



Indigenous Weaning-foods Markets Competition in Enugu State, Nigeria

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Abstract: An ideal weaning food must be affordable to the target market. However, it is difficult to assert, a priori, how competitive the price. For indigenous weaning-foods markets in Enugu State, Nigeria, a study on the nature of competition and societal impact is pro-active. The study used data from a cross-section of 207 indigenous weaning-foods markets in Enugu State, Nigeria to examine the structure, conduct and welfare loss of the firms using the corrected Herfindah-Hirschman Index (HHI), the Lerner index together with the elasticity of demand. The estimates of the market concentration index in the State and across the Local Government Areas (LGAs) of the State showed that weaning-foods markets are unconcentrated, as the corrected HHI was less than 1000, though with difference in comparative difference and relative difference across markets in the LGAs of the State. There was evidence that weaning-foods firms charge a price that range from 4.484 to 8.065 times the marginal cost. The State experienced a welfare loss of about 42% of revenue among akamu-joro firms in Agwu LGA, 35% among akamu-okiri and akamu-joro firms in Enugu LGA, and 36% among akamu-okiri and akamu-joro firms in Nsukka LGA of the State which increased respectively to 45.6%, 41.5% and 42.4% if the weaning-foods firms were in pure monopoly economy leaving an increase in welfare loss of about 4%, 7% and 6%, respectively. It is evident that indigenous weaning-food markets in Enugu State are neither entirely pure competition nor monopolies.

Keywords: Weaning-foods; HHI; Lerner index; Demand elasticity; Welfare loss.

INTRODUCTION

In Nigeria, exclusive breast-feeding is usually adequate up to six months of age, after which it may become increasingly inadequate to support the nutritional demands of the growing infant up to three years of age. This necessitates the change in diet, in terms of consistency and source, from a liquid-milk based diet to easily digestible, high-energy and high-nutritive value semi-solid food called weaning-food (Onweluzo and Nwabugwu, 2009; Ijarotimi and Keshinro, 2013; Awogbenja and Peter, 2021). This can be any food whether manufactured or locally prepared, suitable as a complement to breast milk (World Health Organisation, WHO, 2001), provided it is also affordable to the target market (Food and Agriculture Organisation, FAO, 1985). The locally processed weaning foods are a composites gruel made from either fermented maize (*Zea mays*), millet, (*Pennisetum americanum*), guinea corn (*Sorghum spp.*) or a combination of any (Ugwu, 2009).

Although these products are not promoted as infant foods, it is plausible that nursing mothers do in fact use them for complementary feeding. There is also no documented information on informal business involvement in complementary foods in Nigeria. Anecdotal observation, however, indicates that there are large numbers of individuals and small businesses selling either prepared foods that are used as complementary foods, or weaning mixes for home preparation. The producers of these weaning-foods who, most often, double as the retailers, process the raw materials into the finish products. A large number of small businesses and kitchen enterprises produce weaning mixes and complementary food products across Nigeria. Sustaining success of such businesses greatly depends on market opportunities (Diao and Hazel, 2004; Wanjohi and Karani, 2017).

Complementary food products have high acceptability among consumers in Nigeria. The challenge is in making the nutritionally adequate products available and affordable

to poor consumers. Hence, the use of proper infant feeding remains very low, with only about 13% of infants exclusively breastfed until the age of six months in 2008, a decrease from about 17% in 2003 while only 30% of infants receive proper complementary feeding from 6 to 24 months in accordance with the World Health Organization (WHO) Infant and Young Child Feeding Practices. Despite progress on timely introduction of complementary foods, only 55% of infants receive complementary foods. This has been attributed to affordability and perception of product quality. The prices of complementary food products vary widely yet the rural poor also purchase them though unable to afford sufficient quantities. Products purchased in open markets and prepared at home are, unsurprisingly, assumed cheaper than packaged alternatives. Among packaged products, those available from small and local businesses tended to be cheaper than those from large Nigerian businesses with established brand names. International brand products are the most expensive, although Nigerian-produced versions of these products are much cheaper than imports. Ijarotimi and Ogunsemore (2006) opined that it is possible to produce nutritionally adequate weaning foods in Nigeria at a low cost but does not, however, indicate whether marketing these products could constitute a viable business model under market conditions. In early twenty-first century, the majority of weaning children in Nigeria were fed traditional weaning foods made from un-supplemented tubers or cereals (Maziya-Dixon et al., 2003; Nnam 2000). These traditional complementary foods do not contain sufficient protein or micronutrient levels to support healthy infant development. So, it made much difference for nursing mothers to feed their infants with the foreign of such foods, even when they cannot afford sufficient quantities to support children's health. The welfare of consumers is compromised when low-income households spend their limited budgets on insufficient quantities of international brands in place of cheaper, nutritionally adequate local alternatives. With the skyrocket price of the foreign weaning-foods, contrary to the affordability condition, many low-income group in Nigeria chose the indigenous weaning food for their children on the assumption of getting a fair price. How well their supposition is yet in the empirical box as evidence on the affordability of the various indigenous weaning foods is sparse, and limited to national-level food consumption surveys.

The nature of indigenous weaning-foods firms has been observed to be neglected, not receiving much attention as most industrial products on the assumption that locally processed weaning-foods markets, like most agricultural products, are competitive. The questions that pertain to the "right" price, the ability to price profitability above competitive levels of indigenous weaning-foods and how costly imperfect competition is for the economy in Nigeria in general, and Enugu State in particular remain unanswered. Yet, it is necessary to aggregate the micro-processors into the various industry classifications. Besides, it is difficult to assert, a priori, that these products markets are competitive. In traditional static economic analysis,

welfare is assumed to improve with competition intensity (Whish and Bailey, 2012) while increase in market concentration decreases competition and efficiency but increase market power. Any such trends are of concern to any business community to ensure, according to Mile (1986) that no money is left on the table unnecessarily on the one hand while no opportunities are opened for competitors through inadvertent over-pricing on the other hand.

The study examine the structure, conduct and welfare loss of the weaning-foods firms in Enugu State, Nigeria. It explores a situation where there are processors producing weaning-foods currently perceived as demand-side substitutes but which are produced using assets that could readily be reassigned to other production in the State. It provides up-to-date information that accurately reflects the market within which the price is determined for weaning-foods in Enugu State, Nigeria. The results of the study will provide policy thrust in the task of supervising such agribusinesses to avoid monopolistic practices and unfair business competition.

MATERIALS AND METHODS

Data Collection

The data for the study were drawn from a sampling frame of indigenous weaning-food firms in Enugu State, Nigeria. Enugu State is located within the geographical coordinates of 6° 30'N and 7° 30'E. It shares boundaries with Anambra State on the west, Abia and Imo States on the south, Benue State to the north-east, Kogi States on the north-west and Ebonyi State on the east. It has a tropical climate characterized by wet and dry seasons. The mean temperature in the State is about 30.64°C (87.15°F) in the hottest month of February while the lowest temperatures occur in the month of November, reaching 15.86°C (60.54°F). It has a land mass of approximately 7,161km² and a population of 3,267,837 (National Population Commission, NPC, 2006) spread across the 17 Local Government Areas of the State with the tenth highest Human Development Index (0.634) in the country as at 2018. Economically, the State is based around trading and services along with agriculture, mainly of yams, rice, cocoyam, oil palm, and cassava. The State is mainly agrarian, producing crops such as yam, cassava, cocoa yam, rice, maize, millet, plantain, oil palm and rubber some of which are raw materials for the weaning foods. A large proportion of the population is engaged in farming, fishing, carving and agricultural marketing. A small proportion of the population is also engaged in manufacturing activities, with the most pronounced among them located in Enugu, Oji, Ohebedim, and Nsukka (William, 2008). A key minor industry is mining, especially of coal in the Udi Hills around the city of Enugu. The state boasts of a number of markets especially at each of the divisional headquarters, prominent of which is the Ogbete Main market in the State capital, Enugu. There is also one of the largest highly competitive price grains market, east of the Niger, the Orie-Orba Market with market periodicity of four which plays

host to most farmers from the North Central States of Benue, Kogi, Nassarawa and Plateau who use the market to dispose their produce for consumers in South-East and South-Southern Nigeria.

A three-stage sampling procedure was used to select weaning-foods firms in the states. The first stage used a purposive sampling to select five Local Government Areas (LGAs) from the State. The LGAs were Enugu-east, Enugu-north, Enugu-south, Agwu and Nsukka LGAs. However, Enugu-east, Enugu-north and Enugu-south were merged as Enugu zone due to their homogeneity in output. The second state was the simple random sampling of communities. The sample size for the study in each community was determined using the small sample-size estimator of Krejcie and Morgan (1970) at 95% confidence interval and 0.05 degree of accuracy as used by Ojogho and Imade (2022). The sample-size estimator is given as:

$$s_i = \frac{\chi^2 N_i P(1-P)}{d^2 (N_i - 1) + \chi^2 P(p-1)} \quad [1]$$

Where, s_i is the sample size of the i th community, N_i is the maximum target population proportion of the i th community, $\chi^2_{0.05,1} = 3,841$, and $d = 0.05$. The sample size were respectively 182 from Enugu, 76 from Agwu and 69 from Nsukka LGAs of Enugu State. However, only 110 copies of questionnaire from Enugu, 54 from Agwu and 43 from Nsukka LGAs of the State were valid for analysis.

Model Specification

A number of different indices or measures of industry concentration has been proposed over the years (Kvålseth, 2022). The study used the age-long framework that presumes a causal link between the structure of market, the nature of competition, and market outcomes in terms of prices, output, and profits. The Herfindahl-Hirschman index takes into account both the number of firms and their relative size. It is theoretically justified using the static Cournot competitive model. It satisfies the necessary and desirable properties of continuity, symmetry that preserves the transfer property and the Lorenz order (Marshall et al., 2011), zero-indifference and Schur-convexity (Kvålseth, 2015) except the value validity (Kvålseth, 2022). Hence, the HHI is only appropriate for making order comparisons of concentration values but not for difference or relative difference comparison. Consequently, the study used a corrected concentration index, HHI^c , that approximately meets the value-validity condition and whose values can reasonably be compared in terms of actual, absolute, or relative differences, defined by Kvålseth (2020) as:

$$HHI^c = \begin{cases} \sqrt{HHI} \text{ if } HHI \geq HHI_0 = \left[\frac{(n+20 - \sqrt{(n-1)(n+40)})}{20} \right]^2 \\ \text{undefined if } HHI < HHI_0 = \left[\frac{(n+20 - \sqrt{(n-1)(n+40)})}{20} \right]^2 \end{cases} \quad [2]$$

where $HHI = \sum_i^n s_i^2$, and s_i is the static market share of the i th marketer in the weaning-foods market. Classification of concentration levels based on HHI^c then are $HHI^c > 2500$ for highly concentrated, $1500 < HHI^c < 2500$ for moderately concentrated, and $HHI^c < 1000$ for unconcentrated, ceteris paribus.

Structural measures such as the HHI have trouble reflecting the relationships between firms operating at different stages of the production process, and how well a market performs from an efficiency perspective. Since weaning-foods are closely substitutable in consumption using the cross-price elasticity of demand, the study included production component in the same market. Achieving that was using the Lerner index, (Elzinga and Mills 2011; Giocoli 2012) that relies on the assumption of profit-maximizing behaviour (Bikker, et. al., 2012) and compares a firm's output price with its associated marginal costs. The Lerner index was stated as:

$$L(q) = \frac{P(q) - MC(q)}{P(q)}, q > 0 \quad [3]$$

The Lerner index directly assesses the ability of a particular firm to charge a supra-competitive price for a particular product. The value of the Lerner index is monotonically associated to market power, and a zero value reflects competitive behaviour, while a positive value is associated with market power. Under profit maximization, $L(q^*) = \epsilon_d^{-1}(q^*)$. Here q^* is the profit-maximizing output quantity and $\epsilon_d^{-1}(q^*) = \frac{-P'(q^*)q^*}{P(q^*)}$ the firm's inverse price elasticity of demand evaluated at q^* (Lerner 1934) with $L(q^*) \geq 0$, while $L(q) < 1$ for any $q > 0$. Thus, competitive ($\epsilon_d = \infty$) was distinguished from uncompetitive ($\epsilon_d(q^*) < \infty$) behaviour on the basis of the sign of the Lerner index. The standard interpretation of the Lerner index is that a zero value reflects competitive behaviour, while a positive value is associated with market power. To determine the Lerner Index and market demand elasticities of the different indigenous weaning-foods, given $P(q)$ as the inverse demand function satisfying $P'(q) \leq 0$ and $C(q)$ denoting a twice differentiable total costs as a function of output given as $C(q) = \begin{cases} F + \int_0^q C'(x) dx & \text{for } q > 0 \\ 0 & \text{otherwise} \end{cases}$ with the corresponding marginal cost function, $MC(q) > 0$ and a fixed cost, F , the Cobb–Douglas cost stochastic frontier parameterization that corresponds to the Cobb–Douglas production technology was first estimated to obtain the marginal cost.

The loss to the consumer from pricing above marginal cost is the deadweight loss. For this study, the welfare loss,

as a proportion of total sales revenue to output, was expressed as:

$$Wl = \begin{cases} \frac{1}{2}\eta(LI)^2, \text{ for } 0 < LI < 1 \\ \frac{11}{2\eta}, \text{ for the pure monopoly} \end{cases} \quad [4]$$

where η is the elasticity of demand, and LI is the Lerner index.

RESULTS

The estimates of the market concentration Index of indigenous weaning-foods market for Enugu States are presented Table 1. The results showed that weaning-foods market in Agwu LGA of Enugu State, concentration was higher for akamu (885.997) and with akamu-okiri (555.140) and akamu-okiri and akamu-joro (555.140). This represents a difference and relative difference in market concentration of 108.739 and 59.60% respectively. Similarly, concentration was higher for akamu (896.287) in Nsukka LGA of the State and with akamu and akamu-okiri (701.964) representing a difference and relative difference in market concentration of 194.323 and 27.68%. These suggest that akamu market is more concentrated than akamu-okiri and akamu and akamu-joro market by 59.60% in Agwu LGA while akamu market is more concentrated than akamu and akamu-okiri in Nsukka LGA. This represent about twice the degree of relative difference in

Agwu to Nsukka LGA between the highest and the least concentrated market. Thus, there are more marketers with possibly one marketer with very large market share in akamu market with a tendency for asymmetry compared with akamu-okiri and akamu and akamu-joro market in Agwu LGA and akamu and akamu-okiri market in Nsukka LGA of the State. In the Enugu zone consisting of Enugu-north, Enugu-south and Enugu-east, only akamu and akamu-okiri market had a defined concentration index of 632.827. In the entire State, akamu market had the highest concentration (848.334), followed by akamu-okiri market (815.960) while akamu and akamu-okiri market had the least concentration index (704.846). These mean a difference and relative difference between akamu and akamu-okiri market of 32.374 and 3.97% respectively. Similarly, the difference concentration and relative difference in concentration between akamu and akamu and akamu-okiri market is 143.488 and 20.3% respectively. These may suggest that processors for akamu have higher technological progress and innovation than processors of other weaning-foods. The results of concentration index in the State and across the LGAs of the State suggest that weaning-foods firm can be classified as unconcentrated, though with difference in comparative difference and relative difference across markets in the LGAs of the State. The markets of such weaning-foods with relative higher market concentration are more likely to engage in supra-competitive pricing or other anticompetitive conduct.

Table 1. Estimates of Concentration Index of Indigenous Weaning Foods Market in Enugu State, Nigeria.

Location	$\sqrt{HHI}, HHI, HHI_0$				
	Akamu and Akamu Okiri	Akamu	Akamu Okiri	Akamu Joro	Akamu Okiri and Akamu Joro
Pooled Sample	704.846 (49.681) [146.196]	848.334 (71.967) [81.020]	815.960 (66.579) [663.431]	715.129 (51.141) [875.20]	770.889 (59.427) [1314.471]
Agwu	777.258 (60.413) [636.421]	885.997 (78.499) [611.197]	555.140 (30.818) [4710.338]	700.942 (49.132) [3913.050]	555.140 (30.818) [2800.311]
Enugu zone	632.827 (40.047) [511.710]	690.268 (47.647) [1156.225]	827.412 (68.461) [1027.734]	568.551 (32.325) [1231.044]	815.960 (66.579) [3913.050]
Nsukka	701.962 (49.275) [587.596]	896.287 (80.333) [723.558]	885.997 (78.499) [2934.524]	782.055 (61.161) [2604.645]	885.997 (78.499) [1930.195]

Source: Authors' computation from 2021 Field Data Survey, values in parentheses are HHI values in brackets are HHI_0

Estimates of the Lerner index and marginal cost of indigenous weaning-foods in the study area are presented in Table 2. The results showed the Lerner index values for all weaning-foods in the study area are greater than zero. Lerner index ranges from 0.777 for akamu and akamu-okiri in Enugu to 0.876 for akamu-joro in the state. Under long-run competitive equilibrium, this would imply the market outcome for each weaning-food lies far from the perfect competitive case, and that there is a substantial degree of non-price-taking behavior which suggests some attendant

welfare loss. Similarly, even weaning-foods firms with lower but greater-than-zero Lerner index values indicate a substantial degree of non-price-taking behavior. It may suggest that there a number of the firms that can cover their one-time sunk cost. The results also showed that akamu and akamu-okiri had the highest marginal cost of production (N102.94) and least with akamu-okiri and akamu-joro (N73.82). The trend is the same in Agwu LGAs of the State. This explains the lowest level of market power, as Lerner index showed, for akamu and akamu-okiri in the

state. This also true in Enugu zone and Nsukka LGAs of the State where akamu and akamu-okiri had highest levels of marginal cost than other weaning-foods in the state and the lowest Lerner index.

Overall, it is noticed that the weaning-foods firms in the study area have a high level of market power with the value of Lerner index reached 0.807 in Akamu-Okiri market. In other words, weaning-foods firms in the study area, *ceteris paribus*, yield a higher price level, which is a bad signal for the welfare of the society. This is evident in the mark-up

factor that ranges from 4.484 for Lerner index of akamu and akamu-okiri in Enugu (0.777) to 8.065 for Lerner index of akamu-joro in the state (0.876), suggesting that the weaning-foods producers charge a price that range from 4.484 to 8.065 times the marginal cost. Though, this is a signal for higher profits to the weaning-foods firms, it will most likely improve the production technology and lower future prices of weaning-foods for buyer in the study area.

Table 2. Lerner Index and Marginal Cost Estimates of Indigenous Weaning-Foods Enugu State

Location	Akamu and Akamu- Okiri		Akamu		Akamu-Okiri		Akamu-Joro		Akamu-Okiri and Akamu-Joro	
	MC	Lerner index	MC	Lerner index	MC	Lerner index	MC	Lerner index	MC	Lerner index
Pooled sample	102.936 [29.585]	0.802 [0.055]	74.383 [18.157]	0.843 [0.041]	97.829 [27.590]	0.805 [0.053]	81.231 [19.121]	0.876 (0.067)	73.816 [20.817]	0.853 [0.040]
Agwu	80.680 [13.932]	0.839 [0.028]	63.826 [10.746]	0.868 [0.022]	79.102 [14.537]	0.840 [0.029]	70.207 [12.420]	0.912 (0.034)	59.685 [10.969]	0.879 [0.022]
Enugu	117.035 [31.403]	0.777 [0.061]	92.669 [17.569]	0.797 [0.041]	112.036 [28.270]	0.778 [0.057]	101.215 (20.152)	0.831 (0.094)	84.535 [21.331]	0.832 [0.043]
Nsukka	109.658 [26.976]	0.792 [0.052]	74.608 [16.025]	0.844 [0.031]	101.395 [26.627]	0.801 [0.048]	75.203 (21.167)	0.843 (0.068)	76.506 [20.091]	0.850 [0.036]

Source: Authors' computation from 2021 Field Data Survey, MC is marginal cost, values in brackets are standard deviations

Table 3 shows the results of the welfare loss and demand elasticity for weaning-foods firms in the State. The results showed that welfare loss is highest with akamu-joro (0.416) and least with akamu-okiri (0.336) in Agwu LGA, highest with akamu-okiri and akamu-joro (0.346) and least with akamu and akamu-okiri (0.302) in Enugu LGA while it was also highest with akamu-okiri and akamu-joro (0.361) and least with akamu and akamu-okiri (0.314) in Nsukka LGA of the State. Agwu LGA had the highest welfare loss across the weaning-foods in the State. The trend would be the same if the weaning-foods firms were pure monopoly economy. However, the results showed that the welfare loss would be higher if the weaning-foods firms were in a pure monopoly economy. The difference in welfare loss was highest with akamu-okiri (0.084) and least with akamu-joro (0.040) in Agwu LGA, highest with

akamu and akamu-okiri (0.086) and least with akamu-joro (0.069) in Enugu LGA while it was also highest with akamu and akamu-okiri (0.080) and least with akamu-okiri and akamu-joro (0.063) in Nsukka LGA of the State if the weaning-foods firms were in pure monopoly economy. On average, Enugu LGA had the highest difference in welfare loss across the weaning-foods in the State.

These results suggest that the society experienced a welfare loss of about 42% of revenue among akamu-joro firms in Agwu LGA, 35% among akamu-okiri and akamu-joro firms in Enugu LGA, and 36% among akamu-okiri and akamu-joro firms in Nsukka LGA of the State. The welfare loss increased to 45.6%, 41.5% and 42.4% respectively if the weaning-foods firms were in pure monopoly economy representing an increase in welfare loss of about 4%, 7% and 6% respectively.

Table 3. Welfare Loss and Market Demand Elasticities Estimates of Indigenous Weaning Foods in Enugu State

Location	Akamu and Akamu Okiri		Akamu		Akamu Okiri		Akamu Joro		Akamu Okiri and Akamu Joro	
	Welfare loss	η	Welfare loss	η	Welfare loss	η	Welfare loss	η	Welfare loss	η
Pooled Sample	0.322 0.077*	1.253 [0.399]	0.355 0.066*	1.189 [0.421]	0.324 0.077*	1.248 [0.401]	0.384 0.053*	1.143 [0.437]	0.363 0.063*	1.175 [0.426]
Agwu	0.352 0.067*	1.193 [0.419]	0.376 0.058*	1.152 [0.434]	0.336 0.084*	1.192 [0.420]	0.416 0.040*	1.097 [0.456]	0.386 0.053*	1.138 [0.439]
Enugu	0.302 0.086*	1.295 [0.388]	0.318 0.080*	1.258 [0.398]	0.302 0.084*	1.294 [0.386]	0.345 0.067*	1.213 [0.412]	0.346 0.069*	1.205 [0.415]
Nsukka	0.314 0.080*	1.268 [0.394]	0.356 0.066*	1.186 [0.422]	0.321 0.078*	1.254 [0.399]	0.355 0.066*	1.187 [0.421]	0.361 0.063*	1.179 [0.424]

Source: Authors' computation from 2021 Field Data Survey, values in brackets are welfare loss for the pure monopoly; *difference in welfare loss

CONCLUSION

For indigenous weaning-foods markets in Enugu State, Nigeria, a study of the nature of competition and societal impact is pro-active. The study used data from a cross-section of 207 indigenous weaning-foods markets in Enugu State, Nigeria to examine the structure, conduct and welfare loss of the firms using the corrected Herfindahl-Hirschman index, the Lerner index together with the elasticity of demand. The study found evidence of difference in comparative difference and relative difference across weaning-foods markets in the LGAs of the State. There was also evidence that weaning-foods firms over-charge price that are in range of 4.484 to 8.065 multiples of the marginal cost. The State experienced a welfare loss among akamu-joro firms in Agwu LGA, akamu-okiri and akamu-joro firms in Enugu zone and akamu-okiri and akamu-joro firms in Nsukka LGA of the State that is, however, lower than would be in pure monopoly economy. It is evident that indigenous weaning-foods markets in Enugu State are not entirely pure competition nor monopoly.

Conflict of Interest

There is no conflict of interest to declare.

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