AND DISCUSSION

Factors That Influence The Supply and Demand of Indonesian Pepper

Based on research, there are four simultaneous equation, that are Indonesian pepper production (QPL), Indonesian pepper demand (QDLI), Indonesian pepper export (QXLI), and real price of Indonesian pepper (HLIR).

Table 2. Model estimation results and statistic test of Indonesian pepper in the supply and demand, period 1990-2013

Variable Label	Parameter Estimate	t Value	Pr>t	Elasticity	
				Short run	Long Run
<i>Indonesia pepper Production (QPL)</i>					
Intercept	-16.733.60	-1.14	0.2719	-	-
Area harvested of Indonesian pepper	0.04	0.92	0.3708	-	-
Real price of Indonesian pepper	0.29	2.24	0.0388	0.18	2.34
Indonesian pepper export	0.29	1.74	0.0992	0.07	0.95
Real interest rate of Indonesia	-261.87	-1.84	0.0840	-0.004	-0.05
Indonesian pepper production last year	0.92	4.68	0.0002	-	-
$R^2=0,86$; F value = 20,16; Pr>F=<.0001 h = -0.81					
<i>Indonesian pepper Demand (QDLI)</i>					
Intercept	41.78140	-1.83	0.0844	-	-
Real price of Indonesian pepper	-0.12	-0.52	0.6069	-	-
Real price of Indonesian chili	0.13	0.16	0.8735	-	-
Indonesian population	-	2.13	0.0471	3.17	3.36
Indonesian pepper demand last year	0.06	0.23	0.8180	-	-
$R^2=0,51$; F value = 4,67; Pr>F=<.0092 dh = -					
<i>Indonesian Pepper Export (QXLI)</i>					
Intercept	5.64223	0.46	0.6494	-	-
Real exchange rate of IDR to USD	0.22	0.93	0.3647	-	-
Real price of world pepper	420.78	0.18	0.8562	-	-
Growth of Indonesian pepper demand	-0.80	-4.90	0.0001	-0.02	-
Indonesian pepper export last year	0.82	3.92	0.0010	-	-
$R^2=0,59$; F value = 6,39; Pr>F=<.00022 dh =-					
<i>Real Price of Indonesian Pepper (HLIR)</i>					
Intersep	37.792.91	1.67	0.1147	-	-
Indonesian pepper production	-0.65	-2.02	0.0603	-2.56	-5.07
Indonesian pepper demand	0.09	0.50	0.6214	-	-
Real exchange rate of IDR to USD	0.76	1.31	0.2095	0.39	0.78
Real price of world pepper	2.822.07	0.96	0.3522	-	-

Dexplained by exogenous variable. Overall test (F test) used to measure the effect of Dexogenous variables on endogenous variables simultaneously. Individual test (t test) used to determine the effect of exogenous variables on endogenous variables partially. This research use significant level (α) = 1%, 10%, 15%, 20%, 25%

and 30%. Parameter estimate of variables results such as, determinant coefficient (R²), F statistics, t statistics, and dh statistics presented by Table 2. Parameter estimate of economic model in this research good enough as seen from determinant coefficient (R²) of simultaneous equation model ranged from 0.51-0.86, which means that generally exogeneous variable in model able to explain endogenous variable properly. Exogenous variables in every equation together explain the diversity shown by F value ranged from 4.67-20.16 and F probability ranged in a smaller number of 0.0001-0.0092. The smaller condition of F value indicates the validity of model is getting better. Autocorrelation test done using dh statistics (durbin-h statistics). By using significant level (α) = 5%, so h value ranged from $-1.96 \leq 1.96$ not happened autocorrelation. Durbin-h statistics (dh statistics) in model ranged from -1,71 till -0,81, so equations not happened autocorrelation (Rangkuti, 2005).

Indonesian Pepper Production (QPL)

Indonesian pepper production significantly influenced by real price of Indonesian pepper, Indonesian pepper export, real interest rate of Indonesia, and Indonesian pepper production last year. Whereas area harvested of Indonesian pepper not significantly to Indonesian pepper production. Real price of Indonesian pepper isn't responsive to Indonesian pepper production in short run and responsive in long run. Real interest rate of Indonesia and Indonesian pepper export aren't responsive to Indonesian pepper production in short run and long run.

Indonesian Pepper Demand (QDLI)

Indonesian pepper demand significantly influenced by Indonesian population. Whereas real price of Indonesian pepper, real price of Indonesian chili, and Indonesian pepper demand last year not significantly to Indonesian pepper demand. Indonesian population is responsive to Indonesian pepper demand in short run and long run.

Indonesian Pepper Export (QXLI)

Indonesian pepper export significantly influenced by growth of Indonesian pepper demand and Indonesian pepper export last year. Whereas real exchange rate of IDR to USD and real price of world pepper not significantly to Indonesian pepper export. Growth of Indonesian pepper demand isn't responsive to Indonesian pepper export in short run and long run.

Real Price of Indonesian Pepper (HLIR)

Indonesian pepper price significantly influenced by Indonesian pepper production, real exchange rate of IDR to USD, inflation rate of Indonesia, and Indonesian pepper price last year. Whereas Indonesian pepper demand and real price of world pepper not significantly to real price of Indonesian pepper. Indonesian

pepper production, real exchange rate of IDR to USD, inflation rate of Indonesia aren't responsive to real price of Indonesian pepper in short run and long run. Impact of Government Policy to Indonesian Pepper in The Supply and Demand *Model Validation*

All equation of model in this research must be validate and then simulate by using RMSPE value and U-Theil value criterias. Model validation result of Indonesian pepper in the supply and demand presented by Table 3.

Table 3. Model validation results of Indonesian pepper in the supply and demand, period 1990-2013

Variable Label	RMSPE	UM	UR	UD	US	UC	UM +UR +UD	UM +UR +UC	U
Indonesian pepper production	7.94	0.00	0.01	0.99	0.02	0.98	1.00	1.00	0.04
Indonesian pepper demand	314.90	0.00	0.00	1.00	0.16	0.84	1.00	1.00	0.15
Indonesian pepper expon	16.50	0.00	0.00	1.00	0.13	0.87	1.00	1.00	0.07
Real price of Indonesian pepper	38.35	0.00	0.00	1.00	0.06	0.94	1.00	1.00	0.15

Table 3 showed that validation results from 4 simultaneous equations, there are 3 equations that have RMPSE value smaller than 100% (Indonesian pepper production, Indonesian pepper export, real price of Indonesian pepper) and 1 equation that have RMPSE value bigger than 100% (Indonesian pepper demand). In model happened the systematic unbias because based on result of U-Theil test, all equations have value of U, UM, UR, and US are small while value of UD and UC are high. Based on that value known that model have perfected to simulation.

Model Simulation

Simulation result of Indonesian pepper in the supply and demand presented by Table 4.

Table 4. Model historical simulation results of Indonesian pepper in the supply and demand, period 1990-2013

Variable Label	Unit	Base Simulation Altentative	Simulation Altentative	Simulation Change
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			I	2	3	1	2	3
Indonesian pepper production	Ton	73,072.20	73359.80	73.129.90	73317.50	0.26	0.08	0.34
Indonesian pepper demand	Ton	28.279.60	28.223.50	28.259.80	28.203.80	-0.20	-0.07	-0.27
Indonesian pepper export	Ton	44.792.60	44.96410	44223.70	44,995.30	0.38	0.07	0.45
Real price of Indonesian pepper	Rp/kg	18.723,70	19,205.90	18393.60	19,375.80	2.58	0.91	3.48

Description: Simulation 1 = Exchange rate depreciation of IDR to USD equal to 8.05%

Simulation 2 = Increase price of world pepper equal to 3.04%

Simulation 3 = Combination between Simulation 1 dan Simulation 2

Based on Table 4, historical simulation results from three policy alternative to Indonesian pepper in the supply and demand period 1990-2013 showed that exchange rate depreciation of IDR to USD equal to 8.05%, increase price of world pepper equal to 3.04%, and combination among its gave impact to increase real Indonesian pepper price and Indonesian pepper export. Therefore happened increase of Indonesian pepper production and degradation of Indonesian pepper demand.

CONCLUSION AND SUGGESTION

Indonesian pepper production significantly influenced by real price of Indonesian pepper, Indonesian pepper export, real interest rate of Indonesia, and Indonesian pepper production last year. Indonesian pepper demand significantly influenced by Indonesian population. Indonesian pepper export significantly influenced by growth of Indonesian pepper demand and Indonesian pepper export last year. Indonesian pepper price significantly influenced by Indonesian pepper production, real exchange rate of IDR to USD, inflation rate of Indonesia, and Indonesian pepper price last year. Real price of Indonesian pepper isn't responsive to Indonesian pepper production in short run and responsive in long run. Indonesian population is responsive to Indonesian pepper demand in short run and long run. Other exogenous variables aren't responsive to endogenous variable in short run and long run. The exchange rate depreciation, the increase price of world pepper, and combination among its impact to increase of Indonesian pepper price, export, and production and degradation of Indonesian pepper demand. Development of pepper agroindustry must intensively to improve domestic demand and give economic value to pepper commodity.

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