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The Effect of Changes in Beef Prices on Beef Supply and Demand in Indonesia

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ABSTRACT

The increase in population growth in Indonesia led to an increase in demand for some products, especially food demand. Food demand that exceeds domestic production makes Indonesia an importing country. In general, the problem in this research is how to develop a cattle farming strategy to increase domestic beef production in Indonesia. This study aims to analyze the impact of beef prices on the beef supply and demand in Indonesia. This study uses secondary time series data for the period 1990-2018. The research method is qualitative and quantitative. The analytical method in this study is an econometric model with simultaneous equations and is estimated using the Two-Stage Least Squares (2SLS) method. Data were processed by SAS/EST 9.4 program. This study concludes that factors that influence beef supply in Indonesia are beef production, beef import, and beef export. Demand for beef in Indonesia is influenced by domestic beef price, chicken price, egg price, and income. Domestic beef price has no significant effect on demand for beef, where a one percent decrease in beef price will increase beef demand by 0.00011 percent, while people's income has a significant effect at the 0.05 level. The price of domestic beef itself is influenced by several factors: the price of beef in Jakarta, the price of imported beef, and the amount of domestic beef production. An increase in beef production by one percent will reduce domestic beef prices by 22.6 percent.

1. Introduction

The agricultural sector has a vital role in providing food for the community. As a basic need, food always occupies a high priority in national economic development. The lack of food availability due to the increasing population is a problem that a country cannot avoid, especially for Indonesia as a developing country. Beef is one of the animal food products in demand because its nutritional content in protein and fat causes its consumption to increase. Pahar (2008) and Pramono (2011) stated that in addition to taste, the main reason for consuming beef is nutritional fulfillment. On the other hand, beef is one of the food products that is a typical culinary for the people of Indonesia on specific days such as Ramadan, Eid, and other celebration days. The growth in the level of beef consumption in Indonesia is generally fluctuating and tends to increase. The high growth of beef consumption which is twice as large (6.35 percent) as domestic beef production (3.52 percent), causes a gap between beef supply and demand in Indonesia. This gap makes beef one of several animal food products that experience an increase in prices every year.

The scarcity of beef will affect the price increase. According to Komalawati et al. (2018), with the limited supply of beef in the market, domestic beef prices or beef prices at the consumer level in Indonesia from 2008 to 2016 continued to increase with a growth of 0.57 percent per year. The price at the producer level also increased, although the magnitude of the increase is not as large, where when the price of beef rises 12.5 - 25 percent, while the increase in the price of cattle at the farmer level only increases by 10 percent. Therefore, government intervention is needed to overcome these problems. The government's intervention is to import frozen beef to overcome the high price of beef in Indonesia. One of the research issues is to answer how the effect of beef price on the demand for beef in Indonesia. This study aims to determine the effects of beef price changes on its supply and demand in Indonesia.

2. Method

The data in this study is secondary time series data for the period 1990–2018. The data was taken from various sources such as the Directorate General of Livestock and Animal Health Services, Ministry of Agriculture, Statistics Indonesia, Bank Indonesia, FAO, Directorate General of Customs and Excise, Ministry of Finance, and studies of various literature related to this research. The data is utilized to build a simultaneous equation model. Quantitative variables in Rupiah will be adjusted with the national Consumer Price Index (CPI) for the 2010 base year, as well as the US$ variable will be adjusted with the CPI of the country of origin of beef import with a base year in 2010.

This research applied qualitative (descriptive) and quantitative methods. The descriptive method explained the data obtained from the analysis results carried out using the quantitative method. The quantitative method analyzed the factors that affect imports of cattle and beef in Indonesia. The analytical method is an econometric model with simultaneous equations and is estimated using the Two-Stage Least Square (2SLS) method. The purpose of using the analysis method using the simultaneous equation with the 2SLS estimation method is to understand the relationship between variables from all sides, grouped into several blocks of equations of economic aspects, especially those related to cattle and beef import. Furthermore, data processing was carried out using a computer program, namely Statistical Analysis System/Econometric Time Series (SAS/ETS) 9.4 and Microsoft Excel 2013.

The model's specification formulated in this study is closely related to the research objective, which is to formulate a supply and demand model for Indonesian beef. In this study, the model built is a simultaneous equation model. The relationship between supply and demand for Indonesian beef is presented in Figure 1.

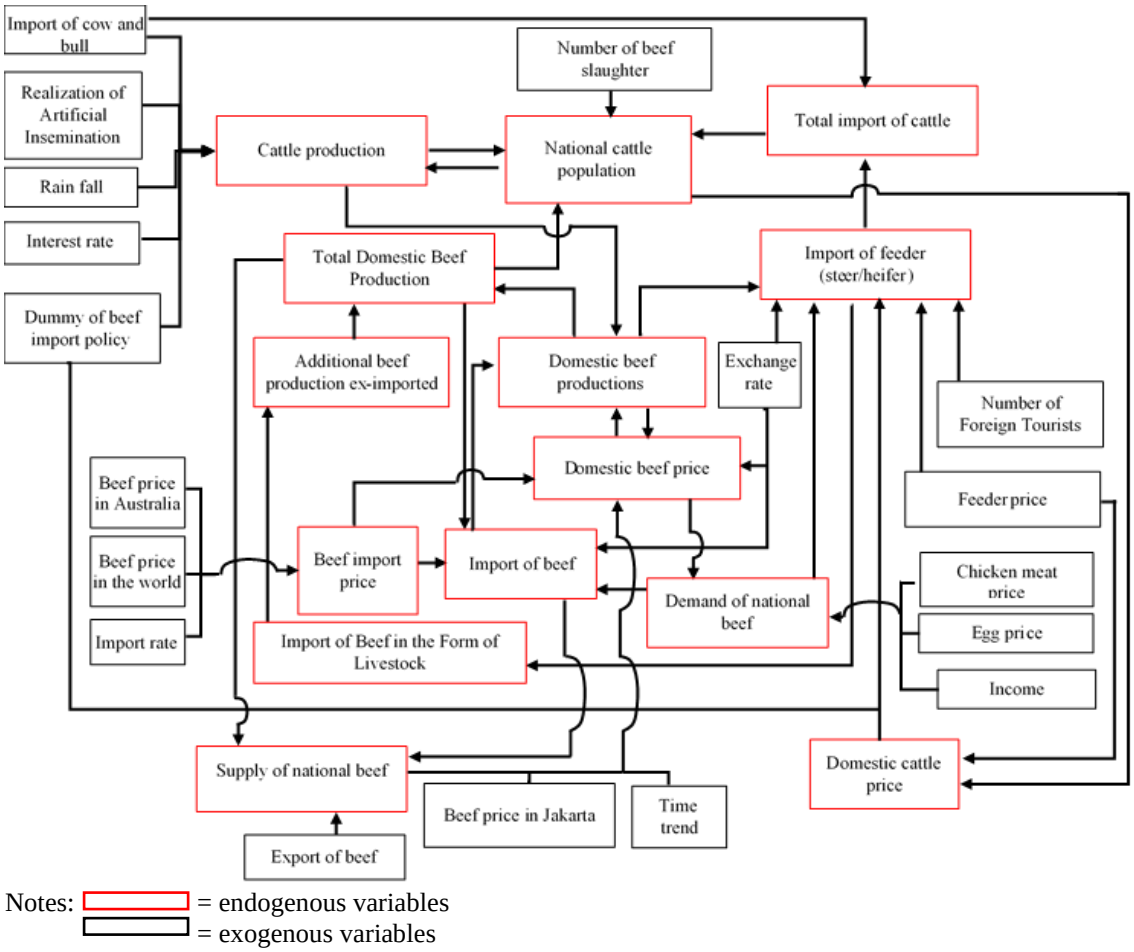

Figure 1
The Relationship Between Exogenous and Endogenous Variables in The Indonesian Beef Import Model

Block of Cattle Supply
Domestic Cattle Production
$PSD_t = a_0 + a_1POPSt + a_2\ IMBS_{t-2} + a_3\ RIB_{t-1} + a_4\ CH_{t-1} + a_5D_{1t} + u_1$
Expected parameter sign: $a_1, a_2, a_3, a_4 > 0; a_5 < 0$
National Cattle Population
$POPS_t = b_0 + b_1PSD_t + b_2JPS_t + b_3TIMS_{1t} + b_4TDDS_t + b5POPS_{t-1} + u_2$
Expected parameter sign: $b_1, b_3 > 0; b_2, b_4 < 0; 0 < b_5 < 1$
Import of Cattle
$TIMS_t = IMSB_t + IMBS_t$
$IMSB_t = c_0 + c_1HSBIR_t + c_2PDSD_t + c_3JWM_t + c_4HSDR_t + c_5QDDS_t + c_6NTR_t + c_7D_{1t} + u_3$
Expected parameter sign: $c_1, c_2, c_6, c_7 < 0; c_3, c_4, c_5 > 0$

Block of Beef Supply
Beef Supply
$QSDS_t = TDDS_t + IMDS_t - EXDS_t$
Domestic beef production
$TDDS_t = PDSD_t + PDTI_t$
$PDTI_t = 0.4062 * IMDB_t$
$PDSD_t = e_0 + e_1HDSDR_{t-1} + e_2IMDS_t + e_3PSD_{t-2} + e_4PDSD_{t-1} + e_5D_{1t} + u_4$
Expected parameter sign: $e_1, e_3, e_5 > 0; e_2 < 0;$ dan $0 < e_4 < 1$
Import of beef
$IMDS_t = f_0 + f_1TDDS_t + f_2QDDS_t + f_3NTR_t + f_4HDSIR_t + u_5$
$IMDB_t = k * IMSB_t$
$TIDS_t = IMDS_t + IMDB_t$
Expected parameter sign: $f_2, > 0; f_1, f_3, f_4 < 0;$

Block of Beef Demand
National beef demand
$QDDS_t = g_0 + g_1HDSDR_t + g_2HDAR_t + g_3HTAR_t + g_4PMP_t + g_5QDDS_{t-1} + u_6$
Expected parameter sign: $g_1 < 0; g_2, g_3, g_4, > 0;$ dan $0 < g_5 < 1$

Block of Beef Price
Domestic beef price
$HDSDR_t = h_0 + h_1HDSJR_t + h_2HDSIR_t + h_3TW_t + h_4PDSD_t + u_7$
Expected parameter sign: $h_4 < 0; h_1, h_2, h_3 > 0$
Imported beef price
$HDSIR_t = i_0 + i_1HRSAR_t + i_2HDDR1_t + i_3TIM1_t + i_4HDSIR_{t-1} + u_8$
Expected parameter sign: $i_1, i_2, i_3 > 0; 0 < i_4 < 1$

Block of Cattle Price
Domestic cattle price
$HSDR_t = j_0 + j_1HSBIR_t + j_2PSD1_t + j_3HSDR_{t-1} + u_9$
Expected parameter sign: $j_1 > 0; j_2 < 0; 0 < j_3 < 1$

According to Koutsoyiannis (1977), model identification has two conditions: the order condition and the rank condition. Based on the order conditions, the identification condition is achieved if:
$(K - M)\ (G - 1)$
where: K = number of variables in the model (endogenous and exogenous variables)
M = number of variables (endogenous and exogenous) included in a particular equation in the model
G = number of equations in the model (number of endogenous variables).

If (K – M) is equal to (G – 1), then the equation in the model is considered to be exactly identified, if (K – M) is less than (G – 1), it is considered to be unidentified, and if (K – M) is greater than (G – 1) then the equation is considered to be overidentified. The rank condition is determined by the determinant of the matrix of the structural equation ≠ 0. The model consisted of 15 endogenous variables and 15 exogenous variables with 5 lagged variables. Based on the provisions of the model identification criteria above, all structural equations compiled in this study are overidentified.

To examine whether the explanatory variables together have a significant effect on the endogenous variables, each equation is tested with the F-test. To examine whether each explanatory variable has a significant effect on the endogenous variables, then a t-test is conducted in each equation.

Furthermore, because the model contains simultaneous equations and lagged endogenous variables, the serial correlation test by Durbin Watson Statistics is not valid to use. Instead, to find out whether there is a serial correlation (autocorrelation) in each equation, the Durbin-h statistics is conducted (Pindyck and Rubinfeld, 1991), as follows:

$$h = \left[1 - \frac{1}{2}d\right]\sqrt{\frac{n}{1 - n[var\ \beta]}}$$

where : h = durbin-h statistic
d = DW statistic
n = number of observations, and
Var (β) = variance of the regression coefficient for lagged dependent variable

If h-value is less than the critical value of h from the normal distribution table, then the equation does not experience serial correlation. Model validation aims to determine the level of model representation compared to the real world as a basis for conducting simulations. Various statistical criteria can be used to validate econometric models by comparing actual and predicted values of endogenous variables (Klein, 1993). Model validation was carried out using Root Means Squares Error (RMSE), Root Means Percent Squares Error (RMSPE), and Theil's Inequality Coefficient (U) (Pindyck and Rubinfield, 1991). The criteria are formulated as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(Y_t^s - Y_t^a)^2}$$

$$RMSPE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}\left(\frac{Y_t^s - Y_t^a}{T_t^a}\right)^2}$$

where :
Y_t^s = the value of the basic simulation results from the observation variable
Y_t^a = the actual value of the observation variable
n = number of observation periods

The RMSPE statistic is utilized to measure how far the values of the predicted endogenous variables deviate from their actual values in a relative measure (percent) or how closely the predicted values follow the development of the actual values. In addition, model validation can also be explained from the coefficient of determination (R^2); the greater the value, the greater the proportion of variations in endogenous variables that variations in explanatory variables can explain, indicating a better fit for the model.

3. Result and Discussion

3.1. Performance of Cattle Population and Indonesian Beef Production

Cattle are Indonesian resources to produce other products, both food and non-food. As livestock belonging to the large ruminant group, cattle are the most significant meat contributor among other livestock. It is what makes the cattle business feasible to be developed as a profitable business. In the 1990-2018 period, the beef cattle population in Indonesia showed positive growth with an average increase of 2.26 percent per year. However, during this period, population development fluctuated. The highest increase in growth occurred in 2009 by 23.72 percent, and the lowest decline in population by 21.02 percent occurred in 2013.

According to the Livestock Business Cost Structure Survey (2017), the purpose of the beef cattle business on smallholder farms is at most breeding at 65.96 percent, fattening at 33.94 percent, and breeding at 0.10 percent. The breeding business is an effort to raise livestock to multiply calves. Fattening business

is an effort to raise livestock to increase its weight by buying feeders or calves and then selling them when old enough.

The growth of national beef production shows positive progress, with growth reaching 14.41 percent. In the last eight years (2010-2018), beef production continued to show positive growth (BPS, 2018; 2020). The spike in beef prices in Indonesia occurs because beef consumption increases on religious holidays and certain national holidays, such as every time before fasting or Ramadan until Eid. The fact that occurs from this phenomenon is that the increase in the beef price never returns to its initial position or decreases after the fasting month and Eid, meaning that the price of beef remains at its new price, and this event keeps repeating from year to year in Indonesia. Therefore, aside from the increasing demand for beef, the increase in beef price in the previous year also increased the beef price in the following year.

During 2010-2018, fluctuating national beef consumption tends to increase by 5.89 percent per year. In order to meet the need for national beef consumption, which continues to increase and is not balanced by domestic beef production, besides importing beef, Indonesia also imports livestock, specifically feeders and breeders. As a result, the development of cattle and beef imports experienced positive growth, 3.92 percent per year for feeders and 47.92 percent per year for beef. Meanwhile, imports of breeders have a fluctuating volume and are much smaller than feeder and beef imports (BPS, 2018; 2020).

Indonesia imports cattle mainly from Australia, aiming to increase the added value of cattle farming businesses in Indonesia. The choice of Australia as the primary supplier of cattle import is due to the relatively close distance between Indonesia and Australia so that the fresh meat consumption can be fulfilled, considering that consumers in Indonesia prefer fresh beef to frozen beef. Aside from Australia, Indonesia imports beef from New Zealand. However, since 2016 Indonesia imports beef from India. This import expansion is based on the amendment to the Law on Livestock and Animal Health, which states the source of origin of cattle or cattle products originating from a zone-based, not country-based.

3.2. Model Estimation Results

In this study, the econometric model of Indonesia's beef import is a simultaneous model built from 15 equations, consisting of nine structural equations and six identity equations. The data in this study is time-series data from 1990 to 2018 or 29 years observation period.

In general, model estimation results using the Two-Stage Least Square (2SLS) method indicate that almost all explanatory variables included in the equation have signs in line with the hypothesis from economics theory. Based on statistical criteria, the estimation results of the model are quite fit, as indicated by the value of the coefficient of determination (R^2) in each equation. The R^2 value of the nine structural equations used in this study ranged from 67.91 percent to 95.80 percent. Around 56 percent of the structural equations have an R^2 above average (83.45%), and 44 percent of the structural equations are below average. It shows that the diversity of endogenous variables can be explained by explanatory variables (exogenous variables) in each equation, which is also indicated by the significant F-statistic value (less than 1%). The t-statistic result indicates that several explanatory variables have no significant effect on the endogenous variables at the specified level. The levels used in this study were 5%, 15%, 25%, and 35%.

The autocorrelation test using the Durbin Watson (DW) statistical value shows no equations that experience autocorrelation symptoms where the DW value ranges between 1.498-2.806 with an expected range of 1.45 - 2.54. However, two structural equations have no conclusion, namely the variable cattle production and local cattle populations. Based on the statistic and econometric tests, with estimated criteria and considering a model with relatively long observations, the estimation results of the model are said to be able to represent and capture the phenomenon of import policy and the supply-demand for cattle and beef in Indonesia. The cattle and beef import policy model on local cattle populations in Indonesia contains 15 equations grouped into several blocks: cattle supply block, beef supply block, beef demand block, domestic cattle price block, and beef price block. The following is a detailed description of the general performance of the cattle and beef import model in Indonesia.

Block of Cattle Supply

Cattle production

Cattle production in this study is the national cattle production originating from small farms and industrial farms. This estimation states that domestic cattle production is influenced by the national cattle population, the value of imported breeders in the previous two years, the artificial insemination (AI) implementation in the previous year, and rainfall in the previous year. The behavioral equation for the response of domestic cattle production is quite good, where the coefficient of determination is 0.75, and the F-statistic test value is 16.31, meaning that the explanatory variable in the equation could explain 75 percent of the endogenous variable, the remaining 25 percent explained by other variables that are not included in

the equation model. Furthermore, the analysis proves that the domestic cattle population variable, the lagged imported breeder variable (t-2), the lagged artificial insemination application dosage variable (t-1), and the lagged rainfall variable (t-1) have a positive influence on cattle production in Indonesia.

Not only importing feeders, but Indonesia also imports breeders. Imported breeders in this study are cows or productive heifers that will breed naturally or through AI with local bulls and are expected to produce calves of better quality. According to Marsh (1994), the production response in large livestock businesses such as cattle requires a relatively long time due to biological factors. As with other agricultural products, producing calves also takes a long time, approximately nine months and ten days. Therefore, the imported breeders variable in this study uses a lag of two previous years by considering the adaptation time required by the imported breeders to the new environment and rearing time to produce calves. Based on the parameter estimation results, the lagged breeder import variable in year t-2 positively affects cattle production in Indonesia. The short-term elasticity value of imported breeders gives a minimal response to the production of cattle in Indonesia, with a value of 0.45 for an increase of 10.000 percent of imported breeders. On the other hand, the low volume of imported breeders compared to feeders is due to the higher price. The number of AI implementations in the previous year had no significant effect. Domestic cattle production is not responsive to the number of AI implementations with a short-term elasticity of 0.000026. It shows that these variables only have a small impact on increasing domestic cattle production.

Table 1

Parameter Estimation Results of Domestic Cattle Production Variables

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	-0.64848	-1.19			
POPS	0.166533	4.11*	0.830984	-	National cattle population
LLIMBS	0.000111	1.32***	0.000045	-	Import of breeder t-2
LRIB	0.000044	0.44	0.000026	-	Realization of AI t-1
LCH	0.000413	2.04*	0.0000003	-	Rainfall t-1
R^2 = 0.74782, F_{value} = 16.31					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

National cattle population

In this study, the cattle production variable and the lagged national cattle population variable in year t-1 positively affected the domestic cattle population. In contrast, the volume of cattle slaughter variable had a negative effect or can reduce the domestic cattle population.

Table 2

Parameter Estimation Results National Cattle Population Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	2.139420	1.01			
PSD	1.480777	3.74*	0.296755	1.381141	Domestic cattle production
JPS	-1.59847	-1.21***	(0.171100)	(0.796327)	Cattle slaughter
TIMS-LTIMS	0.000200	1.29***	0.000110	0.000513	Change in total import of cattle
TDDS	-0.00232	-0.79	(0.061351)	(0.285537)	Total domestic beef production
LPOPS	0.785138	5.51*			Lag national Cattle Population
R^2 = 0.92445, F_{value} = 51.39					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

Domestic cattle population has a negative connection with the volume of cattle slaughter and total domestic beef production, while domestic cattle production, changes in total imports of cattle have a positive relationship. Therefore, an increase in domestic cattle production and a change in total domestic beef production will increase the national cattle population. The coefficient of determination of the national cattle population is 0.92, which means that the explanatory variables in the equation can explain the endogenous variable by 92 percent. The national cattle population is not responsive to domestic cattle production in the short term but responsive to domestic cattle production in the long term. The long-term

elasticity value is 1.381141, meaning that if there is an increase in domestic cattle production by one percent, it will increase the national cattle population by 1.381141 percent.

Import of Cattle

One type of Indonesian imported cattle is the feeders to be fattened and then slaughtered to meet national meat needs. On the other hand, importing feeders is also expected to reduce imports of beef, especially frozen beef. Several factors influence Indonesia to import feeder livestock, such as the price of imported feeder, domestic beef production, the number of foreign tourist visits, and the price of domestic cattle. The estimation parameter test results show that the feeder import equation has a determination coefficient value of 0.80312, meaning that the variation of the exogenous variables in the model is able to explain the variation of Indonesian feeder imports by 80.32 percent. The price of imported feeders has a negative effect on cattle imports, meaning that the higher the price of imported feeders, the lower the volume of feeders import. However, this variable is not statistically significant.

Table 3
Parameter Estimation Results of Import of Feeder Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	-47.7106	-1.76	(0.0000000002)		
HSBIR	-0.01089	-0.68	(1.242763)	-	Feeder price
PDSD	-0.44385	-2.81*	0.418887	-	Domestic beef production
JWM	0.007092	0.69	0.000001	-	Number of foreign tourism
HSDR	0.002349	1.68**	1.947856	-	Domestic cattle price
QDDS	0.561420	2.17*	(0.000000042)	-	Total national beef demand
D1	-44.3016	-0.93	(0.0000000002)	-	Dummy of beef import policy
R^2 = 0.80312, F_{value} = 13.60					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

The local beef production variable showed significant t-statistic test results at the level of 5 percent ($p < 0.05$) with negative effect and responsive in the short term to feeder imports with a short-term elasticity value of 1.24. Table 3 also shows that the number of feeder imports is significantly influenced by domestic beef production in the opposite direction. However, it is not responsive with short-term elasticity of 0.418887, meaning that an increase in domestic beef production by one percent will reduce the number of feeder imports by 0.418887 percent in the short term. Domestic cattle price and domestic beef demand have a significant and positive effect on the cattle import volume but are not responsive. The impact of India's beef import policy is negative, meaning that this policy will reduce the number of feeder imports.

Block of Beef Supply

Domestic beef production

Table 4
Parameter Estimation Results of Domestic Beef Production Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	-163.104	-2.06			
LHDSDR	0.002520	1.62**	0.000000478	0.000002	Lag domestic beef price
IMDS	-0.18892	-0.52	(0.029347)	(0.108270)	Import of beef
LLPSD	47.22003	2.21*	0.397810	1.467642	Domestic cattle production t-2
D1	-14.1476	-0.26	(0.000000003)	(0.000000012)	Dummy of beef import policy
LPDSD	0.728946	5.21*	-	-	Lag domestic beef production
R^2 = 0.89403, F_{value} = 35.43					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

Beef originating from local cattle or so-called domestic beef production is one of the sources in Indonesian beef supply to meet national demand. It covered almost 80 percent during 2010 – 2018, apart from imported beef and imported feeder. Domestic beef production is mainly sourced from small farms, while the feedlot industry produces more beef from imported feeders, both feeders that are ready to be

slaughtered and have been fattened previously. The previous year's domestic beef price coefficient has a significant effect on domestic beef production.

Several factors affect domestic beef production, namely the beef price of the previous year, the volume of beef imports, the amount of beef production two years before, and the amount of beef production the previous year. Meanwhile, Kariyasa (2004) stated that domestic beef prices and cattle prices influence domestic beef production. This equation also studies the impact of India's beef import policy through a policy dummy that negatively impacts domestic beef production. The estimation parameter test results show that the domestic beef production equation has a coefficient of determination of 0.89403, meaning that the variation of the exogenous variables in the model can explain the variation of Indonesian feeder cattle imports of 89.43 percent.

Import of beef

Hanum and Setyari (2016) stated based on the calculation of the degree of commodity concentration, Indonesia has a dependence on imported meat. Australia is one of the beef exporters and is the primary source of cattle and beef imports for Indonesia, with an import share of 60 percent until 2015. However, since 2016 when policies regarding the country of origin of beef imports based on zone-based were implemented, other countries that contribute to the import of meat into Indonesia are India and Brazil.

Table 5
Parameter Estimation Results of Import of Beef Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	77.91309	1.45			
TDDS	-0.16335	-1.54**	(1.204108)	-	Total domestic beef production
QDDS	0.617726	6.75*	4.927491	-	Total national beef demand
NTR	-0.00688	-2.61*	(0.000000020)	-	Exchange rate
HDSIR	-0.04805	-3.50*	(0.000000003)	-	Import beef price
$R^2 = 0.85363$, $F_{value} = 32.08$					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

The estimation parameter test results show that the Indonesian beef import equation has a coefficient of determination of 0.85363, meaning that the variation of the exogenous variables in the model can explain the variation of Indonesian feeder imports of 85.36 percent. The beef import equation is significantly influenced by the total domestic beef production, national beef demand, exchange rates, and imported beef price. Total domestic beef production affects in the opposite direction. National beef demand is not responsive to the volume of meat imports in both the short and long term. It is in contrast to the research conducted by Yudhanto et al. (2019), which stated that the beef demand variable had a significant effect on beef imports volume in Indonesia.

Block of Beef Demand

According to the parameter estimation results, factors that affect the national demand for beef in Indonesia are the price of domestic beef, the price of chicken meat, the price of native chicken eggs, income, and the beef demand in the previous year. The results of parameter estimation from the national beef demand are in Table 6.

The results show that the effect of the chicken meat price, which is suspected as a substitute for beef in this study, does not show the same thing as in the research conducted by Ilham (2001), Sukanata (2008), and Tseoua (2011). However, some of these studies also still show an insignificant effect. The variable price of chicken meat in this study has a negative and inelastic effect in the long and short term, meaning that when the price of chicken meat increases, it can reduce the demand for national beef. It is because the price of beef has a much higher price level than other livestock meat prices, especially the price of chicken meat in Indonesia. On the contrary, the price of native chicken eggs has a positive effect, meaning that the higher the price of native chicken eggs, the higher the demand for national beef.

The coefficient of public income per capita has a significant positive effect on national beef demand, and this is supported by the results of research conducted by Perdana et al. (2013) in Kendal. In addition, we can see that the increase in the domestic beef price will also reduce the public meat demand or consumption, in line with research conducted by Hasibuan et al. (2014) in his research conducted in Medan regarding the impact of rising meat prices on public consumption.

In theory, if last year's demand for beef increased and were not followed by an increase in supply, it would cause the gap to widen; as a result, the demand for beef in the following year would increase. This is evidenced by the parameter estimation results, which show that the beef demand in the previous year has a positive and significant effect ($p < 0.05$). This study is in line with Sukanata (2008) but different from Priyanto (2003), who showed a negative relationship to beef demand in the previous year.

Table 6
Parameter Estimation Results of Total National Beef Demand Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	201.1502	2.16			
HDSDR	-0.00011	-0.07	(0.000000017)	(0.000000028)	Domestic beef price
HDAR	-0.00203	-0.87	(0.000000149)	(0.000000243)	Chicken meat price
HTAR	0.000223	0.25	0.000000010	0.000000016	Egg price
PMP	5.129555	3.04*	0.253263	0.413837	Comunity income
LQDDS	0.388013	2.09*			Lag total national beef demand
$R^2 = 0.95797$, $F_{value} = 95.72$					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

Block of Beef Price
Domestic beef price

The estimation parameters' results show the factors that influence the national demand for beef in Indonesia, such as domestic beef price, chicken meat price, native chicken eggs price, income, and beef demand in the previous year. Domestic beef prices in Indonesia, such as meat prices in Jakarta, imported meat prices, time trends, and domestic beef production, have a coefficient of determination (R^2) of 0.87255. This value explains that variations in domestic beef price changes can be explained by variations in exogenous variables of 87.26 percent, other variables outside the model influence the rest. Based on the t-statistic test, the beef price in Jakarta and the imported beef price have a significant effect at the level of 5 percent. The beef price in Jakarta is not responsive in the short term to the price of domestic beef with an elasticity of 0.601937, meaning that the increasing beef price in Jakarta will increase the price of domestic beef by 0.601937 percent.

Table 7
Parameter Estimation Results of Domestic Beef Price Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	2628.307	0.24			
HDSJR	0.539845	2.89*	0.601937	-	Beef price in Jakarta
HDSIR	5.923007	3.13*	0.000306	-	Imported beef price
TW	737.7619	3.86*	0.191020	-	Time trend
PDSD	-22.6610	-1.52**	(118,281.89)	-	Total domestic beef production
$R^2 = 0.87255$, $F_{value} = 37.65$					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

Not only the beef price in Jakarta, but the imported beef price also has a positive and significant effect at the level of 5 percent ($p<0.05$) on the price of domestic beef. Moreover, Indonesia is known as a net importer and price taker in beef trading, meaning that Indonesia's domestic beef prices will always follow the dynamics of imported beef prices, which are influenced by world beef prices. It is in line with a study conducted by Zainuddin et al. (2015), which stated that the integration between beef prices in the domestic and world markets in the long and short term has implications for the stability of Indonesian beef prices, which depend on beef prices in the international market. From the estimation results, we can also see that beef production has a negative effect on domestic beef prices. It is supported by the results of research conducted by Wulandari et al. (2013) in North Sumatra, which stated that increasing beef production will reduce beef prices in North Sumatra.

Beef import price

The equation for imported beef price in this study is influenced by several factors such as Australian beef prices, the changes in world beef price, the changes in beef import tariffs, and the lagged imported beef prices in the previous year.

The coefficient of determination (R^2) in this equation is 0.77753, which means that the ability of these exogenous variables together can explain the variation of the imported beef price by 77.75 percent, while other variables outside the model influence 22.25 percent. An F-statistic value = 19.22 means that the explanatory variables from the equation for the imported beef price together can explain the behavior of imported beef prices.

Table 8
Parameter Estimation Results of Imported Beef Price Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	131.9907	0.27			
HDSAR	0.287245	1.70**	0.232418	0.809369	Beef price in Australia
HDDR-LHDDR	0.074657	1.15****	(0.000134)	(0.000465)	Change of beef price in the world
TIM-LTIM	15.35365	0.48	(4.584580)	(15.965300)	Change in import rate
LHDSIR	0.712841	7.84*			Lag Imported beef price
R^2 = 0.77753, F_{value} = 19.22					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

Block of Cattle Price

Domestic cattle price

The imported feeder price influenced the price of domestic cattle; the higher the price of imported feeder, the higher the possibility of domestic beef prices also increasing. The results of the estimation parameters (Table 9) showed that the domestic cattle price equation has a coefficient of determination of 0.67911. It means that the dynamics of domestic cattle prices can be explained by the diversity of imported feeder prices, the changes in national cattle production, and the lagged domestic cattle prices in the previous year by 67.91 percent.

The imported feeder price showed a positive and significant effect ($p < 0.25$) and was inelastic in the short and long term. It means that if the price of imported feeders increases by one percent, it can increase the price of domestic beef cattle by 0.0002 percent in the short term and 0.0007 percent in the long term.

Table 9
Parameter Estimation Results of Domestic Cattle Price Variable

Variable	Parameter Estimation	t_{value}	Elasticity		Description
			E_{SR}	E_{LR}	
Intercept	3207.893	0.83			
HSBIR	2.630403	1.22***	0.000198	0.000715	Feeder price
PSD-LPSD	-1524.87	-0.92	(3,246.70)	(11,735.26)	Change in cattle production
LHSDR	0.723338	5.30*			Lag Domestic cattle price
R^2 = 0.68, F_{value} = 16.23					

Description: Significantly affect the level of * = 0.05, ** = 0,15, *** = 0,25, **** = 0,35.

In Table 9 we can see that the import price of feeders has a significant effect on the price of domestic cattle. Feeders Import prices are unresponsive in the short term to changes in domestic cattle prices with a short-term elasticity of 0.000198, meaning that an increase in feeder import prices by one percent will increase the price of domestic cattle by 0.000198 percent, but in the long run, inelastic.

Model Validation Results

The statistical criteria in this validation use several indicators such as Root Means Squares Percent Error (RMSPE) and U-theil's. The RMPSE indicator is utilized to measure how closely the value of each predicted endogenous variable follows the actual data value during the observation period or how far the deviation is in percent. In theory, the smaller the RMSPE and U-Theil's value, the greater the R2 value, the model estimation is better. The value of U-Theil's coefficient (U) ranges between 1 and 0. If U = 0, then the estimation of the model is perfect. If U = 1, then the estimation of the model is naive.

The validation of the cattle and beef import model in Indonesia was carried out in the period 1990-2018 to see a description of the condition of imports of cattle and beef to the domestic cattle population as well as the supply and demand for beef with various alternative policies in Indonesia. Table 10 shows that the endogenous variable with an RMSPE value of 35 percent is around 60 percent, and the U-Theil's value is smaller than 0.25 is 100 percent or as many as the total 15 equations. As for several equations with an RMSPE value greater than 35 percent, most are identity equations caused by errors of endogenous variables that influence each other. Meanwhile, in the structural equation that has a value greater than 35 percent, one of them is the price of domestic cattle.

Table 10
The Results of The Validation of The Cattle and Beef Import Model in Indonesia, in 1990-2018

No	Variable	Descriptions	RMSPE	U
1	HDSDR	Domestic beef price	6.3584	0.0301
2	HDSIR	Import beef price	11.3917	0.0587
3	HSDR	Domestic cattle price	36.7728	0.0997
4	IMDB	Beef production on feeder import	107.1000	0.1788
5	IMDS	Import of beef	416.2000	0.2056
6	IMSB	Import of feeder	107.1000	0.1788
7	PDSD	Total domestic beef production	13.6848	0.0665
8	PDTI	Additional beef production ex imported	107.1000	0.1788
9	POPS	National cattle population	7.4235	0.0362
10	PSD	Number of domestic cattle production	19.6746	0.0747
11	QDDS	Total national beef demand	8.2291	0.0349
12	QSDS	Total national beef supply	13.0644	0.0576
13	TDDS	Total domestic beef production	11.1904	0.0569
14	TIDS	Total beef import	196.3000	0.1621
15	TIMS	Total cattle import	17.9245	0.0165

4. Conclusion

Based on the analysis results, it can be concluded that the factors that influence the supply of beef in Indonesia are the amount of beef production, beef import, and beef export. Demand for beef in Indonesia is influenced by domestic beef price, chicken meat price, egg price, and income. Domestic beef price has no significant effect on demand for beef, where a one percent decrease in beef price will increase beef demand by 0.00011 percent, while people's incomes have a significant effect at the 0.05 level. The price of domestic beef itself is influenced by several factors: the price of beef in Jakarta, the price of imported beef, and the amount of domestic beef production. An increase in beef production by one percent will reduce domestic beef prices by 22.6 percent.

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