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The Role of The Camara Nusantara Livestock Ship in Volatility and Disparity of Beef and Cattle Prices in Indonesia

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This study examines how livestock ships affect price volatility and disparity at the producer and consumer levels. East Nusa Tenggara (ENT) is one of the provinces in Indonesia that experiences a beef surplus. Nationally, Jakarta and East Kalimantan are the provinces that experience the 2nd and 4th beef deficits. Livestock distribution is an expected method to reduce the volatility and disparity of live cattle and beef prices. The ARCH/GARCH model is used in analyzing volatility and forecasting food and agricultural commodity prices. Based on the results of the ARCH/GARCH analysis, livestock ships have not been effective in reducing producer price volatility in East Nusa Tenggara and consumer prices in Jakarta and East Kalimantan before the presence of livestock ships (January 2010-December 2015) and after the presence of livestock ships (January 2016-December 2023). The results show that CN Livestock Ships have not been effective in reducing consumer price volatility in both Jakarta and East Kalimantan and also producer prices in ENT and East Kalimantan. Based on the results of the variation coefficient analysis, livestock ships are effective in reducing price disparities between producers (in ENT) and consumers (in East Kalimantan) centers. The smaller the coefficient of variance of a data group, the more homogeneous the data is and this means that the price is more stable or does not fluctuate This ineffectiveness is influenced by the conditions of the COVID-19 pandemic and ship docking. The price disparity decreased due to lower transportation costs using livestock ships. Referring to this, efforts to increase the effectiveness of the Camara Nusantara livestock ship must be viewed comprehensively. In addition to increasing the operational capacity of livestock ships by increasing the number of fleets and improving ports and other supporting infrastructure, the government also needs to look at the role of inter-island livestock traders, slaughterhouse facilities and wholesalers (distributors, importers) to jointly utilize the Camara Nusantara livestock ship in order to stabilize beef prices both at the producer and consumer levels.
Keywords: Camara Nusantara livestock ship, beef price, volatility, disparity, ARCH, GARCH.

INTRODUCTION

***Importance of Beef Price Stability*:** Beef plays an important role in determining the availability of animal food and is a strategic commodity in Indonesia. Beef price stability needs to be maintained because it will affect the fulfillment of protein needs and consumption and is directly related to the affordability of people's purchasing power for food and the income of farmers. From the consumer side, beef price stability needs to be maintained at a reasonable level and affordable by people's purchasing power. Meanwhile, from the producer side, stability needs to be maintained so that the food prices received are adequate, so that farmers get incentives to continue their farming. From the economic performance side, beef prices also contribute to inflation.

Nationally, the average level of beef consumption in rural areas is 0.1 kg/capita/year and in urban areas 0.5 kg/capita/year (Ariani *et al*., 2018). In line with increasing income, population growth, changes in consumption patterns and public tastes, beef consumption in Indonesia will increase in both the short and long. Demand for meat in Indonesia is less than the available supply (Central Bureau of Statistics in

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Indonesia, 2023). The gap between availability and demand causes the fluctuation of beef prices, availability will be affected by many factors including economic development, population growth, changing consumer behaviour, and climate change, to name a few (Mason *et al*., 2019). Beef is a commodity that has very high volatility when there is an increase in demand during religious holidays (Hasanah *et al.*, 2020; Setiawan and Hadianto, 2014), during the COVID-19 pandemic (Wijayati *et al*., 2022), or when the supply from producer to consumer areas is not easy.

East Nusa Tenggara (ENT) is one of the provinces experiencing a beef surplus. It is because the ENT is the center of beef production in Indonesia and the level of beef and buffalo consumption is relatively low. Jakarta and East Kalimantan are also the provinces that experience a beef deficit, ranking 2nd and 4th nationally (Central Bureau of Statistics in Indonesia data 2023). The main national beef consumption centers are Jakarta and West Java. In addition, there are also new consumption centers, namely East Kalimantan, South Kalimantan, Riau, and several other provinces. Meanwhile, several provincial areas in Indonesia are national livestock barns and act as suppliers, including East Java, Bali, ENT, West Nusa Tenggara and South Sulawesi (Winarso, 2015).

***Challenges in livestock transportation in Indonesia*:** Distribution of cattle from production centers to consumption centers requires land and sea transportation (Ilham dan Yusdja, 2004). For a long time, transportation of livestock between islands in Indonesia has used cargo ships that are not specifically designed to transport livestock and do not pay attention to aspects of animal welfare. Transporting livestock using ships over long distances has a significant impact on the risk of declining livestock welfare. Animals are often exposed to high livestock densities, increased temperatures and ammonia concentrations, and noise (Phillips and Santurtun, 2013).The use of cargo ships for livestock transportation causes high weight loss due to incomplete facilities for animal welfare during the voyage (Haryana and Nuryati, 2016). The use of cargo ships does not provide a definite departure schedule from the area of origin, so the waiting time for livestock at the holding ground or quarantine pen is relatively longer, causing livestock stress and increasing handling costs. Sea transportation facilities consist of ships including cargo ships, Roll On Roll Off (RORO) ships, and ferries. Cattle trade using sea transportation is generally inter-island cattle trade. The problems of long transportation times, long distances, and undesigned ships for transport livestock can cause several problems in the livestock transportation process. The problem of transporting livestock by sea route is long distances, so it takes a long time to reach the target destination. The long distance, in addition to the costs incurred, also affects the health of livestock (Winarso, 2015). In 2015, the Indonesian Government realized the availability of special ships for transporting cattle, namely the Camara Nusantara (CN) Livestock Ship, which initially had one unit increasing to six units in 2018.

***Role of CN livestock ships*:** The existence of the CN livestock ship is an implementation of the sea route aimed at: (1) supporting the program to fulfil food from livestock and ensuring the continuity of livestock distribution through sea transportation with animal welfare principles; (2) Increasing the ease of supply from the ENT region to Jakarta and other areas including East Kalimantan which is planned to become the National Capital. The CN livestock ship is a ship specifically designed for transporting live livestock (cattle) which is equipped with loading and unloading facilities, drinking water and feed facilities. It is equipped with livestock guards and medical/paramedic officers, so that during the voyage the animal welfare aspect can be applied. Transporting livestock using CN livestock ships has been proven to be able to reduce livestock weight loss during transportation from 20% reducing to approximately 2-5% (Haryana and Nuryati, 2016). In addition, the use of CN livestock ships also provides certainty of departure schedules, while the use of cargo ships does not provide a definite departure schedule which can cause the longer waiting time for livestock at the holding ground or quarantine pen, causing stress and increasing handling costs. The implementation of livestock transportation uses a subsidy scheme charged by the Ministry of Transportation budget (Hidayati *et al*., 2023).

The use of livestock ships is expected to help both farmers and consumers. Farmers can receive a reasonable and profitable selling price for cattle, while consumers receive a more affordable selling price for beef (Ministry of Agriculture in Indonesia, 2023). The price of live cattle in ENT is the cheapest compared to Jakarta and other areas (Winarso, 2015). CN livestock ships can be accessed directly by farmers and business actors so that the prices obtained by farmers increase because CN livestock ships are not only dominated by a few business actors.

According Zainudin *et al.* (2015), the price of Indonesian beef fluctuates from year to year, price changes that occur in the world market do not always mean changes at the same level in the price of beef imports in Indonesia. However, in developing countries such as Indonesia, they will respond to changes in beef consumption because people tend to be elastic towards prices. Price volatility analysis is very necessary in order to increase food price stabilization, and in analyzing food price volatility, an analysis of the factors that influence food price volatility is also needed. Volatility analysis can also be used to measure the influence or impact of policies that are implemented. A policy can be considered successful if after the policy is implemented, prices are more stable or volatility decreases. In general, volatility measures the average fluctuation of time series data. However, in measuring volatility, various measurement application methods have been further developed by emphasizing the variance value (a statistical variable that describes how far the changes and distribution of fluctuation values are from the average value) of economic and financial data. Regarding the variance itself, two opinions have developed, namely the opinion that assumes that the variance for time series data is constant (homoscedasticity), and the opinion that assumes that the variance of time series data is not constant, meaning it changes over time (heteroscedasticity).

In the concept of heteroscedasticity, correction of the value of an error from heteroscedasticity can produce more efficient parameter estimates. In some applications, there is a reason to believe that the variance of an error is not a function of the independent variable, but varies over time depending on how large the error occurred in the past. Nuryati and Yudha (2012) stated that information about price fluctuations and disparities that occur due to price changes in a market are partially transmitted to prices in other markets is needed in the formulation and implementation of policies. Price disparities can also occur due to gaps between regions. In addition, the smooth distribution of livestock from the producer center area will certainly affect prices in consumer areas. The disparity in meat prices in traditional and modern markets is also thought to be a result of the length or shortness of the distribution chain from the producer level to the consumer level. Since the number of CN Livestock Ships has increased to six units in 2018 until now there has been no research that tests its level of effectiveness in increasing the stability of beef prices both in producer and consumer areas. This study was conducted to measure the level of effectiveness of CN Livestock Ships with a price volatility analysis approach in livestock producer areas in this case NTT and in the main consumer areas as the destination for livestock shipments, namely DKI Jakarta as the current capital city and East Kalimantan Province which is the new IKN, it is very important to do.

This paper aims to analyze the effectiveness of CN Livestock Ships in reducing beef price volatility between producer centres, namely NTT and consumer centres, namely DKI Jakarta and East Kalimantan and price disparities between producer centres, namely NTT and consumer centres, namely East Kalimantan. The output of this study is expected to be useful in providing contributions and benefits to all stakeholders related to the use of CN livestock ships in efforts to maintain beef price stability both at the producer and consumer levels.

MATERIALS AND METHODS

***Data sources and types*:** This study uses secondary time series data from the Central Bureau of Statistics in Indonesia and Simponi Ternak, Directorate General of Animal Husbandry and Animal Health, Ministry of Agriculture for producer and consumer price data. Import price data is data sourced from BPS and the World Bank. Price Index data (Producer Prices, Consumer Prices and Import Wholesale) and Rupiah Exchange Rate against USD are sourced from BPS and Bank Indonesia. The data collected has a time span from January 2010 to December 2023. Data were collected online. The price data analyzed for both volatility and price disparities are real prices (Nominal prices divided by the respective price index). This article is also equipped with primary data sourced from the Directorate of Traffic and Sea Transportation, Directorate General of Sea Transportation, Ministry of Transportation in the FGD activities evaluating the existence of livestock ships in 2023 and interviews with shippers in Kupang, East Nusa Tenggara.

***Data processing and analysis methods*:** Data processing in this study is using descriptive analysis and quantitative analysis. Descriptive Analysis is used to describe the beef price volatility phenomena. Quantitative analysis is used to analyze the magnitude of beef price and live cattle price volatility in Indonesia using GARCH model. The Data is process using Eviews 6. Generally, economic and business data, including beef prices, have residual variances that always change over time or heteroscedasticity. Time series price data from several food commodities also have heteroscedasticity properties (Sumaryanto, 2009), so it is feared that it can cause bias if the forecasting method is not right. High price volatility is indicated by a phase where the fluctuation is high and then followed by low fluctuation and high again but it is unpredictable when it will occur (FAO, 2011; OECD, 2011; Sumaryanto, 2009). The ARCH (Autoregressive Conditional Heteroscedasticity) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models are models that take into account heteroscedasticity elements in time series analysis. So far, there have been many studies on volatility analysis and price forecasting with these models. The ARCH/GARCH model is used in analyzing volatility and forecasting food and agricultural commodity prices (Wijayati *et al.*, 2022; Kuwornu *et al.*, 2011; Sidik and Badriyah, 2017; Sumaryanto, 2009); and also beef prices (Komalawati *et al.*, 2018; Dewi *et al.*, 2017). Referring to the opinions of Watsham and Parramore (1997), price volatility analysis uses two model approaches, namely (1) volatility analysis with constant variance in the model called the autoregressive model (AR), moving average (MA), and a combination of both, namely ARMA (Autoregressive Moving Average), (2) volatility analysis with non-constant variance in the model called the ARCH (Autoregressive Conditional Heteroscedasticity) model or method which was further developed into GARCH (Generalized Autoregressive Conditional Heteroscedasticity). The use of the ARCH-GARCH model is a fairly appropriate choice for modeling the volatility value of economic and financial data that has a high level of fluctuation compared to the AR, MA and ARMA models. In this study, the ARCH/GARCH method is used to analyze volatility in order to obtain the best model that can be used for forecasting volatility behavior in the future.

***Price volatility analysis using the ARCH/GARCH method*:** ARCH-GARCH modelling starts by identifying whether or not the beef prices and live cattle price data contains heteroskedasticity. One of ARCH effects test on beef price data can be done by observing the autocorrelation of the squared coefficient of the price data. Volatility based on the ARCH(m) model assumes that the variance of fluctuation data is influenced by a number of m previous data fluctuations. This model was developed primarily to answer the problem of volatility in economic and business data, especially in the financial sector. This causes previous forecasting models to be less able to approach actual conditions. This volatility is reflected in the residual variance that does not meet the homoscedasticity assumption. The ARCH test developed by Engle (1982) is used to test the existence of the heteroskedasticity of the residuals and the autocorrelation of the squared residuals.

The variance consists of two components. The first component is a constant variance. The second component is a non-constant variance where there is a dependence of the current variance on the amount of volatility in the previous period. If the volatility in the previous period is large (either positive or negative), then the current variance will also be large.

The general form of the ARCH (m) model:

$h_t = \xi + \alpha_1\varepsilon^2_{t-1} + \alpha_2\varepsilon^2_{t-2} + ... + \alpha_m\varepsilon^2_{t-m}$……. (1)

where: h_t = Response variable (dependent) at time t / variance at time t; ξ = Constant variance; ε_{2t-m} = ARCH rate / volatility in previous period; $\alpha_1, \alpha_2, …, \alpha_m$ = Estimated m-order coefficients

The GARCH model is developed by integrating the auto regression of the second lag residual squares to infinite lags into the form of variance at the first lag. This model is developed as a generalization of the volatility model. In simple terms, volatility based on the GARCH (r, m) model assumes that the variance of the fluctuation data is influenced by a number of m previous fluctuation data and a number of r previous volatility data, the idea behind this model is like in the AR and MA models, namely to see the relationship between random variables and previous random variables.

The variance consists of three components. The first component is a constant variance. The second component is the volatility in the previous period, ε2t-m (ARCH term) and the last component is the variance in the previous period, h_{t-r}. So the GARCH model can be formulated:

The general form of the GARCH (r, m) model:

$h_t = \kappa + \delta_1 h_{t-1} + \delta_2 h_{t-2} + ... + \delta_r h_{t-r} + \alpha_1\varepsilon^2_{t-1} + \alpha_2\varepsilon^2_{t-2} + ... + \alpha_m\varepsilon^2_{t-m}$……………..… (2)

where: h_t = Response variable (dependent) at time t / variance at time t; κ = Constant variance; ε_{2t-m} = ARCH rate / volatility in previous period; $\alpha_1, \alpha_2, …, \alpha_m$ = Estimated m-order coefficients; $\delta_1, \delta_2, ..., \delta_r$ = Estimated r order coefficients; h_{t-r} = GARCH term / variance in previous period

For ARCH/GARCH model determination, we do some simulation models using a variety of best ARIMA model obtained. Then proceed with the estimation of the model parameters to find the coefficients of the model that best fits the data. Next step is choosing the best model from ARCH/GARCH model from some alternatives based on goodness of fit and significant coefficients using Akaike Information Criterion (AIC): AIC= Ln (MSE) + 2*K/N

Where, MSE = Mean Squared Error K = number of estimated parameters N = number of observations

***Price disparity analysis using the coefficient of variation*:** Price disparity is formed due to the distribution process from producers to consumers which creates a margin consisting of distribution costs and business actor profits. The formula for obtaining the price disparity value can be seen in the following formula (3).

$|Pi - Pj| \leq d$ ……….…..........................(3)

where: Pi = price on producers; Pj = price on consumers; d = price disparity

To describe the price disparity before and after the CN ship, the coefficient of variation or coefficient of diversity of the price is used. The coefficient of diversity is the ratio between the standard deviation and the average value (mean). The coefficient of variation (CV) is expressed in percentages and is useful for seeing the distribution of data from the arithmetic average. The smaller the coefficient of diversity of a data group, the more homogeneous the data is and this means that the price is more stable or does not fluctuate. The coefficient of diversity is calculated using the following formula (4).

$CV = \frac{\sigma}{\mu} \times 100\%$ ……………………(4)

Where σ is the standard deviation of live cattle and beef prices and μ is the average of live cattle prices and beef prices.

RESULTS

By dividing the entire data period, the range before and after having the livestock ship, the results of the ARCH/GARCH analysis show the best models as presented in Table 2. The selection of the best model is based on the smallest Akaike Information Criterion (AIC) value. The regression results show that the model regression parameter coefficients have a significance level between 1-10%. The results show that price volatility increased after the ship was present for both consumer and producer prices. For consumer prices, it shows that the volatility of Jakarta is higher when compared to consumer prices in East Kalimantan and ENT. While for producer prices, the volatility after the ship was also higher when compared to before and the volatility of East Kalimantan was higher when compared to ENT. Comparing the results of previous studies with different case studies, it shows that the results of this study also have similarities and differences.

Table 1. Results of the selection of the best model and price volatility of consumer prices, import prices and beef producer prices (2018=100) in the research area.

Price		**Consumers**			**Import**	**Producers**	
Province		**Jakarta**	**East Kalimantan**	**ENT**	**FOB Aus**	**East Kalimantan**	**ENT**
Jan 2010-Des 2023)	Best Model	ARCH (1,1)***	GARCH (1,1)***	GARCH (1,1)***	GARCH (1,1)***	GARCH (1,1)***	GARCH (1,1)***
	AIC	18.16	18.51	17.32	18.65	17.05	15.16
	Volatility (%)	9,89	18,41	12,99	21,04	43,50	34,82
Before CN (Jan 2010 - Des 2015)	Best Model	GARCH (2,1)***	GARCH (2,1)***	GARCH (1,0)***	GARCH (0,1)***	GARCH (2,3)***	GARCH (1,0)***
	AIC	18.30	18.91	17.67	18.63	16.14	15.47
	Volatility (%)	6,82	11,53	15,62	13,67	9,10	10,19
After CN (Jan 2016 - Des 2023)	Best Model	GARCH (1,1)***	GARCH (1,0)***	GARCH (2,1)***	GARCH (1,0)***	GARCH (1,1)***	GARCH (1,1)***
	AIC	17.65	17.69	16.30	18.66	17.25	15.08
	Volatility (%)	37,14	31,02	24,48	26,73	17,37	13,31

Note: indicates all parameters (*)10% significance level, (**) 5% level and (***) 1% level. The value in parentheses is standard errors. AIC = Value of Akaike Information Criterion. The selection of the best model is based on the smallest Akaike Information Criterion (AIC) value.

Information in Table 2 illustrates that livestock ships have not been effective in reducing consumer price volatility in both Jakarta and East Kalimantan. However, if analyzed in depth, this level of effectiveness is influenced by the conditions of the COVID-19 pandemic and ship docking. This is proven in Table 3 which shows that price volatility in the 2016-2019 period is lower when compared to the 2020-2023 period. The results of the analysis of Tables 1 and 2 illustrate that in normal economic and environmental situations, the operation of livestock ships is effective in supporting price stability (reducing volatility) (Tondang 2023). The best model is GARCH. Afriani *et al.* (2024) concluded that the factors that influence the volatility of beef prices in Indonesia are price volatility and price variance in the previous period, with the best model also being GARCH (1,1).

Figure 1. Development of average consumer prices of beef (2018 = 100) in Indonesia, DKI Jakarta, East Kalimantan, and East Nusa Tenggara (NTT), January 2010 – December 2023.

Table 2. Results of the selection of the best model and price volatility of consumer prices, import prices and beef producer prices (2018=100) in the research area before and after the COVID-19 pandemic.

Price		**Consumers**			**Import**	**Producers**	
Province		**Jakarta**	**East Kalimantan**	**ENT**	**FOB Aus**	**East Kalimantan**	**ENT**
Before Pandemic (Jan 2016 - Des 2019)	Best Model	GARCH (1,1)***	GARCH (1,0)**	GARCH (1,2)***	GARCH (1,0)**	GARCH (1,1)***	GARCH (1,1)***
	AIC	16.25	17.39	15.04	18.41	16.33	14.52
	Volatility (%)	11,64	7,03	4,60	5,83	12,27	5,76
After Pandemic and docking (Jan 2020 - Des 2023)	Best Model	GARCH (1,1)***	GARCH (1,0)*	GARCH (1,0)*	GARCH (1,1)***	GARCH (1,1)***	GARCH (1,1)***
	AIC	18.21	18.02	17.33	18.73	17.81	15.31
	Volatility (%)	11,67	8,60	6,87	53,76	19,11	21,73

Note: indicates all parameters (*)10% significance level, (**) 5% level and (***) 1% level. The value in parentheses is standard errors. AIC = Value of Akaike Information Criterion. The selection of the best model is based on the smallest Akaike Information Criterion (AIC) value.

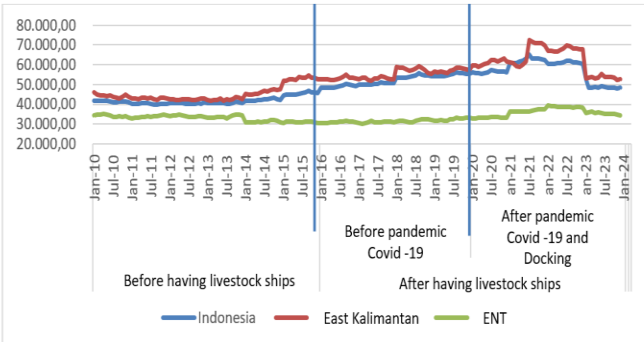

Figure 2. Development of average live cattle prices (2018 = 100) in Indonesia, East Kalimantan, and East Nusa Tenggara (NTT), January 2010 – December 2023.

Table 3. Price disparity between consumer centers and producer centers (2018=100) in the research area.

	Price Difference of Cattle Beef	Price Difference of Live Cattle
	Kaltim-NTT	Kaltim-NTT
Before CN		
STDEV	10107,74	4975,47
Mean	36.665	12.252
KV	27,57	40,61
After CN		
STDEV	5310,10	4183,02
Mean	33.961	24.896
KV	15,64	16,80

The coefficient of variation of the disparity in livestock and beef prices between producer and consumer centres decreased before (January 2010-December 2015) and after having the livestock ship (January 2016-December 2023). The average difference in beef prices before having the livestock ship between East Kalimantan and ENT was 36,665/kg with a coefficient of variation of 27.57. The average difference in live cattle prices before having the livestock ship between East Kalimantan and ENT was 12,252/kg with a coefficient of variation of 40.61. The average difference in beef prices before the livestock ship between East Kalimantan and ENT was 33,961/kg with a coefficient of variation of 15.64. The average difference in live cattle prices before having the livestock ship between East Kalimantan and ENT was 24,896/kg with a coefficient of variation of 16.8. The coefficient of variation of the average price difference between beef (East Kalimantan-NTT) and live cattle (East Kalimantan-NTT) before having the livestock ship was larger than the coefficient of variation of the average price difference between beef (East Kalimantan-NTT) and live cattle (East Kalimantan-NTT) after having the livestock ship was available.

DISCUSSION

Volatility is the distance between the increase or decrease in the price of a commodity. High volatility means that the price rises quickly and then suddenly falls quickly, resulting in a very large difference between the lowest price and the highest price at a certain time. The development of beef prices at the consumer level (Figure 1) and at the producer level (Figure 2) shows differences in behaviour between the periods before and after having the livestock ship. In the period after the livestock ship, the COVID-19 pandemic occurred. In 2020, as the peak period of beef price volatility due to the global economic recession and the COVID-19 pandemic (Tondang, 2023; Bozma *et al.*, 2023). Considering this, data cut-offs were carried out in the periods before and after the pandemic, which have their own characteristics.

Based on the characteristics of the data analysis of the volatility of livestock and beef prices at the research location, it is divided into four data periods as follows: (1) before the CN ship (2010-2015); (2) after the CN ship (2016-2023); before the COVID-19 pandemic (2016-2019); and during and after the COVID-19 pandemic (2020-2023). This division aims to see how the COVID-19 pandemic affects the volatility of beef prices after the CN ship. Based on the breakdown of data periods in Figure 2 and Figure 3, it can be seen graphically that the price fluctuations during the COVID-19 pandemic and ship docking (2020-2023) were higher when compared to the 2016-2019 period. This indication illustrates the COVID-19 pandemic and based on information from the directorate of sea traffic and transportation, ministry of transportation, in 2023 there was excessive CN ship docking which was a factor causing the increase in beef price fluctuations at the consumer level and the price of cattle at the producer level. Both conditions reduce the availability of livestock and beef, which causes increased price volatility (Nelson, 2023).

The results of the study by Dewi *et al.* (2017) show that the volatility of beef prices in Indonesia is more driven by its own variance than external shocks, with the best GARCH (1.1) model, which beef price volatility tend to be smaller and persistent in the future. Statistically, it is proven that the beef self-sufficiency program can reduce beef price volatility in the 2006-2009 period. However, the magnitude of the decrease in volatility is relatively small. This implies that the beef self-sufficiency policy has little impact on the development of overall volatility. If the government can increase the supply, maintain the circulation of imported meat so that it does not disrupt supply and distribution between regions, increase market integration between regions and within provinces and increase the population and meat production and distribution domestically, then price stability is maintained, price volatility decreases as predicted and vice versa. Regarding the impact of the COVID-19 pandemic, the results of the study by Wijayati *et al.* (2022) show that most food commodity prices had high volatility during the 1973 crisis and the 2008 crisis. However, food prices were not affected by the 2020 global recession due to the Covid-19 pandemic.

The volatility of beef producer and consumer prices is greatly influenced by beef imports, as indicated by the higher level of FOB Australia price volatility compared to other price volatility (Table 2), especially during the COVID-19 pandemic or the 2020-2023 period. Previous research conducted by Setiyanto *et al*. (2011) showed that: 1) the behaviour of wholesalers and importers plays an important role in influencing changes in beef producer and consumer prices; 2) changes in fuel prices, both due to government policies and other factors, are one of the sources of producer price volatility; 3) government policies from the fiscal side in the form of subsidies, changes in import tariffs, also affect the volatility of consumer and producer prices, and 4) policies to secure domestic needs to increase beef production also encourage price stability at the consumer level. Referring to this, efforts to increase the effectiveness of the Camara Nusantara livestock ship must be viewed comprehensively. In addition to increasing the operational capacity of livestock ships by increasing the number of fleets and improving ports and other supporting infrastructure, the government also needs to look at the role of inter-island livestock traders, slaughterhouse facilities and wholesalers (distributors, importers) to jointly utilize the Camara Nusantara livestock ship in order to stabilize beef prices both at the producer and consumer levels.

The inequality of meat distribution between regions causes price disparities. Nationally, the level of beef price disparity is categorized as moderate (Triatmojo *et al*., 2023), compared to the prices of goat meat and chicken meat. This is likely due to the more even distribution of cattle in various regions in Indonesia and the supply of imported beef. These results indicate that, although the presence of livestock ships has not been effective in suppressing price volatility, it has been effective in suppressing the disparity in livestock and beef prices at the research location. Prasetyo *et al.* (2023) who stated that shipping cost subsidies on sea toll roads have reduced price disparities between regions. The price disparity decreases further if there is a return load of CN ships from East Kalimantan and Jakarta to ENT.

***Conclusion*:** Based on the results of the ARCH/GARCH model analysis, CN livestock ships have not been effective in reducing price volatility at the producer level in ENT or consumer level in Jakarta and East Kalimantan. This level of effectiveness is influenced by the COVID-19 pandemic and the docking of CN livestock ships, national religious holidays, and economic recession. All of these factors affect the supply and demand of beef. The volatility value illustrates how great the level of risk will be faced in the future. If the government does not quickly address this condition, the negative impact of increasing volatility in livestock and beef prices will cause risks that must be borne by producers, traders and consumers. For this reason, the Government needs to immediately increase the capacity of the supporting infrastructure for CN Livestock Ship operations to be more effective and efficient and increase their number if necessary. The existence of CN livestock ships provides wider opportunities for traders sending from ENT to East Kalimantan and Jakarta, so that the market leads to perfect competition which causes the decrease in disparities. This is also supported by the livestock sea toll program which provides subsidies for sea transportation costs. In order for the disparity to become more convergent, the government is expected to increase the effectiveness of ship operational implementation.

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