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Effects of Price Inflation on Urban Households' Food Expenditure Patterns in Port Harcourt, South-South Nigeria: Insights on Food and Nutrition Security

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Abstract. *Port Harcourt is the most economically vibrant city in Nigeria after Lagos, and it has an estimated population exceeding three million people. In recent years, food commodities, especially energy-rich foods, have continued to gain significant market value in the city. This study examined the effects of price inflation on food expenditure patterns in Port Harcourt, South-South Nigeria, against the backdrop of food and nutrition security. The study examined 265 urban households in the city, and special attention was given to common dietary food sources such as rice, yam, garri, noodles, beans, meat/fish, vegetables, and oils. The research used descriptive and inferential statistical models, including quartile, chi-square, multiple regression, and the Linear Approximate Almost Ideal Demand System models. Results of the analysis revealed that garri and rice were the most frequently consumed food products in the area. Similarly, the households spent a significant weekly share of their food budget (54 per cent) on energy-rich foods (rice, garri, yam, and noodles) compared to meat/fish (46 per percent) and vegetables (27 per cent). Furthermore, in the buildup to the regression analysis. The double-log functional form was selected as the lead equation with an R^2 of 93.68 per cent, with age (0.1893), household size (0.0512), income (0.0201), price of meat and fish (-0.0081), and consumer preference (0.0038) significantly influencing household expenditure on energy-rich foods. The Marshallian uncompensated own price elasticities for rice, garri, beans, and meat/fish were found to be -0.713, 0.374, -0.891, and -1.271, while the Hicksian cross price elasticities for yam and noodles as well as that of vegetables and oils were 0.062 and 0.163, respectively, implying that these commodities were inelastic and close substitutes. The elasticity estimates indicate that most food commodities are inelastic and exhibit substitution tendencies, particularly between vegetables and oils. Policymakers should therefore prioritize price stabilization, income enhancement, and food supply diversification to strengthen urban food and nutrition security.*
Keywords: *urban households; xpenditure; inflation; price; nutrition.*

Type of the Paper: Regular Article.

1. Introduction

Over 821 million people throughout the world struggle to deal with the challenge of hunger and malnutrition [1], and nearly one in nine people globally are undernourished [2,3]. In spite of the efforts of both international and local agencies to reduce these rising and terrifying figures, the number of hungry and malnourished people globally continues to climb [4]. Every year, one out of every five

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newborns die from malnutrition [2,5]. Nigeria is among the several developing countries that remain vulnerable due to this problem.

Malnutrition threatens 12.9 percent of the world's population, and most hungry people live in developing countries [6,7]. A good number of these countries are found in Sub-Saharan Africa where one out of every four individuals is affected by malnutrition, making it the part of the world with the highest prevalence of hunger, according to Edaba et al. [8]. For instance, in Nigeria, over 200 million people live here, making it the most populous Black nation in the world [9,10]. The nation however, has longstanding issues with food insecurity that have a substantial impact on its people, as well as comparatively high rates of malnutrition. Two reasons for this are because individual consumers are unable to access and afford protein-rich meals in their household diets as a result of rising food inflation, which is currently at 38.5% [11], and also due to weak agricultural intensification with consequences on low productivity [12].

Basic food commodities such as rice, cowpea, yam, noodles and garri perform a significant role in economic development since their accessibility and price have a direct impact on food security, household expenditures, and incomes, particularly among the poorer segments of the population, both rural and urban [4]. Energy-rich foods such as rice, yam and noodles account for approximately 55 percent of the food budget share in Nigeria, with the majority of poor households allocating more than 60 percent of their food expenditure to these food groups [5,13]. Nigerian households, like those in other developing nations, spend a huge amount of their income on food, leaving only a little proportion for other necessities and wants [14,15].

Price is an important component in determining food demand and supply gaps [16]. When price increases, consumers are affected in two ways: first, they cut down their purchasing power, and second, they switch to less expensive food sources [17]. According to Adeyonu et al. [18], doubling the price of consumer products is equivalent to cutting consumer income in half. Even a single price increase affects a consumer's ability to acquire the same amount of previously purchased goods. This is particularly true when the commodity in question is a normal food commodity such as staples [19].

Over the past few years, food prices in Nigerian cities have consistently increased. For instance, between January 2021 and January 2024, food prices in Nigeria increased by more than 20% [15]. All indications suggest that this trend is likely to continue in the near future, except interventions are made by all stakeholders. In Port Harcourt for instance, the Consumer Price Index (CPI) for food was 442 pe rcent in March 2021, up from 353.9 percent the previous year, and by January 2024, it had risen to 865.7 percent [14]. This clearly demonstrates that food prices in the country are rising at an increasing

rate and reducing people's actual income. As a result, an overwhelming majority of the people remain poor, with limited physical, social, and economic access to adequate, safe, and nutritious food to meet their nutritional requirements [20,21].

A proper and well-balanced diet is very vital in sustaining a healthy status [8,22]. This study, which aimed to examine the effects of price inflation on food expenditure patterns in Port Harcourt, South-South Nigeria, and provide insights on food and nutrition security, is premised on the theory of consumer behaviour, which examines how people make purchasing decisions within their budget limits and preferences, and on the need to complement macro-data analysis with micro-data analysis on household demand for food staples. The specific objectives of the study were to ascertain the budget share of energy-rich food commodities in the total food expenditure of the households, determine the socio-economic characteristics that influence food expenditure in the area, estimate the effects of prices on the expenditure of energy-rich food sources, and recommend data-driven insights to inform government agencies and development partners on strategies to stabilise rising food prices.

2. Materials and Methods

The study was conducted in Port Harcourt City, Rivers State, Nigeria. Port Harcourt is the capital city of Rivers State of Nigeria. This metropolitan city with a projected human population of over 3 million [19], is home to a happy business friendly and hospitable people. With a human population of over three million, the city is the largest commercial and industrial centre in Nigeria outside Lagos [23]. Recent food consumption statistics reveals that the area is fast becoming one of the largest immediate markets for bulk commodities, especially food calories such as garri yam and rice [8]. The land area of the city is 1200km square, with an excellent transport and communication network, a reliable power supply and efficient banking and hotel facilities. Port Harcourt is also the logical site for some high-profile industries, including two crude oil refineries, and one petrochemical plant, and the Indorama fertilizer plant.

Using Lemeshow's formula of proportional estimation, a total of two hundred and sixty-five (265) household heads were randomly interviewed from each of the three income categories of the city, namely, low-income, medium-income and high-income groups. Data was collected from the households in 2023 using a questionnaire. Household heads who responded to the survey were asked to recall and state how much they spent, how much they consumed and how frequently they consumed each of the food products (including rice, yam, gari, noodles, beans, meat/fish, vegetables, oils, etc.) under consideration over the course of the previous month. The prices used in this analysis are the dominant market prices, gathered as part of the survey at the time of the household survey, while the

survey items included quantities of different food categories consumed, food prices, and socio-economic characteristics of each sampled household. In particular, data on age, gender, marital status, educational levels, household size equivalence, etc. were gathered. Other information collected in the survey included the major occupation of the urban households and constraints limiting consumers' access to food commodities in the area, etc.

The sample size of two hundred and sixty-five (265) was determined using Lemeshow's formula of proportional estimation, and suitable for population-based studies is expressed in equation (1) [24].

$$n = Z^2_{1-a/2} \frac{P(1-P)}{d\hat{}2} \quad (1)$$

Where:

n = sample size

$Z^2_{1-a/2}$ = error term at 0.64 (90 percent confidence interval)

d = relative precision at 0.10.

p = prevalence of household's inability to access adequate food (insecurity) in Port Harcourt at 50.49 percent [20].

In determining the budget share of the food commodities in the total food demand schedule of the households, the quartile and chi-square tests [25], were employed, and the quartile equation is expressed in equation (2-5) [25].

$$Q1, = L1 + \left(\frac{\frac{N}{4} - FC1}{FQ1} \right) \text{x W} \quad (2)$$

$$Q2 = L2 + \left(\frac{\frac{2N}{4} - Fc2}{FQ2} \right) \text{x W} \quad (3)$$

$$Q3 = L3 + \left(\frac{\frac{3N}{4} - Fc3}{FQ3} \right) \text{x W} \quad (4)$$

Where:

Q_1, Q_2, Q_3, and Q_4 are the first, second, third, and fourth quartiles,

FQ_1, FQ_2, and FQ_3, are frequencies of the 1st, 2nd, and 3rd quartiles

L_1, L_2, L_3, and L_4 are Lower boundaries of the 1st, 2nd, 3rd, and 4th quartiles

FC_1, FC_2, and FC_3 are cumulative frequencies before or below the 1st, 2nd, and 3rd quartiles

W = Width of the quartile class

The chi-square equation was used to ascertain if there is any significant difference between income level of a household and the share of energy-rich foods. The null hypothesis was that the

household expenditure share of energy-rich foods in total food expenditure is the same in all income groups. To test this hypothesis, a chi-square test was used. The chi square equation (5) is expressed as follows:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad (5)$$

Where:

O = observed share of bulk food commodities in total food demand (percentage)
E = expected share of bulk food commodities in total food demand (percentage)
O-E = deviations
$(O_i - E_i)^2$ = deviation squared and weighted

In determining the socio-economic characteristics that influence expenditure of energy-rich food commodities in the area, a multiple regression model was employed and stated in Equations (6–9) [12].

The Linear Functional Form:

$$Yd = \beta_0 + \beta_1 W_1 + \beta_2 W_2 + \beta_3 W_3 + \beta_4 W_4 + \beta_5 W_5 + \beta_6 W_6 + \beta_7 W_7 + \beta_8 W_8 + \beta_9 W_9 + \beta_{10} W_{10} + \mu \quad (6)$$

The Semi-Log Functional Form:

$$Yd = \beta_0 + \beta_1 lnW_1 + \beta_2 lnW_2 + \beta_3 lnW_3 + \beta_4 lnW_4 + \beta_5 lnW_5 + \beta_6 lnW_6 + \beta_7 lnW_7 + \beta_8 lnW_8 + lnW_9 + \beta_{10} lnW_{10} + \mu \quad (7)$$

The Double-Log Functional Form:

$$lnYd = \beta_0 + \beta_1 lnW_1 + \beta_2 lnW_2 + \beta_3 lnW_3 + \beta_4 lnW_4 + \beta_5 lnW_5 + \beta_6 lnW_6 + \beta_7 lnW_7 + \beta_8 lnW_8 + lnW_9 + \beta_{10} lnW_{10} + \mu \quad (8)$$

The Exponential Functional Form:

$$lnYd = \beta_0 + \beta_1 W_1 + \beta_2 W_2 + \beta_3 W_3 + \beta_4 W_4 + \beta_5 W_5 + \beta_6 W_6 + \beta_7 W_7 +$$

deal Demand System model is specified in equation (10) [8,15]; $\beta_8 W_8 + \beta_9 W_9 + \beta_{10} W_{10} + \mu$ (9)

Where Yd is the average expenditure on energy-rich food commodities (Naira), W1 is age (in years), W2 is gender, W3 is marital status, W4 is education level (years spent), W5 is household size (in numbers), W6 average income (Naira), W7 is price of vegetables (Naira), W8 is price of beans (Naira) using Lemeshow's formula of proportional estimation, W9 is price of meat/fish, W10 is consumer preference, β0 is constant, β1 to β10 are the coefficients of the parameter estimates, and μ is the error term.

To evaluate the effect of price parameters on food expenditure in the area, the study used an approximation of the Almost Ideal demand system, proposed by Fadare et al. [26], as employed in several food consumption studies such as Tsegai and Kormawa [25], Nuaini et al. [27], Mustafa et al. [28], and Edaba et al. [8], and it's applied to a system of eight products, namely rice, yam, garri, noodles, beans, meat/fish, vegetables, and oils. These eight products are key foods [29] and components in the daily diets of Port Harcourt households (8). In this model, quantity demand is represented by the budget share of each commodity, while price and income are expressed in logarithms. Household demand expenditure is used in this analysis as a proxy for income because data on expenditures are generally more reliable than income data, as questions of income are sensitive, and it is expected that households underestimate their income [25,30]. The study first used a multistage budgeting strategy, where the household first distributes its expenditure in terms of its total expenditure over broad categories of household commodities, such as food and non-food goods, in order to ensure a more accurate estimation. After then, it divides the urban households' spending percentages across the several subcategories of the preceding broad categories.

Because of the model's practical qualities and adaptability, demand analysis has made extensive use of it. This model is unique because imposing or testing for symmetry in the cross-price items is not too difficult. Also, the predicted budget shares will add up to 1.0 if the system of equations is complete, meaning that the actual budget share sums up to 1.0. This is referred to as adding up. Again, the demand equation and its derivation from a well-behaved utility function are consistent with economic theory. The Almost Ideal Demand System model is specified in equation (10) [8,15].

$$\text{Wit} = \alpha\text{it} + \beta\log\left(\frac{Xt}{Pt^{ж}}\right) + \sum_j Y_{ij}\log P_j t \quad (10)$$

Where:

W_i = expenditure share of the ith commodity under consideration (rice, yam, garri, noodles, beans, meat/fish, vegetables and oils).

α_{it} = intercept that is average value of the expenditure in the absence of price, income and other demographic factors.

β_t = expenditure coefficient at period, t

$\log X_t$ = total expenditure on commodities under study

p* = Stone's price index which makes the system linear (approximated using Stone's price index) and its defined in Equation (11) [28].

$$P^{*}_{t} = \sum W_{jwg} P_{jt} \quad (11)$$

Where:

W_j = Expenditure share of the jth commodity

Y_{ij} = Coefficient of the row sums of prices and expenditure matrix (Homogeneity testing)

The theoretical demand restrictions which can be tested and imposed on the LA/AIDS include adding-up, homogeneity and symmetry. These restrictions were captured mathematically in Equations (12 – 14) [27,30].

$$\text{Adding-up: } \sum \lambda = 1, \sum \gamma_{ij} = 0, \sum \beta = 0 \quad (12)$$

$$\text{Homogeneity: } \sum \gamma_{ij} = 0 \quad (13)$$

$$\text{Symmetry: } \sum \gamma_{ij} = 0 \quad (14)$$

The equation applied to each of the eight food commodities under consideration. These equations can be estimated independently under two conditions.

In the context of the LA/AIDS, testing or imposing the symmetry restriction is valid only when the theoretical price index, which is non-linear, is used, and not when an approximation index (Stone's price index) is used. Since the theoretical price index is not used in this study, symmetry restrictions are neither tested nor imposed. Thus, the expenditure elasticity is expressed in equation (15) [8].

$$(W_i) = \mu = 1 + \frac{\beta}{(w\iota)} \quad (15)$$

μ = expenditure elasticity

β = expenditure coefficient

$w\iota$ = share of each commodity under consideration

The uncompensated price elasticity (which contained both price and expenditure) was calculated using equation (16) [8].

$$e_{ij} = \delta_{ij} + \frac{\Upsilon ij}{w\iota} - \frac{\beta\iota X w\iota}{w\iota} - \delta_{ij} + \frac{\Upsilon ij}{w\iota} - \frac{\beta\iota w\iota}{w\iota} \quad (16)$$

Where:

e_{ij} = Uncompensated price elasticity

$\delta = 1$ when $\iota = j, and\ \delta = 0$ when otherwise.

The compensated price elasticity of the LA/AIDS, was estimated in equation (17) [29].

$$eij *= -\delta ij + \frac{\Upsilon ij}{w} + w_j \quad (17)$$

Where:

$eij *=$ Compensated price elasticity

$\beta\iota\ and\ \Upsilon ij$ are parameter estimates

The Marshallian (uncompensated) price elasticities of demand show that when the price of a given commodity rises, the consumer is not compensated with higher nominal income for the fall in their real incomes, while Hicksian price elasticities, also known as compensated price elasticities, measure the responsiveness of quantity demanded to changes in prices, holding utility constant. Unlike Marshallian (uncompensated) elasticities, Hicksian elasticities isolate the substitution effect of a price change by compensating consumers to maintain their original level of satisfaction (utility), thereby removing the income effect [31].

3. Results and Discussions

The distribution of urban households based on weekly frequency of expenditure on food commodities is presented in Table 1.

Table 1. Food expenditure frequencies in the study area

Food dietary Category	Percentage Frequency Once each day (%)	3times each week (%)	Rarely (%)
Rice	20	22	6
Yam	4	5	15
Garri	25	27	2
Beans	8	8	9
Meat/fish	9	7	22
Oils	12	10	19
Vegetables	3	4	8
Noodles	6	6	10
Others	13	11	9
Total	100	100	100

Source: households' food Survey, 2023

Table 1 reveals that on a daily basis, 20 percent of the households consumed rice each day as against 4 percent for yam, 25 percent for gari, 8 percent for beans (cowpea), 9 percent for meat/fish, 12 percent for oils, 3 percent for vegetables, 6 percent for noodles, and 13 percent for other categories of food, respectively. Similarly, 22 percent of the households consumed rice three times weekly, and 5 percent consumed gari three times weekly, while only 23 percent of the urban households rarely consumed meat/fish as against 7 percent for rice, 16 percent for yam and 2 percent for gari. This

implies that gari and rice were food commodities that were highly consumed across the households compared to yam, meat, beans (cowpea), noodles, and oils in Port Harcourt. Thus, gari and rice appear to be "food choices" even in the face of alternative food options in Port Harcourt households. This trend could be attributed to the fact that gari and rice are readily accessible, affordable and can be eaten in a wide variety of forms. Besides, these commodities are an excellent dietary energy source. Equally, certain logistics such as taste, applicability, and preference may have contributed to this trend. This result conforms with the findings of Kormava and Akoroda [32].

Table 2. Households Per Capita expenditure quartile of the poorest and the richest households.

Characteristics	Income Groups				
	Low	Medium	High	Very high	All
Weekly food expenditure per capita (₦)	1.800	2.406	3.354	6.120	3.433
Share of energy-rich foods in total food expenditure (%)	69	56	48	42	54
Share of fish/meat in total food expenditure (%)	21	33	40	44	46
Share of vegetables in total expenditure (%)	17	21	33	36	27

Source: households food Survey, 2023

The results of Table 2 reveals that the average total food expenditure in the survey area amounted to three thousand four hundred and thirty-three Naira (₦3,433) per person per week or one hundred and seventy-eight thousand five hundred and sixteen Naira (₦178,516) per person per annum (equivalent to one hundred and ten Dollars, 110 USD) per person per year. The corresponding estimates of the bottom and top quartiles are one thousand eight hundred Naira (₦1,800) and six thousand one hundred and twenty Naira (₦6,120) per person per week, respectively. From the results, households spent about 54 percent of their total food expenditure on energy-rich foods, with meat/fish constituting 46% while only 27 percent of the food budget share went for vegetables during the study period. The interpretation of this result is that Port Harcourt households spend more of their earnings on energy-rich foods such as gari, rice and yam compared to protein rich foods and vegetables. This may be due to the high cost of meat/fish and eggs etc. Several empirical studies and nutrition economics literature have built on Engel's Law to show that low-income households tend to consume a higher proportion of calories from cheaper, energy-rich staples such as carbohydrates (e.g., cereals, tubers), while higher-income households diversify their diets to include more proteins, fats, fruits, and vegetables [33,34].

Furthermore, Table 2 indicates that as we go from lower to higher income groups the share of energy-rich foods in total food expenditure declines. This indicates that energy-rich foods are necessities for the poor households. It is also surprising to note that average per capita food expenditure of the households in Port Harcourt is far below the average per capita income levels of

Nigeria, which are estimated at one thousand nine hundred and thirty Dollars ($1,880 USD) per annum [2]. The rising human population in the area, prompting larger household sizes, necessitating higher dependency on the few working populace, the recent devaluation of the currency (Naira), the high Naira- Dollar exchange rate (currently at one thousand four hundred Naira per Dollar) as well as the high unemployment rates of the city may be responsible for this disparity.

Table 3. Chi square presentation of expenditure share of energy-rich foods (rice, yam, gari and noodles) in total food expenditure.

Income groups	Observed share of energy foods in total food expenditure (O, %)	Expected share energy foods in total food expenditure (E, %)	Deviations (O-E)	Deviation Squared and weighted $(O-E)^2/E$	Probability of acceptance of Null hypothesis (π)
Low	69.0	53.75	15.25	4.33	0.25
Medium	56.0	53.75	2.25	0.09	0.25
High	48.0	53.75	-5.75	0.62	0.25
Very high	42.0	53.75	-11.75	2.57	0.25
	S = 215	215.0	0	$X^2 = 7.61$	1

Source: households field Survey, 2023

The results in Table 3 reveal that the null hypothesis is rejected. This implies that the share of energy-rich foods in total food expenditure in the area is not the same across the four different income groups. This indicates that the trend shown in the sample did not simply come by chance. The share of energy-rich foods in total food expenditure is relatively higher in the low-income group than in the high-income group. The result in the sample embraces true position in the population as well. This finding is in harmony with Engel, Deaton [34,35] report on households' income and food consumption patterns, which found varied budget shares in total food expenditures.

Table 4 presents the estimated socio-economic characteristics influencing food expenditure in the study area. The multiple regression model predicted four functional forms: linear, exponential, semi-log, and double-log. The double-log functional model was chosen as the lead equation for discussing the findings because it recorded the greatest R^2 (0.9368) and Adjusted R^2 (0.9043) values, demonstrating that it explains the most variability in the dependent variable. Similarly, the Akaike Information Criterion (AIC) was lowest for the double-log model (-1.4971), suggesting the best model fit, and Durbin-Watson was found to be 1.8963, which is near 2, indicating no significant autocorrelation difficulties. The double-log regression model highlights the key factors driving household expenditure on energy-rich foods. In this specification, several variables are expressed in logarithmic form, meaning their coefficients can be interpreted as elasticities. Thus, a 1 percent, 5 percent, or 10 percent change in any of the independent variables lead to a corresponding percentage

change in the dependent variable, thereby capturing the responsiveness of food spending to variations in these underlying determinants.

Table 4. Estimated Multiple Regression Functional model on socio-economic characteristics influencing the expenditure on energy-rich foods (rice, yam, garri and noodles)

Variable	Linear	Exponential	Semi-Log	Double-Log [+]
Constant	1423.216[m]	4.8213 [k]	10280.71 [k]	8.2174 [k]
	(1.7861)	(23.1912)	(3.0314)	(29.4209)
Age	-23.588[l]	-0.0041	-1130.112	-0.1893[m]
	(-2.4056)	(-1.2319)	(-1.0935)	(-1.5261)
Gender	-43.2264	0.0462 [l]	-45.8147	0.0014
	(-0.2916)	(1.7069)	(-1.5632)	(0.4151)
Maristat	661.0532[l]	0.0291	873.2086	0.0556
	(2.2363)	(0.5363)	(1.0146)	(0.9010)
Eductn	-59.001[k]	0.0021	-123.1091 [k]	-0.0046
	(-1.2613)	(0.6116)	(-3.1743)	(1.5941)
Housesize	-21.4314	0.2125	-1013.046	0.0512 [l]
	(-0.4011)	(43.0121)	(-1.4845)	(1.9082)
Income	14.4235	0.0673 [l]	-39.9847	0.0217 [k]
	(2.3295)	(3.4051)	(-1.3841)	87.4103)
Pveg	783.947[k]	0.7167 [k]	7602.729 [k]	0.9351 [k]
	(15.1690)	(34.2315)	(21.3157)	(37.6169)
Pbeans	311.1451	0.0363	-344.3840	0.0451
	(1.02428)	(1.3071)	(-0.4496)	(1.0410)
Pmeatfis	-621.4611 [k]	-0.0153	-105.2297 [k]	-0.0081 [k]
	(-4.4116)	(-0.4731)	(-3.7905)	(-3.1024)
Prefce	401.1137	0.0444	38.6245	0.0038 [m]
	(1.0923)	(1.1006)	(1.0744)	(2.8437)
R-squared	**0.8566**	**0.7405**	**0.8111**	**0.9368**
Adjusted R^2	**0.7428**	**0.6918**	**0.7021**	**0.9043**
Log likelihood	**-817.7853**	**1001.601**	**85.8315**	**51.0772**
F-statistic	**104.9645**	**63.0137**	**103.8618**	**63.2188**
AIC	**13.8631**	**14.6108**	**-1.2954**	**-1.4971**
Durbin-Watson	**1.3224**	**1.1814**	**1.3728**	**1.8963**

Note: [k, l,] and [m] are Significant at 1%, 5%, and 10% level of probability respectively; t-values are in parentheses, AIC is Akaike Information Criterion.
Source: households field Survey, 2023.

From the results, the consumer's age coefficient was -0.1893, which was statistically significant at the 10% level of probability. The negative influence of age on food expenditure implies that older consumers spend less than younger ones; hence, younger energy-rich food consumers were more willing to spend than older ones, most likely due to their lower appetite for energy-rich foods. The coefficient of household size was 0.0512, which was significant at the 5% level of probability. This suggests that household size has a positive and substantial relationship with energy-rich food expenditure, implying that increasing household size by 5% results in a 0.51% rise in energy-rich food expenditure. This is consistent with the findings of Ogunniyi et al. [4], who observed that larger households increase demand for food in any population.

The income variable was significant at the 1percent level, with a positive coefficient of 0.0217. This significant positive relationship indicates that as household income increases, consumers tend to allocate a greater share of their earnings to energy-rich foods. This outcome may be attributed to stronger food preferences, improved accessibility, the presence of younger household members with higher calorie needs, and prevailing lifestyle patterns. The positive coefficient further confirms that energy-rich foods are normal goods.

Similarly, the coefficient for the price of meat and fish was –0.0081 and statistically significant at the 1percent level. This implies that a 1 percent decrease in the price of meat and fish would lead to a corresponding 0.81 percent increase in expenditure on energy-rich foods.

In addition, the study found a positive and significant coefficient for consumer preference (0.0038), indicating that a 1 percent increase in preference results in a 0.0038 percent increase in expenditure on energy-rich foods. The above findings align with the economic theory of consumer demand, which posits that preference shifts can alter expenditure patterns, especially for essential goods [36].

Empirical evidence supports this observation. For instance, Chiaka et al. [37] reported that consumer taste and preference significantly influenced the demand for carbohydrate-based foods among urban households in Nigeria, although the elasticity was low due to the subsistence nature of food consumption. Similarly, Salam et al. [38] found that consumer preferences modestly shaped expenditure on staple foods, with households prioritizing energy-dense options such as rice, yam, and gari due to cultural familiarity and price accessibility.

Moreover, studies from other developing economies show comparable trends. Addai [39] found in Iran that consumer preference had a weak but positive elasticity effect on food expenditure, reflecting that while preferences matter, income and prices remain stronger determinants. In Nigeria's context, the modest coefficient (0.0038) may also reflect structural constraints such as inflation, income instability, and limited substitution possibilities among low- and middle-income consumers [40].

From the results in Table 5, the uncompensated and the compensated expenditure elasticities for all the food commodities are positive ranging from 0.031 to 1.146, implying that consumers in the area are most likely to increase their expenditure on these food categories as their incomes rise. These findings agree with that of Omotayo [41]. Similarly, all own-price elasticities are negative, conforming to the law of demand. The uncompensated and compensated own price expenditure elasticities for meat/fish (-1.271, -1.258) and noodles (-1.246, 1.239) are the highest in absolute values,

indicating that these commodities are price elastic. The understanding is that a 1 percent increase in the price of meat/fish results in a 1.271 and 1.258 percent increase in quantity demanded. This suggests that meat/fish, and noodles are luxury or relatively substitutable product in the average household's diet of the people [42].

Table 5. Mashallian and Hicksian price elasticities of food expenditure

Food products	expenditure elasticities	Own price elasticities	Rice	Yam	Garri	Noodles	Beans	Meat/fish	vegetables	Oils
Mashallian (uncompensated) price elasticities of food expenditure in Port Harcourt										
Rice	0.513	-0.713		0.912	0.281	0.163	-0.116	-0.052	0.102	0.137
Yam	1.007	-0.682	0.210		0.134	0.175	0.059	0.103	0.046	0.161
Garri	0.679	-0.374	0.111	0.164		0.091	-0.061	0.205	0.154	0.132
Noodles	1.061	-1.246	0.172	0.091	0.039		0.155	0.231	0.136	0.108
Beans	0.734	-0.891	0.231	0.170	0.180	0.130		0.119	0.068	-0.093
Meat/fish	1.146	-1.271	0.194	0.134	0.182	0.172	0.207		0.151	0.079
Vegetables	0.660	-0.893	0.052	0.161	0.077	0.034	0.101	0.153		0.241
Oils	0.823	-0.611	0.133	-0.087	0.128	0.311	-0.146	-0.196	0.117	
Hicksian (compensated) price elasticities of food expenditure										
Rice	0.733	-0.812		0.016	0.079	0.094	-0.06	0.193	0.051	0.135
Yam	0.876	-0.717	0.173		0.042	0.062	0.138	0.22	0.081	0.102
Garri	0.809	-0.559	0.235	0.175		0.131	0.071	0.119	0.064	0.104
Noodles	1.071	-1.239	0.191	0.173	0.181		0.082	0.211	0.152	0.071
Beans	0.917	-0.521	0.167	-0.011	0.215	0.084		0.056	0.104	-0.144
Meat/fish	1.130	-1.258	0.219	0.064	0.132	0.176	0.056		0.046	0.163
Vegetables	0.031	-0.646	0.050	0.162	0.070	0.038	0.104	-0.192		0.243
Oils	0.676	-0.550	0.053	0.160	0.073	0.033	0.108	0.156	0.201	

Source: households field survey, 2023

Similarly, the compensated and uncompensated own-price elasticities were less than one (in absolute value) for rice, gari, beans, vegetables and oils, indicating price inelastic demand; they are staple foods. The demand for these commodities is less responsive to price changes, consistent with previous findings in the literature Omotayo [41].

On the other hand, the cross-price elasticity estimates of both compensated and uncompensated expenditure categories revealed a potential substitution or complementary relationship. From the results, the magnitudes of most cross-price elasticities in the area were relatively low, suggesting that these food items are weak substitutes, and price changes in one may not drastically affect the demand for others. In particular, there were positive uncompensated and compensated cross-rice elasticities (compared to rice) between yam, garri, noodles and vegetables (0.912, 0.281, 0.163 and 0.102; and 0.016, 0.079, 0.094, 0.051). This aligns with the findings of Salman [43], who noted that Nigerian households often switch between cereals and tubers in response to price fluctuations. Also, the elasticity between meat/fish and beans in both uncompensated and compensated cross-price categories

was found to be 0.207 and 0.056 respectively. This shows substitutionary effects, and suggests that consumers may switch between protein-rich sources of diet depending on relative prices.

4. Conclusion

The study investigated the effects of price inflation on food expenditure patterns in Port Harcourt, South-South Nigeria: insights on food and nutrition security. Data collected were analysed using suitable tools such as descriptive statistics, chi square, multiple regression and Almost Ideal Demand System model. The study reveals that rising inflation has greatly influenced how households in Port Harcourt spend on food. As prices continue to climb, many families are forced to focus more on cheaper, energy-rich staples like rice, garri, yam, and noodles, while cutting back on more nutritious options such as meat, fish, and vegetables. This shift in spending shows how inflation erodes purchasing power, limiting people's ability to maintain a balanced diet. The growing gap between calorie and protein intake highlights a worrying trend toward poor nutrition, calling for urgent government and community actions to stabilize food prices and improve access to affordable, healthy foods.

Thus, food price inflation significantly shapes household expenditure patterns and nutritional security in Port Harcourt. Energy-rich foods such as rice, garri, yam, and noodles dominate urban diets, reflecting consumers' sensitivity to food prices and income changes. Also, household size, income, and consumer preferences play critical roles in determining food expenditure levels. The elasticity estimates indicate that most food commodities are inelastic and exhibit substitution tendencies, particularly between vegetables and oils.

It is recommended that the government, policymakers, and development partners take deliberate steps to reduce the impact of inflation on household food access and nutrition. Efforts should focus on stabilizing food prices, supporting low-income families through targeted subsidies or cash transfers, and improving the supply of affordable, nutritious foods. There is also the need to intensify local food crop production. This is necessary to ensure lesser imports and lesser shocks due to price hike in the global markets. To make this possible, government and all stakeholders could expand access to affordable credit facilities for farmers to invest in modern farming techniques and technologies. Encouraging small-scale and urban farming can also help boost the availability of fresh produce and protein-rich foods within local communities. In addition, regular monitoring of household food consumption and nutrition trends will help ensure that policies and interventions are responsive to the real needs of families struggling with the effects of rising food costs. To this end, efforts towards

providing more education and training to enlighten consumers on their dietary needs and how to access nutrients rich food sources within their local environments should be encouraged.

Abbreviations

AIC	Akaike Information Criterion.
LA/AIDS	Linear Approximate Almost Ideal Demand

Data availability statement

Data will be made available upon request by the readers

CRediT authorship contribution statement

Michael Ige Ediabai Edaba: role in this manuscript included conceptualizing the paper, methodology, investigation, project administration, draft preparation, data analysis, and editing. **Emmanuel Akosim Ebele**: includes data collection and funding.

Declaration of Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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