Analysis of beef price determinants in North Sumatera

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Abstract. Beef Prices in North Sumatera show a continuous increase. This research was conducted by collecting secondary data in North Sumatera in 2020. The purpose of this research was to find the factors that influenced the increase in the price of the beef. The analysis method to explain the factors that influence the beef prices in North Sumatera was Multiple Linear Regression analysis. There was no violation of classical assumptions such as autocorrelation, heteroscedasticity and multicollinearity so it can be said that the estimation of the regression model was unbiased. The results showed that there were three factors that had a positive and significant effect on the 5% error rate on the beef prices in North Sumatera, namely the world beef prices, Rupiah exchange rate against the Dollar and beef imports in North Sumatera. The beef production in North Sumatera affected on the beef prices in North Sumatera at an error level of 10%. The consumption of beef did not have a significant effect on the beef prices in North Sumatera.

1. Introduction
The consumption of beef in Indonesia shows a continuous increase. Several factors have led to increased consumption of beef in Indonesia, such as population growth, increased public awareness of the importance of animal protein and increased income. In the long term, it is estimated that there will be a production shortage because the rate of increase in beef consumption in 2001 was quite high, reaching 4.43%, compared to the increase in beef cattle production of 2.33%. So that to meet this consumption needs to be supplied from imported beef [1]. This is evidenced by the government's policy of importing live cattle and beef in 2016.

National beef production comes from people's farms (± 90%), and the rest from companies and government-owned farms. Apart from having a small scale of ownership, community farms are also not well-developed commercial characteristics, so often adult cows that are still productive are sold or slaughtered. The reason for smallholder farmers to sell the cattle before the ideal slaughter weight was due to limited capital, the need for cash for family needs such as school fees for children, medical / health care, crop production costs and so on. Some of these reasons also caused the proportion of increased cow production to be low and unable to keep up with the increasing public demand for the beef. The cattle business income was influenced by the beef production, meaning that the income of cattle breeders will increase if the beef production increases [2-4].

Domestic beef prices in 1999 increased to 45 percent that was IDR 22,070.00 due to the effects of the 1998 crisis and decreased beef production. In 2010 the price of domestic beef was IDR 60,000.00 higher than the world price of beef IDR 30,000.00 [5]. World / imported beef prices were relatively low.
compared to domestic beef prices, this was because livestock management abroad was more efficient than in Indonesia [4,6,7].

For the two decades, the increase in the domestic beef prices has reached 300 percent with a price range of IDR 110,000.00 - IDR 120,000.00 in 2019. This was due to the production rate that cannot keep up with the rate of consumption [8,9]. The consumption of beef per capita continued to increase so that the shortage of beef was filled with imports. The low price of beef also affected the demand for imported beef. Imported beef prices had a negative effect on beef import demand. The higher the price of imported beef, the lower the demand for imports of beef and vice versa, the lower the price of imported beef, the amount of import demand will increase [10].

![Figure 1. Development of beef prices in international markets, 2004-2013 [2]](image)

North Sumatera Province with a population of 14.42 million people is one of the local cattle productions centre’s which also experiences a shortage of beef supply. This causes an increase in prices where when demand increases but the supply is low [4]. Local cattle farmers had benefit significantly when the price of cattle increases, but on the other hand, they experienced a loss when the price was low. The government imports beef to cope with rising prices. On the one hand, this policy could reduce price increases, but this policy did not provide a long-term solution. In the long term, the government needed to provide affordable prices for beef consumers but also needed to provide a selling price of beef that was profitable for cattle breeders so that the beef cattle business continued. Based on this, this study aimed to analyse the influence of Beef Consumption in North Sumatera (BCNS), Beef Production in North Sumatera (BPRO), World Beef Prices (WBP) the Rupiah Exchange Rate against the Dollar (RERD), Beef Imports in North Sumatera (BINS) on Beef Prices in North Sumatera (BPNS)

2. Methodology

2.1. Location and sampling method
The location of research was implemented in North Sumatera. It was chosen purposively based on the consideration that North Sumatera is one of the centres of cattle production in Indonesia. Determination of the factor or variable was based on the close relationship between the independent variables of Beef Prices in North Sumatera (BPNS) and the independent variables of Beef Consumption in North Sumatera (BCNS), Beef Production in North Sumatera (BPRO), World Beef Prices (WBP) the Rupiah Exchange Rate against the Dollar (RERD), Beef Imports in North Sumatera (BINS). Observations were made based on available data from 2001-2017.
2.2. Types of data
The data types was a time series sourced from secondary data. The secondary data were obtained from the Statistic Centre Bureau (BPS) and the Agriculture Department, the regency or subdistrict as well as the village, the results of the other relevant studies, the related journals and other references.

2.3. Analysis methods
The analysis method to answer the factors that influence beef prices in North Sumatera was Multiple Linear Regression Analysis. The equation was as followed:

\[ Y = b_0 + b_1 x_1 + b_2 x_2 + b_n x_n + \cdots + \varepsilon \]

(1)

Description:
- \( Y \) = The Dependent Variable
- \( b_0 \) = The Intercept Coefficient
- \( b_1 \)-\( b_n \) = The Regression Coefficient
- \( x_1 \)-\( x_n \) = The Independent variables
- \( \varepsilon \) = The Error terms

After doing the specification, the model obtained from the study was as followed:

\[ \log\text{BPNS} = b_0 + b_1 \log\text{BCNS} + b_2 \log\text{BPRO} + b_3 \log\text{WBP} + b_4 \log\text{RERD} + b_5 \log\text{BINS} + \varepsilon \]

(2)

Description:
- \( \log\text{BPNS} \) = The Beef Prices in North Sumatera (Rupiah)
- \( b_0 \) = The Intercept Coefficient
- \( b_1 \)-\( b_5 \) = The Regression Coefficient
- \( \log\text{BCNS} \) = The Beef Consumption in North Sumatera (ton / year)
- \( \log\text{BPRO} \) = The Beef Production in North Sumatera (ton / year)
- \( \log\text{WBP} \) = The World Beef Prices (Rupiah)
- \( \log\text{RERD} \) = The Rupiah Exchange Rate against Dollars (Rupiah)
- \( \log\text{BINS} \) = The Beef Imports in North Sumatera (ton / year)
- \( \varepsilon \) = The Error terms

To determine whether the independent variable simultaneously has a significant effect on the dependent variable or not, the F statistical test was carried out. Meanwhile, to test whether each explanatory variable has a significant effect on the endogenous variable, the t statistical test was used at an error level of 5%.

Meanwhile, to see the relationship between the independent variables, it was necessary to do a multicollinearity test. To see the correlation that occurred between the residuals in one observation and another, an autocorrelation test was performed. The Heteroscedasticity test was to see the variance inequality of the residuals for all observations in the linear regression model. The multicollinearity test was seen with the Variance Inflation Factor (VIF) value, the autocorrelation test used the Durbin-Watson Statistics (DW) test and the Heteroscedasticity test used the Bruesch-Pagan-Godfrey test [11].

3. Results and discussions

3.1. The development of beef prices determinants
The beef prices are determined by the supply and the demand. The local and imported beef production is the stock of domestic beef. If the stock or the supply is lower than the demand, the beef price will increase, and vice versa. In order to maintain price stability, additional supply is needed through imports if the domestic production supply is still less than the existing demand. The beef imports are influenced
by the exchange rate of Rupiah to the Dollar. The amount of imports that enter North Sumatera depends on the Rupiah exchange rate at the time of the transaction.

Overall, the factors affecting the price of beef in North Sumatera showed an increasing trend (Figure 2). The consumption and production of beef in North Sumatera has shown an increase from 2001-2017. The consumption of beef which was higher than production causes the government to implement an import policy, so that imports had increased considerably from 2001 to 2017. World beef prices were integrated with beef prices in North Sumatera. The data showed that for almost two decades the world price of beef has been cheaper twice than the price found in the local market for the beef.

![Determinant of Beef Prices](image)

**Figure 2.** Determinant of beef prices

### 3.2. Analysis of the beef prices determinants in North Sumatera

Before being taken into a regression model, the first stage that the classical assumption test should be implemented such as the autocorrelation test, the heteroscedasticity test and the multicollinearity test. The autocorrelation test shows no autocorrelation with the Durbin-Watson stat value 2.2428 which was between dU (0.6641) and (4-dU) with a value of 3.559.

The Heteroscedasticity test with the Breusch-Pagan-Godfrey test showed a probability value of 0.96 > 0.05 so that in the regression equation there was no Heteroscedasticity. The multicollinearity test with the Variable Inflation Factor (VIF) value showed that there were five variables did not show symptoms of multicollinearity, excepted for two variables which showed a non-serious relationship, namely the beef production and consumption in North Sumatera. Overall, the variables were considered good enough and had the regression model which produced the best linear unbiased estimator [11].

The results of data processing with EViews 9 showed that the model had an R-squared of 98.25%, meaning that the variables in the model were able to explain the effect of beef prices in North Sumatera. This was also indicated by the value of the F statistic which was smaller than zero, which meant that all independent variables were simultaneously significant explanations for the variable price of beef in North Sumatera. The partial test result (t statistic) stated that there were three variables had a positive and significant effect on the price of beef in North Sumatera, that was the World Price of Beef (WBP), the Rupiah exchange rate against the Dollar (RERD) and the beef imports in North Sumatera (BINS). Increased the world beef prices (WBP) had a positive effect on local cattle prices in North Sumatera (BPNS). The data showed that the price of beef in international markets and local markets showed an increase every year. The local market experienced a fairly high increase from 2001 to 2017 compared to world markets. In 2001 the price in the range of IDR. 38,000.00 increased almost three times from
the initial year to IDR. 111,732.00. This was the same as the research results from [11,12], which stated that domestic beef prices were positively influenced by world / international beef prices (world beef prices increase, so domestic beef prices will also increase and vice versa).

### Table 1. The result of beef price determinants

| Variable      | Coefficient | Std. Error | t-Statistic | Prob.  |
|---------------|-------------|------------|-------------|--------|
| LOG(BCNS)     | -0.000169   | 0.174943   | -0.000968   | 0.9992 |
| LOG(BPRO)     | 0.226088    | 0.111898   | 2.020493    | 0.0684 |
| LOG(WBP)      | 0.489397    | 0.175876   | 2.782620    | 0.0178 |
| LOG(RERD)     | 0.734304    | 0.138219   | 5.312628    | 0.0002 |
| LOG(BINS)     | 0.064710    | 0.025618   | 2.525944    | 0.0282 |
| C             | -5.477115   | 0.925887   | -5.915532   | 0.0001 |

The exchange rate of Rupiah to Dollar (RERD) showed a positive and significant effect on beef prices in North Sumatera (BPNS). The higher or the stronger the Rupiah, the higher the price of beef in North Sumatera. The strengthening of the rupiah exchange rate caused reduced the profits for the importing countries so that the importing countries delayed and reduced the exports to the destination countries. This thing causing the production that was not able to meet the beef consumption or the people demand in North Sumatera which caused a decrease in the supply of local beef so that the price of local beef increased [13].

The amount of beef imports had a positive and significant effect on the beef prices in North Sumatera (BPNS). This can be explained based on the data and theory of the demand and supply, that the increasing import (supply) and consumption (demand) caused the prices to continue to rise. The increase in population in North Sumatera has resulted in a significant increase in beef consumption. This caused the beef prices never decline. Other factors that contributed to increasing the consumption of beef include: the increasing awareness of good nutritious food, the increasing number of processed foods and the food variety made from the beef.

### 4. Conclusions

The factors that had a positive and significant effect at the 5% error rate on beef prices in North Sumatera (BPNS) were world beef prices (WBP), the rupiah exchange rate against the dollar (RERD) and beef imports in North Sumatera (BINS). Beef production (BPRO) factors had a significant effect on the 10% error rate on beef prices in North Sumatera (BPNS). Consumption of beef (BCNS) did not have a significant effect on beef prices in North Sumatera.

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