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Economies of size of the Marketing of Tomatoes in a Highly populated Nigerian town.

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Abstract

This paper establishes that economies of size exist in tomato marketing in a highly populated city in Nigeria. But to capture the advantages of the economies, a minimum of 28,000kg of annual tomato trade per wholesaler is recommended. However, because of the problems identified by the study, 80% of the wholesalers handled less than the recommended minimum volume. This is ironical, given that not more than 10% of the requested quantity at any marketing level was met by marketer's supply.

Suggestions submitted to remedy this shortcoming include organising of farmers and wholesalers into cooperatives, training them in the techniques of efficient growing and marketing of tomatoes; providing them with financial assistance, and intensifying research in tomato breeding.

Introduction

In attempts to promote programs, policy makers often tend to overlook some basic economic principles which should hold before such programs could be accepted by the generality of the people. One of those principles is that of economies of size as they relate to increases in production and marketing of commodities. The existence of economies of size in the production and marketing operations of firms in an industry will suggest that, with the government or other aspects of the market environment preventing exploitation, firms in that industry can increase their production, and sell their commodities at the lowest prices permitted by existing technology. Should there exist diseconomies of size however, the extent to which at least the price reduction objective of government could be achieved, in the absence of subsidies, is very limited. This study was therefore executed to determine the extent of economies of size in tomato marketing in Nigeria using the Ibadan situation as a case. The tomato was chosen because the nutritional and economic importance of diversifying the production and consumption of foostuffs in Nigeria to include fresh fruits and vegetables, most especially tomatoes, has for long, been emphasised (FAO, 1971; Olayide and Heady, 1974; Olayemi, 1972; Townsend, 1979). One tonne of tomatoes contains 164 calories of energy, 219 grams of proteins, 109 grams of calcium, 75 miligrams of phosporus and 189 miligrams of iron. (Townsend, 1979). The investigation focussed on the marketing phase rather than production, because studies conducted within the past few years have shown the importance of marketing, especially at the wholesale level, in stimulating production itself, in contributing to fuller use of a given level of production, in stimulating an increase in return on investment, and in generating an increase in consumer satisfaction (Abott, 1975; Abott, 1962; Olayemi, 1972; Kohls, 1959; Shepherd *et al,* (1976).

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Research Method

Scope of Study

The research focused mainly on the wholesalers of tomatoes in Ibadan, the second most populated city in the continent of Africa, after Cairo. Ibadan's population is about two million. According to Hodder (1967) particular market sites in Ibadan, especially Gege and Oritamerin, serve not only as distribution centres for all of Ibadan, but also major centers for redistribution of foodstuffs for Yorubaland and beyond.

Definition of a Wholesaler

For purpose of the study, a tomato retailer was classified as a marketer who sells not less than 50% of his/her tomatoes meant for marketing to those he/she strongly believes will not resell the commodity in the form it was purchased even if some reselling will eventually take place. Tomato wholesaler are those who sell not less than fifty percent of their tomatoes to tomato retailers.

Data Collection

The cost route approach was used in data collection. The researchers stayed with the wholesalers from September 1988 to March 1989, making various measurements, recording what was done and spent, and obtaining viewpoints from individuals drawn from the various institutions in the marketing channel. The researchers were therefore able to eliminate any definitional and recall problems that may otherwise have arisen.

The questionanire for the study was drawn, pretested and corrected before final administration. Information was obtained on quantity of tomatoes handled, transport, equipment, labour, rent and other miscellaneous items. Management costs could not be recorded directly, but returns to Management were estimated as the residual that went to management when all costs have been paid.

There are many market sites in Ibadan, but samples were drawn from the five major ones in which considerable wholesaling activities of agricultural commodities are done. Relevant information was collected from 70 wholesalers (being a twenty percent sampling fraction of the total); 120 farmers, 60 retailers and 761 ultimate purchasers made up of one quarter percent of the total estimated number of buyers that patronised the market sites.

Data Processing and Analysis

Stepwise polynomial regression runs were made, with the data of those firms that opened for 10 hours, 11 hours and 12 hours per day. These were the daily opening hours of a total of 91% of the wholesaler sample. Twenty one percent of the sample opened for 10 hours per day, 39% opened for 11 hours and 31% for 12 hours. The dependent variable was total marketing charges (costs) TMC, and the independent variable was the quantity of tomatoes marketed per annum (Q). Classification by oepning hours was considered a good attribute for its potential to examine the situations of each subgroup within the industry and to provide recommendations for each sub-group.

The polynomials runs were allowed to the fifth degree. The first degree equation obtained at any run was meant to indicate the direction of the relationship of Q with the dependent variable, and the extent to which it (Q) was a significant explanatory variable. The other powers of the polynomial were meant to indicate the structural equation that gave the best fit. The indicator of the best fit equation was the Mean Square Residual (MSR) which is always as specified in equation 1. (1) MSR = Variance + $(\text{Bias})^2$.

In effect, the equation that has the lowest MSR among a class of equations derived from the same set of data was accepted as the most efficient form that gave the best fit. The best fit equation is also indicated by the value of the adjusted R^2 (R^{-2}). The same equation will always be chosen if both criteria (of lowest MSR, and highest R^{-2}) are used.

Ordinarily, for a regression run meant for testing hypothesis, some assumptions will be made. These assumptions include the normal distribution, zero mean, homoskedastic and non-autoregressive nature of the stochastic disturbance. They also include the non-stochastic nature of each explanatory variable as well as the adequacy of the number of observations, and a low degree of multicollinearity among explanatory variables (See some econometric text books among which are Johnston, 1963; Kmenta, 1971; and Koutsoyiannis, 1979).

Given the nature of this investigation, it is only for the first degree equation among a class of polynomial equations that a hypothesis could be tested via the conventional test procedure. In respect of the other powers, one should not look for the significance of each explanatory variable via the conventional t-test procedure. In this work for example, since Q will normally be correlated with each of Q^2 and Q^3, one would not expect each of Q, Q^2 and Q^3 to be necessarily statistically significant via the conventional t-test procedure in any equation that contains all of them. One knows however that if the lowest positive power of a variable used in a simple regression run is statistically significant in that equation, higher powers of that variable will also each be statistically significant if each is used in a simple regression run. The MSR obatained for each of such independent regression run would however not have been the lowest if comparisons were made with all those involving polynomials.

It is however possible, to discountenance not caring about testing for the significance of each explanatory variable in a polynomial series after the lowest positive power had turned out to be statistically significant, and to insist on testing for the significance of each of the powers of polynomial. The relevant test procedure in such a case will be different from the common t-test. It is as stated in expression 2 below.

$$(2)\quad \frac{(SSR_Q - SSR_K)/(Q-K)}{SSE/n-Q} \sim F_{Q-K,\ n-Q}$$

Where n — number of observations
SSE = sum of squares due to error
SSR = sum of squares due to regression
Q = number of the highest power of polynomial of all the runs.
K = number of the power of polynomial beyond which the significance of the subsequent powers is to be tested.

The conclusion that will be obtained from this test procedure will however be the same as the one that will be obtained from either the MSR or the R^{-2} approach. Hence, the values of the MSR was used for choosing the equations to use for further analysis in this study.

From the equations that were chosen for further analysis in the regression runs involving TMC and Q (these equations are henceforth called 'lead equations') the average marketing cost (AMC) and marginal marketing cost (MMC) equations and curves were derived. For each case, the AMC and MMC equations were derived following expressions 3 and 4 below.

(3) $AMC = \frac{TMC}{Q}$

(4) $MMC = \frac{d(TMC)}{d(Q)}$

Direct values of the average marketing costs for each firm were also obtained. These values were called UMC to distinguished them from the AMCS' which were derived from the TMC functions. A UMC —Q Scattergram for all the firms in the industry was then examined, and from this was drawn the industry minimum cost and average cost curves depicting the curves of the most and averagely efficient firms for all available marketing volume levels.

Results and Discussions:

Volume of Tomatoes Handled by Firms

The maximum annual volume of sales handled in the industry was 82,620 kg; while the minimum was 3,672 kg.

Total Marketing Charges (TMC) and the Quantity of Tomatoes Handled (Q) for Specified Numbers of Opening Hours

In each of the regression equation sets for the relationship between TMC and Q obtained for firms that opened for a specified number of hours per day, the MSR decreased up to the third degree polynomial and from then started increasing. The equations for the first three degrees in each set are recorded in equations 5 to 13 of Table 1. In the Table, the values of the standard errors are in parentheses.

Equations 5, 8 and 12 indicate that the quantity of tomatoes handled by the firms for each of the three different opening hours is a positively statistically significant explanatory variable of toal marketing costs at the 10% level.

The lead equations for the specified opening hours are equations 7, 10 and 13.

Average Marketing Charges (AMC) and Marginal Marketing Charges (MMC) Curves

The AMC and the MMC Curves derived from the TMC lead equation for each of the opening hours are displayed in Fig. 1

The shapes and positions of these curves suggest that those firms that open for 11 and 12 hours per day are more efficient in terms of unit cost minimisation than those firms that open for 10 hours. Those firms in the industry that open for 10

TABLE 1: OLS ESTIMATED TMC EQUATIONS FOR FIRMS THAT OPENED FOR SPECIFIED HOURS

EQN NO.	DEP. VARIABLE	CONSTANT	Q	Q^2	Q^3	R^{-2}	F	MSR
		10 Opening Hours Per Day						
5.	$\hat{TMC}$	480.70	0.07599	—	—	0.25402	4.427	10.8×10^2
			(0.03612)					
6	$\hat{TMC}$	2,844.70	0.17520	0.00001	—	0.34153	5.813	9.6×10^5
			(0.15928)	(0.00001)				
7	$\hat{TMC}$	10,830.77	-1.55239	0.00008	0.00001	0.52161	5.276	7.0×10^5
			(0.60779)	(0.00003)	(0.00001)			
		11 Opening Hours Per Day						
8	$\hat{TMC}$	64.07	0.08329	—	—	0.56034	30.588	10.8×10^5
			(0.01506)					
9	$\hat{TMC}$	592.60	0.01886	0.00001	—	0.56395	15.972	10.7×10^5
			(0.06175)	(0.00001)				
10	$\hat{TMC}$	1,869.34	0.17291	0.00001	-0.00001	0.58599	11.920	10.2×10^5
			(0.04320)	(0.00001)	(0.00001)			
		12 Opening Hours Per Day						
11	$\hat{TMC}$	733.29	0.06314	—	—	0.28107	7,819	21×10^5
			(0.02258)					
12	$\hat{TMC}$	2,809.84	0.12027	0.00001	—	0.34251	5.671	19×10^5
			(0.11145)	(0.00001)				
13	$\hat{TMC}$	6,788.04	0.64673	0.00002	0.00001	0.43267	5.690	17×10^5
		(0.28419)	(0.00001)	(0.00001)				

hours or less per day, should therefore endeavour to increase their opening hours per day. The curves also indicates that it is more efficient for firms that handled below 15,000 kg tomatoes per annum to open for 11 hours per day; whereas, once the total volume handled per annum is beyond that level, the more efficient hours to open per day is twelve.

The unit cost minimising annual volume of trade derived from the lead equations and Fig. 1 are 11,700 kg; 14,000kg and 18,500 kg respectively for firms opening for 10 hours, 11 hours and 12 hours per day.

Eighty percent (80%) of the firms that opened for 10 hours per day handled beyond the unit cost minimising annual sale level, while 62% and 46% of the firms opening for 11 and 12 hours respectively handled beyond their respective unit cost minimising annual sale levels.

UMC — Q Scattergram

Fig. 2 contains the UMC-Q scattergram for all sample firms and the associated industry unit minimum and average cost curves.

Each of Figs. 1, and 2 indicates that considerable economies of size exist in the Ibadan based tomato wholesale industry. Fig. 2 illustrates that if the "averagely efficient" industry curve is considered, there are economies of size up to about 14,000 kg of tomatoes, but if the "minimum" unit cost curve which depicts the unit cost curve of the most efficient firms is considered, economies of size are enjoyed up to a marketed colume of 9,000 kg. For the averagely efficient industry curve, economies

of size appear not to be enjoyed beyond a marketed volume of 15,000 kg. For the "minimum" unit cost curve however, economies of size appear not to be enjoyed beyond a marketed volume of 28,000 kg.

An assertion about the particular level at which diseconomies of size begin, is not advisable given the low number of firms which marketed beyond the 28,000 kg of tomatoes. It would therefore seem appropriate to recommend at least 28,000 kg volume (tomato) trade per firm per annum in the Ibadan based wholesale industry. This recommended unit cost minimising annual marketed volume should be the minimum. A recommendation of the profit maximising level of sales will need the estimation fnot only the cost functions, as done here, but also for the demand function for tomatoes at the wholesale level.

Recommended Maximum Number of Wholesalers for the Volume Handled by the 70 Firms

Since about 1,637,766 kg of tomatoes was handled by the 70 wholesalers studied in 1988/89, and the recommended minimum annual volume of trade per firm was 28,000 kg, the maximum number of firms recommended for the 1988/89 volume of trade of the wholesalers was calculated to be fifty-nine. This figure suggests that the number of firms that did market the analysed volume was too large. This however does not mean that wholesalers necessarily have to quit the industry. What is required is for the firms handling less than the recommended minimum annual volume to increase their volume up to at least that level.

This recommendation is crucial in the light of the estimation done in this study that wholesalers have been able to meet only between 8% to 10% of their request quantity; meaning that to meet the request, at least 16,377,660 kg of tomatoes will have to be marketed per annum by the 70 firms. This implies an annual average of 233,967 kg per firm, which is over 8 times the minimum volume of sales recommended. Based on this and, the tentative recommended opening hours suggested earlier, one can recommend that the minimum volume of sales of firms should be 28,000 kg per annum with 12 opening hours per day. The larger than 28,000 kg of tomato marketed per annum by each firm, and the faster the hours within which these can be sold, the better. As much as 80% of the wholesalers handled less than the recommended minium annual volume of sale.

Problems that Limit the Size of Operations of Tomato Wholesaling Firms

If the percentage of wholesalers that listed problems is used as an indication of their severity, the problems that limited the size of operations of wholesale firms can be listed in order of decreasing severity as: insufficient regular supply quantity from the producing sector, high transport costs, lack of special storage facilities, high spoilage rate, and lack of security of stall site (see Table 2).

An implication from the wholesaler's submissions on their problems is that the government should make conscious efforts to organise tomato wholesalers into cooperatives. These cooperatives can buy in greater bulk from the sources of supply, and can maintain their own trucks and other vehicles which they can utilise in transporting their purchased tomatoes, an arrangement that can considerably reduce

TABLE 2: PROBLEMS FACED BY TOMATO WHOLESAILING FIRMS IN IBADAN 1988/89.

Problems encountered in the industry	% of the firms that indicated the problems
High transportation cost	69
Lack of special storage facilities	63
High spoilage rate	62
Lack of security of stall site	55
Others	31

Source: Personal interview conducted in this study.

transport costs and therefore marketing costs. Where it is economically possible, the cooperatives can also own and operate storage facilities. The cooperatives can also protect/defend/represent members' interest, either by ensuring with relevant authorities the tenure of wholesalers in their different stalls or by building stalls for their members. The input on high spoilage rate suggests that government agencies like the Ministry of Agriculture and National Horticultural Research Institute should organise formal and informal training for wholesalers, retailers and farmers for imparting knowledge concerning better techniques of growing, handling, and storing of tomatoes. Appropriate arm of the government should fund workshops for this purpose. The input also suggests that, to the extent that it is economically feasible, tomato canning industries should be established, either by the government or/the private sector, so as to reduce present and future wastage. If canned tomatoes are produced in sufficient volume as to eliminate the necessity for importantion, which is what is now prevalen in Nigeria, the country's foreign exchange can be conserved.

Factors that Limit Farmers in Producing Tomatoes

All the farmers indicated that insufficient demand for tomatoes was not a problem at all. In fact, they felt that they were able to provide only between 3% and 10% of the quantity demanded of their commoditty.

All the farmers indicated that availability of water was a limiting factor to production, especially during the dry season. This problem calls attention to the need for government, if it is economically feasible, to provide irrigation facilities for farmers.

All the farmers also reported that they had inadequate financial resources (capital), a problem which the high cost of labour magnifies. This input implies that both formal and informal financing institutions should be encouraged by the Government to provide financial assistance to farmers so that they can expand and improve their existing business volume. This can be facilitated if the farmers form cooperative organisations so that the pecuniary and non pecuniary cost of borrowing per farmer will be reduced.

Nine-five percent of the farmers indicated that unsufficient land was a problem, and that there were instances when the government acquired land without compensation. This aspect of farmers' problems implies that the government should make more land available for farmers to grow tomatoes. The government should also guard against not paying compensation for acquired land.

Retailers' Requirements and Problems

All the retailers interviewed indicated that they want to be able to purchase tomatoes at a low price, and to have a regular supply of tomatoes produced around the area where they are being purchased so that transport costs might be lowered. They also require tomatoes of good quality — big and thick-skinned.

The retailers' inputs imply that agricultural research agencies should be encouraged to breed high yielding, disease resistant, big size, thick-skinned tomatoes, the type preferred by purchasers. The provision of research funds by the government may prove helpful.

The major problems the retailers reported they were facing include their not having facilities with which they can store their tomatoes for as long as they want, and their not meeting the demand quantity of their purchasers (they thought they would still have a market even if they increased their present volume of sales ten times). They regarded fluctuating prices as a problem, though they said their purchasers often paid those prices, their fluctuation notwithstanding.

Provision of storage facilities, as earlier discussed, may help in reducing these problems.

Ultimate Purchaser's Requirements

Ultimate purchasers expressed that they want a regular supply of clean unblemished, thick skinned, big size tomatoes.

The role suggested earlier for agricultural research will serve in meeting these requirements of purchasers.

Ultimate purchasers also want prices lower than what they paid, and said that if prices went down by as much as half, they would increase their purchase of tomatoes, but they were not sure whether the quantity would be twice their present purchase.

When one considers the problems of the whole producing and marketing systems and the implication of coordination that these raise, one wonders if the time is not ripe to execute Arthur Lewis' 1967 suggestion of having the organization of supermarkets reach back to the farmers (Lewis, 1967).

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