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HOW BEEF, CHICKEN, AND EGG DEMAND ELASTICITIES VARY WITH INCOME IN INDONESIA

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ABSTRACT

Regional economic factors, income levels, and the availability of substitutes influence the demand for beef, chicken, and eggs in Indonesia. Beef is considered a luxury commodity in higher-income areas and exhibits greater price sensitivity in lower-GDP regions. Chicken, a staple protein source, generally demonstrates inelastic demand but increases price sensitivity in the lower GDP areas. Eggs, being more affordable, exhibit higher price elasticity, particularly in lower-GDP regions, and often complement beef consumption. This study examines the own-price, cross-price, and income elasticities for beef, chicken, and eggs in Indonesia, comparing these effects across provinces with varying income per capita levels. The research utilized secondary data from the Central Statistics Agency, encompassing per capita commodity consumption, consumption values, and prices from 2013 to 2023 across 33 provinces. The Almost Ideal Demand System (AIDS) model analyzed the interrelated consumption of beef, broiler chicken, and eggs. Certain provinces were excluded due to data limitations, particularly in newly formed regions with insufficient historical records. The findings of this research indicate that price sensitivity, regional economic factors, and consumer preferences influence the demand for beef, chicken, and eggs. Income disparities affect substitution patterns, wherein rising chicken prices lead to increased beef consumption, while eggs complement beef and premium varieties are perceived as luxury goods. Consequently, there is a

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necessity for policies addressing regional economic disparities, food security, and affordability, especially as premium products such as organic eggs become more prevalent and the cost of animal proteins increases.

Keywords: *AIDS, beef, chicken, demand, elasticity*

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INTRODUCTION

Demand for food is dynamic and influenced by various factors, including income and prices (Muzayyanah et al., 2017; Novarista & Syahni, 2013; Ugwumba & Effiong, 2013). Increased beef, chicken, and egg consumption in Indonesia has led to significant price fluctuations. Price increases are primarily attributable to increased feed costs, which differentially affect income groups. High-income consumers tend to exhibit inelastic demand, while low-income consumers experience more significant pressure on their purchasing power. Consequently, food price volatility disproportionately impacts the economic well-being of different income groups.

As an upper middle-income country, Indonesia recorded an annual economic growth of 5%, driven by the industry, trade, and services sectors. The post-COVID-19 economic recovery has been rapid; however, income distribution remains unequal, with the Gini Coefficient ranging from 0.37 to 0.39 (Badan Pusat Statistik, 2023). Significant income disparities between provinces reflect differences in access to economic resources. Although the government has implemented various poverty alleviation programs, economic inequality remains a significant challenge in promoting more inclusive growth.

In the context of income inequality, consumption inequality has also increased, albeit slower (Jappelli & Pistaferri, 2010; Krueger & Perri, 2006). Consumers demonstrate more excellent responsiveness to long-term changes in income than to short-term fluctuations or transitory shocks. Furthermore, consumers' sensitivity to price changes depends on the purchase frequency of a good (D'Acunto et al., 2021). Frequently purchased goods, such as staple foods, are more susceptible to price changes as their impact accumulates in the household budget.

In contrast, infrequently consumed luxury goods exhibit lower price elasticities as consumers do not immediately experience the financial impact of a temporary price increase. However, structural price changes can exacerbate income and consumption inequality, particularly in food. Low-income households allocate a more significant proportion of their income to food. Thus,

rising food prices can restrict their access to adequate nutrition. Food inflation further intensifies inequality by diminishing the purchasing power of middle- and low-income groups.

In Indonesia, income inequality varies between urban and rural areas. The Gini ratio ranges from 0.39 to 0.42 in large cities, indicating higher inequality than in rural areas (Badan Pusat Statistik, 2023). Rapid urbanization has resulted in the concentration of wealth among certain groups, particularly in the high-income sector. Consequently, increases in the price of essential food items, such as meat and eggs, disproportionately affect low-income urban communities. Workers in the informal sector generally have unstable incomes and are the most vulnerable to food price pressures.

Income inequality between provinces is also influenced by urbanization, economic growth, and dependence on specific sectors (Andari, 2020; Putra et al., 2020). Provinces that rely on extractive industries often demonstrate greater inequality due to uneven wealth distribution. Conversely, regions with a dominant agricultural sector tend to exhibit lower inequality but still face challenges in ensuring equitable distribution of rural wealth. Lusk and Tonsor (2016) found that meat demand is nonlinear, where price elasticity varies at different price levels. As prices increase, demand becomes more inelastic. High-income consumers are more responsive to price variations and select higher-quality products. At the same time, low-income groups are more sensitive to changes in the price of the meat they consume regularly.

Concurrent with economic growth, the size of Indonesia's middle class is expanding, driving increased demand for meat, particularly poultry (Bank Indonesia, 2024). While demand for beef has also risen, it remains a luxury item compared to chicken or fish. Inflationary pressures and escalating living costs may constrain beef consumption, especially in provinces characterized by lower economic growth and high levels of inequality.

Previous research on meat demand in Indonesia has primarily focused on national-level and urban household analyses (Anindita et al., 2022; Pangaribowo & Tsegai, 2011; Umaroh & Vinantia, 2018; Widarjono & Mumpuni Ruchba, 2021). However, these studies have not fully addressed regional variations in meat consumption patterns. Geographical, cultural, and economic factors in different provinces contribute to price and income elasticity disparities, which could yield more comprehensive insights into food policy and nutrition security in Indonesia.

This study analyzes the linkages between the demand for beef, chicken meat, and eggs in different regions in Indonesia. In addition, it will evaluate the substitution effect and the influence of income level on the consumption pattern of the three commodities based on economic and demographic characteristics in each region to gain a more comprehensive understanding of the dynamics of animal food demand at the regional level.

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RESEARCH METHOD

The research was conducted using secondary data published by the Central Statistics Agency (Badan Pusat Statistik, 2023). The data used in this study includes per capita commodity consumption, commodity consumption values, and commodity prices from 2013 to 2023. This study utilizes consumption data from 33 provinces in Indonesia, chosen for their ability to represent the broader consumption patterns across the country. These provinces span various key islands and archipelagos, ensuring that different regions' geographic diversity and consumption characteristics are adequately captured. The selection of provinces was primarily based on data availability for analysis. Some provinces were excluded from the study due to significant data limitations. These limitations are particularly evident in newly formed provinces, where historical data is sparse, often only covering the past two to three years. Additionally, certain provinces face data reporting or record-keeping challenges, resulting in incomplete data for the variables needed in this research.

This study analyses the demand for animal-based food products, namely beef, broiler chicken, and chicken eggs. Mudassar et al. (2012) assert that how households adjust their consumption in response to fluctuations in income and prices is a key factor in determining the impact of various disruptions to market prices and commodity availability. The consumption of these products is suspected to be interrelated. Therefore, the Almost Ideal Demand System (AIDS) analyses per capita beef consumption, broiler chicken, and chicken eggs. Deaton & Muellbauer (1980) introduced the AIDS (Almost Ideal Demand System), a demand function model that offers several advantages over other demand system models. These advantages include: It provides a first-order approximation for all demand systems; It precisely satisfies the axioms of choice; It allows for accurate consumer aggregation; It is straightforward to estimate in linear form; It enables testing of homogeneity and symmetry properties through simple parameter restrictions; It has a functional form consistent with consumer budget data (Deaton & Muellbauer, 1980).

This study employs the Almost Ideal Demand System (AIDS) due to its superior flexibility in estimating own-price, cross-price, and income elasticities compared to alternative demand models. The Linear Expenditure System (LES) is frequently utilized in food demand studies; however, this model assumes minimum consumption and inadequately captures substitution between items, rendering it less appropriate for analyzing the dynamics of beef, chicken, and egg consumption. Conversely, the Quadratic AIDS (QUAIDS) model, an extension of AIDS, allows for curvature in the relationship between income and consumption but necessitates more complex parameter estimation and requires more comprehensive data. AIDS model employed in research (Anindita et al., 2022; Pangaribowo & Tsegai, 2011; Umaroh & Vinantia, 2018; Widarjono & Mumpuni Ruchba, 2021) but did not account for variations in elasticity among

provinces. Sinaga et al. (2022) utilized AIDS; however, their focus was limited to price elasticity without considering income inequality. Suryana et al. (2019) emphasized food consumption patterns without exploring cross-elasticity among animal protein products.

Static-demand systems, such as the LA-AIDS model, assume that consumers quickly adjust to a new long-run equilibrium after a shock. Barnett & Seck (2008) highlight that the AIDS model aggregates data efficiently, satisfies the axiom of choice, is relatively simple to estimate, and enables the imposition and empirical testing of theoretical restrictions like homogeneity and symmetry. While these restrictions hold in short-run models, they may be rejected when attempting to capture long-run effects. The LA-AIDS model is estimated using Zellner (1962) iterated seemingly unrelated regression (ISUR) method to handle correlations between equations. To prevent singularity in the variance-covariance matrix, one share equation is omitted during estimation and later recovered post-estimation by applying the adding-up restriction. However, linear demand models may not provide an accurate approximation for non-linear demand behaviour, and the linearization in demand models can distort cross-price relationships between goods (Barnett & Seck, 2008). Despite this, linear demand model estimation can still perform reasonably well when the substitution between goods is low.

Deaton & Muellbauer (1980) stated that the AIDS model produces two key demand elasticities: price and expenditure. The model satisfies the foundational assumptions of Homogeneity, Adding-Up, and Slutsky Symmetry in-demand functions. It is derived from a second-order approximation of the indirect utility function, which is expressed in a form linear in the logarithm of total income.

The AIDS model is well-suited for analyzing various aspects of food demand and its components (Anindita et al., 2020). Coefficient estimates from the model can be converted to derive elasticity estimates, providing insights into consumer price and expenditure responsiveness). The AIDS model has been widely used in studies on meat demand. In Indonesia, Ani & Antriyandarti (2019) applied the AIDS model to analyze household demand for chicken meat in Yogyakarta. The study utilized household social and economic survey data from 2017 to examine household behaviour. The empirical results revealed that the price elasticity of chicken meat was inelastic. The study also highlighted an inverse relationship between household expenditure and the budget share for chicken meat while showing a direct relationship between the price of chicken meat and its budget share.

The AIDS model, developed by Deaton & Muellbauer (1980), can estimate multiple equations involving interrelated groups of commodities. It is derived from a utility function.

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$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} ln\rho_j + \beta_i ln\left(\frac{x}{a(p)}\right) + e_i \quad (1)$$

Where i and j represent types of goods; w_i is the budget share allocated to good i; p_j is the price of good j; x is household expenditure on the analyzed commodities; $a(p)$ is the stone price index; and α, γ, dan β are the estimated parameters; and $e_i$is the standard error.

To satisfy demand theory, estimating the AIDS model requires certain restrictions, including adding-up, homogeneity, and Slutsky symmetry. Therefore, these restrictions can be formulated based on the model as follows.

$$\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \beta_i = 0, \sum_{i=1}^{n} \gamma_{ij} = 0 \text{ (adding up)} \quad (2)$$

$$\sum_{i=1}^{n} \gamma_{ij} = 0 \text{ (Hommogeneity)} \quad (3)$$

$$\gamma_{ij} = \gamma_{ji} \text{ (Slustsky Symmetry)} \quad (4)$$

Zellner's application of Generalized Least Squares (GLS) to the SUR model in the AIDS framework assumes homoscedastic and non-autocorrelated disturbances within each equation while allowing for correlations between disturbances across different equations. The Breusch-Pagan test's χ^2 statistic is employed to assess the estimates' robustness. This test significantly rejects the null hypothesis of no contemporaneous correlation between disturbance terms across equations at the 5% level, confirming the reliability of the regression results. Additionally, the Wald statistic is used to test the validity of the homogeneity and symmetry restrictions imposed on the system of demand equations. The Durbin-Watson test is applied to check for autocorrelation, although the GLS estimator for the SUR model remains efficient even when autocorrelation is present.

To calculate each commodity's elasticity, own-price elasticity, cross-price elasticity, and expenditure elasticity are used. The elasticity calculations can be formulated as follows.

$$e_{ii} = -1 + \left(\frac{\gamma_{ij}}{w_i}\right) - \beta_i \text{ (own price elasticity)} \quad (5)$$

$$e_{ij} = \left(\frac{\gamma_{ij}}{w_i}\right) - \beta_i\left(\frac{w_j}{w_i}\right) - \delta_{ij} \text{ (cross price elasticity)} \quad (6)$$

$$e_i = 1 + \frac{1}{w_i}(\beta_{ij}) \text{ (income elasticity)} \quad (7)$$

This study estimates three commodities: beef, broiler chicken, and eggs. These three animal-based food sources are assumed to be interrelated, meaning

that consumption decisions for one commodity will affect the consumption levels of the others. Therefore, the AIDS equation model is used. The equation model for each food source is formulated as follows.

$$w_b = \alpha_b + \gamma_{bb} l\eta\rho_b + \gamma_{bc} l\eta\rho_c + \gamma_{be} l\eta\rho_e + \beta_b l\eta\left(\frac{x}{a(p)}\right) + e_b \quad (8)$$

$$w_c = \alpha_c + \gamma_{cb} l\eta\rho_b + \gamma_{cc} l\eta\rho_c + \gamma_{ce} l\eta\rho_e + \beta_b l\eta\left(\frac{x}{a(p)}\right) + e_c \quad (9)$$

$$w_e = \alpha_e + \gamma_{be} l\eta\rho_b + \gamma_{ce} l\eta\rho_c + \gamma_{ee} l\eta\rho_e + \beta_b l\eta\left(\frac{x}{a(p)}\right) + e_e \quad (10)$$

Where b represents beef, c represents broiler chicken, and e represents broiler chicken eggs.

RESULT AND DISCUSSION

Engel's law posits that as household earnings increase, the share of income devoted to food diminishes while the portion allocated to other goods grows (Clements & Si, 2018). In developing economies, food expenditure constitutes a significant fraction of total per capita spending, often nearing 50% (Faharuddin et al., 2015). Hayat et al. (2016) suggest a direct relationship exists between the percentage of income spent on food, market prices, and income levels. The escalation in food expenditure percentages indicates rising poverty rates and heightened vulnerability to food insecurity. More expenses are typically allocated to food in rural regions than in urban areas (Devi & Purnomosidi, 2019).

Own Price Elasticity

The own-price elasticity value indicates the impact of price changes of a commodity on its consumption level (Afifi, 2022; Naheed & Hussain, 2024). Based on the calculations for the three animal-based protein commodities studied, the own-price elasticity values for all these commodities mostly have a negative sign in each region, which aligns with demand theory. The negative sign means that if the price increases, the quantity consumed of the commodity will decrease, resulting in a decline in expenditure share. It must be noted that although a negative sign is attached to the own-price elasticities, interpretation ignores this negative sign and considers the elasticity value in absolute terms. In addition, an elasticity value greater than one in absolute terms would mean that the good in question has elastic demand or is very responsive to changes in its price (Khoiriyah et al., 2023, 2024)

Table 1. Own-Price Elasticity for the 33 Provinces in Indonesia.

No.	Province	Beef	Chicken	Egg	GDP/Capita (000 IDR)
1	Aceh	-0.521	-0.757**	-1.610*	26,800.13
2	Sumatera Utara	-0.995	-1.370***	-0.932***	39,140.19
3	Sumatera Barat	-0.822	-0.997***	-0.627	33,188.21
4	Riau	-1.831	-0.928***	-0.401	83,070.74
5	Jambi	-0.812	-0.989***	-1.030**	46,007.34
6	Sumatera Selatan	-0.151	-0.968***	-0.987***	41,277.53
7	Bengkulu	-0.124	-1.083***	-1.211**	24,947.62
8	Lampung	-0.854	-1.147***	-0.774***	28,907.12
9	Kep. Bangka Belitung	-3.913	-0.725	-2.161**	39.908,84
10	Kepulauan Riau	-1.810*	-0.317	-4.631	92,930.2
11	Jakarta	-2.361	-0.629	-0.567	192,133.32
12	Jawa Barat	-1.089**	-0.694***	-0.614***	33,481.87
13	Jawa Tengah	-0.404	-1.422***	-0.511	29,369.6
14	DIY	-0.677	-1.339***	-0.963**	31,748.21
15	Jawa Timur	-0.158	-1.298***	-1.080	44,423.32
16	Bali	-0.278	-0.887***	-1.352***	36,203.02
17	Banten	-1.213*	-0.624***	-0.840***	41,228.33
18	NTB	-0.475	-1.154***	-0.644***	18,687.15
19	NTT	-3.728***	-0.700**	-0.917***	13,513.49
20	Kalimantan Tengah	-0.870	-0.690***	-1.616***	27,560.34
21	Kalimantan Barat	-2.897	-0.930***	-1.849**	40,959.59
22	Kalimantan Selatan	-1.294	-0.558***	-1.939***	35,343.25
23	Kalimantan Timur	-1.884*	-0.929***	-0.664	137,510.39
24	Sulawesi Utara	-3.697	-0.912	-1.642***	38,064.2
25	Sulawesi Tengah	-0.695*	-1.256	-0.718***	62,584.06
26	Sulawesi Selatan	-0.857	-1.164***	-1.030***	40,285.25
27	Sulawesi Tenggara	-0.796	-0.565***	-1.536***	39,342.46
28	Gorontalo	-0.122	-1.037***	-1.766***	26,086.44
29	Maluku	-1.545	-0.612***	-1.059***	18,392.66
30	Sulawesi Barat	-0.618	-0.956***	-0.813**	23,919.08
31	Maluku Utara	-0.578	-1.123*	-0.921*	36,267.29
32	Papua Barat	-0.175	-0.821***	-1.253***	71,904.88
33	Papua	-0.392	-0.941***	-1.305***	47,323.87

*significance 10%, **significance 5%, ***significance 1%

Based on the calculation of the own-price elasticity, the highest elasticity is found for beef demand (Arifatus et al., 2019; Maina & Yusuf, 2023). Based on calculations of own-price elasticity, the highest elasticity for beef demand was

found in Nusa Tenggara Timur (NTT) at -3.728 (Arifatus et al., 2019; Maina & Yusuf, 2023). This means that a 1% increase in beef prices in NTT would result in a 3.728% decrease in beef consumption. NTT is a key beef-producing province in Indonesia, thanks to its large cattle farming industry, which plays a significant role in the local economy. However, despite being an important producer, NTT is not the top beef producer compared to Java, which has a larger-scale production. NTT is known for its strong livestock culture, and beef is an important part of the diet, especially during traditional celebrations and feasts. However, the region's beef production is often insufficient to meet local demand. As NTT is considered one of the lower GDP regions in Indonesia, an increase in beef prices may lead to a significant reduction in local consumption, as residents are more sensitive to price changes.

Most provinces in Indonesia show that the demand elasticity of beef is insignificant, reflecting that beef is more often considered a luxury good with limited substitutes. Widarjono & Mumpuni Ruchba (2021) found that the price elasticity of beef is lower than that of chicken, indicating that consumers do not easily substitute beef consumption despite price increases. This is in line with Pangaribowo & Tsegai (2011) findings that the elasticity of demand for beef in Indonesia is smaller than other protein sources, such as chicken and fish. In addition, Sinaga et al. (2022) revealed that beef consumption in Indonesia is relatively low compared to the consumption of other animal proteins, such as chicken and fish, which are more commonly used as the primary source of protein in the daily diet. Beef is more often consumed in certain cultural events and celebrations, as confirmed by Anindita et al. (2022), who found that beef demand tends to increase during major religious holidays, such as Idul Fitri and Idul Adha. This high cultural value causes people to continue to buy beef despite increasing prices, as noted in Mahbubi & Uchiyama (2019) study, which showed that social factors influence beef demand. Sugiharto et al. (2023) that social factors and tradition play an important role in beef consumption decisions in Indonesia. Therefore, despite increasing beef prices, demand remains stable due to limited substitutes and the cultural significance inherent in Indonesian consumption patterns.

Most chicken demand in Indonesia exhibits significant negative inelasticity, meaning it is less sensitive to price changes. This is because chicken is a staple protein in the Indonesian diet, offering an affordable alternative to more expensive meats like beef or lamb. As a result, chicken is the preferred meat choice for many middle- and lower-income households. Additionally, the abundant availability of chicken, supported by partnerships between large poultry companies like Charoen Pokphand and Japfa with local farmers, ensures a steady supply. There are no perfect substitutes for chicken, which remains the most cost-effective option for the lower- and middle-income segments, further contributing to its inelastic demand.

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Provinces with higher GDP tend to have less elastic chicken demand than provinces with moderate or lower GDP. This suggests that consumers may have more disposable income in wealthier regions, allowing them to absorb price increases more easily without significantly altering their consumption patterns. In these areas, chicken is often seen as an affordable and regular part of the diet. However, price changes may not drastically affect consumption due to the greater purchasing power of residents.

Any increase in chicken prices in provinces with lower GDP is more likely to have a noticeable impact on consumption, as consumers may cut back on purchases or switch to cheaper alternatives like tofu or tempeh. In these areas, price sensitivity is greater, and demand for chicken becomes more elastic. This disparity between high-GDP and low-GDP provinces reflects broader economic inequalities across Indonesia. In wealthier provinces, consumers are less constrained by price increases and can maintain their consumption habits even with rising prices. However, in less affluent areas, price fluctuations can significantly affect spending choices and food consumption patterns, highlighting the economic divide and the sensitivity of lower-income segments to changes in food prices.

The most elastic own-price elasticity for chicken was found in Central Java (Jawa Tengah) at -1.422. This means that if the price of chicken increases by 1 per cent in Central Java, chicken consumption will decrease by 1.422 per cent. On the other hand, the lowest own-price elasticity for chicken was found in the Riau Islands region, at -0.317. This means that if the price of chicken increases by 1 per cent in the Riau Islands, chicken consumption will decrease by 0.317 per cent.

The own-price elasticity of demand for eggs is higher than for chicken and beef, primarily because eggs are consumed more frequently and are more affordable. Additionally, eggs have a variety of substitutes, such as tofu and tempeh, which makes it easier for consumers to switch to alternatives if egg prices rise. Eggs are also commonly consumed by lower- and middle-income households, making their demand more sensitive to price changes. Typically, these income segments purchase eggs in larger quantities, so even a slight price increase can significantly reduce demand as consumers seek to cut costs. Furthermore, eggs are not as culturally essential or consistently consumed as chicken, which holds a more prominent place in many diets. As a result, consumers are likely to adjust their consumption of eggs when prices change.

The highest own-price egg elasticity was found in the Bangka Belitung Islands at -2.161. This means that a 1% increase in the price of eggs in this region would result in a 2.161% decrease in egg consumption. This relatively high elasticity indicates that consumers in Bangka Belitung Islands are susceptible to price changes, likely due to the region's economic conditions, consumer habits, and availability of substitutes.

Furthermore, the own-price elasticity of egg demand tends to be less elastic in regions with higher GDP. In wealthier provinces, consumers generally have higher disposable incomes, which makes them less sensitive to price increases. This means that, even if the price of eggs rises, the demand reduction is less pronounced than in regions with lower GDP. In higher-income areas, eggs may not be the primary protein source, and people may recognize price increases without significantly altering their consumption habits. Conversely, in regions with lower GDP, eggs are likely to be a staple food, and consumers may be more price-sensitive, making their demand for eggs more elastic.

The demand for beef, chicken, and eggs in Indonesia exhibits varying levels of price sensitivity, influenced by regional economic conditions, consumer behaviour, and the availability of substitutes. Beef is generally seen as a luxury good, with higher price sensitivity in lower-GDP regions like NTT, where price increases lead to significant reductions in consumption. However, in higher-GDP regions, beef demand tends to be less elastic, reflecting greater purchasing power and the cultural importance of beef during special occasions. As a staple protein, chicken displays inelastic demand overall, with the most significant price sensitivity observed in lower-GDP regions, where consumers are more affected by price fluctuations. In wealthier provinces, chicken remains an affordable option even with price increases. Similarly, the demand for eggs is more elastic than for beef and chicken due to their affordability and frequency of consumption, with lower-GDP regions showing higher price sensitivity. As a result, regional differences in GDP and income levels significantly shape the elasticity of demand for these animal-based protein sources, highlighting the broader economic inequalities and the varying purchasing power of Indonesian consumers.

Cross Price Elasticity

The compensated own-price elasticity measures the percentage change in demand for a good when its price increases by 1 per cent while holding the consumer's income constant (Roosen et al., 2022; Salsabila et al., 2023). This metric provides insights into how consumers adjust their purchasing behaviour in response to price changes, assuming no change in their purchasing power (Delport et al., 2017; Ghide et al., 2024). When the cross-price elasticity value is positive, it indicates that the commodities are substitutes, meaning an increase in the price of one good leads to an increase in demand for the other. Conversely, a negative cross-price elasticity suggests that the goods are complements, where a price increase in one good reduces demand for the other.

Table 2 illustrates that most cross-price elasticities between beef, chicken, and eggs are insignificant. Furthermore, the regions with significant demand elasticity estimates tend to exhibit less elastic demand, suggesting that meat consumption in most provinces is relatively insensitive to price changes in other

meat products. This indicates that in many areas, the demand for one type of meat is not strongly influenced by changes in the price of another, reflecting a more inelastic response to price fluctuations in the meat market.

Table 2. Cross Price Elasticity for the 33 Provinces in Indonesia

No	Province	BC	BE	CB	CE	EB	EC
1	Aceh	1.608***	0.973	0.041	-0.389	-1.610	-0.583*
2	Sumatera Utara	3.727**	2.461**	-0.226	-0.405**	-0.055	-0.158
3	Sumatera Barat	0.566	0.639	-0.302	-0.515	0.297	-0.229
4	Riau	2.281	-0.534	0.259	-0.355	-0.167	-0.603**
5	Jambi	1.390	-1.349	0.340	0.209	-0.577	-0.326
6	Sumatera Selatan	0.454	0.762	-0.167	-0.140	0.026	-0.132
7	Bengkulu	3.135**	1.609	0.155	-0.121	-0.467*	-0.615**
8	Lampung	6.534**	-1.814*	0.598*	0.004	-0.624**	-0.677*
9	Kep. Bangka Belitung	2.151	6.588	0.273	0.045	-0.702	-0.938
10	Kepulauan Riau	-3.929	-3.110*	2.904*	1.791*	-1.407*	0.054
11	Jakarta	-2.382	-0.950	-0.346	0.235	1.694	1.428
12	Jawa Barat	-1.781***	-1.617***	-0.070	0.131	0.126	0.208
13	Jawa Tengah	1.215	2.408	-0.494	-0.726	0.372	0.315
14	DIY	1.478	2.419	-0.253	-0.436	0.263	0.119
15	Jawa Timur	-0.956	2.269**	-1.298***	-0.859**	0.953*	0.796*
16	Bali	1.382	-0.720	0.132	0.215	-0.329*	-0.355*
17	Banten	2.529	-1.206**	0.759*	0.184*	-1.025*	-1.438*
18	NTB	0.586*	-0.458*	-0.081	-0.070	-0.193	-0.130
19	NTT	2.735**	-0.591	0.796***	0.093	-0.217	-1.579***
20	Kalimantan Tengah	-0.135	0.171	0.279**	0.345***	-0.497**	-0.514**
21	Kalimantan Barat	5.562***	7.520***	-0.071	-0.228	-0.508	-0.970**
22	Kalimantan Selatan	-0.026	0.134	0.482**	0.716***	-0.578**	-0.564**
23	Kalimantan Timur	2.938***	-3.186	0.628***	0.298*	-0.678*	-0.799*
24	Sulawesi Utara	6.704*	9.064*	-0.089	-0.286	-0.384	-0.734*
25	Sulawesi Tengah	0.489	1.363	-0.477*	-0.627	0.338	0.127
26	Sulawesi Selatan	0.640	0.602	-0.127	-0.058	0.092	0.058
27	Sulawesi Tenggara	0.749	0.289	0.331*	0.706***	-0.261	-0.408**
28	Gorontalo	1.345**	2.001**	0.040	0.146	-0.385**	-0.371**
29	Maluku	0.795	-2.680	0.524*	0.330	-0.389*	-0.384*
30	Sulawesi Barat	-1.357	2.138	-0.184	-0.475	0.107	0.074
31	Maluku Utara	-0.826	1.027	-0.273	-0.281	0.130	0.152
32	Papua Barat	3.089***	0.771	0.316*	0.150	-0.424***	-0.593***
33	Papua	-0.703	0.760	-0.052	0.117	0.007	-0.007

Note: BC: Beef-Chicken; BE: Beef-Egg; CB: Chicken-Beef; CE: Chicken-Egg; EB: Egg-Beef; EC: Egg-Chicken

*significance 10%, **significance 5%, ***significance 1%

The research reveals that only 12 provinces show significant cross-price elasticity between beef and chicken demand. In comparison, the remaining 21 provinces exhibit no notable relationship between changes in beef prices and chicken consumption. Among the provinces with significant elasticity, beef is found to be a substitute for chicken in 10 regions. For example, in Riau Islands, the cross-price elasticity value is 2.904, meaning that a 1 per cent increase in the price of beef leads to a 2.904 per cent increase in chicken consumption. In contrast, a complementary relationship between beef and eggs was identified in 11 regions. In Riau, the cross-price elasticity value between beef and eggs is 1.407, indicating that a 1 per cent rise in beef prices results in a 1.407 per cent increase in egg consumption. These findings highlight that, in some regions, consumers tend to substitute beef with more affordable alternatives like chicken when prices rise. However, eggs are generally considered a complementary food in beef-based dishes, especially in most provinces where both are consumed together in traditional meals.

A substitution relationship between chicken and beef was found in 12 out of 33 regions studied. For example, in the West Java, the cross-price elasticity value is 1.781, meaning that if the price of chicken increases by 1 per cent, beef consumption will increase by 1.781 per cent. In contrast, a complementary relationship between chicken and eggs was found in 16 regions. In the Riau Islands, the cross-price elasticity value is -0.603, meaning that if the price of chicken increases by 1 per cent, egg consumption will decrease by 0.603 per cent.

The research reveals distinct patterns of substitution and complementarity between animal-based proteins across different regions. While beef and chicken exhibit a substitution relationship in several provinces, with a significant increase in chicken demand when beef prices rise, eggs generally complement beef in most regions. The findings also show that chicken and beef can be substitutes in certain areas, particularly when chicken prices rise, leading to higher beef consumption. Additionally, the relationship between chicken and eggs shows that while they are complements in many provinces, the impact of price changes varies, with an increase in chicken prices generally leading to a decrease in egg demand in some regions. These findings suggest that meat consumption in Indonesia is influenced by a combination of price dynamics, availability of substitutes, and regional dietary habits, with varying sensitivity to price changes across different provinces.

Income Elasticity

Income elasticity measures how the demand for a commodity changes in response to consumer income changes. This elasticity helps categorize goods as inferior, usual, or luxury items. For beef, most income elasticity values are insignificant, indicating that income or expenditure changes do not notably affect beef demand. However, beef is classified as a luxury good in regions with

significant income elasticity, such as Riau Island, Jakarta, West Java, and East Kalimantan, with elasticity values of 1.696, 2.221, 1.821, and 1.361, respectively. The strong relationship between income/expenditure changes and beef demand is particularly evident in regions with higher GDP. Economic growth and urbanization increase purchasing power in these areas, allowing consumers to buy more beef (see Table 3).

Table 3. Income Elasticity for the 33 Provinces in Indonesia

No.	Province	Beef	Chicken	Egg	GDP/Capita (RP)
1	Aceh	0.291	1.045***	1.262***	26,800.13
2	Sumatera Utara	1.222*	1.435***	0.865***	39,140.19
3	Sumatera Barat	0.386	1.286***	0.896**	33,188.21
4	Riau	1.050	1.122***	0.824***	83,070.74
5	Jambi	1.387	0.911***	1.054***	46,007.34
6	Sumatera Selatan	0.282	1.122***	1.001***	41,277.53
7	Bengkulu	0.510	1.127***	1.180***	24,947.62
8	Lampung	0.466	1.150***	0.915***	28,907.12
9	Kep. Bangka Belitung	3.414	0.945*	2.111**	39.908,84
10	Kepulauan Riau	1.696*	0.064	-1.654	92,930.2
11	Jakarta	2.221**	0.723*	0.404	192,133.32
12	Jawa Barat	1.821***	0.822***	0.954***	33,481.87
13	Jawa Tengah	0.324	1.479*	0.633	29,369.6
14	DIY	0.071	1.322***	0.813**	31,748.21
15	Jawa Timur	0.021	1.507***	0.877**	44,423.32
16	Bali	0.429	0.908***	1.237***	36,203.02
17	Banten	0.744	0.795***	1.387***	41,228.33
18	NTB	0.740***	1.221***	0.854***	18,687.15
19	NTT	1.121**	0.898***	1.118***	13,513.49
20	Kalimantan Tengah	1.114**	0.719***	1.466***	27,560.34
21	Kalimantan Barat	4.106	1.120**	1.626***	40,959.59
22	Kalimantan Selatan	1.279	0.546***	1.544***	35,343.25
23	Kalimantan Timur	1.360**	0.926***	1.018***	137,510.39
24	Sulawesi Utara	5.155	1.151	1.473***	38,064.2
25	Sulawesi Tengah	0.082	1.388***	0.839***	62,584.06
26	Sulawesi Selatan	0.844	1.201***	0.845***	40,285.25
27	Sulawesi Tenggara	0.663	0.748***	1.223***	39,342.46
28	Gorontalo	0.254	0.986***	1.397***	26,086.44
29	Maluku	2.229	0.672***	1.173***	18,392.66
30	Sulawesi Barat	0.769	1.017***	1.006***	23,919.08
31	Maluku Utara	0.858	1.128***	0.934***	36,267.29
32	Papua Barat	0.303	0.927***	1.248***	71,904.88
33	Papua	0.342	0.945***	1.184***	47,323.87

*significance 10%, **significance 5%, ***significance 1%

In contrast, in regions with low or moderate GDP, changes in income tend to have little effect on beef demand. Beef is generally more expensive to produce,

which makes it less accessible and affordable in lower-income regions, limiting its consumption. High GDP regions with stronger economies experience greater demand for beef as rising income levels enable consumers to afford this relatively expensive protein more regularly.

Globally, the income elasticity of beef demand varies depending on the level of economic development, consumption patterns and the relative price of beef compared to other protein sources. Regmi et al. (2001) found that in developed countries such as the United States and the European Union, the income elasticity of beef tends to be lower, ranging from 0.3 to 0.6, suggesting that an increase in income does not significantly increase beef consumption as it is already part of the daily diet. In contrast, in developing countries such as China and Brazil, the income elasticity of beef is higher, with values around 1.5 to 2.0, indicating that beef is categorized as a luxury good whose demand increases with income.

In rapidly urbanizing developing countries, the demand for beef is increasing in line with urban dwellers' changing lifestyles and consumption patterns. Jiang et al. (2015) found that in China, the income elasticity of beef reached 2.3 in major cities such as Beijing and Shanghai, reflecting an increase in beef consumption as purchasing power increases. This study reinforces the findings of this research, where regions with stronger economies in Indonesia show more significant demand for beef as rising incomes allow consumers to purchase this relatively expensive protein more regularly. In contrast, beef remains an expensive item with limited consumption in regions with low GDP, as observed in low-income countries in Africa and South Asia (Delgado et al., 2001; Delport et al., 2017).

Most income elasticity values for chicken demand are significant, indicating that when consumers experience an increase in income, their spending on chicken is likely to change. In most regions of Indonesia, chicken demand is sensitive to income changes. Chicken is classified as a normal good in Jakarta, East Kalimantan, and West Papua, with income elasticity values of 0.723, 0.926, and 0.927, respectively. In contrast, in regions like Aceh, Bengkulu, and Lampung, chicken is considered a luxury good, with elasticity values of 1.045, 1.127, and 1.150, respectively. This suggests that chicken is seen as a normal good in higher GDP regions, where rising incomes lead to increased consumption. However, in regions with moderate GDP levels, chicken takes on the characteristics of a luxury good.

In recent years, chicken prices have risen significantly, mainly due to increased feed costs, which has made chicken less affordable and positioned it as a premium product rather than a staple food. These price dynamics, particularly during periods of scarcity or price hikes, can shift the perception of chicken from an everyday necessity to a luxury item. As a result, in regions where income

increases or chicken becomes more expensive, it is increasingly viewed as a luxury good, further altering consumer behaviour and demand patterns.

Most income elasticity values for egg demand are significantly positive, indicating that as consumers' income increases, their spending on eggs is likely to rise. In many regions, eggs are classified as a luxury good, including in the Bangka Belitung Islands, West Kalimantan, and South Kalimantan, with elasticity values of 2.111, 1.626, and 1.544, respectively. This shift in classification is partly driven by the growing availability and demand for premium or speciality eggs, such as organic or free-range eggs, which are typically more expensive than conventional eggs. As egg prices have seen a significant upward trend, lower-income consumers may face limited access to eggs, often substituting them with more affordable protein sources like tempeh, tahu, or other plant-based proteins. Eggs, therefore, become a luxury good in regions where income disparities exist, with people in lower-income brackets cutting back on consumption while wealthier consumers can continue to afford them.

The classification of beef, chicken, and eggs as either standard or luxury goods varies significantly across different regions in Indonesia, mainly depending on the region's GDP and income levels. Beef tends to be viewed as a luxury good in high-GDP regions, where rising incomes enable consumers to afford it more regularly. In contrast, in lower-income areas, the demand for beef remains relatively insensitive to income changes due to its higher price. Similarly, chicken is generally seen as a normal good in wealthier regions, but it can shift to a luxury item in moderate-GDP areas or during periods of price increases. The rise in chicken prices, mainly driven by higher feed costs, has contributed to this shift in perception, making it less affordable for some consumers.

On the other hand, eggs have increasingly been classified as a luxury good in several regions due to the growing demand for premium types, such as organic or free-range eggs, which have seen price hikes. As a result, in areas with significant income disparities, lower-income individuals may substitute eggs with more affordable protein sources, while wealthier consumers continue to purchase eggs. Ultimately, these patterns highlight the complex relationship between income, price dynamics, and consumer behaviour across different regions in Indonesia.

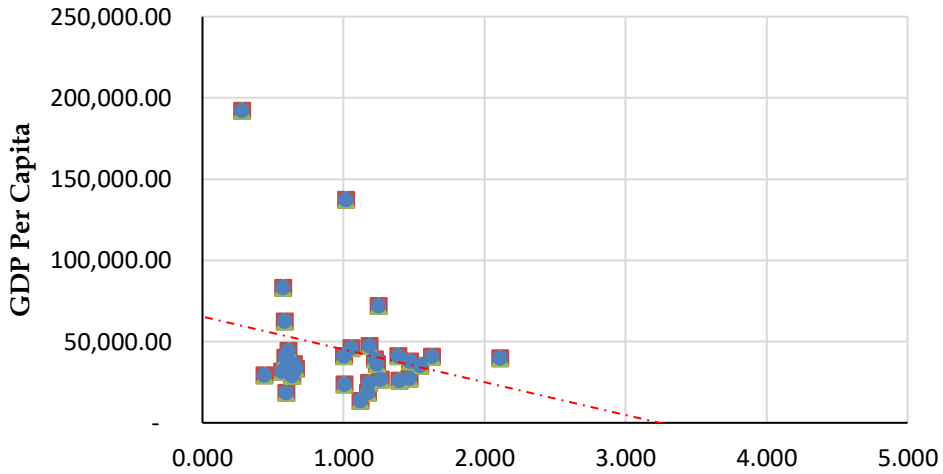

Figure 1.
Income Elasticity for Egg

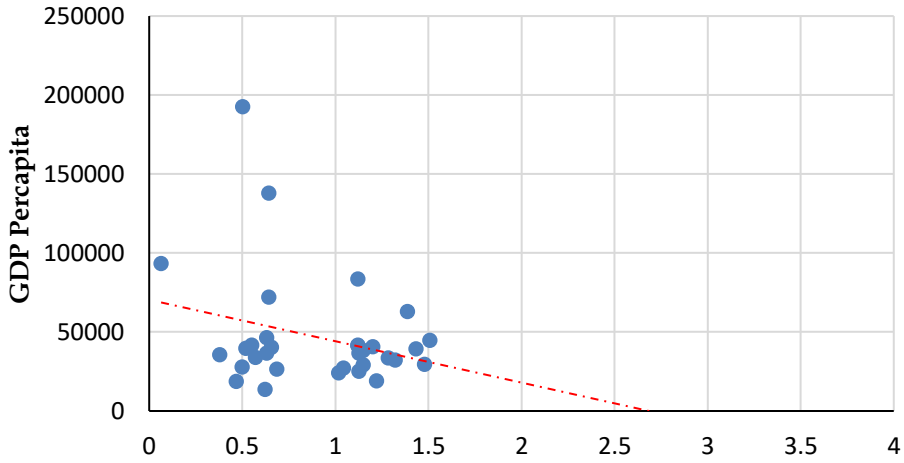

Figure 2.
Income Elasticity for Chicken Meat

The demand for beef among high-income groups is more sensitive to changes in income. In contrast, the demand for chicken and eggs is less responsive to income fluctuations in the higher-income group. Provinces with higher income levels will likely significantly increase beef demand when economic growth is rapid. However, higher economic growth is less likely to result in a substantial increase in the demand for chicken and egg products.

Income elasticity analysis of beef, chicken, and egg consumption shows that regional income changes have different impacts on each type of animal protein. Beef has a higher income elasticity in areas with high GDP, meaning that when regional income increases, beef consumption also increases significantly. This confirms that beef is a luxury item, with increased income allowing consumers to buy more beef. Conversely, in areas with low GDP, the income elasticity of beef tends to be small or insignificant, indicating that increased income in these areas does not significantly increase beef consumption due to limited purchasing power or preferences more directed towards other protein sources.

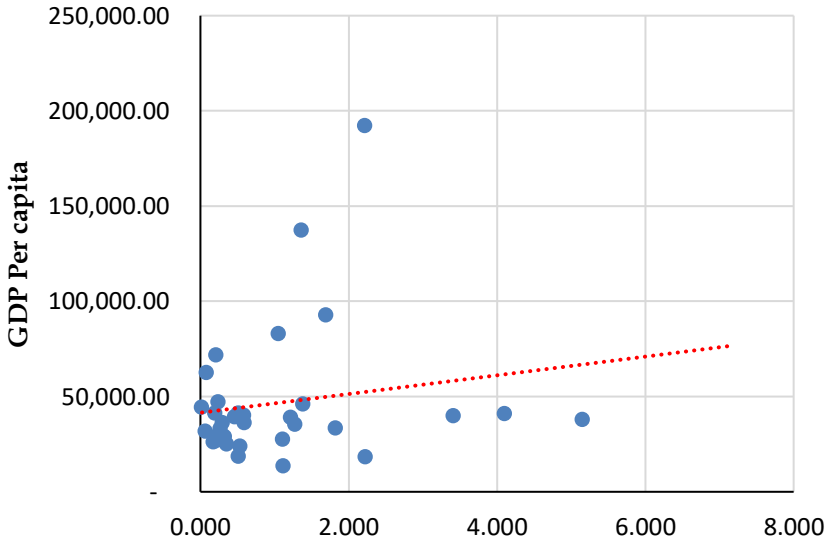

Figure 3.
Income Elasticity for Beef Meat

On the other hand, chicken and eggs show a different trend, where income elasticity is higher in areas with lower GDP but decreases as regional income increases. This suggests that in low-lying areas, increased income tends to increase chicken and egg consumption faster than beef because chicken and eggs are more affordable and more flexible in people's consumption patterns. However, in areas with higher GDP, the income elasticity for chicken and eggs is getting smaller, which means that when income increases, the additional consumption of chicken and eggs is not as large as in low-income areas because consumption is already relatively stable and has become part of daily basic needs.

The government can stabilize the volatility of animal protein product prices through interventions that can lead to changes in demand elasticity. The government can improve the supply chain management of beef, eggs, and

chicken meat by utilizing Perum BULOG. Intensification of farmers can be a further strategy for the government. Intensification of farmers will lead to an increase in productivity so that the production of animal protein ingredients can increase, which can reduce prices. In addition, the government can also make changes to the international trade system specifically for imported animal protein products by reducing import tariffs to increase the availability of animal protein products in the Indonesian market.

CONCLUSION AND SUGGESTION

Conclusion

The demand for beef, chicken, and eggs in Indonesia varies in response to price sensitivity, shaped by regional economic factors, consumer preferences, and the availability of alternatives. Beef is generally perceived as a luxury item, with lower-GDP regions showing greater price sensitivity. In contrast, higher-GDP regions exhibit less elastic demand, influenced by more substantial purchasing power and beef's cultural significance during special occasions. Chicken, a common protein source, demonstrates generally inelastic demand, but lower-GDP regions show more sensitivity to price changes, while wealthier provinces can absorb price hikes without significantly altering consumption. More affordable and commonly consumed Eggs display a higher price elasticity than beef and chicken, especially in lower-GDP areas. Regional differences in income and economic conditions play a key role in shaping the demand for these animal proteins, highlighting the impact of economic inequality and varied purchasing power across Indonesia. Beef and chicken are often substitutes in several regions, particularly when chicken prices rise, leading to an increase in beef consumption.

In contrast, eggs tend to complement beef in most areas. Regional GDP levels influence the classification of these foods as usual or luxury goods. Beef is considered a luxury good in wealthier regions, where rising incomes allow for more frequent consumption, while in poorer regions, high prices make beef less responsive to income changes. Chicken is typically viewed as a normal good in higher-income areas, but it may be seen as a luxury in regions with moderate GDP or during price increases. Eggs are increasingly classified as luxury items in regions where premium varieties, such as organic or free-range eggs, have increased prices. Consequently, lower-income consumers may substitute eggs with cheaper protein alternatives in regions with significant income disparities, while wealthier individuals continue to purchase eggs. These findings illustrate the complex interaction between income, price changes, and consumer behaviour across Indonesia. They emphasize the need for policies that consider regional economic disparities, particularly as premium products like organic eggs become more prevalent and animal protein costs rise. Understanding these

dynamics can help policymakers address food security, affordability, and nutrition issues in Indonesia's diverse economic landscape.

This research can serve as a foundation for policy recommendations to governmental bodies. The government may mitigate the volatility of animal protein product prices through interventions that can influence demand elasticity, such as modifications to the supply chain of animal protein products, intensification of farmers, and enhancement of international trade regulations.

Suggestion

The findings highlight the importance of policymakers accounting for regional differences in demand elasticity when developing food and agricultural policies. Targeted subsidies or taxes could help address regional disparities, ensuring fair access to protein sources across Indonesia. The identified substitution and complementary relationships between commodities emphasize the need to consider cross-commodity effects when designing price or income-based interventions. In provinces with higher income levels, policymakers may need tailored strategies to manage anticipated increases in beef demand during periods of rapid economic growth. Future research could investigate how dietary shifts, such as the growing popularity of plant-based diets or alternative proteins, impact the demand for traditional animal-based proteins like beef, chicken, and eggs. Understanding these shifts could provide valuable insights into evolving consumer preferences. Expanding the analysis to include other protein sources like fish, goat, and plant-based alternatives such as tofu would offer a broader understanding of the protein market and cross-commodity relationships. Moreover, research could explore how regional and cultural dietary preferences influence demand, providing valuable data for improving nutrition and food security policies. Examining the impact of food prices, subsidies, and government policies on-demand elasticity across income levels and regions could further enhance understanding of these dynamics. Finally, a deeper investigation into socio-cultural and regional factors influencing consumption patterns could help shape more effective and inclusive food policies, addressing diverse needs and ensuring equitable access to nutrition.

Future research could expand the scope by including other protein sources not modelled in this analysis. In addition, expanding the analysis to a broader scope, such as shifts in consumer behaviour to alternative plant-based foods or processed foods, would provide a broader understanding of food consumption patterns in each region in Indonesia.

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