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Seasonality in Cowpea Prices: Effect of Technology in Ekiti State, Nigeria

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Abstract: The study, Seasonality in Cowpea Prices: Effect of Technology in Ekiti State, was done to actually know the impact of technology in stabilizing the prices of cowpea in off- season and on-season from the first quarter of 1992 to the fourth quarter of 2002. It was found out that the people of Ekiti State consumed or demanded for higher quantities of cowpea during the second and fourth quarters of each year examined for the study. These two quarters were seen to be the harvesting and sales periods of the red or brown beans, and this also coincided with quarters of lower prices of the cowpea. The vector error correction result showed that among all the variables used, only the cost of applying technology (i.e. cost of the use of fertilizers, herbicides, pesticides, storage devices and transportation) was significant, and should have impacted a great influence in stabilizing the seasonal prices of cowpea but this was not the case as rightly shown by coefficient of the error correction, 0.3 85456, which is positive (wrongly signed) and fairly low. It follows that from the findings that only a few farmers and wholesalers of cowpea applied technologies to improve the shelf lives of their products, and therefore can not influence the market price of cowpea. The state and local Governments of Ekiti State should put in place policies and structures like good road networks within the state, affordability and availability of agricultural pesticides and herbicides, improvement on the available agricultural storage facilities, building of more modern storage facilities, and buying of excess agricultural produces in the on-season to release them in the open market during the off-season in other to stabilize prices at all seasons, as well as, to reduce the loses to the farmers and marketers.

Key words: Seasonality, Cowpea, Prices, Technology, Ekiti state, Nigeria

Introduction

Cowpea *(Vigna unguiculata)* is a source of relative low cost protein (Dovlo *et al,* 1976) and for many West and Central African farmers, a major cash crop. As production and consumption do not occur simultaneously, producers and traders need efficient storage and transport systems to ensure timeliness of cowpea availability to consumers. Consumers on the other hand, want to buy cowpea at the cheapest cost without compromising quality characteristics such as the texture of the skin, colour of the eye and ease of cooking. Production and marketing are therefore inseparably linked. Information on cowpea production is important to all stakeholders; producers, traders, warehouse operators, transport owners, consumers and policy makers.

The importance of cowpea in the drive to provide adequate good source of protein for man and his livestock throughout the country cannot be overemphasized. Since protein is short supply in Nigerian's diet and animal protein like eggs, meat, milk and so on are very expensive, plant protein through crops like cowpea provides alternative source for maintaining nutritional standard.

This study is appropriate as due consideration is given to the causes of seasonal price variation of cowpea and its effects on the producers, marketers and consumers despite all the technologies involved to make the price at least fairly stable. It is clear that cowpea stands prominently in the social and economic lives of people by providing income, food for the farmers and those involved in the marketing of cowpea. For this reason, seasonal price variation of cowpea is examined here to determine how technology affects price changes from on-season to the off-season.

Cowpea Varieties

According to the field survey carried out on this topic it was noticed that cowpea comes in various shapes, sizes and colours in the market. The most common ones observed are Brown beans which have brown colours and they can be grouped into three types namely

(a) Oloyin: this variety of cowpea is harvested every three months. The harvesting periods are March, June, September and December.
(b) Olo I and II: these species are harvested every six months. The harvesting periods is June and November/ December and
(c) *Drum:* this is usually harvested around October/ November. Other types are White beans which also have two types viz:
Sokoto: which is harvested in July/August and
Mala: which is also harvested in July/August.

Seasonality of Cowpea Production

Cowpea grows well in rich sandy loam soils in areas with a moderate rainfall. If grown in the rain forest areas, it produces too many leaves and a reduced number of seeds. The crops may be sown on ridges or on flat land. Planting usually begins towards the end of the wet season. In the savanna area, July-August is the usual sowing period, while it is sown in September in the rain forest zone. Three or four seeds are sown in hole, 3cm deep and 30cm apart. Cowpea germinates 4- 5days after sowing. Thinning and weeding are not as necessary as they are with other crops since the cowpea grows very rapidly. Since it is a leguminous crop, nitrogenous fertilizers are not required. It starts to flower two months after planting and matures in approximately 3-5\4 months from sowing. The mature pods are harvested during November and December in the savanna zone. They are threshed by beating the heaped pods with sticks. The seeds are usually stored in jute bags.

Seasonal and Cyclical Variations

Most farm products available only in small quantities at start of the maturing season. After that there supply builds up to a peak, following which supply gradually diminishes until the crop is finished. Every type of food has a production calendar. A production calendar shows the dates when the crops mature in a given locality. These seasonal increases and declines in deliveries are matched by inverse movement in prices. The monthly changes in prices within each year generally conform to the pattern of arrivals. Prices fall as the new crops reach the markets and lower income consumers are able to buy, they then rise again when arrivals slow down i.e. when supplies declines. At this stage, only the rich can afford to buy as much as they want while the low income consumers either have to cut down or do not buy at all.

In addition to variations in prices and supply during a single season, there are constant changes between one set of year and another. These changes are usually called cyclical changes. There are also long term changes known as secular trends. Cyclical price changes are not linked with the seasons of the year, but are based on the reactions of supply to changing market conditions. In principle, these changes originate from the short term inelasticity of supply certain crops. Low prices for several seasons lead many producers to reduce the amount they plant. This action causes prices to go up again. Eventually the area planted and market supplies will expand once more and so cycle continues. The detailed analysis of the tendency for prices and supplies to fluctuate continuously around an equilibrium level has been formalized into what is known as the 'cobweb theorem'. Secular trends are caused by a number of factors such as advances in production and marketing techniques, the development of new ideas about what we should eat, other products which can used are as substitutes, changes in the preference of the consumers. Price is considered to be the chief agent through which the quantities of factors of the products supplied and demanded are brought into a state of equilibrium in the market (Olayemi, 1972). Agriculture markets provide signals through price changes to the producers and consumers for adjustment between, supply and demand. They equate the supply and demand over time and space within each production. Prices of farm products are more volatile than prices of any other commodity in an economy. This is due to inelastic supply and demand curves characterize agriculture and because of the unpredictable changes in food supplies as a result of weather conditions, diseases and other factors (Kohl, et al., 1985).

Olajide and Olatunbosi (1975) revealed that instability of domestic food prices is due to stochastic fluctuations, which do not occur with any degree of consistency or regularity, because they are governed by unpredictable conditions e.g. weather. This is because each crop has its own season, i.e., a period by which it is favoured by the weather prevailing. Cowpea for example thrives well during cold and wet weather and is thus best p anted during the wet season.

In an article written by Otite (1989), the relationship between the relative price of food and incidence of poverty and the issue of distribution in Nigeria was addressed. The effects of relative food prices on food production, marketing and distribution system were considered. It is suggested that polices to increase food production and even marketing and distribution of these food crops should not be politicized in view of the existing ethnic, religious and political affiliations.

Prices of food crops, including cowpea, change with season. It is noted that during harvest and shortly afterwards, food prices are cheaper and become progressively expensive as the lean periods approaches. In a research conducted by Kormawa et al 2000, monthly prices of cowpea were collected from two urban markets in four cities, viz - Abuja, Kaduna, Kano and Ibadan from November, 1999 to August, 2000. The collected data indicated those seasonal and temporal variations, as well as, establishing the facts that produce are.

In most countries, there are substantial differences in prices through the year for seasonal crops or for livestock depending on seasonal food supplies. This a normal feature of agricultural marketing. It reflects the need to spread supplies coming into the market one time over a much longer period of consumption. Necessarily, this involves costs, The degree of seasonal difference in price is determined by how far farmer's sal's are seasonally concentrated, the perishability of the product, and the storage, credit and risk charges involved in holding it over the time required (Abbot and Makeham, 1990).

Methodology

This study was carried out in Ekiti state of Nigeria. Ekiti State is situated entirely within the Tropics. it is located between Longitudes 4° 45' to 5° 45' east of Greenwich Meridian and Latitudes 7° 15' ▮ 8° 5'

North of Equator. It lies South of Kwara and Kogi States as well as East of Osun State. It is bounded in the East by Edo State and in the SoLith by Ondo State. Ekiti state is an agrarian society. Ekiti state has a total landmass of 5,804,602 km with population density of 250 people per square kilometre. The state enjoys tropical climate with no distinct season. The state is divided into two ecological zones (northern savannah and southern dry forest zones) for agricultural purposes. Both zones occupy 48% and 52% of the landmass of the state respectively. By 1991 census, Ekiti State Population was 1,647,822 while the estimated Population on October 1, 1996 was put a 4,256,436.

The data used in the study are secondary data. They are got from Ekiti State Ministry o: Agriculture and Natural Resources, Ekiti State Agricultural Development Programme (ADP5) Office, and Federal Office of Statistics. The data collected were that of quarterl) quantities of cowpea consumed (demanded) in Ekiti State and quarterly total quaittitie consumed in Kwara, Kogi, Osun, Edo and Ondo State (neighbouring states) from 1992 t 2002, quarterly prices of cowpea in Ekiti State from 1992 to 2002, Sum total (in Naira) o: fertilizers, irrigation, pesticides, herbicides, storage services and transportation cost (applied to the cowpea produced within the state and those from other neighbcurin states) from 1992 to 2002 as the technologies used or involved.

Method of Data Analysis

The following tools were used for the purpose of achieving the stated objectives of this study: Descriptive Analysis using trend analysis via graphs, and tables; and Erro: Correction Mechanism (ECM) via Vector Error Correction Method (VECM).

Co-integration and *Error* Correction Modeling

The analysis of data of this study is based on the co-integration analysis also referred U as Error Correction Models (ECM). Co-integration has gained increasing popularity and importance in analysis that describe long run or equilibrium relationships (Tambi, 1998) An equilibrium relationship is said to exist between variables in a model when those variables are co-integrated. Two or more variables are said to be co-integrated when the) co-move or move together at the same 'wavelength'. In other words, for co-integration a occur, the data series for each variable involved must exhibit similar statistical properties that is, be integrated of the same order with evidence of some linear combination of the integrated series. A variable is integrated of the order I(1) when it is stationary in level form. Time series is stationary if its mean, variance and autocorrelation are constant over time. Fuller (1976) defined a stationary series as one that has its mean and variance constant over time and the value of the covariance between two time periods and not or the actual time at which the covariance is captured. If X is a non stationary series

Xa+I3Xt—j+e . . . . .0)

Where a is a constant drift, [3 =1, and e is an error term. Most economic series tend to exhibit non-stationary stochastic process of the above form.

If e has zero mean, constant variance and zero covariance, then X is a random walk am it is said to be integrated of order 10). The series X is integrated because it is the sum o: its base value X0 and the difference in X up to time t. If X1 is non-stationary, 3 is unit) and is said to have a 'unit root'. Such a series variances may become infinite and an stochastic shock may not return to a proper mean level; such a non-stationary series ha no error correction representation (Engle and Granger 1987). A non-stationary series requires differencing to become stationary. X is integrated of order D or X I(D<) if i is differenced D times to achieve stationarity. This can be achieved by using the D ickey Fuller (DF) and Augmented Dickey Fuller (ADF). statistics (Engle and Granger, 1987) These tests are based on t-statistics on § obtained from estimates of the following respective OLS regressions applied to each of the series:

= a + 6X_ I + e (for of test) . .. (2)

AX1= a0+oX_i +ZPAX1_il+e (forADFtest) .. ... (3)

Where the lag length K chosen for ADF ensures that et is empirical white noise (i.e stationary). Once the stationarity properties of the individual series are established, linear combinations of the integrated series are tested for co-integration. Co-integration is a test of stationarity of the residuals generated from running a static regression in levels of one or more of the regressor variables on the dependent variables.

ECM is accepted when the residuals from the linear combination of non-stationariry 10) series are themselves stationary. The acceptance of ECM implies that the model is best specified in the first differences of its variables. Thus, the applications of the cointegration paradigm will guard against the loss of information from long term relationships in the first differences.

Empirical Estimation

Augmented Dickey-Fuller (ADF) was used to test for the stationarity of all the variables under study. These tests are based on t-statistics and a1 obtained from the estimates of static ordinary least square (OLS) applied to each of the series. In this study, the ADF test has been chosen because it captures additional dynamic left out by the DF (DickeyFuller) and ensures that the error term is white noise through the inclusion of additional lag length. Johansen Tests for co-integration was also carried out using a linear deterministic and in the VAR (Vector Autoregressive Representation) in order to know the number of cointegrating vectors. The variables are represented as follows:

i. P = Quarterly prices of cowpea (N)
ii. Qit Quarterly quantities of cowpea consumed or demanded (tones)
iii. XIE = Sum total of value of technologies used (N).
iv. K,I = quantities of cowpea demanded by other Western States (tones).
v. U = The stochastic error term

Eigen test was used to s how if any of the three variables under study are co-integrated and invariably to find out if a long-run relationship can be established among them. The general form of the equation is specified in double log form as follows:

LnP = 13o + I3iLnQit + P2LnX1tj33Ln ▮ J34ECM (-I) + U

Where U is the stochastic error term assumed to be independently and normally distributed with zero mean and constant variance. ECM(-1) is the error correction factor. When the coefficient of the ECM is statistically significant, it gives the credence to the existence of co-integration. Its magnitude defines the feedback mechanism amongst the co-integrating variables.

The a priori expectations are: the prices and quantities are expected to have an i werse relation, while technology is expected to have a direct relationship with the price.

Results and Discussion

Trend of Quantity of Cowpea Demanded in Ekiti State

The quantity of cowpea demanded or consumed in the first quarter of 1992 was 4822 tones with a slight increase in the second quarter of the year. Cowpea of 5867 tones was demanded in the forth quarter of 1992. In the first quarter of 2002, a quantity oi' 8000 tones was demanded, and in the forth quarter of the same year, a quantity of 930C tones was demanded or consumed, which happens to be the highest quantity demanded or consumed throughout the study period. As shown in figure 1, the quantities of cowpea demanded were seen to be higher in the second and forth quarters of each year. This may probably due to the likeness towards "brown" or "red" beans by the people of Southwestern of Nigeria. These types of beans are usually harvested and made available for sales usually in May/June and October/November/ December of every year.

Trend of Cowpea Prices in Ekiti State.

The price of cowpea in the first quarter of 1992 (as shown in Figure 2) was N7915 per ton. It dropped to N7800 per ton in the second quarter of the same year. *It went up again in the third quarter of the year to N7999 per ton. At the forth quarter of the year the price was* seen to have fallen to N6990 per ton. This type of trend continued in the same pattern throughout the study period. The highest paid price for cowpea was in the third quarter of the year 2002, while the least paid price was in the second quarter of 1993. One thing is obvious among the prices of various years of the period studied. The prices were seen to be higher in the first and third quarters of each year, while the second and forth quarters of each year were lower, This is not surprising as the quantity supplied to the market during the second and forth quarters of the year were known to be more than the quantity demanded and therefore, the prices of the various cowpea types will fall since every farmer is scrambling to completely sell his product in other not to incure more cost a: a result of damages caused by pests and more cost of production due to storage.

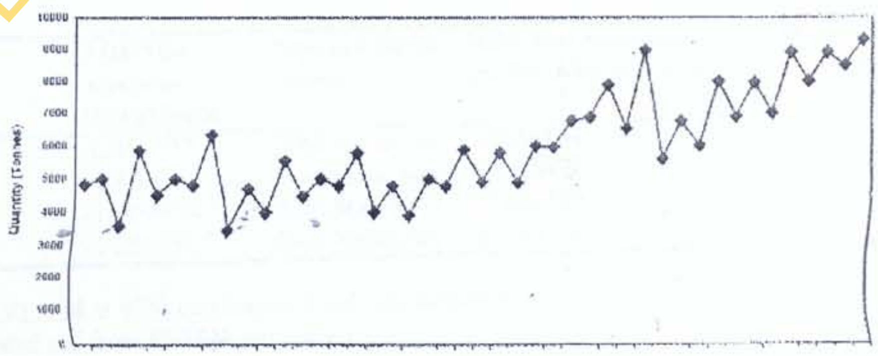

Fig. 1. Trend of cowpea demanded in Ekiti state.

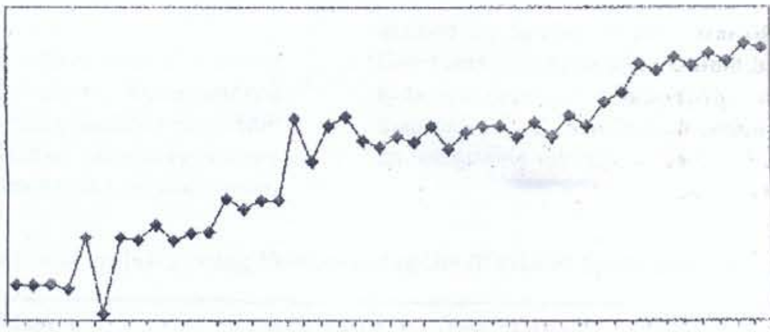

Fig.2: Trend of Cowpea Prices in Ekiti State.

Trend of Costs of Technology on Cowpea in Ekiti State

A sum of N4540 was spent on one ton of cowpea in Ekiti State in the first quarter of the year 1992 as shown in Figure 3. The cost of applying technological means of keeping cowpea for a longer period of time continued to fluctuate in an upward manner until the N245673 per ton of cowpea in the forth quarter of the year 1995, and then started trending in a downward manner to N145004 per ton of cowpea in forth quarter of 2002.

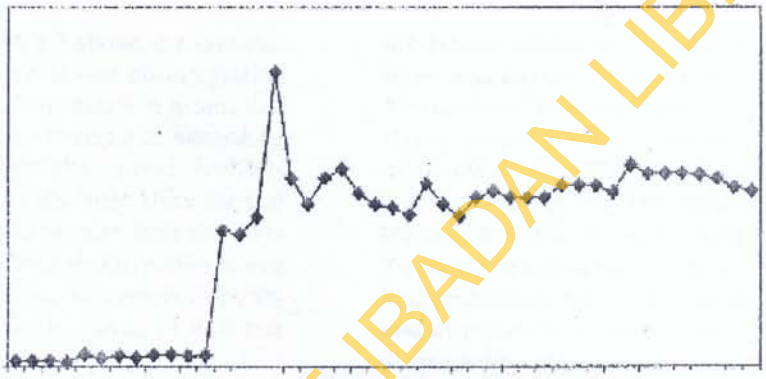

Fig.3: Trend of Costs on Technology

Stationarity Tests of the Variables

Table 2 presents the results of the augmented Dickey-Fuller (ADF) test statistics hr unit root of all the variables (influencing or causing variations in prices of cowpea) N their level form (of natural logarithm) from first quarter 1992 to fourth quarter 2002 without a time trend. The ADF tests strongly show that all variables are 10) or non-stationary. There is, therefore, the need to difference the variables once to arrive at stationaiity. In essence, any attempt to use the non-stationary variables at their level form could lead to spurious results.

Table 1. Augmented Dickey-Fuller unit root tests of variables at their level form and first differencing

Variables	ADF Test Statistics (Level form	Remark (level form)	ADF Test Statistics (at First Difference)	Remark (first Difference)
LnQt	-0.407137	Non Stationary	-18.58144	Stationary
LnP_1	-1.8 84133	Non Stationary	-14.05478	Stationary
LnTt	-1. 853954	Non Stationary	-7.540709	Stationary
LnKt	-2.256051	Non Stationary	-9.015078	Stationary

Critical value is -2.933158 at 95% confidence level. Significant at 5%.
Source: results printed out from EVIEW software

Co-integration Test Result

Estimates as presented table 3 have been determined using the Johasen procedure. Unrestricted co-integration test was done using linear deterministic trend in the VAR (Vector Autoregressive Representation). A VAR lag length of 1 tol was chosen according to the minimum Akaike Information Criterion (AIC) technique. The null hypothesis is taken to be that the number of co-integrating vectors is less than or equal to K (where K denotes the number of co-integrating vectors.

Table 2: Test for Number of co-integrating Vectors Using the Maximal Eigen Statistics

Hypothesis		Eigen Value	Test Statistics	95% Critical value
Null	*Alternative*			
K=0	K=1	0.488864	28.18703*	27.07
K≤1	K=2	0.251792	12.18311	20.97
K≤2	K=3	0.135974	6.138377	14.07
K≤3	K=4	0.033605	1.435655	3.76

* denotes rejection of the null hypothesis at the 95% critical level.
Sources: Computed from survey

According to the results in table 3 above, the maximal Eigen values show that there is one co-integrating equation at 95% critical level. It therefore means that the null hypothesis (K = 0) of not having a co-integrating equation will be rejected and the alternative hypothesis of having one (K = 1) will be accepted since the test statistic value of 28.18703 is greater than the 95% critical value of 27.07. The other null hypotheses will not be rejected but accepted since their respective 95% critical values are greater than the values of their test statistics.

The Error Correction Model (ECM) Results

The model provides estimates of short run elasticities while the ECM coefficients show the speed with which the system converges to equilibrium. The vector of interest in this study is P (price per ton) equation.

The results of the vector error correction model are as shown in table 4.3. The n,sults show that the coefficient of the ECM(-1) is 0.385456. It is not properly signed, but significant at 1%. The positive sign indicates that the adjustment is not in the right direction to restore the long run relationship. The means that there is no long term relationship between the price variable and that of technology, quantity demanded, and quantity demanded by other western states. The coefficient of determination, R2, of 0.676962 is good, and that means the independent variables explained the 67.7% variations in the dependent variable (price).

Table 4: The Vector Error Correction Model Estimates.

Variables	Coefficients	Standard Error	t-Statistics
C	0.104903	0.06436	1.62983*
Δ InQ(-l)	-0.216382	0.48050	-0.45033
Δ InQ(-2)	-0.673518	0.46757	-1.44045
Δ InP(-l)	-0.044097	0.31291	-0.14092
Δ InP(-2)	-0.083202	0.19195	-0.43347
Δ InT(-l)	-0.337921	0.15828	2.13492**
Δ InT(-2)	-0.116901	0.16339	-0.71549
Δ InK(-1)	-0.138861	0.21599	-0.64291
Δ InK(-2)	0.177362	0.20079	0.88332
ECM(-1)	0.385456	0.14388	2.67894***

* t values significant at 10%, ** value significant at 5%
*** t values significant at 1%. R2 = 0.676962, Sehwarz criterion = 1.517314.
Source: Computed from survey data.

The estimates of VECM show that in the short run, only the technology is significant at 5% level, while others are not. This simply means that application of technology is an effective tool in stabilizing the seasonal variations in the prices of cowpea but the opposite was seen to be the case as strongly shown by positive sign (which should have been negative in order to have statistical, econometric and economic meanings) of the ECM coefficient. This was due to wrong use of technology, or late application of technology means to help in keeping cowpea seeds from being attacked by pests, or inadequate use of technology. It can also be attributed that only few farmers an wholesalers applied modern technologies on their farms and stores to improve the shel lives of their commodities, and therefore, can not dictate prices of cowpea in the entiri cowpea market, since they are very few in number and with very small holdings, an therefore, are insignificant in stabilizing the seasonal prices of cowpea.

Conclusion

The study has successfully shown that the demands for, or consumptions of cowpea wen seen to be seasonal in Ekiti State. More of cowpea were demanded and consumed in the second and third quarters of the studied period. The prices of cowpea were always Fiighe in the first and fourth quarters of the years studied. The study also found out tha technology should have stabilized the seasonal prices of cowpea but due to the faDt tha only few farmers and wholesalers of cowpea were involved in the use of it and the refor could not help. So, the prices continued to vary in different quarters of the period studied.

Recommendations

The following will be recommended towards the stabilizing seasonal variations of cowpea prices in Ekiti state:

There should be greater awareness of the use of technologies in terms of herbicides, pesticides and improved storage conditions in various warehouses in the state by th state and local governments of the state to improve the shelf live of agricultural products. This will go a long way in stabilizing the variations in the seasonal prices of cowpea. The government should encourage the few farmers growing cowpea, as well as, cowpea sellers in the state by ensuring that the prices of the herbicides and pesticides are affordable and available always.

Government should provide good road networks to link the major towns and rural areas within the state in order to foster quicker distributions of cowpea within the state for quicker consumption and storage. This will not allow delay in both consumption and storage of cowpea and therefore variations in cowpea prices among the local government areas of the state will be minimal. Improved or modern storage facilities should be constructed in all the local government areas of the state in order to keep the agricultural products produced in and transported to the state. This will make most of the seasonal products available almost all year round, and there will be no more needed for the variations in the prices of most agricultural products within the state. The state and local governments of the state should place incentives like buyirg the excess agricultural produces produced in the state and those from neighbouring states for storage during on-seasons of various agricultural products and release them to the open market for sales at regulated prices that will effectively cover the costs of buying and storage.

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