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ANALYSIS OF PRICE VARIATIONS AND INTEGRATION OF BROILER CHICKEN EGGS MARKET IN WEST SUMATRA

Analisis Variasi Harga dan Integrasi Pasar Telur Ayam Broiler di Sumatera Barat

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ABSTRACT

Chicken eggs are one of the primary sources of protein for people in West Sumatra. The level of consumption continues to increase every year, while the availability of broiler eggs is not stable. This condition illustrates the problems faced by consumers and producers, namely price instability. Market integration is a metric that demonstrates how price changes in the reference market affect price changes in the follower market. The objective of this research is to examine the price variation and market integration of broiler eggs in West Sumatra. Coefficient of variation analysis is used to examine price variation, while cointegration analysis with the Vector Autoregression (VAR)/Vector Error Correction Model (VECM) model is used to investigate market integration. The variations coefficient analysis shows that the price of chicken eggs on the market is relatively more stable than that of the consumer market. The results of the integration analysis show that there is no integration between the market for broiler eggs at the producer and consumer levels, both in the long and short term. This is due to the information asymmetry between the two markets.

Keywords: *coefficient variations, Johansen cointegration, price behavior, VAR/VECM*

ABSTRAK

Telur ayam merupakan salah satu sumber protein utama bagi masyarakat di Sumatera Barat. Tingkat konsumsi yang terus meningkat setiap tahunnya, sedangkan kondisi ketersediaan pasokan telur ayam broiler tidak stabil. Kondisi ini

menggambarkan adanya permasalahan yang dihadapi oleh konsumen maupun produsen yaitu ketidakstabilan harga. Integrasi pasar merupakan dimensi yang menampilkan sejauh mana perubahan harga di pasar utama hendak menciptakan perubahan harga di pasar pengikut. Tujuan penelitian yaitu menganalisis tingkat variasi harga serta integrasi pasar telur ayam broiler di Sumatera Barat. Variasi harga dianalisis mengunakan koefisien variasi dan integrasi pasar melalui pendekatan kointegrasi dengan model Vector Autoregression(VAR)/ Vector Error Correction Model(VECM). Hasil analisis koefisien variasi menampilkan jika harga telur ayam broiler pada pasar produsen relatif lebih stabil dibanding dengan harga pada pasar konsumen. Hasil analisis integrasi menampilkan bahwa tidak terjadi integrasi antara pasar telur ayam ras di tingkat produsen dan konsumen baik dalam jangka panjang maupun jangka pendek. Hal tersebut dikarenakan adanya asimetris informasi antara kedua pasar tersebut.

Kata kunci: *koefisien variasi, kointegrasi johansen, perilaku harga, VAR/VECM*

INTRODUCTION

West Sumatra is one of the regions producing broiler eggs in Indonesia. In 2020, the total production reached 5.98% of the total production of broiler eggs in Indonesia, which reached 5.04 million tons (BPS West Sumatra, 2021). However, this area is not the leading center for chicken eggs for Indonesia. However, this business has a strategic role for the economy of West Sumatra and becomes a supplier for the surrounding areas such as Lampung and Pekanbaru. The prospect of developing laying hens agribusiness is relatively rapid, as seen from the average population growth of 23% over the last ten years. The fundamental problem faced by marketers of chicken eggs is price volatility which also affects their welfare.

The average price of broiler eggs changes every month, affecting price determination in producer and consumer markets. According to Salfadri (2017), the price difference is one of the reasons for inter-regional trade. Figure 1 shows that from 2015 to 2019, the price development of broiler eggs in the consumer market changed by 0.07 percent. Meanwhile, the price of broiler eggs in the producer market experienced a change of 0.05 percent (BPS West Sumatra, 2021). This condition indicates that price changes in the producer and consumer markets have the same direction (positive/increasing) but different values. This difference is caused by the availability of supply of chicken eggs and differences in the community's needs in both producer and consumer markets (Silalahi et al., 2017; Stemberger & Gerra, 1961).

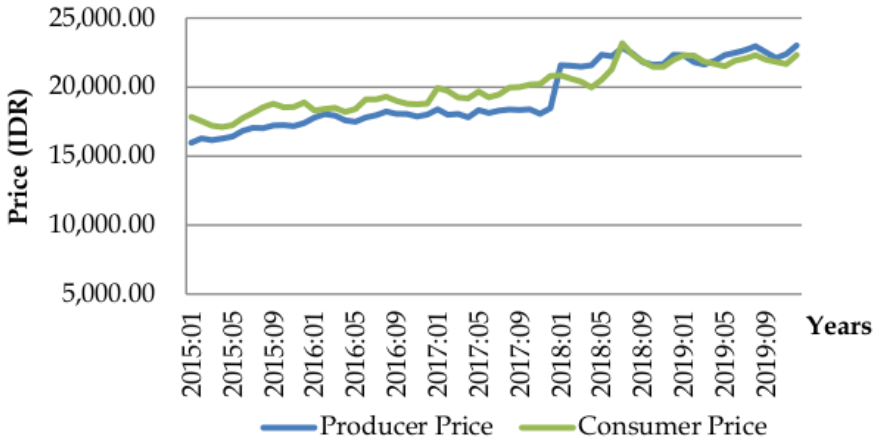

Figure 1.
Price Behavior of Chicken Eggs at Producer and Consumer Levels, 2015-2019

The condition of the price of broiler eggs is inelastic, meaning that the demand for eggs will continue to exist even though there are price changes (Yusri et al., 2007; Nafaati et al., 2021). The consumer's need for broiler eggs has become a fundamental need to meet animal protein sources (Fang, 2021; Arbel, 2020). Although from 2017 to 2019, the consumption of broiler eggs by the people of West Sumatra decreased by 6.04 percent (BPS West Sumatra, 2021). However, broiler eggs are still the prima donna in trading activities. According to Survey results, BPS (2019) related to the marketing actors of broiler eggs in West collectors, agents, wholesalers, retailers, and supermarkets/supermarkets. The most significant distribution that producers do is through agents. Agents distribute for the needs of business activities, households, processing industries, government and non-profit institutions both within and outside the province. The government has a strategic role in maintaining the stability of the price of chicken eggs (Neric, 2019).

The topmost significant consumer is Padang City. The activity of flowing goods from producer areas to consumers is a good business activity. Traders will benefit from the price difference between the origin and destination areas(Salfadri, 2017). According to Ulul Albab et al. (2019) and (Wang, 2021), there is a significant link between the selling price and volume sales. However, the problem is if market conditions are not integrated between producer and consumer markets. It will provide a risk of price fluctuations in both the consumer and producer markets (Salam, 2020; Fang, 2021). According to (Wibowo, 2021) price fluctuations occur due to price information between marketing actors is not properly transformed. Price changes in the consumer market are not followed by price changes in the producer market. Markets that are not integrated indicate that there is information asymmetry.

Prevention efforts can be made by providing accurate and sustainable market information. If the information goes smoothly, then price changes can be responded to quickly by market participants so that decision-making can be made quickly and accurately (Sukmaya & Hidayati, 2020). In line with Ravallion (1986), integrated markets have a favorable relationship because of the current flow of information from the market. Research related to the market integration of producers and consumers of broiler eggs in West Sumatra has never been done. Previous studies have studied many related to marketing analysis (Putri et al., 2020; Witria & Wardani, 2016; Yusri et al., 2007) and analysis of broiler egg business in West Sumatra (Salfadri, 2017).

Based on the background, research problems can be formulated, namely, first, how is the price behavior of broiler eggs in West Sumatra? Secondly, how is the vertical integration between producer and consumer markets for broiler eggs in West Sumatra? Thus, the objectives of this study are: (1) analyzing how chicken egg price behaves in west Sumatra and (2) analyzing the vertical integration rate of the chicken egg market between the producer and consumer market in west Sumatra.

RESEARCH METHOD

The research relies on secondary data to illustrate the monthly rate of purebred chicken eggs in front of producers and customers. The data is a time series taken from the West Sumatra Province's Central Statistics Agency (BPS) from 2015:1-2019:12.

Data Analysis

Price Behavior Analysis

Price analysis of broiler eggs was carried out using descriptive statistical analysis. It aims to determine the price behavior that occurs in the producer and consumer markets. Meanwhile, to see the level of fluctuations in the price of red chili can be calculated using the coefficient of variation formula. Mathematically can be written as (Thomas, 1997):

$$KV = \frac{S}{\ddot{X}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$S = \sqrt{\frac{1}{n-1}\sum(x - \ddot{x})^2} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Information:
KV = Coefficient of variation
S = Standard deviation

$\ddot{X}$ = Average price of broiler eggs
n = Number of samples

Vertical Market Integration Analysis

The data was analyzed using Vector Autoregression (VAR) in the Eviews.5.1 program. The VAR approach tries to "let the data speak for themselves" by making all variables potentially endogenous. In the VAR framework, each variable, both in level and first difference, is treated symmetrically in a system of equations containing the same regressor set. (Firdaus, 2011). The stages of data processing are as follows:

1. Test for data stationarity using the unit root test. Indicators such as Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) are utilized (Thomas, 1997).
2. Determines optimal level of lag, the standard criteria used are (1) Akaike Information Criterion (AIC), (2) Schwartz Information Criterion (SC), (3) Hannan-Quinn Criterion (HQ), (4) Likelihood Ratio (LR)), and (5) Final Prediction Error (FPE) (Pesaran, 2016).
3. The dual cointegration test was based on a VAR model that was no longer constrained by the p and order lag k dimensions (created by Johansen).
4. Granger's causality test is performed to see how it relates to the variables of the model (Firdaus, 2011).
   In this study, the causality test examined the relationship between producer and consumer markets for broiler eggs in West Sumatra. The Granger test method shows that the causality relationship occurs in two directions (producer prices affect consumer prices, and vice versa).
5. Modeling each endogenous variable as a function of all endogenous variables in the system is required for VAR/VECM analysis (Widarjono, 2007).

Vertical examination of market integration between the producer's and consumer's markets. The equation for the market integration VAR model is as follows:

$$PPT_t = a_{01} + \sum_{i=1}^{p} a_{i1} PPT_{t-1} + \sum_{i=1}^{p} \alpha_{i1} PKT_{t-1} + \varepsilon_{1t} \dots\dots\dots\dots (3)$$

$$PKT_t = a_{02} + \sum_{i=1}^{p} a_{i2} PKT_{t-1} + \sum_{i=1}^{p} \beta_{i2} PPT_{t-1} + \varepsilon_{2t} \dots\dots\dots\dots (4)$$

Information:
PPT_t = price of broiler eggs at the producer level in a period t (IDR/kg)
PPT_{t-1} = price lag of broiler eggs at the producer level in a period t (IDR/kg)
PKT_t = price of broiler eggs at the consumer level in a period t (IDR/kg)

PKT_{t-1} = price lag of broiler eggs at the consumer level in a period t (IDR/kg)
p = length of the lag
ε_{nt} = vector residual size n x 1

According to the ratio test, there is no cointegration (LR). Cointegration of many variables occurs when the LR value is more than the LR's critical value and vice versa when the LR count is less than its critical value. If there is cointegration, there is a long-term link between variables, and the market is integrated. When a market is fully integrated, it is in a state of perfect competition (Irawan & Rosmayanti, 2016).

6. VAR/VECM Model Estimation

The *Vector Error Correction Model* (VECM) is a constrained VAR model used for nonstationary variables that have the potential to be cointegrated. After testing the cointegration of the model used, it is encouraged to include cointegration equations into the one used. The time series mostly has degrees in the station at first differences or I(1) (Firdaus, 2011).

VECM is a restricted form of VAR. This additional restriction must be given due to data forms that are not stationary at the level but are cointegrated. As a result, VECM is frequently referred to as VAR for nonstationary series with a cointegration relationship, indicating that in VECM, the speed of adjustment varies from short to long term as indicated by the Error Correction Model value. After the variables for stationarity, cointegration, lag, and variable fit are identified, the VAR model can be constructed.

Based on the statements of the VAR model (Widarjono, 2017), it is reasonable to assume that the lag VAR model is one. If there is cointegration in the data that is checked for stationary, then the model used is the VECM (Vector Error Correction Model) lag p rank r model. VECM is a restricted form of VAR. This additional restriction must be given due to data forms that are not stationary at the level but are cointegrated. VECM then leverages this cointegration restriction information into its specifications. As a result, VECM is also known as a VAR design for cointegrated nonstationary series.

RESULT AND DISCUSSION

Price Behavior of Chicken Eggs in West Sumatra

The price fluctuation of broiler chicken eggs in West Sumatra is indicated by the Coefficient of Variation (CV) value. The value of the price coefficient can describe the price behavior that occurs. During 2015-2019, the cv average for the price of purebred chicken eggs on the market was 1.86 percent and 2.71 percent respectively. The CV value in the producer market is smaller than the

KV value in the consumer market. This circumstance shows that the producer market price of broiler eggs is relatively more steady than the consumer market price or that the pace of demand and supply in the producer market is generally stable.

Table 1. Price Behavior of Broiler Chicken Eggs in West Sumatra Province during 2015-2019

Year	Producer Market		Consumer Market	
	Average price (IDR/kg)	CV (%)	Average price (IDR/kg)	CV (%)
2015	16,749.17	**2.97**	18.007.33	3.60
2016	17,899.75	1.18	18,722.17	1.92
2017	18,216.75	1.12	19,802.17	2.42
2018	21,952.00	2.07	21.326.17	**4.31**
2019	22,341.50	1.93	21,973.42	1.28
Average Price (IDR/kg)	**19,431.83**	**1.86**	**19,966.25**	**2.71**

Table 1 shows the KV value of broiler egg prices in West Sumatra during 2015-2019 in the producer and consumer markets. Conditions in the producer market are different from the consumer market. The consumer market is seen from the demand side, price fluctuations occur due to high demand during religious holidays such as Fasting Day, Christmas, New Year, and Lebaran. During these periods, demand increased between 10-15% (Nuryati & Nur, 2012). While the producer market can be seen from the supply side, one of the factors that cause the price of chicken eggs is the condition of unstable production costs. The biggest cost (>40%) is the cost of feed. Therefore, farmers need to find alternative cost-efficient feed (Gebremedhn, 2019).

The highest CV value in the producer market occurred in 2015, while in the consumer market it occurred in 2018. It illustrates that in the producer market during 2015, the dynamics of the number of offers relatively fluctuated. The same is true in the consumer market. It followed under the highest price level in July 2018, and the lowest price occurred in April 2015 in the consumer market. The rapidly increasing price fluctuations were caused by several factors, including the limited supply of broiler eggs and high demand. Therefore, the ability of marketers to anticipate price spikes needs to be improved.

Vector Autoregression (VAR) Model Testing

According to Thomas (1997), the method of vector-autoregression (var) has a definite advantage, including that obtained results are not spurious, can determine massive integration, the direction of transforming prices, which

market leader (leading) and market followers. The assumptions that must be met in var's methods, all non-change workers must be stationary (mean, variance, and covariance must be constant) and all-white noise in that is zero, variant, and free.

a. Data Stationarity Test and Determination of Optimal Lag Level

Time series data station is studied using the root of the unit based on the Augmented Dickey-Fuller test (ADF). The test involves two variables used in the model: the price of broiler eggs in the producer market (HRGPROD) and the price of chicken eggs in the consumer market (HRGKONS). Table 2 shows that the data used in this research is not stationary at the level and stationary at the first difference so that the testing can be done in the next stage.

Table 2. Stationary Test Results of Price Data in Producer and Consumer Markets in 2015-2017 using ADF test

Variable	Equation Test	ADF statistics	Critic Value		Prob	Information
HRGPROD	Level	-0.7768	1%	-3.5461	0.8181	Not Stationary
			5%	-2.9117		
			10%	-2.5936		
	First Difference	-7.0646	1%	-3.5482	0.0000	Stationary
			5%	-2.9126		
			10%	-2.5940		
HRGKONS	Level	-0.9727	1%	-3.5461	0.7574	Not Stationary
			5%	-2.9117		
			10%	-2.5936		
	First Difference	-6.4930	1%	-3.5550	0.0000	Stationary
			5%	-2.9155		
			10%	-2.5956		
RESID	First Difference	-8.0392	1%	-3.5575	0.0000	Stationary
			5%	-2.9166		
			10%	-2.5961		

Note: 1) H0 (δ 1) = ADF count > critical value means that the time series data contains a unit root or is not stationary, 2) H1 (δ < 1) = ADF count < critical value means that the time series data do not contain a unit root or it can be said that the data is stationary.

The subsequent analysis is tested to determine the optimal lag length. Information criteria that can be used are (1) Akaike Information Criterion (AIC), (2) Schwartz Information Criterion (SC), (3) Hannan-Quinn Criterion (HQ), (4) Likelihood Ratio (LR), and (5) Final Prediction Error (FPE). Table 3 shows the optimal lag length based on all criteria is lag 1.

Table 3. Optimal Lag Test Results

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-925.6150	NA	1.53e+12	33.73145	33.80445	33.75968
1	-825.5690	189.1779	**4.65e+10***	30.23887	**30.45785***	**30.32355***
2	-823.1587	4.382328	4.93e+10	30.29668	30.66165	30.43782
3	-821.0983	3.596340	5.30e+10	30.36721	30.87817	30.56480
4	-813.5637	12.60326*	4.68e+10	30.23868	30.89563	30.49273
5	-809.5413	6.435848	4.70e+10	30.23787*	31.04080	30.54837

* indicates the lag order chosen by the criterion (each test at 5% level)

b. VAR System Stability Test

After testing the optimal lag on the VAR system used. The next step is to test the stability of the VAR system at the optimal lag. The results of the analysis in Table 4 show that the VAR system in the study is stable.

Table 4. VAR System Stability Test Results

Root	Modulus
0.981635	0.981635
0.675498	0.675498

No root lies outside the unit circle.
VAR satisfies the stability condition.

c. Cointegration Test

The cointegration test in this study was carried out through the Johansen test approach, namely by comparing the trace statistic with the critical value or by comparing the maximum eigenvalue with the critical value used, namely 5%. This test was carried out on the Vector Autoregression (VAR) system using the assumption of a linear deterministic trend (restricted). This assumption was selected based on the best assumptions using the Akaike Information Criteria by Rank (rows) and Model (columns) criteria.

Table 5. Johansen Cointegration Test

Hypothesis	Trace			Max-Eigenvalue		
	Trace-Stat	CV=5%	Prob	Max-Eigen Stat	CV=5%	Prob
None	30.22496	25.87211	0.0135	23.13372	19.38704	0.0136
At most 1	7.091248	12.51798	0.3351	7.091248	12.51798	0.1133

Note: 1) H0 (δ 1) = trace-stat > critical value means the equation is cointegrated, 2) H1 (δ < 1) = trace-stat < critical value means that the equation is not cointegrated. Likewise for max-eigenvalue.

Table 5 explains that at rank = 0 (none) the trace and max-eigenvalue tests show that the equation is cointegrated for a 5% significance level with two linear combinations occurring. This shows that there is a vertical cointegration between the producer and consumer markets for broiler eggs in West Sumatra or other words, it can be interpreted that there is a long-term balance between each variable in the model.

c. Granger Causality Test

The results of the Granger causality test are shown in Table 6.

Table 6. Granger Causality Test

Hypothesis Nol	Obs	F-Stat	Prob
HRGPROD does not Granger Cause HRGKONS	59	5.38808	0.0239**
HRGKONS does not Granger Cause HRGPROD		0.78103	0.3806

*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level

Granger causality test results show that the value of the F statistic and the probability at the producer and consumer level is a one-way causality, namely the price at the producer level is influenced by prices at the consumer level ($\alpha < 0.05$).

Market Integration for Chicken Eggs in West Sumatra

Market integration can be defined as how far the formation of the price of a commodity at the level of certain marketing institutions is influenced by prices at the level of other marketing institutions. This concept is known as vertical market integration. In an efficient market, an integrated market system has a positive relationship over time between price levels in different markets (Heytens, 1986). According to the cointegration test results which show that the equation is cointegrated, the following estimation is used the Vector Error Corrections Model (VECM) (Shang, 2020; Vijayakumar, 2021; Wibowo, 2021). The VECM model will show the long-term and short-term relationship between the producer market price and the consumer price of broiler eggs.

The results of the VECM test in Table 7. show that the error correction term (Error Correction Term) on consumer prices is significant at the 1% level of significance, which is 0.631. This significant value of the ECT coefficient indicates the importance of the long-term relationship in the price formation process in the consumer market. According to (Enders & Silkos, 2001), the ECT coefficient is a measure of the speed of adjustment towards long-run equilibrium between markets. The larger the ECT coefficient, the faster the adjustment towards long-term equilibrium with other markets and vice versa.

Table 7. Producer and Consumer VECM Model Estimation Results

Error Correction	D(HRGKONS)	D(HRGPROD)
CointEq1	-0.630666***	-0.162469
	(0.12427)	(0.16803)
	[-5.07489]	[-0.96689]
D(HRGKONS(-1))	0.425035***	0.136856
	(0.13546)	(0.18316)
	[3.13779]	[0.74721]
D(HRGPROD(-1))	-0.134108	0.010320
	(0.10799)	(0.14602)
	[-1.24181]	[0.07067]
C	69.40004	105.8174
	(51.0428)	(69.0172)
	[1.35964]	[1.53320]
R-squared	0.328840	0.021349

Note: Numbers in [ ] are statistical values,
*** = significance level at 1%, ** = significance level at 5%, * = significance level at 10%,
Value of t table : t(α=1%) = 2.6870, t(α=5%) = 2.0129, t(α=10%) = 1.6787

The ECT value in the consumer market is -0.631, meaning that every month, imbalances that occur in the short term will be corrected by -0.631 by price changes in the consumer market to reach a long-term balance. Meanwhile, at the producer level, the ECT value obtained is not significant, so it can be indicated that there is no adjustment in the long term. In addition, the results of the analysis show that in the short term changes in consumer prices are only influenced by changes in consumer prices themselves in the previous month and are not influenced by changes in producer prices.

This indicates that there is no integration between the consumer market and the producer market in both the long and short term. Unintegrated market conditions illustrate that the market at the consumer level leads to an imperfect competition market (Nuraeni et al., 2015). Generally, the market structure that occurs in agricultural commodities is in the oligopsony market structure (Astaman et al., 2020; Silalahi et al., 2017; Yusri et al., 2007). The market information gap is one of the causes of the market being in a condition of imperfect competition.

Information on producer markets requires a bridge that can educate consumers in purchasing chicken eggs both in terms of quantity and quality produced. (Fearnley, 2021) also stated that consumers need to know information about the quality of the eggs produced. On the other hand, producers also understand that the involvement of other marketing agencies

plays a very important role in determining prices at the consumer level. stated that the bargaining power of producers is lower than that of downstream actors. This of course will have an impact on the price risk faced by producers.

Overall, the results of the VECM analysis show that there is no integration between the broiler egg market at the producer and consumer levels, both in the long and short term. When there is a price change at a market level for broiler eggs, either an increase or a decrease, the price changes that occur at the market level are not responded to. The consequence of a non-integrated market is that price changes that occur in producer markets do not have a full impact on changes in prices received at the consumer level.

CONCLUSION AND SUGGESTION

Conclusion

The following conclusions can be derived from the findings of the research:

1) According to price variation analysis, the average value of the coefficient of variation for the price of broiler eggs in the producer and consumer markets between 2015 and 2019 is 1.86 percent and 2.71 percent respectively. The CV value in the producer market is smaller than the KV value in the consumer market. This situation indicates that the price of broiler eggs in the producer market is relatively more stable than the price in the consumer market, or the demand and supply in the producer market is relatively stable.
2) The results of market integration analysis show there is no integration between the market for broiler eggs at the producer and consumer levels, both in the long and short term. This is due to the information asymmetry between the two markets.

Suggestion

Given the importance of broiler eggs as a food ingredient in West Sumatra, the government must play a role in maintaining price stability through policies that can support the sustainability of marketing chicken eggs.

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