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Price Volatility and Correlation of Animal Protein Food Commodities in South Sulawesi

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Abstract

This study aims to analyze the price fluctuations of beef, broiler chicken, and chicken eggs as sources of animal protein, as well as to analyze the correlation between commodity prices and food inflation in South Sulawesi Province, during 2021–2025. Secondary monthly time series data were obtained from the Strategic Food Price Information Center (PIHPS) and the Central Statistics Agency (BPS). Data were analyzed using coefficient of variation (CV) analysis and Pearson correlation. The results show that beef prices in modern markets fluctuate more (CV 9.16%) than in traditional markets (CV 8.01%), while wholesalers experience the highest volatility in the beef supply chain (CV 11.11%) compared to producers (CV 8.86%) and retailers (CV 8.51%). Broiler chicken prices were more stable in modern markets (CV 12.64%) than in traditional markets (CV 19.82%), but wholesalers again experienced the highest volatility (CV 31.07%), followed by producers (CV 28.56%) and retailers (CV 10.17%). Egg prices were slightly more stable in modern markets than in traditional markets (CV 19.45 vs. 20.24%), while producers recorded the highest volatility (CV 24.06%), followed by wholesalers (CV 21.13%) and retailers (CV 18.54%). Monthly food inflation averaged 0.331% and was highly volatile (CV 5.228%). Pearson correlation analysis revealed a strong and highly significant positive correlation between beef and egg prices ($r=0.759$; $p<0.01$), while the correlations between beef and broiler chicken, and between broiler chicken and eggs, were weak and insignificant. The correlation between each animal protein price and food inflation is negative and statistically insignificant, indicating that food inflation in South Sulawesi is mainly driven by other staple commodities.

Keywords: price volatility, beef, broiler, eggs, food inflation.

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INTRODUCTION

Indonesia's demand for animal-source foods (ASF) has increased in line with income growth and urbanization, with poultry meat and eggs becoming key affordable protein sources while beef remains a higher-value commodity consumed more by higher-income households and during special occasions (Harahap et al., 2023; Warr & Yusuf, 2014; Wibowo et al., 2025). Price instability in ASF markets can directly reduce consumption and household welfare, particularly among low-income families for whom these foods are important sources of protein and micronutrients (Harahap et al., 2023; FAO, 2021).

Since 2020, global food systems have experienced heightened volatility due to COVID-19, the Russia–Ukraine conflict, and climate shocks, with low- and middle-income countries being disproportionately affected (World Bank, 2024; IFPRI, 2024; FAO, 2026). ASF are especially exposed because they depend heavily on imported feed grains, energy, and cold-chain logistics, so shocks in these inputs can translate into amplified price movements for meat and eggs (Javadi et al., 2024; Nazlioglu et al., 2013). In Indonesia, substantial volatility and imperfect market integration have been observed in beef, broiler, and egg markets, alongside asymmetric price transmission along the supply chain (Komalawati et al., 2021; Mubarok et al., 2024; Pratiwi et al., 2025; Saptana & Ilham, 2020).

South Sulawesi is a major production and distribution hub for poultry and fisheries in Eastern Indonesia, with increasing per capita consumption of broiler, eggs, and fish and a large share of households dependent on these foods for protein. At the same time, the province experiences recurrent ASF price spikes around religious holidays and during feed supply disruptions, and its food inflation is highly volatile (Badan Pusat Statistik, 2024). Previous studies show that provincial food inflation in Indonesia is dominated by rice, chili, and a few other staples, but the contribution of ASF can vary according to consumption weights and substitution patterns (Anwar et al., 2023; Hasanah et al., 2025; Lestari, 2025).

Nationally, the government is preparing large-scale nutrition-sensitive programs, such as the Free Nutritious Meals (*Makan Bergizi Gratis*, MBG) initiative, which will likely increase demand for eggs and broiler. Without parallel investments in supply capacity, feed diversification, and logistics, such demand growth could put upward pressure on ASF prices and affect both household welfare and program effectiveness (Harahap et al., 2023; Tenriawaru et al., 2024).

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Despite the strategic role of ASF, there is limited empirical evidence for Eastern Indonesia on (i) how volatile beef, broiler, and egg prices are at different market levels, (ii) how these prices co-move, and (iii) how they relate to local food inflation. This study addresses these gaps by focusing on South Sulawesi Province over the period 2021–2025. Specifically, it aims to: (1) Analyze the magnitude of price fluctuations for beef, broiler chicken, and chicken eggs across market types and marketing levels in South Sulawesi; (2) Examine the correlation structure among beef, broiler, and egg prices; (3) Assess the correlations between these ASF prices and monthly food inflation in the province.

The study contributes to the literature by combining provincial-level price data for multiple market segments with food inflation data, thereby providing an integrated view of ASF price dynamics and their implications for policy in one of Indonesia's key food-producing regions.

RESEARCH METHODS

Study Location

This study was conducted in South Sulawesi Province, Indonesia, located between 0°12′–8°00′ south latitude and 116°48′–122°36′ east longitude with a land area of 45,330.55 km². The province is a major center of poultry and beef production and a key hub for food distribution to Eastern Indonesia (Badan Pusat Statistik, 2025).

Data Sources

This study uses secondary monthly time series data from January 2021 to December 2025. The data sources are:

- The Strategic Food Commodity Price Information Center (PIHPS) for prices of beef, broiler chicken, and eggs at the producer, wholesale, and retail levels in traditional and modern markets.
- The Central Statistics Agency (BPS) for monthly food inflation (food groups) in South Sulawesi.

All price series are expressed in Indonesian rupiah per kilogram and represent the provincial average. Monthly food inflation is measured as the percentage change in the Consumer Price Index for food groups in South Sulawesi.

Analytical Techniques

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This study employs descriptive and inferential statistical methods. Descriptive statistics are used to summarize the level and dispersion of prices and food inflation, and to compare volatility across market types and value-chain levels.

To analyze price fluctuations of animal protein food commodities (beef, chicken, chicken eggs), the Coefficient of Variation (CV) formula is used, as follows:

$$CV = \frac{\sigma}{\overline{X}} x100\%$$

Where: CV = Coefficient of Variation
σ = Standard Deviation
$\overline{X}$ = Average Price

Pearson correlation analysis is used to measure the strength and direction of the relationship between the prices of the animal protein commodities studied. The correlation coefficient (r) indicates whether the relationship between prices is positive, negative, or insignificant. The correlation formula is:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Pearson product–moment correlation coefficients (r) were calculated to assess:

- Pairwise correlations among average beef, broiler, and egg prices.
- Correlations between each ASF price and monthly food inflation.

Correlation strength was interpreted as: |r| = 0 (no correlation), 0–0.25 (very weak), 0.25–0.50 (moderate), 0.50–0.75 (strong), and 0.75–0.99 (very strong) (Gujarati & Porter, 2021). Statistical significance was tested at α = 0.05 and α = 0.01.

RESULTS AND DISCUSSION

Volatility of Animal Protein Prices

Beef prices in South Sulawesi were relatively high and moderately volatile in both traditional and modern markets. In traditional markets, average beef prices during 2021–2025 were IDR 121,315/kg, with a CV of 8.01%, while in modern markets average prices were IDR 166,676/kg with a CV of 9.16%. The highest volatility was observed between late 2022 and early 2023, a period that coincided with global feed and energy price spikes and domestic supply adjustments (World Bank, 2024; FAO, 2026).

Volatility along the beef value chain differed by marketing level. Producer prices averaged IDR 112,752/kg (CV 8.86%), wholesale prices IDR 114,538/kg (CV 11.11%), and retail prices IDR 143,995/kg (CV 8.51%). The higher CV for wholesalers suggests

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greater exposure to both upstream and downstream shocks, consistent with findings of asymmetric price transmission and margin compression in beef markets elsewhere (Erol & Saghaian, 2022; Fousekis et al., 2016; Ogundeji & Maré, 2020).

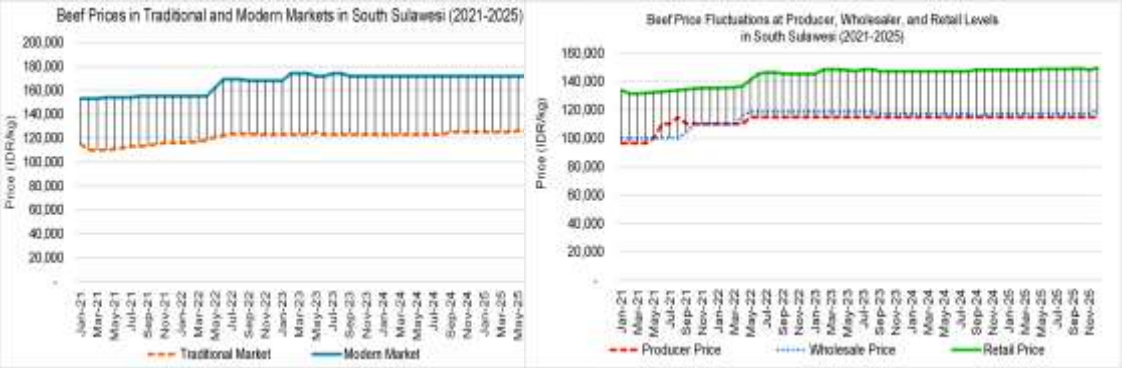


Figure 1. Beef Price Fluctuations in South Sulawesi (2021-2025)

Broiler prices were much more volatile than beef prices, particularly in traditional markets and at upstream levels. Traditional market broiler prices averaged IDR 25,791/kg (CV 19.82%), while modern market prices averaged IDR 43,562/kg (CV 12.64%). At the producer, wholesale, and retail levels, broiler prices averaged IDR 21,168/kg (CV 28.56%), IDR 21,951/kg (CV 31.07%), and IDR 34,676/kg (CV 10.17%), respectively. These results align with studies in other Indonesian provinces showing that broiler producers and wholesalers face substantial price risk due to feed cost volatility and market integration issues, while consumers, especially in modern markets, are relatively protected (Afriani et al., 2022; Saptana & Ilham, 2020).

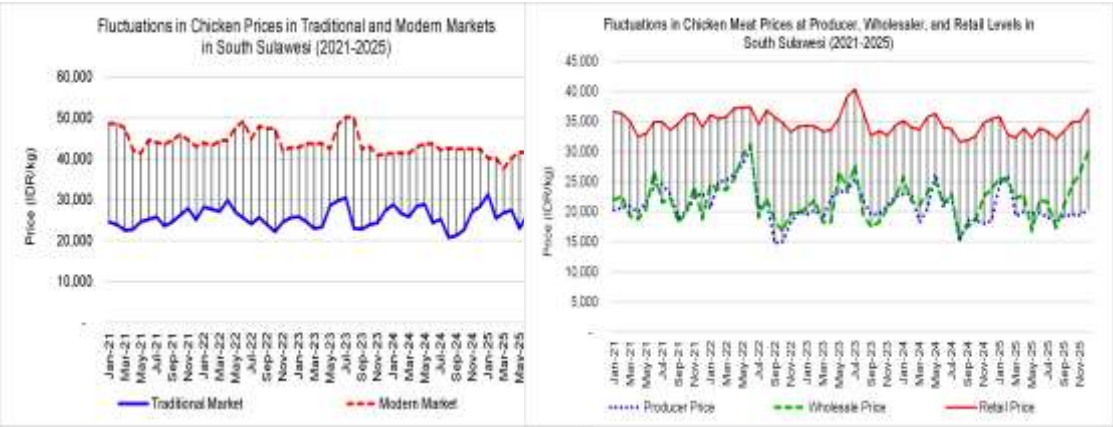


Figure 2. Chicken Meat Price Fluctuations in South Sulawesi (2021-2025)

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Egg prices displayed moderately high volatility in both market types. Traditional market eggs averaged IDR 24,502/kg with a CV of 20.24%, and modern market eggs averaged IDR 30,349/kg with a CV of 19.45%. Along the value chain, producer prices averaged IDR 22,637/kg (CV 24.06%), wholesale prices IDR 24,207/kg (CV 21.13%), and retail prices IDR 27,425/kg (CV 18.54%). These findings corroborate evidence that egg producers in Indonesia are particularly vulnerable to feed price and demand shocks and that price volatility tends to be higher upstream than at retail (Girsang et al., 2023; Javadi et al., 2024).

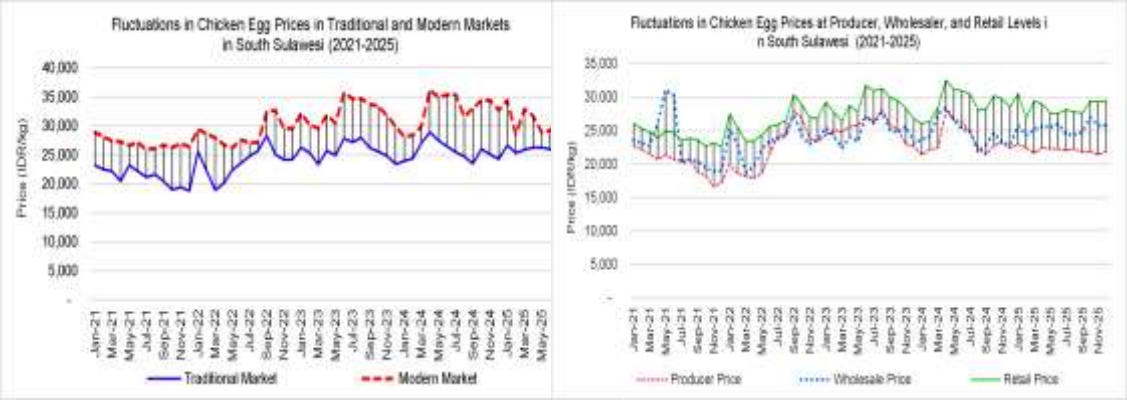


Figure 3. Chicken Egg Price Fluctuations in South Sulawesi (2021-2025)

Overall, the volatility patterns highlight that producers and wholesalers of beef, broiler, and eggs bear greater price risk than retailers and consumers, especially in traditional markets. This suggests that policy interventions should focus on reducing upstream volatility through improved access to affordable feed, credit, and risk-sharing mechanisms, and through strengthening farmer organizations and cooperative marketing arrangements (Barrett & Bellemare, 2011; Glauber, 2007).

Table 1. Price Volatility of Beef, Broiler, and Eggs in South Sulawesi, 2021–2025

Commodity /Segment	Mean Price (IDR/kg)	Min (IDR/kg)	Max (IDR/kg)	Std. dev. (IDR/kg)	Coefficient of Variation (CV)
Beef – traditional market	121,315	110,000	127,500	9,721	0.0801
Beef – modern market	166,676	153,100	174,200	15,261	0.0916

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Commodity /Segment	Mean Price (IDR/kg)	Min (IDR/kg)	Max (IDR/kg)	Std. dev. (IDR/kg)	Coefficient of Variation (CV)
Beef – producer level	112,752	96,650	115,000	9,991	0.0886
Beef – wholesaler level	114,538	100,250	120,000	12,730	0.1111
Beef – retailer level	143,995	131,550	149,600	12,247	0.0851
Broiler – traditional market	25,791	20,750	32,950	5,111	0.1982
Broiler – modern market	43,562	37,700	50,200	5,508	0.1264
Broiler – producer level	21,168	14,750	30,500	6,046	0.2856
Broiler – wholesaler level	21,951	15,750	31,150	6,819	0.3107
Broiler – retailer level	34,676	31,675	40,325	3,527	0.1017
Eggs – traditional market	24,502	18,800	28,900	4,959	0.2024
Eggs – modern market	30,349	25,850	36,200	5,904	0.1945
Eggs – producer level	22,637	16,600	28,150	5,447	0.2406
Eggs – wholesaler level	24,207	18,700	31,050	5,115	0.2113
Eggs – retailer level	27,425	22,600	32,550	5,084	0.1854
Food inflation – foodstuffs group	0.331%	–1.28%	2.80%	1.732	5.228

Source: Secondary data analysis, 2026.

Food inflation in South Sulawesi during 2021–2025 was characterized by high month-to-month variability but no strong long-term trend. The average monthly foodstuffs inflation rate was 0.331%, with values ranging from –1.28% (October 2022) to 2.80%

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(April 2022). The coefficient of variation (CV = 5.228) indicates substantial instability relative to the mean.

Correlations between Animal Protein Food Prices and Food Inflation

Correlation analysis indicates that only one pair of ASF prices exhibits a strong and statistically significant relationship. The correlation between beef and egg prices is strongly positive ($r = 0.759$; $p < 0.01$), implying that these two commodities tend to move together over time. This co-movement likely reflects shared upstream drivers, especially feed costs and logistics, and synchronized demand peaks around religious holidays and other events (Mubarok et al., 2025; Tenriawaru et al., 2024).

By contrast, the correlation between beef and broiler prices is weak and negative ($r = –0.165$; $p = 0.207$), and the correlation between broiler and egg prices is near zero ($r = 0.016$; $p = 0.906$). These results suggest that broiler markets in South Sulawesi are partially decoupled from beef and egg markets, probably because of differences in production systems, market structures, and consumer segments (Harahap et al., 2023; Girsang et al., 2023).

Table 2. Correlations among Beef, Broiler, and Egg Prices and Food Inflation in South Sulawesi, 2021–2025

Variable pair	Correlation coefficient (r)	p-value	Interpretation
Beef – broiler	–0.165	0.207	Weak negative, not significant
Beef – eggs	0.759	0.000	Strong positive, highly significant
Broiler – eggs	0.016	0.906	Very weak, not significant
Beef – food inflation	–0.119	0.366	Weak negative, not significant
Broiler – food inflation	–0.081	0.540	Very weak negative, not significant
Eggs – food inflation	–0.159	0.225	Weak negative, not significant

Source: Secondary data analysis, 2026.

Correlations between ASF prices and food inflation are negative and statistically insignificant: beef–inflation ($r = –0.119$; $p = 0.366$), broiler–inflation ($r = –0.081$; $p = 0.540$), and egg–inflation ($r = –0.159$; $p = 0.225$). This contrasts with macro-level evidence that food prices, including ASF, generally have positive relationships with inflation indices

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(Rizvi et al., 2020; Siregar et al., 2025). At the provincial level, the insignificance of these correlations suggests that food inflation in South Sulawesi is driven mainly by other items with larger CPI weights, such as rice and chili, and that substitution among ASF and between ASF and plant-based foods further dampens their net effect on aggregate food inflation (Harahap et al., 2023).

These findings support the view that, in South Sulawesi, ASF price stabilization should be treated primarily as a nutrition and welfare issue rather than as a key instrument for inflation control. Policy design should therefore distinguish between “inflation-critical” staples and “nutrition-critical” ASF and use tailored tools for each category (FAO, 2021; World Bank, 2024).

CONCLUSION

This study showed that prices of beef, broiler chicken, and chicken eggs in South Sulawesi during 2021–2025 were highly volatile, with producers and wholesalers experiencing greater price risk than retailers and consumers, especially in traditional markets. Beef and egg prices exhibited strong upward trends across markets and value-chain levels, while broiler prices declined in modern markets and at the farm level but remained volatile upstream. Monthly food inflation in the province was highly unstable but did not display a significant long-term trend, and its correlations with ASF prices were weak and negative.

A key empirical finding is the strong positive correlation between beef and egg prices, indicating common upstream drivers and synchronized demand shocks, contrasted with weak correlations between broiler and egg prices and between ASF prices and food inflation. These results imply that:

1. Producer- and wholesaler-level interventions are essential to manage price risk, particularly through feed cost stabilization, access to credit and insurance, and cooperative marketing arrangements.
2. ASF policies in South Sulawesi should be framed as nutrition and welfare interventions, given their limited direct impact on provincial food inflation, and should be aligned with national nutrition programs such as MBG.
3. Integrated stabilization strategies targeting common upstream drivers, especially feed costs and logistics, are needed to prevent joint spikes in beef and egg prices.
4. Anticipatory planning for demand growth is critical, including investments in local ASF production capacity, feed diversification, and cold-chain and transport

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infrastructure, so that future increases in demand from school feeding and other programs do not trigger excessive price volatility.

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