UNRAVELING THE DYNAMICS PRICE VOLATILITY AND RISK OF LIVE BROILER CHICKEN IN JAWA TENGAH PROVINCE

Mutia Ayu Safitri[*)], Any Suryantini[**)1], Irham[**)]

[*)]Master of Agribusiness Management, Gadjah Mada University
MMA Building, Jl. Flora, Bulaksumur, Yogyakarta 55281, Indonesia
[**)]Department of Agricultural Socioeconomics, Faculty of Agriculture, Gadjah Mada University
Jl. Flora, Bulaksumur, Yogyakarta 55281, Indonesia

Article history:

Received
2 July 2024

Revised
3 August 2024

Accepted
2 October 2024

Available online
30 November 2024

Abstract

Background: Jawa Tengah Province is one of the main broiler production centers in Indonesia, but fluctuations in live chicken prices in this area remain a big problem for farmers.
Purpose: This study aims to (1) determine the volatility of live broiler chicken prices in Jawa Tengah Province, and (2) understand the level of price risk for live broiler chickens in Jawa Tengah Province.
Design/methodology/approach: This research uses secondary time series data from January 2016 to February 2024 with ARCH-GARCH (Autoregressive Conditional Heteroskedasticity and Generalized Autoregressive Conditional Heteroskedasticity) and CCV (Conditional Coefficient Variance) analysis tools.
Finding/Result: The results showed that (1) the volatility of broiler prices in Jawa Tengah Province is influenced by the variance and volatility of the previous period, and (2) the level of risk of broiler prices in Jawa Tengah Province is low.
Conclusion: To estimate the price of live broilers in Jawa Tengah province in the next period the price reference used is the previous period broiler price data and farmers can produce broilers with an independent system.
Originality/value: This study uses CCV (Conditional Coefficient Variance) to describe market risk from two perspectives, namely producers and consumers.

Keywords: price reference, price risk, live broiler chicken, ARCH-GARCH, CCV

How to Cite:
Safitri MA, Suryantin A, Irham. 2024. Unraveling the dynamics price volatility and risk of live broiler chicken in Jawa Tengah Province. *Jurnal Manajemen & Agribisnis* 21(3): 348–259. https://doi.org/10.17358/jma.21.3.348

[1] Corresponding author:
Email: any.suryantini@ugm.ac.id

INTRODUCTION

Broiler chicken is one of the leading commodities in the livestock sector in Indonesia, which plays an important role in fulfilling people's animal protein needs (Bahari et al. 2016; Irmawati et al. 2020). Jawa Tengah Province, as one of the broiler production centers, contributes significantly to the supply of chicken meat at the national level (BPS, 2022). Along with the increasing consumption of chicken meat in Indonesia, broiler production has also increased in various regions, including Jawa Tengah, making this industry even more potential. Broiler farming has many advantages, such as a short production cycle of around 32–35 days, high productivity, relatively affordable prices, and increasing demand (Ratnasari et al. 2015; Syarifah et al. 2021; Lisnahan et al. 2021). However, one of the main challenges faced in this industry is the fluctuation of live broiler prices, which affects farmers and business actors in this sector (Ministry of Agriculture, 2023).

High price fluctuations in commodity markets can increase financial risks for market participants, especially for producers and traders who are vulnerable to sudden price changes (Tang and Xiong, 2012). Sudden price changes can cause high and erratic price variations, known as volatility (FAO, 2010). Volatility itself is the value of price fluctuations (Dewia et al. 2017). Price volatility, which is characterized by price instability over a period, can impact the supply chain. Various factors, such as changes in supply and demand, feed price fluctuations, weather conditions, and government policies, influence price volatility (Heatubun et al. 2023; Matsumoto et al. 2023). This price volatility increases risks for farmers, especially when prices fall sharply, leading to difficulties in covering production costs. This means that volatility will affect the income received by farmers (Miftahuljanah et al. 2020; Ginting et al. 2023). This condition greatly impacts business continuity, especially for small farmers who dominate the broiler farming sector.

In addition, price volatility also affects farmers' investment decisions and production planning. Uncertainty in determining selling prices often results in difficulties for farmers in maximizing profits. In highly volatile price situations, the risk of loss increases, especially for farmers who do not have access to adequate market information or price stabilization mechanisms. Belinska (2023) emphasizes that food price volatility can distort input distribution and discourage investment, particularly among smallholder farmers who rely heavily on food sales for their income. This suggests that price volatility can lead to reduced investment in the livestock sector, which in turn can affect the productivity and growth of the sector. If not managed properly, high price volatility could threaten farmers' welfare and affect the availability of chicken meat supply nationally. Therefore, an in-depth analysis of live broiler price volatility in Jawa Tengah is needed to understand market dynamics. This research is expected to provide effective policy recommendations to reduce the risk of volatility and support price stability among farmers.

Volatility and price risk are inseparable concepts (Ezeaku et al. 2021). Previous studies have combined the concepts of volatility and risk, but the concept of volatility has not been able to distinguish between the risks faced by consumers and the risks faced by producers. In this study, further analysis was carried out using CCV (Conditional Coefficient Variance). This analysis was carried out to be able to describe the market risk faced from two different perspectives, namely from the producer side and the consumer side. By looking from two different perspectives, it can be clearly seen which party benefits or is disadvantaged by this price risk.

In dealing with the problem of live broiler price fluctuations, information about the volatility of live broiler prices in Jawa Tengah Province is very important. The value of live broiler price volatility in Jawa Tengah Province is analyzed using the ARCH-GARCH approach. In addition, information on the risk of live broiler prices is analyzed using the CCV approach. Information on the value and model of volatility and the level of risk of live broiler prices in Jawa Tengah Province allows market players including farmers to get a reference in the form of predictions of volatility, risk, and live broiler prices in the future. Thus, farmers can make the right decision regarding the best momentum in producing and marketing live broilers in Jawa Tengah Province.

This study was conducted with the main objective of analyzing the price volatility of live broilers in Jawa Tengah Province. Specifically, this study aims to assess the level of price fluctuations over time and determine the associated level of risk for producers and consumers in the region. By understanding the volatility and risk of live broiler prices in Jawa Tengah Province, this study

is expected to provide insights that can help develop effective strategies to manage price volatility and risk. The findings from this study are expected to provide valuable information for various parties, including farmers in particular, researchers, and policymakers.

METHODS

This study uses quantitative time series data. The data is sourced from a secondary database. This data is obtained from the Dinas Peternakan dan Kesehatan Hewan of Jawa Tengah Province. The type of time series data was chosen with the consideration that the identification of volatility and projection of live broiler prices in Jawa Tengah Province is based on the observation of live broiler prices sequentially over time, in the form of monthly data. It can be said that the basic method used is also a time series method. In addition, the data source from Dinas Peternakan dan Kesehatan Hewan of Jawa Tengah Province has more complete data on live broiler prices in Jawa Tengah Province.

The data collection technique in this research is a literature study. Data were collected by exploring all types of documents and data on broiler chicken prices available in several agencies and selecting the most relevant data to the price situation in the field. The time series data used is live broiler price data in Jawa Tengah Province from January 2016 to February 2024 in the form of monthly data. Data with this time span was selected by considering data availability. In addition, data with a time span of less than ten years (short-term data) is better able to describe the seasonal effects that occur in live broiler price data in Jawa Tengah Province. By analyzing seasonal patterns in data, companies can improve inventory planning and develop more effective marketing strategies, by utilizing recognized seasonal patterns. This study uses several analytical tools including ARCH-GARCH, CCV, and descriptive analysis.

ARCH and GARCH

To analyze the price volatility of live broiler chickens in Jawa Tengah Province, ARCH and GARCH models were employed. ARCH is used for analyzing and forecasting price volatility, assuming the conditional variance of the error term depends on past squared errors (Engle, 2001). The GARCH model extends ARCH by including both the previous time's conditional variance and the error term (Engle & Bollerslev, 1986; Tan, 2023). These tools effectively model the time series data on broiler chicken prices, which show signs of autocorrelation and heteroscedasticity. ARCH and GARCH models can capture heteroscedasticity, where error variance changes over time. In financial data, volatility often fluctuates, causing traditional models like ARIMA to fail to provide accurate estimates (Li et al. 2002; Aprilia et al. 2017). The GARCH (r,m) model used in this research is represented as Equation 1:

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon^2_{t-1} + \alpha_p\varepsilon^2_{t-p} + \beta_1\sigma^2_{t-1} + \beta_q\sigma^2_{t-p} \ldots\ldots (1)$$

σ_t^2 is the volatility of the price of live broiler chickens at t-time, σ^2_{t-1} is the GARCH term of the volatility of the price of live broiler chickens in the previous period (t-1), $\varepsilon^2_{t-p}$is the ARCH term or The error term in the previous period (t-1). Then α_0 is a constant, $\alpha_1 \ldots \alpha_p$ is the estimated ARCH parameter or coefficient, and $\beta_1 \ldots \beta_q$ is the estimated GARCH parameter or coefficient. ARCH-GARCH analysis follows five main steps: (1) Stationarity test, (2) ARIMA model selection, (3) ARCH-LM test, (4) selecting the best model, and (5) volatility estimation.

Stationarity Test: In this test, the Augmented Dickey-Fuller (ADF) Test is used. ADF tests stationary data by comparing the absolute value of the ADF t-statistic with the 5% critical value. If the ADF t-statistic exceeds the critical value, then the data is considered stationary (Juanda & Junaidi, 2012; Pipit et al. 2019).

ARIMA test: This step identifies the optimal ARIMA model by assessing the largest R-squared value, the smallest Akaike Information Criterion (AIC), and the smallest Schwarz Criterion (SC) (Juanda & Junaidi, 2012; Pipit et al. 2019).

ARCH-LM test: This test detects the ARCH effect on broiler prices using F or Chi-square statistics. A significant result at the 5% level indicates the presence of volatility in t.

Best Model Selection: ARCH-GARCH parameter estimation starts from the low-order model and proceeds to the higher-order model. The best model is selected based on the largest R-squared, smallest AIC, smallest SC, largest log-likelihood, and significance (Rizqika, 2021).

Volatility Estimation: This final step estimates future price volatility, providing insight to farmers on potential risks and optimal production timing in Jawa Tengah Province.

CCV

Live broiler price risk in Jawa Tengah Province was analyzed using the Conditional Coefficient of Variance (CCV). CCV can measure variability relative to the mean. Higher CCV values indicate greater risk, as they reflect prices that are farther from their expected values. The CCV model is considered superior as it takes into account both volatility and prior period variance. This provides a more accurate estimate of risk (Rizqika, 2021).

$$CCV_t = \frac{\sqrt{\alpha_0+\alpha_1\,\varepsilon_{t-1}^2+\alpha_p\,\varepsilon_{t-p}^2+\beta_1\,\sigma_{t-1}^2+\beta_q\,\sigma_{t-q}^2}}{(\sum_{i=1}^{12} x_i)/12}\,100\% \quad ....(2)$$

CCV_t is the conditional σ_t^2 coefficient of variation in the price of live broiler chickens in t period, and x_i is the price before the t-period. The CCV model is superior to the general coefficient of variation that uses standard deviation. This is because the conditional coefficient of variation takes into account the volatility effect in the previous period and the variance effect in the previous period. The estimation complexity provides a higher level of accuracy on the percentage of price risk (Rizqika, 2021). It can be concluded that in calculating price risk, the conditional coefficient of variation model is considered more accurate.

The basic hypothesis of this study is the volatility of live broiler prices in Jawa Tengah Province which is influenced by the volatility and variance of the previous period. This hypothesis is based on research by Sari et al. (2022). The study showed that the volatility of broiler meat prices is influenced by price patterns in the previous period. In addition, the price of broiler chickens in the field often refers to the price of the previous period. Therefore, this assumption is relevant to explain future price dynamics.

In this research, volatility and risk are considered as different, although related, concepts. Volatility refers more to uncertain price variations, while the price risk of live broiler chickens in Jawa Tengah Province refers to the difference between current prices and expected prices, both from the perspective of producers and consumers. This information can be implemented in business managerial decisions or government policies. This information can be implemented especially in price control. To better understand this research, a research framework is presented which can be seen in the following Figure 1.

Based on the framework, this study was initiated due to the problem of uncertain price fluctuations. To calculate the value of this fluctuation and forecast future price volatility, an analysis was carried out using ARCH-GARCH. In addition, a risk level assessment was carried out using CCV. Other information obtained from this CCV is to see the risk from the perspective of producers and consumers. The results of forecasting and analyzing the risk level are useful for making managerial decisions for farmers. Meanwhile, the results of risk knowledge from each side of producers and consumers can be information for the government in making policies.

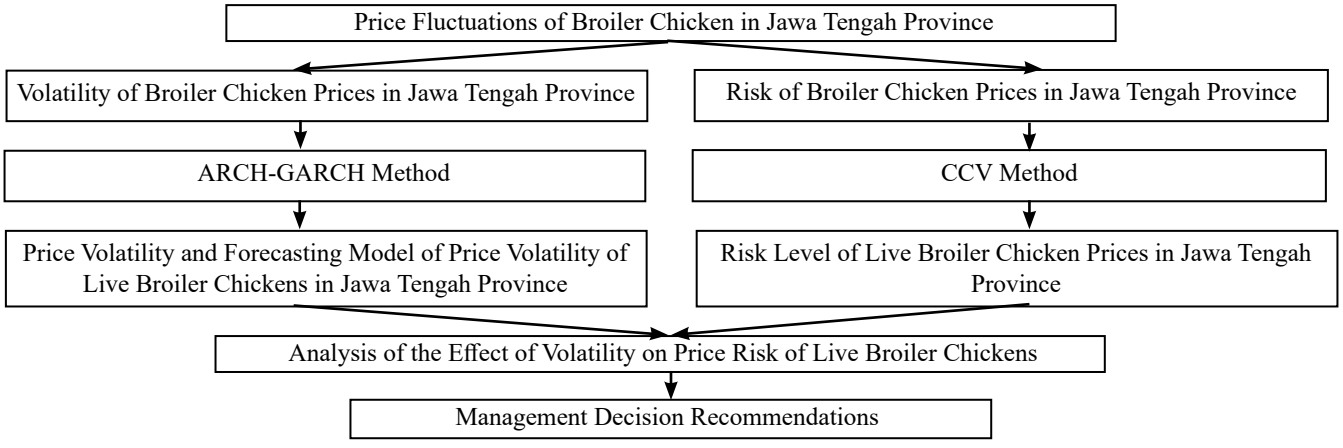

Figure 1. Research framework

RESULTS

Volatility of Live Broiler Price in Jawa Tengah Province

Data Stationarity Test

The stationarity test results show that the live broiler price data in Jawa Tengah Province covering the period January 2016 to February 2024 is stationary. Thus, the original data is feasible to use in further analysis. These findings are detailed in Table 1. This ensures the reliability of the data for further statistical evaluation. The stationarity of the dataset allows for accurate modeling and forecasting in the next stage of the research.

The live broiler price data in Jawa Tengah Province has been confirmed to be stationary. This conclusion is drawn from the absolute value of the ADF t-statistic that exceeds its critical value, which indicates significant statistical reliability. Stationarity is very important to prevent bias or spurious regression in predictive modeling. The stationarity of the data is very important and highly emphasized. This is to ensure stationarity will ensure the accuracy and validity of subsequent econometric analysis (Dewi et al. 2017; Sari et al. 2023).

ARIMA Test

ARIMA (Autoregressive Integrated Moving Average) modeling expertly combines autoregression, integration, and moving averages to spot patterns in data. This model utilizes the interaction between past values and past errors to forecast future data points. In this study, the ARIMA model was identified as ARIMA (1,2). The details of this model are documented in Table 2. This modeling approach is integral to predicting future trends based on historical data.

The ARIMA test results, shown in Table 2, found that the AR (1) MA (2) or ARIMA (1,0,2) model is the most appropriate for predicting live broiler prices in Jawa Tengah Province. This model uses the first lag value (1st order) of the variable and two lags of the previous moving average value (2nd order). This function aims to predict the current value based on the previous value. Thus, the current price of live broilers in Jawa Tengah Province is influenced by the price in the previous period and the moving average of the previous two periods. This ARIMA model helps in identifying future price patterns based on historical data.

ARCH LM test

The ARIMA model alone may not be able to adequately predict future live broiler prices in Jawa Tengah Province, especially in the event of sudden price changes. Therefore, ARCH-LM testing is applied to further analyze the price fluctuations. This test helps identify volatility patterns that cannot be captured by ARIMA. By incorporating ARCH-LM testing, the analysis becomes more resilient to sudden market changes. This comprehensive approach ensures more accurate forecasting of live broiler prices.

Table 1. Test of stationarity of live broiler chicken prices

Variable	t-statistic (Level)	Critical value (5%)	Probability
Price of Live Broiler	-4.8309	-2.8915	0.0001

Table 2. ARIMA test price of live broiler chickens

ARIMA Models	Criteria			
	R-square	AIC	SC	Sig. (5%)
1.1.0	0.391	18.191	18.297	Sig.
1.2.0	0.391	18.191	18.297	Sig.
1.0.1	0.391	18.191	18.296	Sig.
1.0.2	0.395	18.184	18.290	Sig.

Bolded letters indicate the fulfillment of the best criteria

Based on Table 3, the Prob. F-value for live broiler chicken price data in Jawa Tengah Province is 0.0036 and Prob. Chi-Square is 0.0039 (less than 5%). This value indicates that there is an ARCH effect in the ARIMA model used, thus indicating volatility. If there is no ARCH effect, then the analysis is sufficient for the ARIMA stage only. However, due to the ARCH effect, the analysis must be continued with the ARCH-GARCH model to handle the volatility (Pipit, 2019). The volatility effect shows that the variability in the data changes over time and is not fixed.

Selection of the Best Model

After the influence of ARCH on the model is found, the next step is to estimate the parameters of the ARCH-GARCH model. The estimation shows that the ARCH-GARCH (1,1) model is the best for determining the volatility of live broiler chicken prices in Jawa Tengah Province. This model was chosen because of its ability to capture volatility fluctuations accurately. Information about this model can be seen in Table 4. By using this model, the analysis of price volatility becomes more precise.

Based on the results of the ARCH-GARCH test (Table 4), it shows that the ARCH-GARCH (1,1) model is the chosen model. The model was chosen because it meets the criteria mentioned earlier, namely the largest R-squared, smallest AIC, smallest SC, and significant coefficients. The amount of volatility of live broiler prices in Jawa Tengah Province can be calculated using the best ARCH-GARCH model chosen, the ARCH-GARCH (1,1) model. The ARCH-GARCH (1,1) model provides information that the price movement pattern of live broiler chickens in Jawa Tengah Province is influenced by the variance of the previous period and the volatility of the previous period. This means that if the price of live broiler chickens this month has relatively high price variance and residual values, then the price of live broiler chickens in the following month will tend to be high (Burhani et al. 2013; Nurmapika et al. 2018).

The next step is to evaluate the ARCH-GARCH (1,1) model to produce an accurate estimate or prediction of live broiler price volatility in Jawa Tengah Province. The evaluation is carried out by looking at the F and Chi-Square values of the ARCH-GARCH (1,1) model. If the F and Chi-Square values are not significant, or the Prob. F and Prob. Chi-Square values are greater than 5%, then the model is considered feasible. This indicates that the ARCH-GARCH (1,1) model can be used for prediction purposes. This evaluation is important to ensure the accuracy of the analysis results.

Based on the model evaluation results (Table 5), the ARCH-GARCH (1,1) model is most appropriate to use to estimate the price volatility of live broiler chickens in Jawa Tengah Province. This result is in line with research from Sari et al. (2022) which shows that the best ARCH-GARCH model for broiler chicken meat prices is ARCH-GARCH (1,1). Even though they use the same model, the mathematical equations in the model will clearly define the level of volatility and shocks. More specific equations provide in-depth details about the behavior of the data. Volatility refers to how much the data changes or fluctuates. Meanwhile, shocks refer to unexpected events that affect the data.

Table 3. ARCH-LM test price of live broiler chickens

Heteroscedasticity Test: ARCH			
F-statistic	8.9085	Prob. F	0.0036
Obs*R-squared	8.3162	Prob. Chi-Square	0.0039

Table 4. The Best ARCH-GARCH model for live broiler chickens

Model	Criteria			
	R-sq	AIC	SC	Sig. 5%
1.0	0.343	17.958	18.090	Sig.
1.1	0.366	17.896	18.056	Sig.
1.2	0.322	17.812	17.998	No
1.3	0.353	17.828	18.041	No

Bolded letters indicate the fulfillment of the best criteria

Estimated Volatility of Live Broiler Chicken Prices in Jawa Tengah Province

Volatility estimation is conducted to determine the level of price uncertainty that farmers will face in the future and estimate broiler prices in the next period. Some important parts of volatility estimation include (1) the volatility equation, which describes the pattern of price changes, and (2) Conditional Standard Deviation (CSD), which measures the magnitude of price fluctuations dynamically. These two components are very important in predicting and measuring price uncertainty. With these estimates, farmers and related parties can get a more accurate picture of price risk. These estimates help in making better decisions in the future.

Volatility Equation

In the previous analysis, the ARCH-GARCH (1,1) model is the best model that can be used to estimate the volatility of live broiler chicken prices in Jawa Tengah Province. This model produces a pattern of live broiler chicken price movements in the province. This pattern is represented by the equation generated from the ARCH-GARCH (1,1) model. This equation reflects the price fluctuations that occur. The mathematical equation generated from the ARCH-GARCH (1,1) model can be seen in Equation 3.

$$\sigma_t^2 = 252.528 + 0{,}360\ \sigma^2_{t-1} + 0{,}850\ \varepsilon^2_{t-1} \quad \text{... (3)}$$

The ARCH coefficient in the model shows the volatility of live broiler prices in Jawa Tengah Province. Meanwhile, the GARCH coefficient in the model indicates the presence of shocks in the price of live broilers in Jawa Tengah Province (Burhani et al. 2013; Lestari et al. 2022). Shocks mean unpredictable changes in broiler prices due to certain conditions. In the estimation model, an ARCH of 0.850 (close to one) means that the volatility of live broiler prices in Jawa Tengah Province is high. The GARCH coefficient of 0.360 (not close to one) means that shocks to the volatility of live broiler prices in Jawa Tengah Province tend to be temporary. So, the volatility of broiler prices in Jawa Tengah Province is quite high, but the shocks do not last long.

Conditional Standard Deviation (CSD)

Volatility measurement can be assessed using the standard deviation value. For the price of live broiler chickens in Jawa Tengah Province, volatility from January 2016 to February 2024 is measured using the Conditional Standard Deviation (CSD). High volatility is indicated by a CSD value that is much higher than the others. This is indicated by a peak on the graph. Conversely, a sloping graph indicates relatively normal price volatility.

The volatility pattern of live broiler chicken prices in Jawa Tengah Province is seasonal. The volatility of live broiler chicken prices in Jawa Tengah Province was in normal and consistent conditions between July 2017 and July 2018. After re-observation, Bank Indonesia's interest rates decreased during that period. Based on the Gibson Paradox theory, there is a relationship between an increase in interest rates and an increase in prices, and vice versa, a decrease in interest rates will cause a decrease in prices (Iswardono, 1999). This can be seen in Figure 2.

Table 5. Evaluation of live broiler chicken price data models

Heteroscedasticity Test: ARCH			
F-statistic	0.9730	Prob. F	0.3081
Obs*R-squared	0.9836	Prob. Chi-Square	0.3213

Table 6. ARCH-LM test based on covid-19 period

Heteroscedasticity Test: ARCH			
Period	Prob. Chi-Square	Prob. F	Volatility (critical value 5%)
Jan 2016-Nov2019	0.4403	0.4515	There isn't any
Dec 2019-Jul 2022	**0.0252**	**0.0252**	**There is**
Aug 2022-Feb 2024	0.9635	0.9607	There isn't any

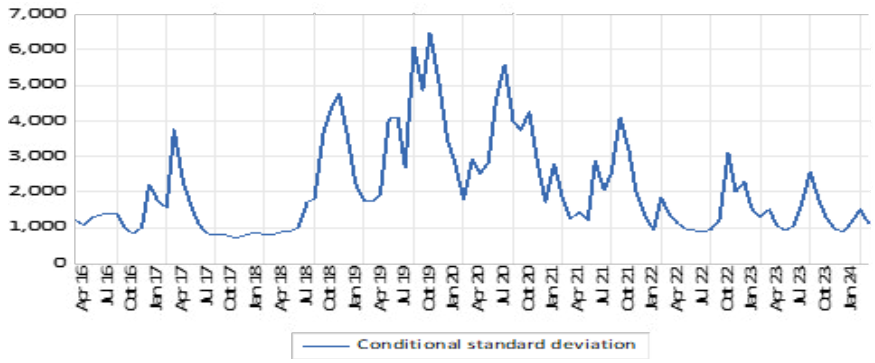

Figure 2. Conditional Standard Deviation (CSD) price of live broiler chickens

Based on Figure 2, the highest volatility occurred at the end of 2019. Volatility can be triggered by the occurrence of extreme prices during a crisis (Tangermann, 2011). At the end of 2019-2022, there was a global problem of the COVID-19 pandemic that made the world economy unstable, including that in Indonesia. During the COVID-19 pandemic, namely 2019-2022, broiler price volatility in Jawa Tengah Province tends to be higher than in other years. There was a drastic decline in prices during the Covid-19 pandemic which caused negative volatility. The price of live broilers in Jawa Tengah Province once reached Rp11,620 per kilogram. The volatility of live broiler prices in Jawa Tengah Province after COVID-19 has gradually begun to decline, although there is still a seasonal pattern observed each year. If the price series for live broiler chickens in Jawa Tengah Province in January 2016-February 2024 are grouped based on the period during which the Covid-19 pandemic occurred, three periods will be found, namely (1) January 2016-November 2019 (before the Covid-19 pandemic); (2) December 2019-July 2022 (covid-19 pandemic period); (3) August 2022-February 2024 (after the Covid-19 pandemic) as shown in Table 6.

Based on Table 6, information is obtained that in both the periods before and after the Covid-19 pandemic there were no symptoms of extreme price volatility. However, symptoms of volatility and price uncertainty occurred during the COVID-19 pandemic period. This indicates the price variance during the COVID-19 pandemic. December 2019-July 2022, had quite a big influence on the uncertainty in the price of live broiler chickens in Jawa Tengah Province. This price uncertainty can occur due to significant changes in demand and supply of live broiler chickens during the COVID-19 pandemic.

As happened in several regions in Indonesia during the COVID-19 pandemic, the COVID-19 pandemic caused a decrease in demand for broiler chicken meat and changes in the distribution flow for broiler chicken meat (Yurike, 2022). Suryani *et al.* (2020) explained that during the COVID-19 pandemic, breeders found difficulty in selling business products and making a profit and that the selling prices were lower. After the COVID-19 pandemic, price volatility for live broiler chickens in Jawa Tengah Province began to be controlled and showed a downward trend. However, there are several commodities whose prices increased during the COVID-19 pandemic, with the same estimation model GARCH (1.1), there were fluctuations in sugar commodities in Indonesia which tended to increase sugar prices (Meliany, 2022). This indicates that the impact of Covid-19 is different in different industries.

The Managerial Implementation of Model Equation and CSD Results

By looking at the high and short-term volatility of broiler prices, farmers can take reference to the price of the previous period to make a decision to produce independently or in partnership. If the residual price of live broilers in the previous period tends to be high, then it is likely that the price tomorrow and the next period will also be high, so farmers can produce independently, getting a higher market margin with an independent production system will be greater. Conversely, if the residual price of live broilers in the previous period tends to be low, then farmers should postpone production under an independent system. In addition, during a crisis, it is safer for farmers to run a partnership system until the situation looks better. Producing without insurance support during a crisis is very risky for farmers, as happened during the COVID-19 crisis when the price of live broilers in Jawa Tengah Province dropped dramatically.

Price Risk for Live Broiler Chickens in Jawa Tengah Province

Risk is the possibility of an undesirable event occurring that could affect the achievement of objectives. Risk is usually associated with uncertainty because the outcome or impact is difficult to predict accurately. In the context of the study of live broiler price risk in Jawa Tengah Province, two main topics are often discussed. First, the risk level of live broiler prices in Jawa Tengah Province refers to the magnitude of price fluctuations that can affect farmers and market participants. Second, the live broiler price surplus in the region describes the potential for more profit or price stability expected in each period. Understanding these two aspects is important for managing risks and opportunities in the livestock business.

Risk Level for Live Broiler Chicken Prices in Jawa Tengah Province

The price risk of live broiler chickens in Jawa Tengah Province in this research was analyzed using the conditional coefficient of variation (CCV). Based on the CCV equation, it was found that the price risk of live broiler chickens in Jawa Tengah Province in the period January 2016 to February 2024 was at a value of 13.972% to 68.962%. This risk reflects the potential financial loss for producers or consumers due to price changes. The higher the risk, the greater the difference between the expected price and the price occurring in the market. This can be seen in Figure 3.

In Figure 3, the risk movement of live broiler chicken prices in Jawa Tengah Province is presented. This risk is in line with the volatility of live broiler chicken prices in Jawa Tengah Province. The risk value for the price of live broiler chickens in Jawa Tengah Province was highest in September 2019 at 68.962%, while the lowest was in October 2017 at 13.972%. In September 2019, the price deviation value for live broiler chickens in Jawa Tengah Province was 68.962% of the expected price. In September 2019 there was a shock to the price of live broiler chickens in Jawa Tengah Province. Meanwhile, in October 2017 the risk level faced by farmers was 13.972%, which means that 13.972% of the price of live broiler chickens deviated from the expected price. The average price risk of live broiler chickens in Jawa Tengah Province from January 2016 to February 2024 is 25.534%. The risk is classified as low because the price risk value is less than 50% or 0.5 (0.2534<0.5) (Rahma, 2020). These results provide information that live broiler farming in Jawa Tengah Province with an independent system is feasible considering the low level of market price risk faced.

Surplus Price of Live Broiler Chickens in Jawa Tengah Province

The risk of live broiler chicken prices can be understood in real terms by changing equation (3) into a model of producer surplus and consumer surplus. Producer surplus is the difference between the price expected by producers and the price in the market. Meanwhile, consumer surplus is the difference between the price consumers are willing to pay and the price actually paid (Hasan, 2021). The producer surplus and consumer surplus models are then represented through a series of estimations. This is very necessary because considering the risk with CCV and volatility with ARCH-GARCH cannot distinguish between producer risk and consumer risk.

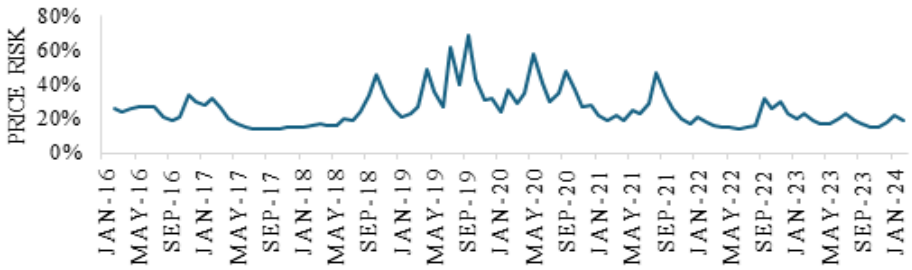

Figure 3. Price risk for live broiler chickens in Jawa Tengah Province

$PS_t = WA_t + \sqrt{(252.528 + 0{,}850\ \sigma^2_{t-1} + 0{,}360\ \varepsilon^2_{t-1}}$ ... (4)

Where PS_t is the producer surplus in the t-period and WA_t is the willingness to accept in t period.

$KS_t = WP_t - \sqrt{(252.528 + 0{,}850\ \sigma^2_{t-1} + 0{,}360\ \varepsilon^2_{t-1}}$ ... (5)

Where KS_t is the consumer surplus in the t-period and WP_t is the willingness to pay in t period.

The price surplus faced by producers and consumers in the period January 2016 to February 2024 was mostly enjoyed by producers or breeders. This can be seen from the frequency of producer surplus, which reached 55%, while consumer surplus only amounted to 35%. Meanwhile, around 10% of the total frequency showed no surplus for either producers or consumers. This neutral condition indicates that the price of live broilers in Jawa Tengah Province is mostly in line with the expectations of producers and consumers. Based on the risk percentage results, a producer surplus of 5% indicates that the volatility of live broiler prices in the region tends to benefit producers or farmers. With positive volatility for producers, farmers are more likely to get prices that exceed their expectations, thus providing higher financial returns compared to the risks or losses that consumers may face. This also reflects that market dynamics favored producers during this period, especially in the face of price fluctuations.

The Implementation of CCV and Surplus Price of Live Broiler Chicken

Broiler farmers get greater benefits than consumers related to fluctuations in live broiler prices in Jawa Tengah Province. Thus, independent broiler farming is feasible, but with attention to the variance and residuals of the previous period. If farmers see that the residual price of live broilers in the previous period is high, then the price of broilers in the next period tends to be high, so that is the right time for farmers to produce with an independent system. From the government side, to protect the interests of consumers, several strategies need to be implemented. One strategy that the government can apply is to contract with farmers in terms of broiler production so that they have chicken stock that can be used to maintain price stability (Tangerman, 2011). If contracting with broiler farmers is only done by large companies that allow them to control the price of broiler chickens in the market, then to reduce this dominance the government can implement a livestock contracting strategy.

CONCLUSION AND RECOMMENDATION

Conclusion

The results of this study strengthen the results of existing research with more comprehensive details. The volatility of live broiler prices in Jawa Tengah Province in the period January 2016 to February 2024 is influenced by the variance of the previous period and the volatility of the previous period. The ARCH order is 0.850 and GARCH is 0.360. The risk of live broiler prices in Jawa Tengah Province was highest in September 2019 at 68.962% and lowest in October 2017 at 13.972%. The average risk of live broiler chicken prices in Jawa Tengah Province in the period January 2016 to February 2024 is 25.534% and is classified as low risk.

Recommendation

Further researchers should examine the influence of several factors that can affect the volatility and risk of broiler chicken prices. In addition, the volatility of several other strategic food products can also be studied for the sake of price stability and to determine the condition of food security in a region. Farmers should actively pay attention to the movement of live broiler chicken prices in Jawa Tengah Province by paying attention to the volatility that occurred in the previous period. Policymakers at the regional level, especially the Jawa Tengah Provincial Government should pay attention to the volatility and risk of live broiler chicken prices in Jawa Tengah Province in the future from two perspectives. Using the model found in this study, they can adopt the right policies if a crisis occurs and achieve regional food security.

FUNDING STATEMENT: This research did not receive any specific grant from funding agencies in the public, commercial, or not - for - profit sectors.

CONFLICTS OF INTEREST: The author declares no conflict of interest.

REFERENCES

Aprilia AE, Soehardjoepri S, Widjajati FA. 2017. Estimasi risiko investasi saham di sektor keuangan menggunakan metode ARCH-GARCH. *Jurnal Sains Dan Seni ITS* 6(2): 83–87.

[BPS] Badan Pusat Statistik Provinsi Jawa Tengah. 2021. Produksi Daging Unggas menurut kabupaten/kota dan jenis unggas di Provinsi Jawa Tengah (ton), 2020 dan 2021. https://jateng.bps.go.id/statictable/2022/03/16/2555/produksi-daging-unggas-menurut-kabupaten-kota-dan-jenis-unggas-di-provinsi-jawa-tengah-ton-2020-dan-2021.html. [19 Oct 2023].

Bahari, Mustadjab M. M, Hanani N, Nugroho B.A. 2016. Analisis contract farming usaha ayam broiler. *Jurnal Agro Ekonomi* 30(2): 109–127.

Belinska S, Bielik P, Belinska Y. 2023. The impact of the price factor on farmers' incomes in turbulent conditions. *Agris on-Line Papers in Economics and Informatics* 5 (13): 15–24.

Burhani F.J, Fariyanti A, Jahroh S. 2013. Analisis volatilitas harga daging sapi potong dan daging ayam broiler di Indonesia. *Forum Agribisnis : Agribusiness Forum* 3(2): 19–40.

Dewia I, Nurmalina R, Adhi AK, Brümmer B. 2017. Price volatility analysis in Indonesia beef market. *KnE Life Sciences* 2(6): 403–420.

Engle R. 2001. GARCH 101: The use of ARCH/GARCH models in applied econometrics. *Journal of Economic Perspectives* 15(4): 157–168.

Robert FE, Bollerslev T. 1986. Modelling the persistence of conditional variances. *Econometric Reviews* 5 (1): 1–50.

Ezeaku HC, Asongu SA, Nnanna J. 2021. Volatility of international commodity prices in times of covid-19: effects of oil supply and global demand shocks. *The Extractive Industries and Society* 8(1): 257–270.

[FAO] Food and Agriculture Organization. 2010. Price volatility in agricultural markets. https://www.fao.org/3/mr119e/mr119e.pdf. [20 Oct 2023].

Ginting NM, Lubis AR, Zendrato M. 2023. Analisis volatilitas, integrasi pasar dan transmisi harga cabai merah di provinsi Sumatera Utara, Indonesia. *Agro Bali: Agricultural Journal* 6(3): 827-839.

Hasan A. 2021. Power stakeholder dalam bisnis. *Media Wisata* 15(2): 513–539.

Heatubun AB, Matutula MJ. 2023. Analisis peramalan harga daging ayam pedaging di kota Ambon dan risiko yang ditimbulkan terhadap daya beli masyarakat. *Agrinimal Jurnal Ilmu Peternakan* 11(1): 1–7.

Huchet-Bourdon M. 2011. Agricultural commodity price volatility: an overview. *OECD Food, Agriculture and Fisheries Papers (OECD Publishing)* (52): 1-51.

Irmawati, Sandiah N, Fitrianingsih. 2020. Bobot potong, persentase karkas dan lemak abdominal ayam broiler yang diberi tepung usus ayam broiler dengan level berbeda. *Jurnal Ilmiah Peternakan Halu Oleo* 2(1): 46-50.

Iswardono. 1999. Suku bunga diturunkan investasi meningkat? *Jurnal Ekonomi dan Bisnis Indonesia* 14 (2): 1-13.

Juanda B, Junaidi J. 2011. *Ekonometrika Deret Waktu Teori dan Aplikasi.* Bogor: IPB Press.

[Kementan] Kementrian Pertanian RI. 2023. Sistem informasi pasar online nasional-ternak. https://simponiternak.pertanian.go.id/harga-daerah.php. [3 Oktober 2023]

Lestari EP, Prajanti SDW, Wibawanto W. 2022. ARCH-GARCH analysis: an approach to determine the price. *AGRARIS: Journal of Agribusiness and Rural Development Research* 8 (1): 91-105.

Li WK, Ling S, and Mcaleer M. 2002. Recent theoretical results for time series models with garch errors. *Journal of Economic Surveys* 16 (3): 245-269.

Lisnahan CV, Seran A, Bira GF. 2021. "Pengaruh suplementasi l-arginine dalam pakan terhadap pertambahan bobot badan, konsumsi pakan dan konversi pakan ayam broiler. *Journal of Animal Science* 6(3): 49-51.

Matsumoto A, Pescatori A, Wang X. 2023. Commodity Prices and Global Economic Activity. Japan and the World Economy. 66.

Meliany BS, Sahara, Probokawuryan M, Ahmad FS. 2022. Covid-19 pandemic and volatility of sugar price at regional level in Indonesia for the period august 2018-august 2021. *Jurnal Manajemen & Agribisnis* 19 (2): 229-238.

Miftahuljanah, Sukiyono K, Asriani PS. 2020. Volatilitas dan transmisi harga cabai merah keriting pada pasar vertikal di provinsi bengkulu. *Jurnal Agro Ekonomi* 38 (1): 29-39.

Nurhabibah, Firmansyah, Pramushinto B, Hoesni F. 2022. Analisis permalan harga daging ayam broiler di pasar tradisional Provinsi Jambi. *Jurnal Manajemen dan Sains* 7(1): 35-43.

Pipit, Pranoto YS, Evahelda. 2019. "Analisis volatilitas

harga daging sapi di Provinsi Kepulauan Bangka Belitung. *Jurnal Ekonomi Pertanian dan Agribisnis* 3(3): 619-630.

Rahma. 2020. Analsis risiko harga komoditi jagung manis (Zea Mays L Saccaharata Sturt) di kelurahan juata laut kecamatan tarakan utara kota tarakan [skrpsi]. Tarakan: Universitas Boreng Tarakan.

Ratnasari R. Sarengat S, Setiadi A. 2015. Analisis pendapatan peternak ayam broiler pada sistem kemitraan di kecamatan gunung pati kota semarang. *Animal Agriculture Journal* 4(1): 47-53.

Rizqika LC. 2021. Analisis volatilitas dan risiko harga komoditas kedelai di Pasar Internasional [skrpsi]. Mataram: Universitas Mataram Repository.

Säfvenblad P. 2000. Trading volume and autocorrelation: Empirical evidence from the stockholm stock exchange. *Journal of Banking and Finance* 24(8): 1275-1287.

Sari LK, Achsani NA, Sartono B, Anggraeni L. 2023. Investigating the asymmetric effect of food commodity price in the volatility in Indonesia. *Jurnal Manajemen & Agribisnis* 2(30): 440-454.

Sari RM, Mulyati S, Astuti A, Mulyaningsih A. 2022. Risiko harga ayam ras dan telur ayam ras di Provinsi Banten selama pandemi covid 19. *Jurnal Universitas Galuh* 6 (1): 308-314.

Suryani JA, Sugiarto M, Wakhidati YN. 2020. Dampak wabah virus corona (covid-19) terhadap kegiatan ekonomi usaha peternakan ayam broiler bemitraan di Kabupaten Banyumas. *Journal of Animal Scince and Technology* 2 (2): 188-202.

Suwati. 2013. Profitabilitas dan rentabilitas kemitraan ayam pedaging kandang terbuka dan tertutup. *Jurnal Gamma* 8(2): 108–116.

Syarifah PN, Setiadi A, Setiawan B. 2021. Analisis faktor-faktor yang mempengaruhi permintaan karkas ayam broiler di Kota Semarang. *AGRISAINTIFIKA: Jurnal Ilmu-Ilmu Pertanian* 5(1): 56-63. doi:10.32585/ags.v5i1.1490.

Tan J. 2023. Research on the volatility of the s&p 500 stock index based on garch family models. *Advances in Economics Management and Political Sciences* 51(1):178-184

Tang K, Xiong W. 2012. Index investment and the financialization of commodities. *Financial Analysts Journal* 68(6): 54-74.

Tangermann S. 2011. Policy Solutions to Agricultural Market Volatility: A Synthesis. Geneva, Switzerland: International Centre for Trade and Sustainable Development (ICTSD).

Yurike. 2022. Dampak covid-19 terhadap konsumsi dan distribusi daging ayam broiler di Kota Bengkulu. *Bulletin of Tropical Animal Science (Buletin Peternakan Tropis)* 3 (1): 60-67.