VEGETABLE PRICE IMPROVEMENT THROUGH CHOICE OF MARKETS

by

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Thesis submitted to the Graduate Faculty of the

Virginia Polytechnic Institute

in candidacy for the degree of

MASTER OF SCIENCE

in

Agricultural Economics

APPROVED:

Director of Graduate Studies

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September, 1957

Blacksburg, Virginia

ACKNOWLEDGEMENTS

The author expresses his gratitude to Dr. Joseph M. Johnson under whose direction this study was performed. His suggestions, assistance, and constructive criticism have provided inimitable aid during all phases of this study. For assistance in these and many other ways, the author is humbly grateful.

The author also expresses his gratitude to Dr. Carl W. Allen, Dr. Peter L. Henderson, and Dr. M. C. Conner. Their guidance and constructive criticism are greatly appreciated.

Appreciation is also extended to other members of the Agricultural Economics staff, who have helped plan and carry out this research project. For consultation and advice received from members of the Statistics Department, the author is grateful.

The author extends his appreciation to the ladies of the Department for their typing, clerical, and calculating work. Special appreciation is extended to my wife for her long hours of typing and calculating work.

The cooperation of the Virginia vegetable growers and shippers who made their records available for use in this study is appreciated.

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VEGETABLE PRICE IMPROVEMENT THROUGH CHOICE OF MARKETS

INTRODUCTION

The vegetable industry is an important segment of Virginia's agriculture. The latest census indicates there are seventy-two thousand acres of commercial vegetables in Virginia with an annual gross return of over ten million dollars. Farms growing these crops are concentrated mostly in Eastern Virginia and are relatively close to large vegetable consumption areas. The climate and types of soil in these areas of Eastern Virginia are also very suitable for vegetable production. Since World War II, these vegetable farms, through modern technology, have increased their per acre output of most all vegetable crops. Larger financial returns per acre to the vegetable industry might be expected to have resulted from these increased yields; however, this has not proven true in Virginia. Prices received for some of the most important vegetables produced in Virginia between 1952 and 1954 were 40% less than those received for vegetables produced in other areas during the same seasonal period.[1/]

Vegetable acreage in Virginia, during the 20 years from 1935 through 1954, has declined an average of 1,263 acres a year. During World War II, the acreage did increase over some of the pre-war years,

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1/ U. S. Department of Agriculture, Agricultural Statistics, 1955, pp. 199-249.

but even then the total acreage did not regain the 1935 level.[1/]

Why has Virginia, with its improved production technology, favorable climate and soils, and its relative nearness to large consumption areas, been forced to withdraw over twelve hundred acres of its commercial vegetables each year? A possible answer lies in the fact that Virginia vegetable growers received lower average prices for their produce than did growers from other areas. The explanation of these lower prices may be either that Virginia growers produced poorer quality produce, or that improvements in marketing methods and techniques in Virginia have not kept pace with those of other areas.

Problem

Since Virginia vegetable growers are close to the traditional large Northern consumption areas relative to other vegetable producing areas, they have shipped and still do ship most of their produce to these markets. The large Northern markets receive the bulk of their produce from the various vegetable areas along the coast from Florida to New York as the marketing season for each crop moves from South to North.

Normally, each of these areas has a definite period in which to market the various vegetables in the Northern markets. However, variations in the weather, which may cause either early or late planting

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1/ U. S. Department of Commerce, U. S. Census of Agriculture, 1954, Volume 1, Counties and State Economic Areas; Part 15, Virginia and West Virginia, p. 51.

or fast or slow maturing of the crops, change the seasonal production pattern of an area and often cause its production to arrive on the market at abnormal times. This variation sometimes results in produce from areas, which are normally either earlier or later, arriving on the market at the same time as Virginia's production. An oversupply in the Northern markets is likely to result from this overlapping of the production areas.

During recent years, transportation improvements have made it possible for some more western regions to ship vegetables into these markets. When vegetables from these areas arrive at the same time as those produced in Virginia, an oversupply is also likely to result.

The latest census figures show that there has been a decrease of 21.4 percent in the number of vegetable growers in the South between 1940 and 1950.[1/] Even with this decrease in the number of vegetable growers, there has been an increase of 4.4 percent in vegetable acreage. However, this increase in acreage when compared with an acreage increase of 21.8 percent for the United States is small.[2/] This would indicate the supply of fresh vegetables in the South is relatively less than in other parts of the country.

1/ States includes in the South for this comparison are North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana.

2/ U. S. Department of Commerce, U. S. Census of Agriculture, 1950, Volume II, General Report, Chapter VII, Field Crops and Vegetables, p. 658.

Industrialization of the South has progressed rapidly during recent years and is a factor which has likely increased the demand for vegetables in that area. This industrialization has caused a gradual shift in population from the farm to industrialized towns or cities. As a result, the South's urban dwellers have increased by 4.8 percent between 1940 and 1950. The number of urban dwellers in the North has decreased 1.7 percent during the same ten years. The total population of the South has increased by 14.2 percent while the total population in the North has increased only 9.7 percent over the 1940 population level.[1/] These population shifts and growths should logically increase the relative demand for vegetables in the South.

During the fifteen years from 1940 through 1954, there has been an increase in personal income of 312 percent in the South, while during the same fifteen years in the Northeast, there was a rise in personal income of only 202 percent.[2/] This additional disposable income in the South, which gives more buying power to the consumer, will logically increase the demand for vegetables relatively more in that area.

Considering these factors that may affect supply and demand of vegetables in each area and the fact that Virginia with its cooler summers can produce some vegetables more economically than they can be

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1/ U. S. Department of Commerce, Statistical Abstract of the United States, 1956, pp. 22-23.
2/ Ibid., p. 299.

produced in the deeper South with its higher temperatures, it is appropriate to ask the following question: "Can Virginia shift its marketing pattern from the traditional Northern markets to the increasingly industrialized South and increase the net return to Virginia vegetable growers?" A further extension of this question is to determine when during the season shipments to each of these areas could be most profitable.

Objectives of the Study

The objectives of this study are to determine: (1) if a difference exists in the price levels of the Northern and Southern marketing areas, (2) the market in which the highest net price is available to Virginia vegetable growers after transportation cost is considered, (3) if a relationship exists between price and the quantity of produce arriving on the market or between price and total production, (4) the effect on the market price of additional carlot arrivals in each market, (5) if the prices quoted in the terminal markets are representative of the prices received by Virginia vegetable growers, and (6) the primary seasonal variation in both price and the quantity arriving on the terminal markets.

Review of Literature

Very few price studies concerning terminal markets for vegetables have been published. A search of available publications on the subject

revealed no studies which relate specifically to a comparison of two terminal markets.

Lindstron and King at North Carolina State College as a part of their study on slicing cucumbers and green peppers attempted to measure and explain the variations in prices for these two commodities in the New York terminal market.[1/] The study included 27 days between June 9 and July 17, 1953. The "highest price" of each day was used as representative of the market price for the purposes of their study.[2/] It should be pointed out that no attempt was made in their study to establish the price level of the market as is being attempted in the present study. A price which is more representative of the price level is desirable in this study. However, other relationships which they found are applicable to this study. Lindstron and King found that 37 percent of the variance in the price of slicing cucumbers on the New York market was accounted for by variations in: (1) daily available supply on the market in carlots, (2) available supply on the market on the preceding day in carlots, and (3) the highest price on the

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1/ I. A. Lindstron and R. A. King, The Demand for North Carolina Slicing Cucumbers and Green Peppers, North Carolina State College, AE Information Series No. 49, 1956.

2/ The justification for using the "highest price" in the study as stated by Lindstron and King was that, "the 'highest price' was the best price measure that was available for the study and was used with the implicit assumption that there was a certain scale from the 'highest price' paid for best quality downward to lower prices and poorer qualities. The range, of course, was considerable and increased or decreased depending upon how high the 'highest price' was."

preceding day in dollars per bushel. These same three factors accounted for 94 percent of the variance in price of green peppers. The price elasticity of demand for slicing cucumbers over the 27-day period centered around -1.5 in the New York market. The price elasticity of demand for green peppers was found to be very elastic, centering around -10.0.

The following statement which should be considered in the interpretation of the above results was made in their study:

> In spite of the fact that a high proportion of the variation in New York price is accounted for in this model, the reader should be cautioned against placing complete faith in the results until other models and longer time periods have been examined.

Shuffett included cabbage and tomatoes in an analysis of several vegetables.[1/] This study was conducted over the 21 years between 1921 and 1941 for cabbage. Per capita production of cabbage and per capita personal income were the independent variables used to explain the variations in prices and to establish a demand curve. Shuffett found the demand for cabbage to be inelastic with an increase of 1 percent in per capita production associated with a decrease in price of 2.4 percent. He also found that a 1 percent increase in per capita disposable income was associated with a 1.2 percent increase in price. These two factors explained 73 percent of the variance in the price of cabbage over the 21 years.

1/ D. Milton Shuffett, The Demand for Price Structure for Selected Vegetables, U. S. Department of Agriculture, Tech. Bul. No. 1105, December 1954, pp. 67-79, 91-111.

Shuffett further divided the years into four seasons. During the summer, which is the period of primary interest in the present study, he found cabbage to be inelastic also.[1/] He found that an increase of 1 percent in per capita production of cabbage was associated with a 2.1 percent decrease in prices. However, only 69 percent of the variance was explained during this period.

The per capita production of tomatoes, per capita personal income, and per capita imports of tomatoes were used to explain variations in prices of tomatoes. Shuffett found the price elasticity for tomatoes to be elastic over the 30 years between 1921 through 1950. A 1 percent change in per capita income resulted in an 0.8 percent change in price in the same direction. He also found that on the average a change of 1 percent in imports per capita resulted in a change of 0.1 percent in the season average price in the opposite direction. These three factors accounted for only 34 percent of the variation in prices of tomatoes in the multiple regression model used.

Two of the variables, per capita production and per capita income, explained 45 percent of the variance in price during the summer period. Per capita imports, which were unimportant during this period, were not used. The demand for tomatoes during the summer period was found to be even more elastic than for the entire year.

1/ The months included in each season are as shown below:

Winter - January, February, and March
Spring - April, May, and June
Summer - July, August, and September

The studies reviewed in this section are concerned primarily with determining the elasticity for the vegetable indicated. Shuffett used yearly prices and Lindstron and King used daily prices to calculate the elasticity values. No study could be found which used an intermediate time period, such as a week. In their studies, no attempt was made to establish price levels and to compare the difference between the price levels of markets.

DESIGN OF THE STUDY

This study is designed to: (1) compare the net returns from vegetables marketed in the Northern and Southern marketing areas, (2) determine the relationship between price and carlot arrivals, and (3) determine the effect of additional quantities arriving on the market.

Selection of Markets

The primary considerations in selecting the markets to be used in this study were: (1) defining the marketing areas to be studied, and (2) finding the market that is most representative of the areas. For the purposes of this study, the dividing line between the Northern and Southern areas was established along the southern state line of Virginia and Kentucky. The Southern area includes the states south of this line and extending west to the Mississippi River. The Northern area consists of the states which lie north of the southern boundaries of the Virginia and Kentucky state lines and east of the western state lines of Indiana and Kentucky.

The selection of the representative market within each area was restricted to the larger markets, because complete market report data were not available for the smaller markets. In the south the larger cities are: Atlanta, Georgia; Birmingham, Alabama; and Memphis,

Tennessee.[1] Atlanta, which is the largest of these three cities, was selected to represent the Southern area. Memphis is too far north and is probably influenced somewhat by Northern markets. Atlanta was selected over Birmingham because of its more suitable location with respect to Virginia and its central location with respect to other Southern markets.

New York was selected as the representative market for the Northern area. It is the largest market in the Northern area and is generally considered the price leader. New York is also centrally located in relation to other Northeast and New England markets.

When the representative market was selected for each area, the assumption was made that other markets within the area follow the pattern of the representative market. The Baltimore market was compared to the New York market to determine if the markets within an area conform to each other. This comparison gave an indication of the applicability of the results from the representative market to other markets in the area.

Selection of Crops

The crops to be used in this study were selected primarily on the basis of their importance in Virginia. Irish and sweet potatoes were not considered in this study. Based on the acreage devoted to

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1/ Harry Hansen, The World Almanac and Book of Facts, New York World News, 1957, pp. 329-362.
(The population of the cities is more than 300,000.)

to each, the eight most important green vegetables in Virginia are tomatoes, snap beans, green lima beans, sweet corn, cabbage, cucumbers, peppers, and watermelons.[1] Two of these, green lima beans and watermelons, have been excluded from the study. The largest part of the green lima bean crop is used by processors in Virginia and so would likely contribute little to this analysis.[2] Watermelons accounted for the smallest percent of the acreage of any of the eight vegetables in Virginia. Since they account for such a small proportion of the total acreage, they were dropped from this study also. The six remaining crops account for 66 percent of the green vegetables grown in Virginia. The acreage and percent of the total production of each vegetable are shown in Table I.

Table I. Acreage of Vegetable Crops in Virginia*

Crop	Acreage	Percent of Total Acreage
Tomatoes	17,792	24.5
Snap beans	15,430	21.2
Sweet corn	4,722	6.5
Cabbage	3,931	5.4
Cucumbers	2,934	4.0
Peppers	2,861	3.9

* U. S. Department of Commerce, 1954 Census of Agriculture, Summary Sheet, State of Virginia, November 1955.

1/ U. S. Department of Commerce, 1954 Census of Agriculture, Summary Sheet, State of Virginia, November 1955.
2/ U. S. Department of Agriculture, Agricultural Statistics, 1955, p. 206.

Scope of the Study

The vegetable industry has experienced many changes during the last twenty years, both in technology and in marketing methods. In considering the time period to be covered in this analysis, it appeared that the inclusion of years before many of the current changes took place would make the findings less applicable to the problems facing the vegetable grower today. Since the industry is changing so rapidly, the most recent three years, 1954, 1955, and 1956, were selected to be included in this study. This period should be long enough to establish relationships without encountering the effects of pronounced industry changes.

The length of the time period selected for each of the observations was a week. The monthly period was not considered satisfactory because variations that take place within the month are not revealed. It was expected that the weekly period would smooth over some of the effects of large day-to-day variations due to local factors that may affect an individual market.

Eighteen weeks during which the bulk of Virginia vegetables are harvested were chosen for study rather than the entire year. This period began with the Monday nearest to the first day of June and continued for 18 consecutive weeks to the last of September or the first of October depending on the year. It was not feasible to include the entire marketing period of all the crops because of limited time and funds. This eighteen-week period does account for

the vegetables marketing from 70 percent of the acreage of the six leading green vegetable crops in Virginia.[1/]

Source of Data

Weekly average prices, the price data desired for this analysis, were not available in published sources. Since weekly data were not available, weekly averages for both price and quantity were computed from the daily market reports of the three cities included in the analysis.[2/] Because of the variations in container size and the absence of uniform terms to establish quality, it was difficult to obtain a common weekly price throughout all markets and years. Rather than attempt to adjust the variety of container used to a standard weight, only the price quotations of one container were extracted for use.[3/]

1/ U. S. Department of Agriculture, Agricultural Statistics, 1955, pp. 199-246.

2/ U. S. Department of Agriculture, Fresh Fruit and Vegetable Market News, New York Daily Report, 1954, 1955, 1956; U. S. Department of Agriculture, Daily Fruit and Vegetable Report, Atlanta, Georgia, 1954, 1955, 1956; U. S. Department of Agriculture and Maryland State Department of Agriculture, Daily Fruit and Vegetable Report, Federal State Market News Service, Baltimore, Maryland, 1954, 1955, 1956.

3/ In order to avoid errors in the prices due to the nature of the container, rather than the produce itself, one standard container was chosen for each crop and the price of that container of produce was used in each market throughout all weeks. One exception to this is in Atlanta for tomatoes. The 60-pound box was not quoted in that market, so the prices had to be converted from the 40-pound box. All prices quoted in this study will be in terms of the following containers: Snap beans, bushel; Cabbage, 50-pound sack; Sweet corn, 5 dozen ears; Cucumbers, bushel; Peppers, bushel; and Tomatoes, 60-pound box.

Additional data were collected from Virginia vegetable shippers in order to determine what prices they actually received for their produce in the markets being studied.[1/] Data on the destination of the vegetables from these Virginia shippers were also collected. Produce included in these shipments was often purchased from local vegetable growers by the local produce firm and then shipped to the terminal markets by the produce firm. Data on transportation costs were obtained from Virginia Truck Brokers recommended rates and the Inter-State Commerce Commission rail rates.[2/]

Procedure of Analysis

Several methods of computing the most representative weekly price from the prices quoted in the daily market reports were tried. A weighted average price, which would be the most desirable, could not be calculated because the quantities sold at each of the quoted prices were not given.

Many difficulties were encountered by using the price of a standard quality product as quoted in the daily market reports. In many instances, the terms used to describe the quality were not

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1/ Data include information from five produce firms in Eastern Virginia on size of each shipment, destination of each shipment, and price received for each shipment in the terminal market.

2/ Unpublished transportation rates for fresh vegetables recommended by the Virginia Truck Brokers Association from Eastern Virginia to primary markets.
U. S. Department of Commerce, Agent Boin's Tariff No. 69, ICC 339; Agent Boin's Tariff No. 72-B, ICC 819; Agent Spaninger's Tariff No. 718, ICC 518; Agent Jamison's Perishable Protective Tariff No. 18, ICC 31.

uniform in all markets or during different periods of the year. It was also found that there were many weekly periods when the price of a particular quality product was not quoted in the reports.

The weakness in the use of an arithmetic average of all the prices quoted for the week was that if one or two very high price observations occurred, even though only a small quantity may have been sold at that price, the weekly average price was inflated above the general level of prices during that week. The example shown in Table II will best illustrate this weakness. The arithmetic average price is $2.71 in the example, yet over 70 percent of the observed prices fell below this price.[1/] It does not seem correct to say such a price was representative of the prices in the market that week.

Table II. Example of the Effect of Extreme Observations on Average Weekly Prices.

Price	Number of Observations	Price x Number of Observations
$ 1.00	4	$ 4.00
2.00	6	12.00
3.00	2	6.00
8.00	2	16.00
	14	$ 38.00

1/ $\frac{\$38.00}{14}$ = $2.71, 10/14 = 71%

If the median price of all the weekly observations is used, rather than the arithmetic average, the influence of extreme observations is avoided.[1/] The median price in the example shown in Table II is $2.00. This price seems to be more representative of the prices at which most transactions took place.

When the median price is used to represent the weekly market price, the assumption is made that equal quantities of produce were sold at each of the quoted prices during the week. This assumption must be kept in mind while interpreting the results of this analysis. The weekly median prices from the daily market reports were plotted in order to establish any trends in prices that may have existed. These prices were also used in establishing preliminary relationships with other factors.

The quantity of each crop that arrived in the markets during each week was calculated by simple addition of the daily arrivals by truck and rail.

The data collected from the Eastern Virginia vegetable growers were used to calculate the weighted weekly average prices for shipments of each crop to the markets being studied. The weekly quantity of each crop shipped from Virginia to each market was calculated by addition of the daily carlot shipment to each market during each week.

1/ The median price is the price of the $\frac{\text{Number of observations} + 1}{2}$ observation when the price are arrayed from the lowest to the highest price.

The weekly weighted average price to Virginia growers was compared to the weekly median prices of the daily market reports in order to determine if the prices from the market reports were an accurate measure of the prices which Virginia growers actually received.

The weekly median prices were averaged over the three years for the crops in each market. The curve of these prices shows the average price that existed in the markets during each of the eighteen weeks over the three years.

An analysis of variance test was performed on the median prices from the three markets to determine if there was a significant difference between the price levels of the Northern and Southern markets and to further determine if the price levels of the markets within the Northern area were the same. A 95 percent confidence level was used for this analysis. The analysis of variance model used to establish these differences in the price levels was the completely randomized block design with sub-sampling.1/ The specific application of this model to the median price data is discussed in a later section.2/

The market sums of squares from the analysis of variance were subdivided by an orthogonal contrast to determine which markets account for significant differences in the price levels.3/ In order to determine if there was a difference in the price levels of the Northern and

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1/ Bernard Ostle, Statistics in Research, The Iowa State College Press, 1954, pp. 305-311.
2/ See page 41
3/ Ibid., pp. 267-272.

Southern markets, one contrast used was New York and Baltimore versus Atlanta. A second contrast where New York versus Baltimore was used to determine if there was a difference between the price levels within the Northern area.

The transportation cost for the crops from Virginia to each market was deducted from the three-year average weekly price of each market to determine the net price that Virginia vegetable shippers could have received in each market. The weekly net prices of each crop in the markets were plotted and a curve was drawn through the highest point for each week. This curve was coded according to the market that was organic to the highest net price for that week. This curve for the individual crops then shows the week and the market in which Virginia growers could have received the highest net price for each crop.

Other costs, such as commissions and unloading charges, were considered; however, these costs seemed to vary more within each market than they did between the different markets. The normal commission charge was 7 to 10 percent on most commodities with an unloading charge of 1 to 3 cents a unit depending on the container size.[1/] Since no significant difference in this cost could be established between the markets, they were not used in this study.

In order to determine preliminary relationships that existed between price and quantity arriving on the market, the quantities

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1/ Unpublished data from Virginia Truck Brokers Association.

of each crop in carlot equivalents[1] that arrived each week in the markets were plotted. The curves from these data also show the seasonal trends in arrivals in each market.

The three-year average carlot arrivals for the crops in each market were calculated by a method similar to that used to calculate the three-year average price. In order to obtain a common denominator for the quantity of carlot arrivals in the small and large markets each week's arrivals was expressed as a percent of the three-year weekly average arrivals for the respective market. By plotting these index values for each crop on a common graph, periods of above and below average arrivals for each crop in any market could easily be recognized, regardless of the size of the market.

The total production of each of the crops in the United States was studied in relation to price to get a preliminary idea of the relationship between these two factors. Up to date weekly data on the total production were not available for this purpose, so seasonal production data on each crop were used. The length of the seasons quoted in the publication was not equal.[2] Therefore, the production

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1/ U. S. Department of Agriculture, Unloads of Fresh Fruits and Vegetables, Federal-State Market News Service, New York, 1955, p. 57; Baltimore, 1955, pp. 28-30; Atlanta, 1955, p. 2.

2/ U. S. Department of Agriculture, Vegetables - Fresh Market 1955 and 1956 Annual Summary, pp. 18-49.

in a long season may appear larger in relation to the production of a shorter season than it actually was. To remedy this, the data were expressed as a percent of the three-year average production of each season and these values were used to establish relationships with market price.

In order to establish any interrelationship between the weekly market prices and carlot arrivals, a simple correlation between these two factors was performed for each crop during each year. The dependent variable was the weekly median price and the independent variable was the weekly carlot arrivals on the market. The statistical procedure as outlined by Freund was carried out to obtain the correlation coefficients (r) and the coefficients of determination (r^2).[1/] The r values were tested for significance by the 5% and 1% tables for the Simple Product-Moment and Multiple Correlation Coefficients.[2/]

A simple correlation between the link relative indexes of price and the link relative indexes of arrivals on the market for each year was used to remove the effect of the seasonal trend which may have distorted some of the results.[3/] By this method, a change in quantity which may have induced a change in price can be measured, regardless of the price level during different parts of the season.

1/ John E. Freund, Modern Elementary Statistics, Prentice Hall, Inc., 1952, pp. 258-290.

2/ George W. Snedecor, Statistical Methods, 4th ed., The Iowa State College Press, 1954, p. 351.

3/ The link relative index is computed by dividing each week's price or quantity of arrivals into the following week's price or arrivals. The resulting index gives the percent change from the previous week's price or quantity of arrivals.

A simple correlation between price and quantity of arrivals on the market was performed with the period of local production near each market omitted.[1] This analysis was used because during periods of local production near each market many of the vegetables were sold directly to local stores or handled by hucksters. Quantities of vegetables sold in this manner could not be measured since they did not pass through the terminal market; however, it appears that these quantities did affect the total supply within the area.

In order to see if the quantity arriving during the previous week affected the price of the present week the quantity of weekly carlot arrivals was lagged one week behind the weekly price in a trial analysis.

The possibility of using a multiple correlation where several factors were included in one analysis was investigated by the graphic approximation method.[2] The dependent variable in this multiple correlation analysis was the median weekly price of the crop on the market and the three independent variables were: (1) arrivals during the present week, (2) arrivals during the previous week, and (3) total arrivals on the market of all six crops included in the study.

A three-year correlation coefficient between price and carlot arrivals in each market was calculated by using the data from all

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1/ U. S. Department of Agriculture, Commercial Vegetables for Fresh Market, Usual Planting Dates, Usual Harvesting Dates, Principal Producing Areas, Agriculture Handbook No. 80, December 1954, pp. 6-105.

2/ Robert Ferber, Statistical Techniques in Market Research, 1st ed., McGraw Hill Book Company, 1949, pp. 370-379.

54 weeks in one analysis. The correlation coefficients from this analysis made it possible to determine the overall three-year relationship between price and carlot arrivals for each crop. These three-year correlation coefficients were also calculated by an alternate method using the three-year link relative prices and carlot arrivals.

The elasticity of demand for the crops in each market was calculated to determine the effect on price, when the quantity arriving was varied. To calculate the point elasticity equation, it was necessary to first obtain the regression equation from the price and carlot arrivals data by the method shown by Freund.[1/] The regression equations from the three-year link relative indexes of price and carlot arrivals were obtained by the same method. The regression equation from either the unadjusted data or the link relative index data was used to calculate the elasticity, depending on which of these equations explained more of the inverse relationship between price and carlot arrivals on the market. The point elasticity equations were calculated from the appropriate regression equation by use of calculus as outlined by Tintner.[2/]

The effect of an additional carlot of produce arriving on the market may be determined by first calculating the point elasticity at

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1/ Freund, op. cit., pp. 246-255.
2/ Gerhard Tintner, Mathematics and Statistics for Economics, Rinehart and Company, Inc., 1953, pp. 119-120.

the appropriate level for the change. Since the elasticity has been calculated and the percent change in quantity can be established, the percent change in price in each market may be calculated for each crop.[1/]

1/ Percent change in price = $\frac{\text{Percent change in quantity}}{\text{point elasticity}}$

COMPARISON OF DAILY MARKET REPORT PRICES AND PRICES RECEIVED BY VIRGINIA SHIPPERS

In determining the relationship between the reported market prices and prices received by Virginia vegetable growers, a complete coverage of all markets and crops was not feasible. Only New York and Baltimore were used in this comparison because insufficient shipments were made from Virginia to Atlanta during the three years studied to permit calculation of a weekly weighted average price. Furthermore, sufficient observations were not available to include sweet corn and peppers in this phase of the analysis. The difficulties in obtaining reliable data for sweet corn arises from the fact that the local produce dealers in Eastern Virginia from whom the data were obtained shied away from handling it because of its perishability. Peppers were not included because sufficient observations were not available during the eighteen weeks of this study. The larger portion of Virginia's peppers is marketed in the late fall.

Some criterion for an acceptable range of agreement between the local weighted average price and the median terminal market price was needed because some variation between the two prices would be expected due to variations in quality of the produce, size of load, and other factors which affect the price of any particular lot of produce. The criterion established for this purpose was for the two prices to fall within a 25 percent range of each other. For example, if the terminal market price was $2.00, the lowest Virginia price would be $1.50 and the highest price would be $2.50. If the criterion for the agreement of

prices was widened more of the weekly prices would agree with each other. If the range of acceptability was narrowed, the opposite would be true. The 25 percent range of prices was considered most suitable for the purposes of this comparison.

The cabbage prices in the terminal market and the Virginia grower prices agreed with each other better than the prices of any of the other crops (Table III). The two prices agreed 92 percent of the weeks observed over the three years in both markets. The New York price agreed every week and the Baltimore prices agreed during two of the three weeks observed.

The conformance of the two snap bean prices was second best of all of the crops. The two prices of snap beans agreed 78 percent of the weeks over all three years in both markets. The prices in New York conformed to those received by Virginia growers 81 percent of the weeks while those in Baltimore conformed only 74 percent of the weeks.

The cucumber prices ranked third in conformance to each other when 62 percent of the weekly prices over the three years agreed in both markets. New York and Virginia prices agreed 57 percent of the weeks and the Virginia prices agreed with the Baltimore prices during 71 percent of the weeks.

The tomato prices conformed to each other less than did the prices of any of the other crops. The two prices agreed only 33 percent of the weeks in both markets. In New York, the prices agreed 66 percent of the weeks. The prices did not agree during any of the nine weeks observed in Baltimore. One shipper from whom a large portion of the

Table XII. Comparison of New York and Baltimore Weekly Median Prices with the Weekly Weighted Average Prices Received in these Markets by Virginia Vegetable Shippers, 1954-55-56

Week	Snap Beans						Cabbage						Cucumbers						Tomatoes					
	New York City			Baltimore			New York City			Baltimore			New York City			Baltimore			New York City			Baltimore		
	54	55	56	54	55	56	54	55	56	54	55	56	54	55	56	54	55	56	54	55	56	54	55	56
1	◆	-		◆	◆		◆	◆	◆															
2	◆	◆		◆	◆		◆	◆	◆		-													
3	◆	◆	◆	◆	◆	-		◆	◆		◆	◆												
4	◆	◆	◆	◆	◆	◆			◆				-											
5		◆	◆			◆							-	◆			◆		◆	◆	-	-	-	-
6													-	◆	-	-	◆		-	◆	◆	-	-	-
7													◆	◆	◆	◆		-	-	◆		-	-	
8													-	◆	◆	◆		-		◆			-	
9															-									
10															◆									
11																								
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13																								
14						-																		
15		-		-	-																			
16		◆		-	-																			
17		◆		◆	◆			◆																
18		◆	◆	◆	◆	-		◆																
Percent weeks prices agree		88	83	71	75	80	67		100	100	100	-	50	100	20	100	60	66	100	50	33	100	50	0	0	0

◆ indicates the price received by Virginia vegetable shippers falls within the 25 percent range of the terminal market price.
- indicates the price received by Virginia vegetable shippers does not fall within the 25 percent range of the terminal market price.

tomato data were collected stated that he used Baltimore as a "dumping market". 1/ This marketing practice may explain the complete disagreement of prices in Baltimore since the assumption was made that the quality of the produce from Virginia was the same as the average quality produce on the terminal market.

When plotted, the shipments of the crops from Virginia form curves which approach a bell shape. This bell shape is caused by the large volume of shipments that take place during the middle of the Virginia marketing period. In Table III most of the negative signs, which indicate the two prices do not agree, occur during the first and last weeks of the Virginia marketing period. The disagreement of prices in the first and last of the marketing period may be due to immature, overmature, or other sub-standard quality produce. Poor quality produce would be expected to bring low prices when in competition with higher quality produce from other areas. Since smaller quantities were marketed during the first and last weeks of the marketing season, the number of shipments that took place when the two prices agreed was probably larger than the number of weeks when prices agreed indicated (Table III).

Seventy-four percent of the weekly prices received by Virginia growers were found to agree with those from the daily market reports

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1/ The "dumping market" is the market to which much of the low quality produce was shipped.

of the respective cities over the three-year period for snap beans, cabbage, sweet corn, and tomatoes. The 9 weeks of tomato observations in Baltimore were excluded from this overall average since that market was used as a "dumping market".

ANALYSES OF MARKET PRICES AND THEIR RELATIONSHIP WITH OTHER FACTORS

Many of the variations in the price and quantity of the various crops arriving in the selected markets cannot be accounted for because of imperfect knowledge of the individual market conditions and external factors that may affect the markets. However, the trends in price and quantity are shown because the vegetable grower must take the uncertainties caused by these variations into account when planning his marketing pattern.

Preliminary relationships between prices and the other factors are often distinguishable by graphic analysis. Several such relationships are discussed for the individual crops in this section. A graphic comparison of the weekly carlot arrivals and the weekly median prices in the markets for each crop indicates that there is some relationship between these two factors. A correlation analysis between price and quantity is presented in a subsequent section to determine this relationship.

Weekly data on the total United States production of all crops were not available throughout all three years, so seasonal production data were used. The eighteen weeks studied were divided into three seasons for all the crops except snap beans which was divided into two seasons.[1/]

1/ The corresponding weeks within the three seasons are: Late Spring - weeks 1 through 5; Early Summer - weeks 6 through 11; Late Summer - weeks 12 through 18. The corresponding weeks within the two seasons are: Spring - weeks 1 through 5; Summer - weeks 6 through 18.

The analysis of variance test was used to determine if there was a significant difference between the yearly price levels in the three markets and to determine in which of these markets the highest price level existed. It was necessary to perform a statistical test of this nature since only sample observations of the price in each market were quoted in the daily market reports. The completely randomized block design with sub-sampling was used to obtain the values for the analysis of variance. The mathematical model of this design is shown below.

$$X_{ijk} = \mu + M_i + Y_j + EE_{ij} + ET_{ijk}$$

Where

μ represents a true mean of the prices

M represents the effect of the markets on price

Y represents the effect of the years on price

EE represents the effect of interaction between markets and years

ET represents the effect of interaction of the weeks on the experimental unit

The mathematical procedure used to obtain the analysis of variance with the orthogonal contrast from this model is shown in Appendix B.

The assumption of this design that the variance of all the prices are homogeneous was tested by Bartlett's test.[1/] The

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1/ George W. Snedecor, Statistical Methods, 5th ed., The Iowa State College Press, 1956, pp. 285-287.

calculated chi-square values obtained from this test in all markets are shown under "total" in Table IV. When these values were tested with the chi-square tabular value, all were found to be significant.[1/]

Table IV. Calculated Chi-Square Values from Bartlett's Test for Homogeneity of Price Variances of Six Vegetable Crops in New York City, Baltimore, and Atlanta During 1954 55-56.

Vegetable	Total	New York City	Baltimore	Atlanta
Snap beans	27.145*	5.708	5.244	11.405*
Cabbage	28.122*	6.221	15.141*	.895
Corn	24.304*	2.413	3.587	7.200
Cucumbers	22.119*	5.742	8.661	4.656
Peppers	69.073*	18.878*	19.454*	16.641*
Tomatoes	65.864*	10.572*	15.038*	28.573*

* Denotes significance at the 1 percent confidence level.

The primary purpose of this analysis is to determine if there was a significant difference between price levels in the markets. Differences in the price levels of the years was of minor interest. Therefore, rather than test the price variances of both markets and years, only the market price variances were tested for homogeniety. The number of variances tested in each individual Bartlett's test was then reduced from 9 to 3. The chi-square values from these Bartlett's tests are shown in Table IV for each market.

1/ A. Hald & S. A. Sinkbaek, "A Table of Percentage Points of Chi-Square Distribution," Skandinavisk Aktuarietidskrift, 1950, pp. 170-175.

The analysis of variance for the prices of each crop was carried out even though all crops did not completely conform to the assumption of homogeneous variances. The greatest danger in performing statistical tests of this nature when the variances are not equal is that results will be obtained which "would lead to more than 5 percent rejections (the desired level of confidence is 5 percent in the discussion) if the null hypothesis is true."[1/] Therefore, in instances where the variances are heterogeneous, significant F values may be accepted; however, when the F values are not significant, the possibility still remains that they are significant. Instances where the results are questionable because of the heterogeneous variances are considered in the interpretation of the results.

Snap Beans[2/]

The weekly prices of snap beans in New York and Baltimore tended to remain near the same level throughout the season. The trend of prices in Atlanta was similar to that in the Northern markets, although the price level was higher. There also seems to have been a general tendency for the spread of prices between the Southern market and Northern markets to be greatest in the later part of the season, roughly from the middle of August through September.

1/ George W. Snedecor, Statistical Methods, 5th ed., The Iowa State College Press, 1956, p. 97.

2/ See Appendix A for additional illustrations relating to this discussion.

Over the three years the carlot arrivals of snap beans in the Atlanta market were well above the three-year average arrivals during June (Figure 1). This characteristic may be accounted for by the liklihood that most of the early local production was shipped to the nearby markets. The arrivals in Baltimore were above average during the later part of June and July and this period also coincides with the peak period of local production in that area. No relationship between arrivals and local production was evident in the New York market.

Table V. Analysis of Variance for Snap Bean Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta during 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Squares	F
Years	2	80,631	40,316	2.625
Markets	2	246,130	123,065	8.011*
Atlanta vs. New York City and Baltimore	1	239,828	239,828	15.613*
New York City vs. Baltimore	1	6,302	6,302	.410
Experimental Error	4	61,442	15,361	
Sampling Error	153	536,489	3,506	
Total SS	161	924,692		

* Denotes significance at the 5 percent confidence level.

The analysis of variance test for snap bean prices indicates there was a significant difference between the price levels of the markets (Table V). The F value for years indicates that there was no significant

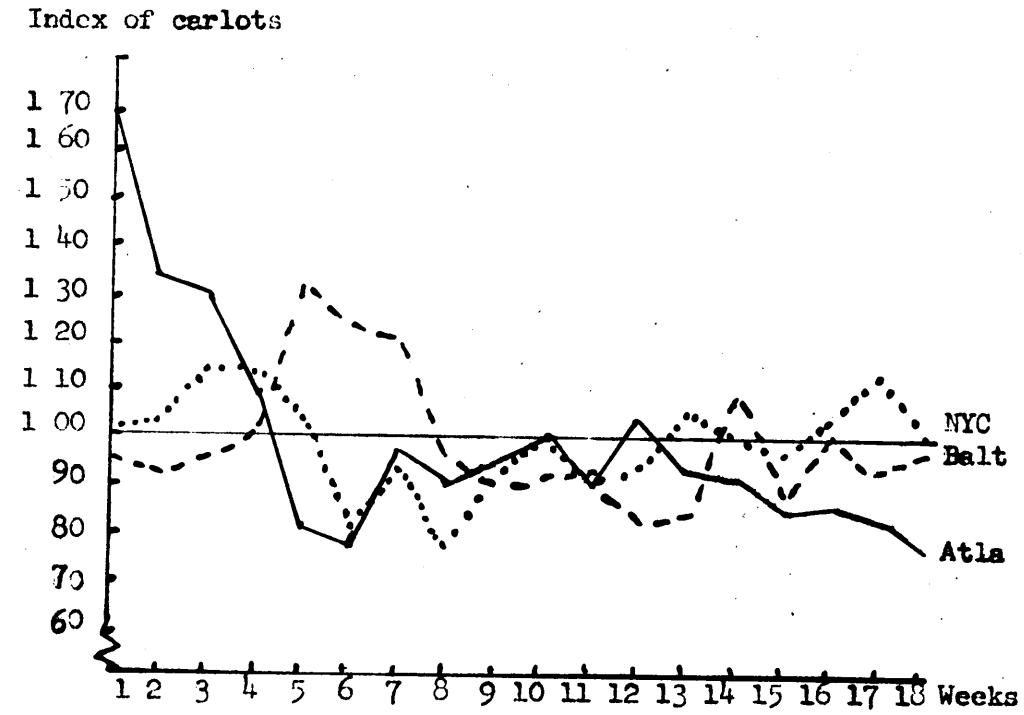

Figure 1 - SNAP BEANS: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore, and Atlanta.

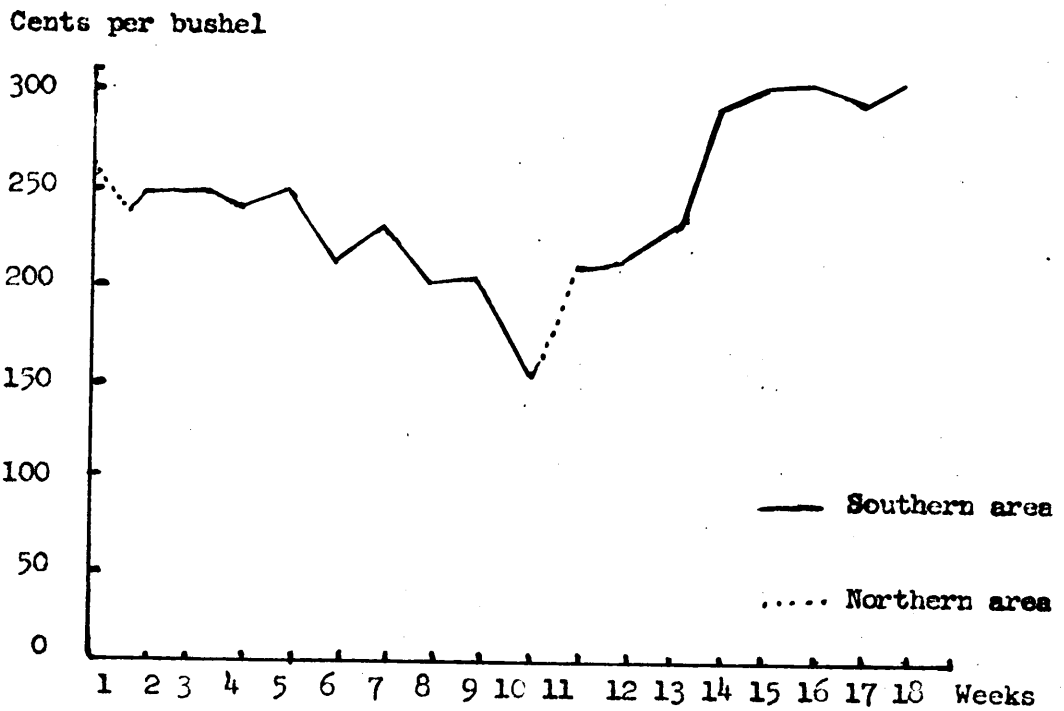

Figure 2 - SNAP BEANS: Market area and period of highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

difference in the yearly level of prices between the three years.[1/] Since all of the variances of the prices were not equal, this value may possibly be significant and the F value not indicate it.

When the market sums of squares were sub-divided by an orthogonal contrast, a significant difference in the price levels was found between Atlanta and the Northern markets. The F value from the analysis of variance for New York versus Baltimore indicates that there was no significant difference in price levels within the Northern area.

Although one market may have a higher price level than another, the question remains: "Would it be profitable to ship produce to that market after deducting transportation costs?" After the three-year average weekly snap bean prices were adjusted for transportation cost from Virginia,[2/] the highest net price was found to be in Atlanta during most of the season, except for the first week in June and the first two weeks in August (Figure 2).

There seems to have been little gross relationship between price and production in 1954 during the Late Spring (Figure 1 and 4).[3/]

1/ Tabular required F value is:

Degrees of freedom	2 & 4		1 & 4	
Confidence level	5%	1%	5%	1%
Critical F value	6.94	18.00	7.71	21.20

2/ Transportation cost per bushel: Atlanta - $.50; New York - $.30; Baltimore - $.25.

3/ The term price will be used throughout this section to refer to the weekly median price as calculated from the daily market reports for each crop in each market and production will refer to the total production of the respective crop in the United States. The sequence of the figures referred to in these comparisons is the appendix figure first (1) and then the text figure (4).

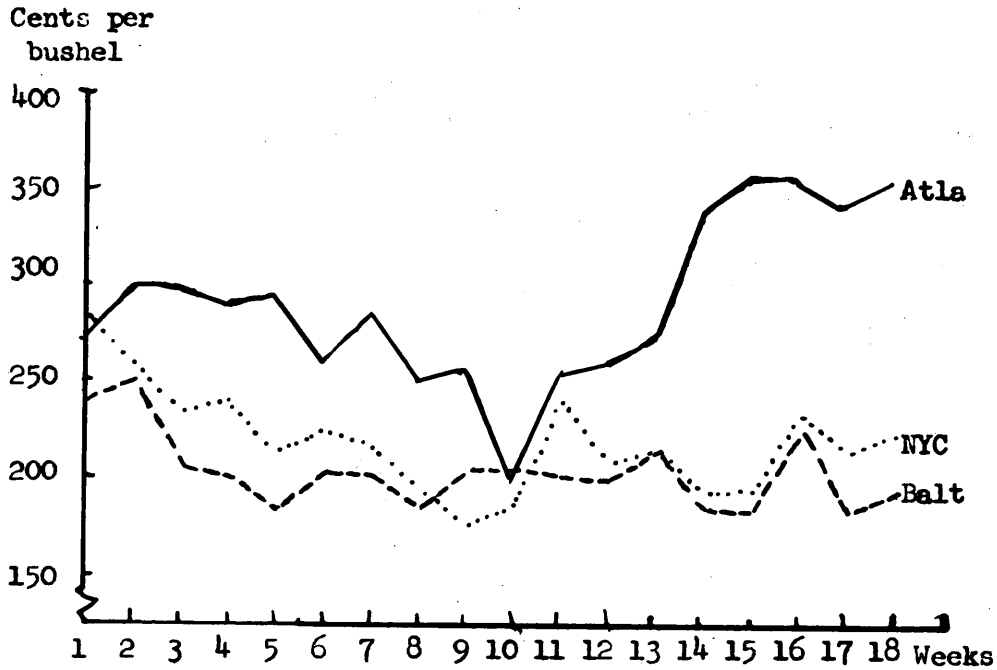

Figure 3 - SNAP BEANS: Average 3 year seasonal prices in New York, Baltimore and Atlanta.

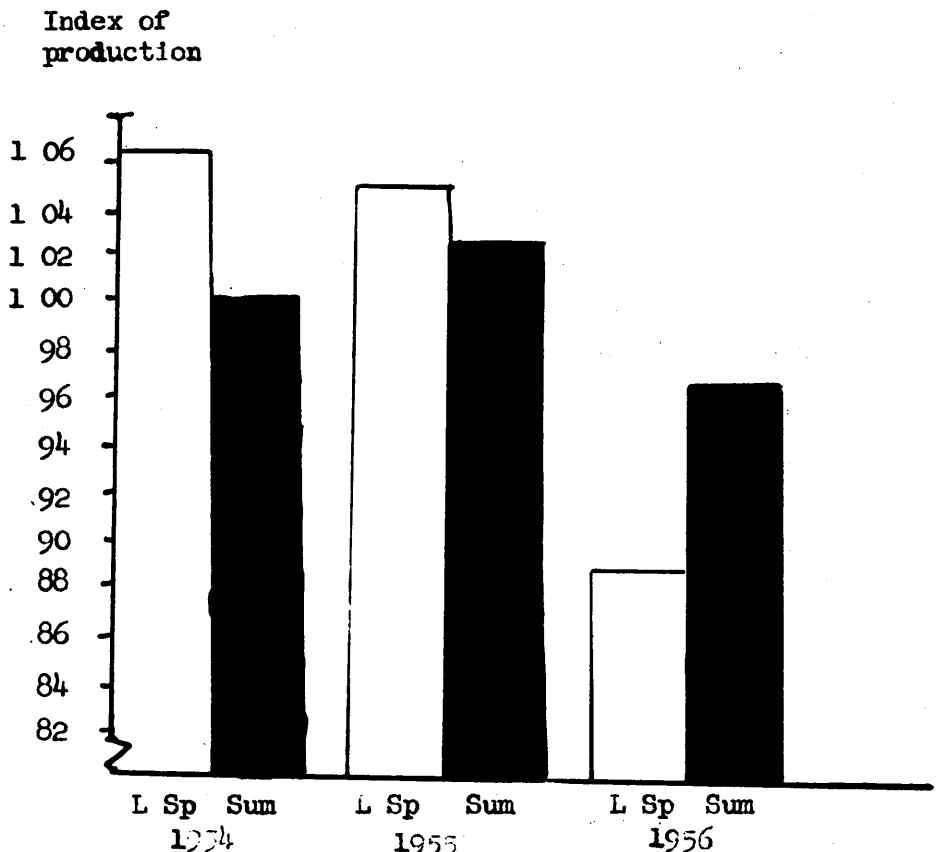

Figure 4 - SNAP BEANS: Seasonal volume of United States production expressed as a percent of the 3 year average seasonal production.

Production was high and the price level was near average in 1954. An inverse relationship between price and production was more apparent in 1955 when the price was below average and the production above average.[1/] In 1956, an inverse relationship also occurred when the price was well above average and production was below average.

Little relationship between price and production was distinguishable during the Summer period. There was a relatively constant price level over all three years while production varied considerably both above and below the three-year average.

Cabbage[2/]

The weekly prices of cabbage in the three markets remained relatively close together throughout the season during 1954 and 1955. In 1956, the prices in Atlanta were generally higher than in New York and Baltimore.

The index of carlot arrivals as shown in Figure 5 form three roughly "U" shaped curves. New York carlot arrivals were well above average during the first few weeks, while the arrivals in the Southern market were about average. During midseason, the carlot

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1/ The term average for price and production used in these comparisons refer to the three-year average price in each market and the three-year average production in the United States.

2/ See Appendix A for additional graphs relating to this discussion.

arrivals in all the markets decreased below average and in the late summer the Atlanta carlot arrivals rose above the average.

Table VI. Analysis of Variance for Cabbage Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta during 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Squares	F
Years	2	6,459	3,230	.403
Markets	2	27,559	13,780	1.719
Atlanta vs. New York City and Baltimore	1	20,307	20,307	2.534*
New York City vs. Baltimore	1	7,252	7,252	.905
Experimental Error	4	32,060	8,015	
Sampling Error	153	180,721	1,181	
Total SS	161	246,799		

* Denotes significance at the 20 percent confidence level.

None of the F values from the analysis of variance for cabbage prices are significant at the desired confidence level. Since Baltimore, which has heterogeneous price variances, was included in all the contrasts, there is a possibility that some of the means are actually significant, but are not shown by the F values. Even though none of the F values are significant, the relative ratio of these values as shown in Table VI may indicate the nature of the difference in the means.

The F values from orthogonal contrast indicates there was no difference in the yearly price levels of the Northern markets. The between area comparison of Atlanta versus New York and Baltimore gave

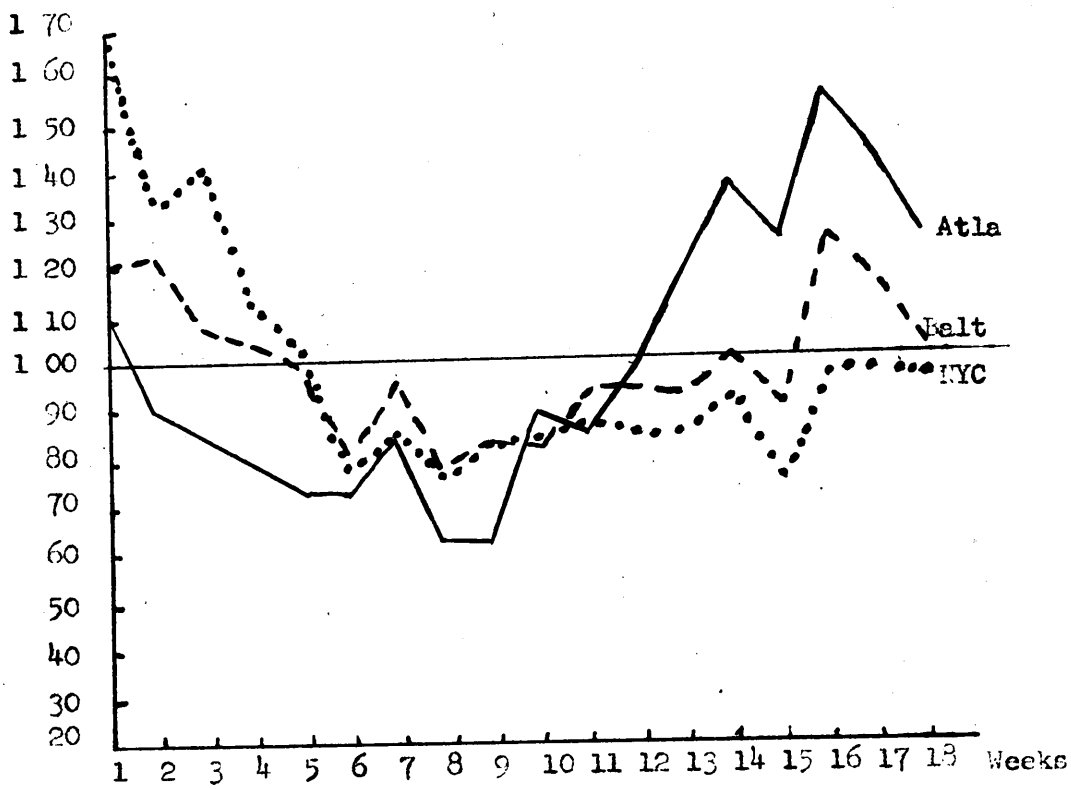

Figure 5 - CABBAGE: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore, and Atlanta.

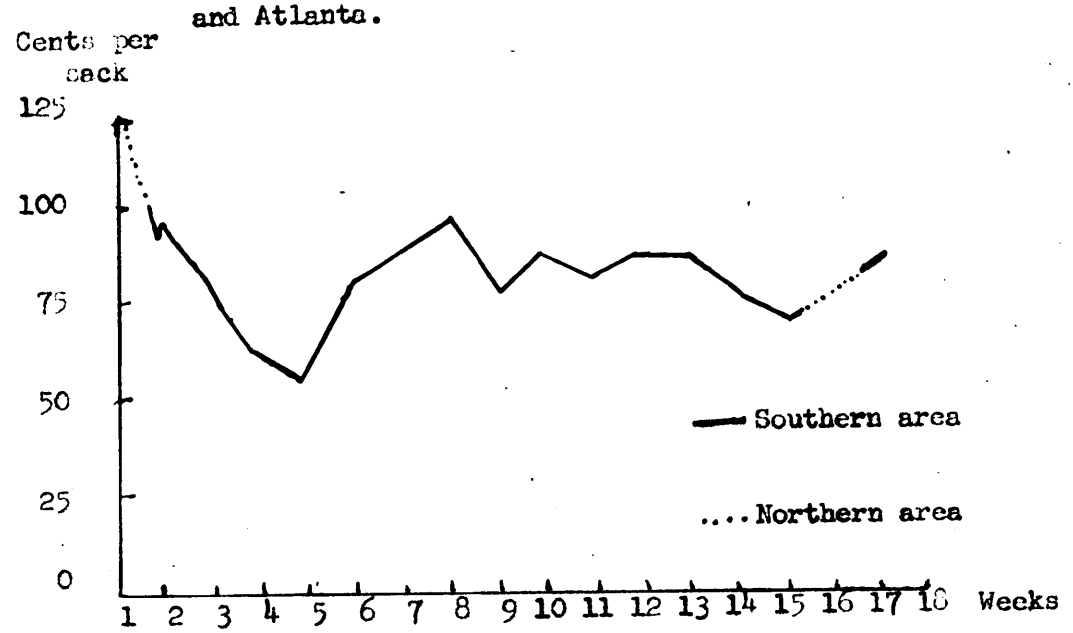

Figure 6 - CABBAGE: Market area and period of highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

the highest F value in the table. Since there was only one degree of freedom associated with this F value, it was converted to a T value to determine the confidence level. By this method, it was found that a difference in the Northern and Southern market prices existed at the 20 percent confidence level.

Even though the three-year price level for cabbage in the South was not statistically higher than in the North at the desired confidence level, the net market price to Virginia growers was found to be higher in the South sixteen of the eighteen weeks. The curve in Figure 6 indicates the market area where the highest net return to Virginia growers could have been received after adjusting for transportation costs.1/

An inverse relationship between production and market price of cabbage existed for the three years during the Late Spring (Figure 3 and 8). The production was above average in 1954 and the price was below average. In 1955, the production was below average and the price was high. In 1956, the production was slightly above average while the price fell between the price levels of the other two years.

During the Early Summer period of 1954, an inverse relationship also existed between production and price. The production was well below average and price was high. The production was above average and the prices were below average in both 1955 and 1956.

1/ Transportation cost per 50-pound sack or crate. Atlanta - $.55, New York - $.35, and Baltimore - $.30.

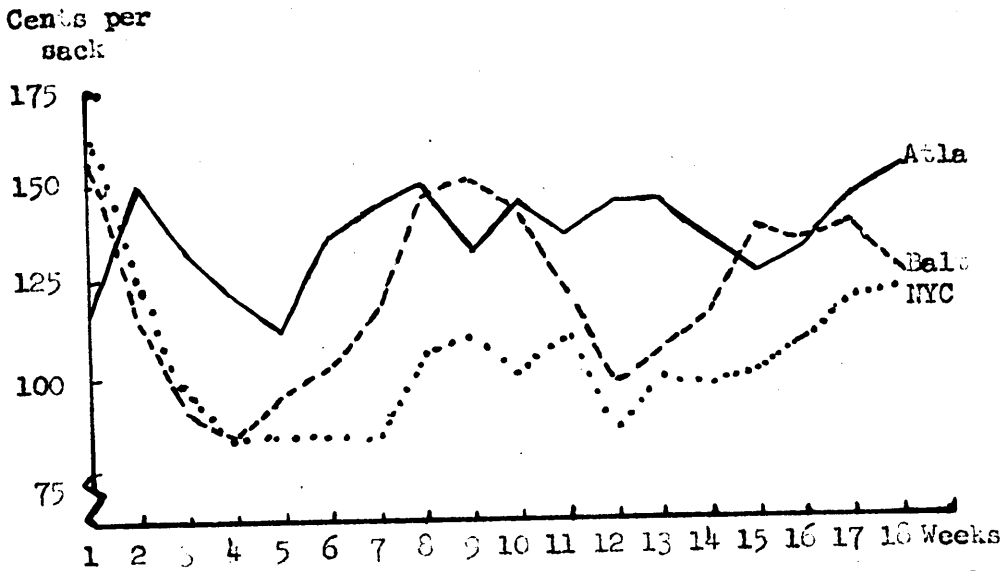

Figure 7 - CABBAGE: Average 3-year seasonal prices in New York, Baltimore and Atlanta.

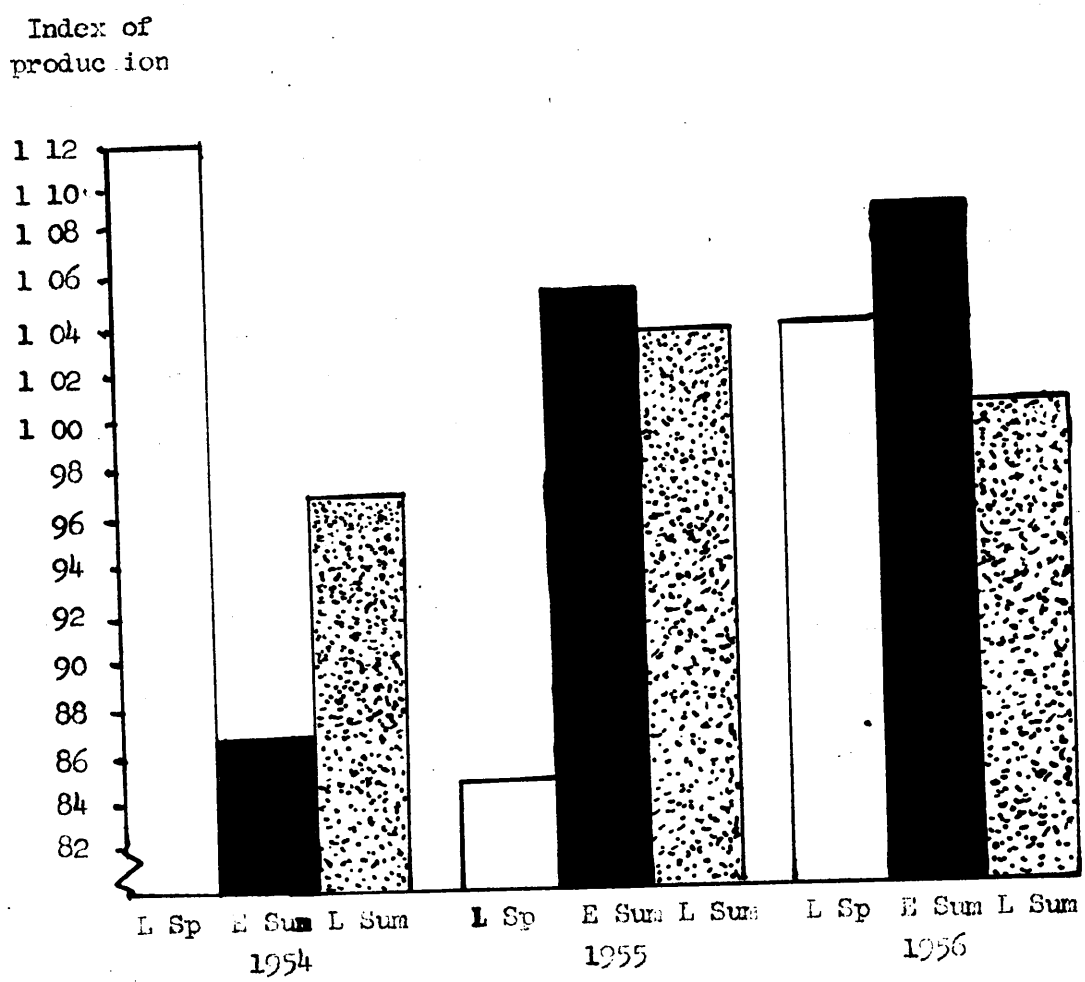

Figure 8 - CABBAGE: Seasonal volume of United States production expressed as a percent of the 3-year average seasonal production.

During the Late Summer period there was no indication of an inverse relationship between price and production. The price was highest and production was largest in 1955. There was virtually no difference in price levels during 1954 and 1956 while production was slightly below average in 1954 and about average in 1956.

Sweet Corn[1/]

The weekly prices of sweet corn in the three markets remained near the same level throughout the season until around the first of August during each year. The prices in the Northern markets then declined, while the prices in Atlanta remained well above the three-year average price of all markets. The difference in prices ranges from $0.50 in 1956 to as high as $2.00 during one week in 1954.

The trend in carlot arrivals over the three years for the Southern market declined throughout the season as shown in Figure 9. The larger volume on the Atlanta market during the first weeks may have been caused by the large local production in that area. The peak of carlot arrivals in the Baltimore market occurred a little earlier than the New York peak. These weeks of highest arrivals in the Northern markets also occurred when local production in each area was at the highest level. The effect of local production on the quantity arriving in nearby markets can be seen more clearly in the case of sweet corn than with the other

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1/ See Appendix A for additional graphs relating to this discussion.

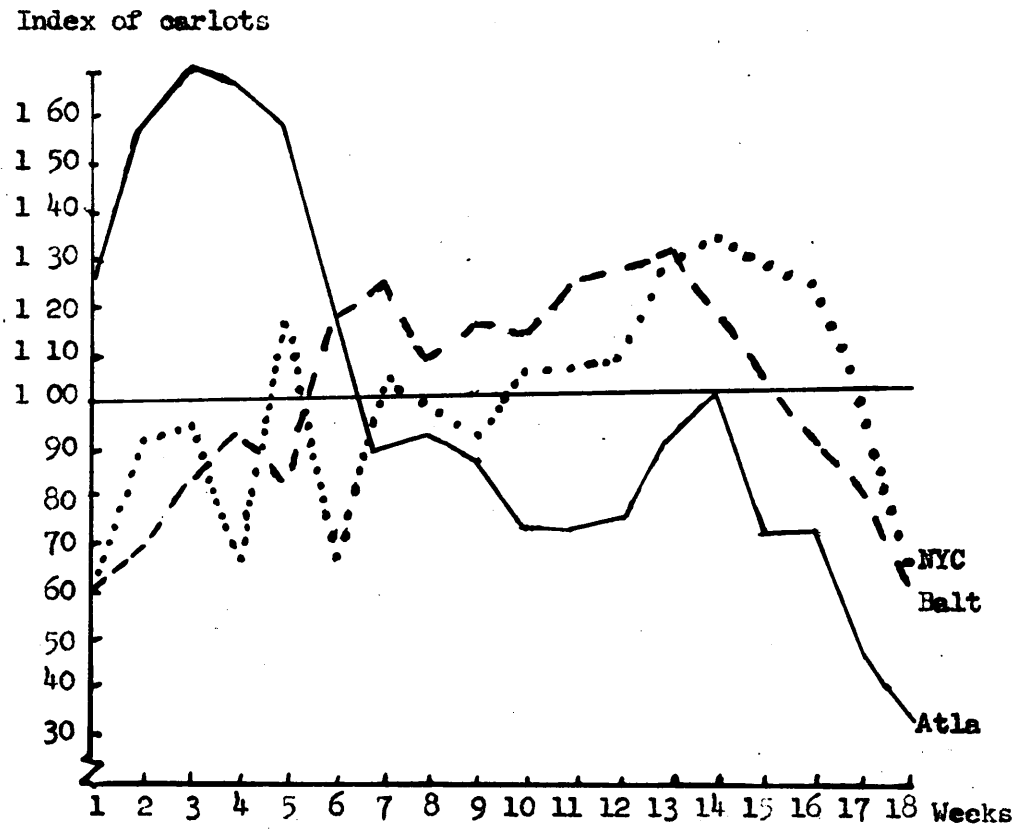

Figure 9 - SWEET CORN: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore and Atlanta.

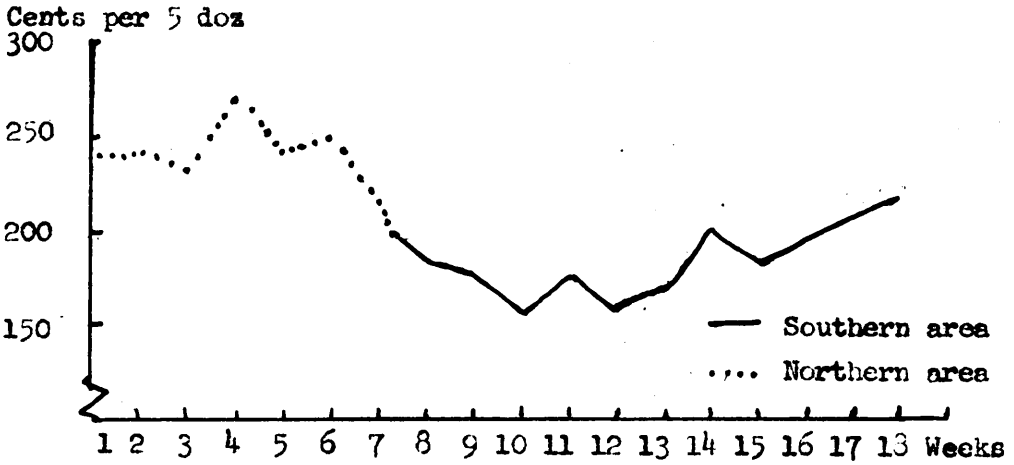

Figure 10 - SWEET CORN: Market area and period of highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

crops studied. Because of the perishable nature of sweet corn, it cannot be transported as easily as most other crops and is therefore often shipped to the nearby markets.

As with cabbage, none of the F values obtained from the analysis of variance for sweet corn prices are significant at the 95 percent confidence level (Table VII). The ratio of the F values is also similar to those obtained for cabbage.

Table VII. Analysis of Variance for Sweet Corn Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta during 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Squares	F
Years	2	17,395	8,698	.202
Markets	2	153,219	76,610	1.780
Atlanta vs. New York City and Baltimore	1	137,353	137,353	3.191*
New York City vs. Baltimore	1	15,866	15,866	.369
Experimental Error	4	172,180	43,045	
Sampling Error	153	328,494	2,147	
Total SS	161	671,288		

* Denotes significant at the 20 percent confidence level.

When the market sums of squares were sub-divided by an orthogonal contrast, the F value obtained from the Northern and Southern area contrast was much larger than that from the within area contrast of New York City versus Baltimore. By converting the F value with one degree of freedom to a T value for the Northern and Southern market area

comparison, a difference in the price levels was found at the 20 percent confidence level.

Even though the price level was not significantly higher at the desired confidence level in the Southern market, it was found that the highest net price to Virginia growers occurred in the South from the middle of July throughout the remainder of the season. The curve in Figure 12 shows the market that would have yielded the highest net price to Virginia vegetable growers for each week after the three-year average weekly market prices were adjusted for transportation cost.1/

The effect of total production of sweet corn on market price is difficult to determine (Figures 5 and 12). The prices during the Late Spring varied only slightly; however, in 1954 when production was highest, the prices were lowest. In 1956, production was lowest and prices were slightly higher than during the other two years. The inverse relationship that apparently existed was slight.

During the Early Summer period, there was only small changes in production over the years. In 1954 when production was highest, the price was also high. In 1955, the production was the lowest and the price was lowest. In 1956, the production and price were both roughly average.

1/ Transportation cost for 5 dozen ears of corn, Atlanta - $.55, New York - $.35, and Baltimore - $.30.

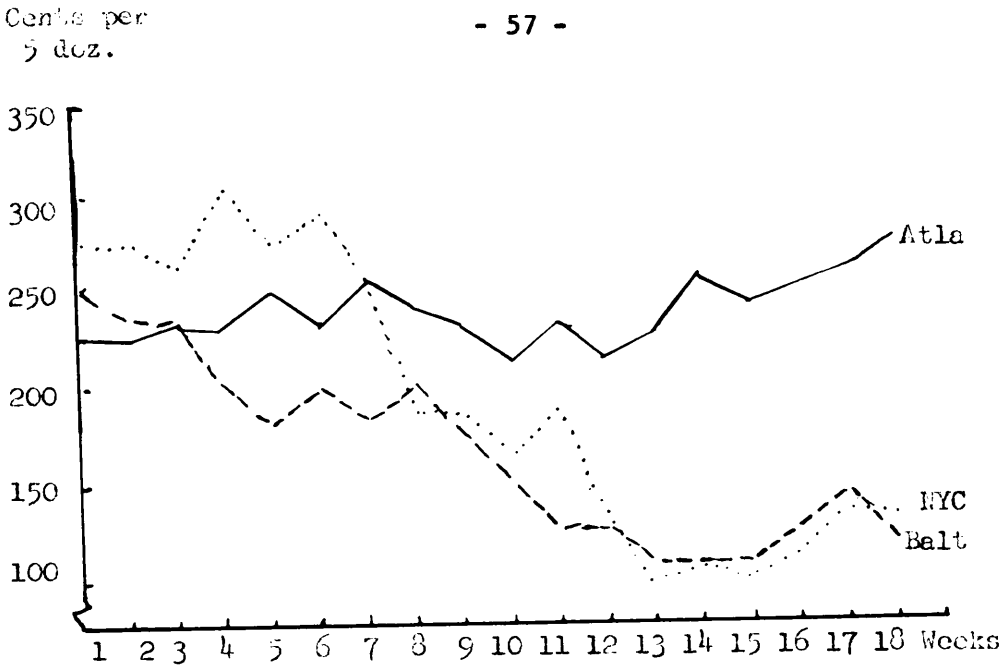

Figure 11 - CORN: Average 3 year seasonal prices in New York, Baltimore and Atlanta.

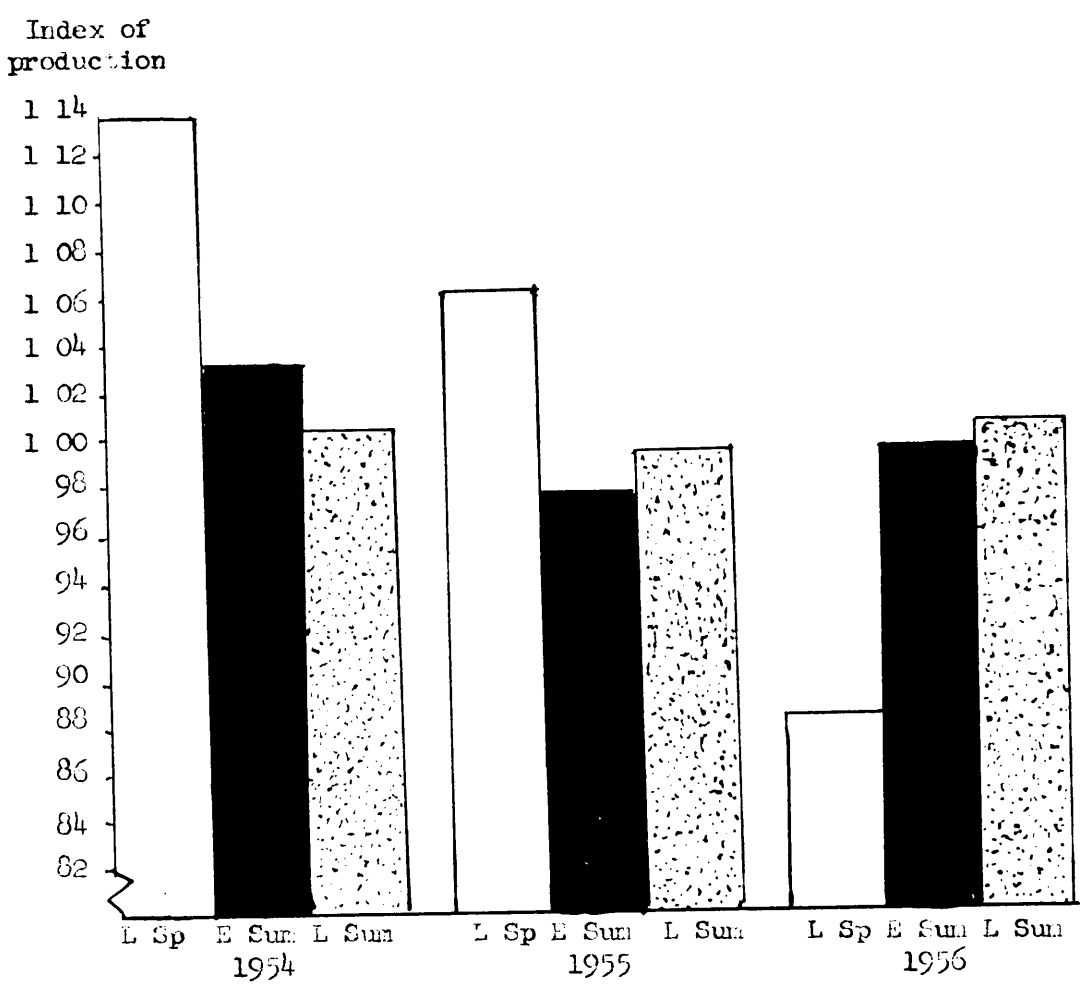

Figure 12 - CORN: Seasonal volume of United States production expressed as a percent of the 3-year average seasonal production.

During the Late Summer period, there was virtually no difference between the production or the price levels of the three years, so no relationship could be established for this period.

Cucumbers[1/]

The prices for cucumbers in the Northern and Southern markets did not remain as near each other throughout the seasons as the prices of the crops discussed previously. The prices of the two Northern markets remained fairly close to each other, but there were several large price fluctuations in the Southern markets that did not occur in the other two markets. These divergencies were most pronounced in 1954 during the last of June and the first of July when the Atlanta prices rose about two dollars above the price level of the Northern markets. In September, the prices in Atlanta again rose to a peak similar to that in June, still with no significant rise in the Northern market prices. A similar rise in prices of the Southern market occurred during August of 1955 and September of 1956.

A declining trend in the number of carlot arrivals existed in all three markets for the three years (Figure 13). The arrivals in all the markets were above average during June and July and fell below average for the remainder of the season. The Southern market reached a peak in the number of carlot arrivals early in the season and then

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1/ See Appendix A for additional graphs relating to this discussion.

declined throughout the remainder of the season. The Northern markets reached their peaks of arrivals later in the season and then declined throughout the remainder of the season. These peaks of arrivals on the market coincided with the most active marketing period for the particular market in both the North and South. Therefore, it appears that many of the cucumbers were shipped into nearby markets as was the case with sweet corn.

Table VIII. Analysis of Variance for Cucumber Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta During 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Squares	F
Years	2	122,554	61,277	8.655*
Markets	2	570,587	285,293	40.296**
Atlanta vs. New York City and Baltimore	1	566,674	566,674	80.039**
New York City vs. Baltimore	1	3,913	3,913	.553
Experimental Error	4	14,274	3,569	
Sampling Error	153	1,097,338	7,172	
Pooled Error 1/	157		7,080	
Total SS	161	1,804,753		

* Denotes significance at the 5 percent confidence level.
** Denotes significance at the 1 percent confidence level.

1/ Pooled Error $= \frac{4(V_{EE}) + 153\ (V_{SE})}{157}$

In the analysis of variance test for cucumber prices, the sampling error mean square was larger than the experimental error mean square as

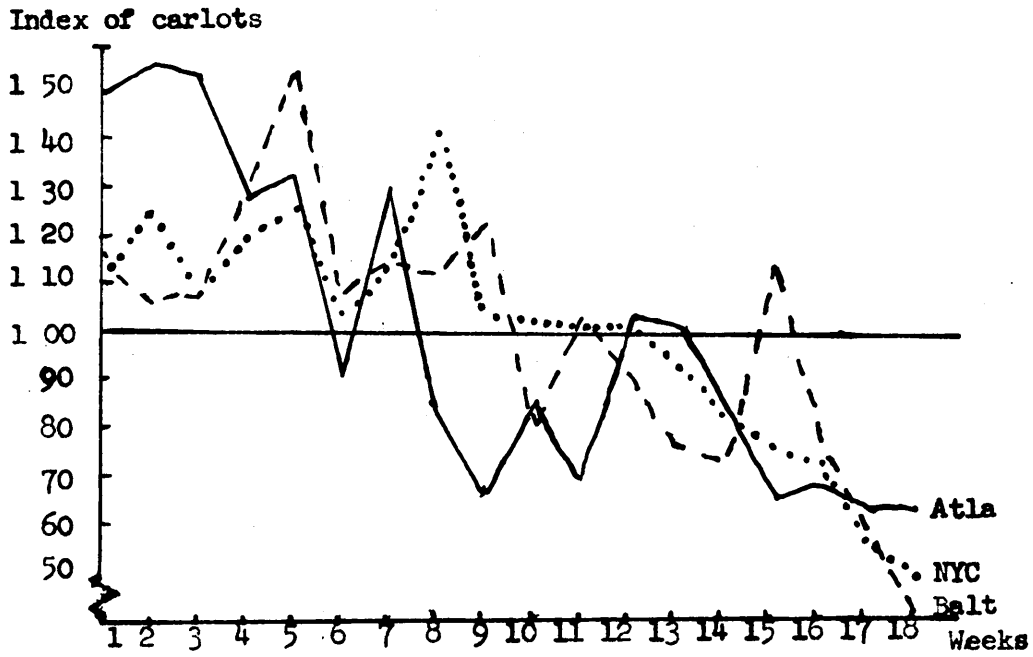

Figure 13 - CUCUMBERS: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore, and Atlanta.

Figure 14 - CUCUMBERS: Market area and period of highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

shown in Table VIII. The exact reason why there was more extraneous variation within the cell than between the cells cannot be explained with the data at hand. However, since the sampling error mean square was larger, the two mean squares were pooled to obtain a valid test. The method of pooling the two mean squares as outlined by Paull[1] was used.

The analysis of variance test for cucumber prices indicates that there was a significant difference in both the yearly price levels and the price levels of the different markets (Table VIII).

When the market sums of squares were sub-divided by an orthogonal contrast, no significant difference was found in price levels within the Northern marketing area. The difference in the price levels of the Northern and Southern markets was significant at the desired confidence level.

The highest net weekly price to Virginia growers for cucumbers occurred in the Southern market from the last of June throughout the remainder of the season. The net price during each week throughout the season after the three-year average price was adjusted for transportation cost is shown in Figure 14.[2]

1/ A. E. Paull, "On a Preliminary Test for Pooling Mean Squares in the Analysis of Variance", Annals of Mathematical Statistics, XXI, (1950), p. 541.

2/ Transportation cost per bushel; Atlanta - $.55, New York - $.35, and Baltimore - $.30.

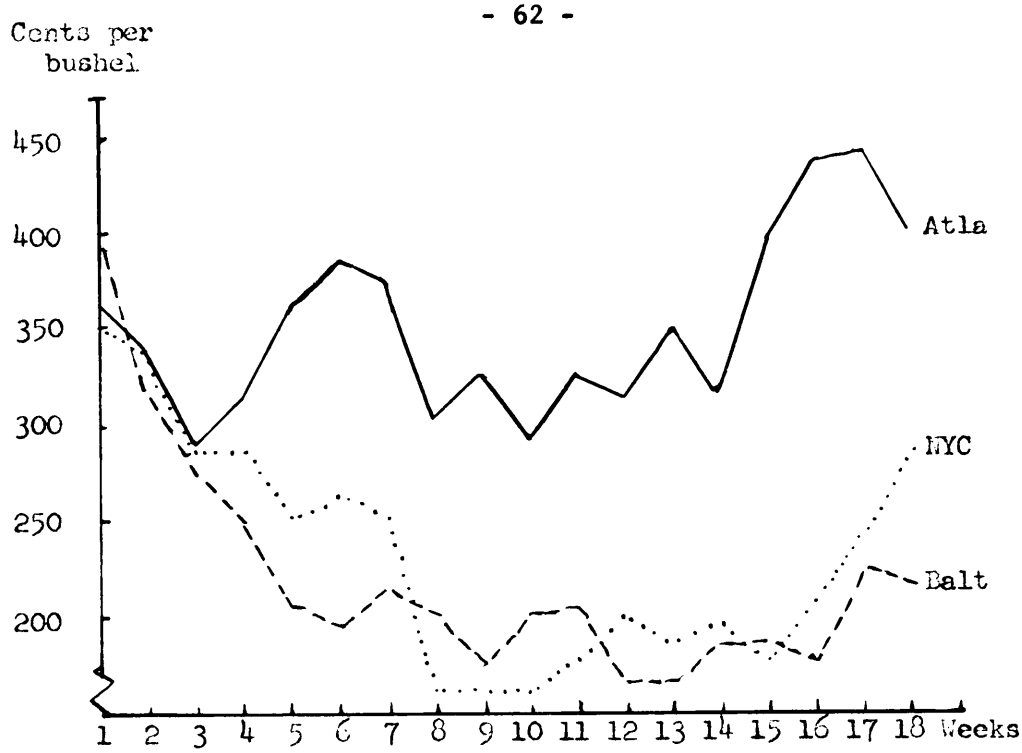

Figure 15 - CUCUMBERS: Average 3-year seasonal prices in New York, Baltimore and Atlanta.

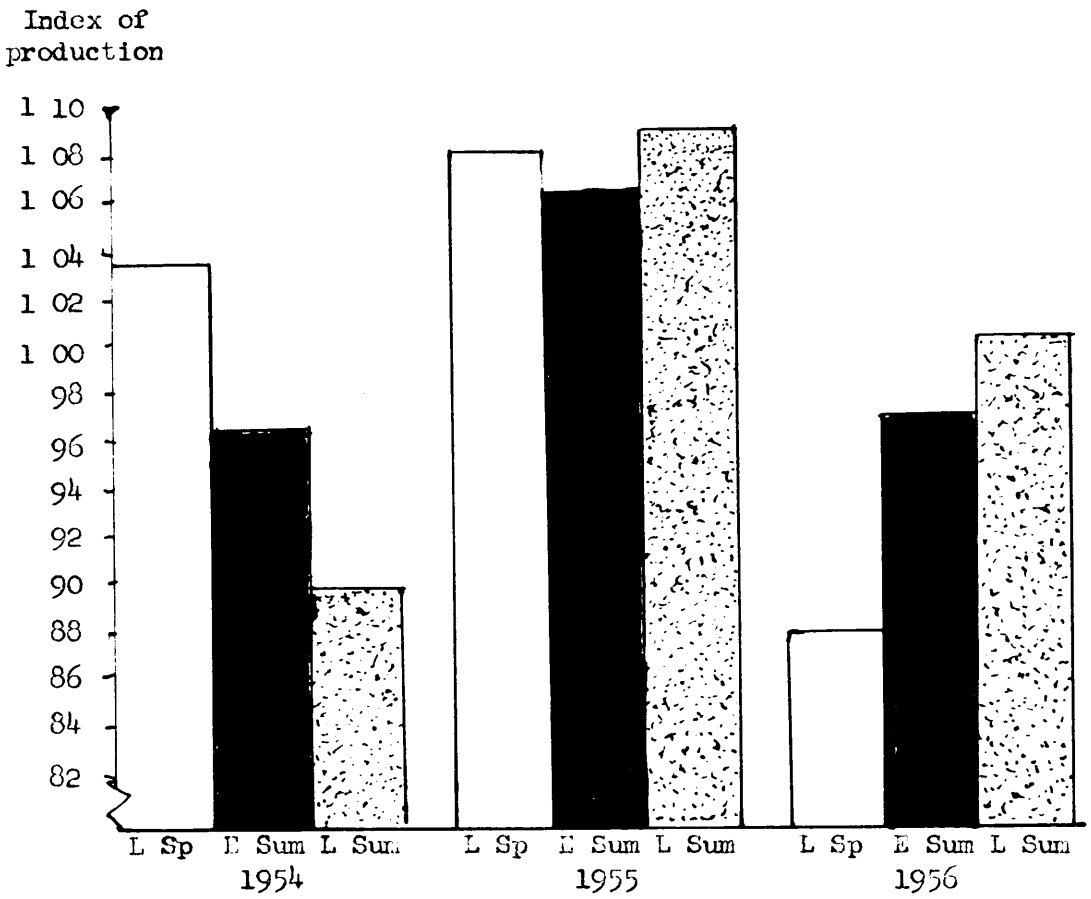

Figure 16 - CUCUMBERS: Seasonal volumes of United States production expressed as a percent of the 3-year average seasonal production.

During the Late Spring period, there was an inverse relationship between the prices in all markets and total production of cucumbers (Figures 7 and 16). In 1954, the price was below average and production was slightly above average. In 1955, the price was below average and production was well above average. In 1956, the price was above average and production was below average.

An inverse relationship between price and production existed during the Early Summer period also. The 1954 price was the highest of the three years and production was lowest during this year. In 1955, the production was highest and the level of prices was lowest. In 1956, both price and production fell between the 1954 and 1955 levels.

During the Late Summer period, the production was lowest in 1954 and highest in 1955. Because of extreme variability of the prices, no relationship between the price level and production could be determined.

Peppers[1/]

The prices of peppers in the three markets remained near the same level throughout the season during all three years. There was a tendency for the prices in the Southern market to rise during the month of September, while the prices in the Northern markets decline throughout the entire marketing season.

In analysis of variance test for the pepper prices, the sampling error mean square was larger than the experimental error mean square as

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1/ See Appendix A for additional graphs relating to this discussion.

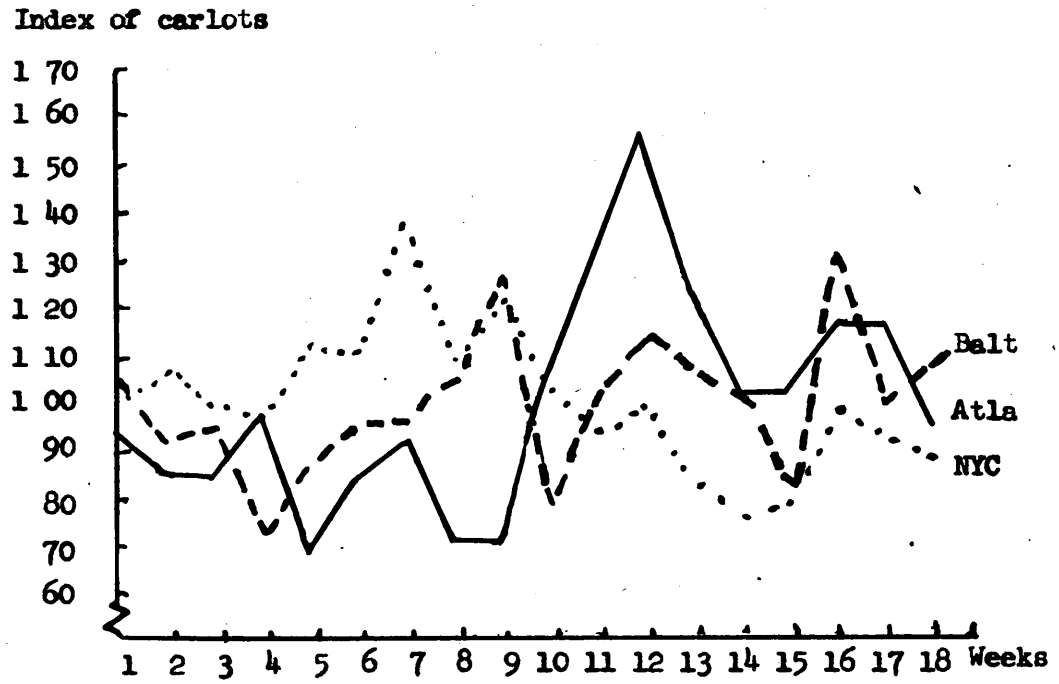

Figure 17 - PEPPERS: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore, and Atlanta.

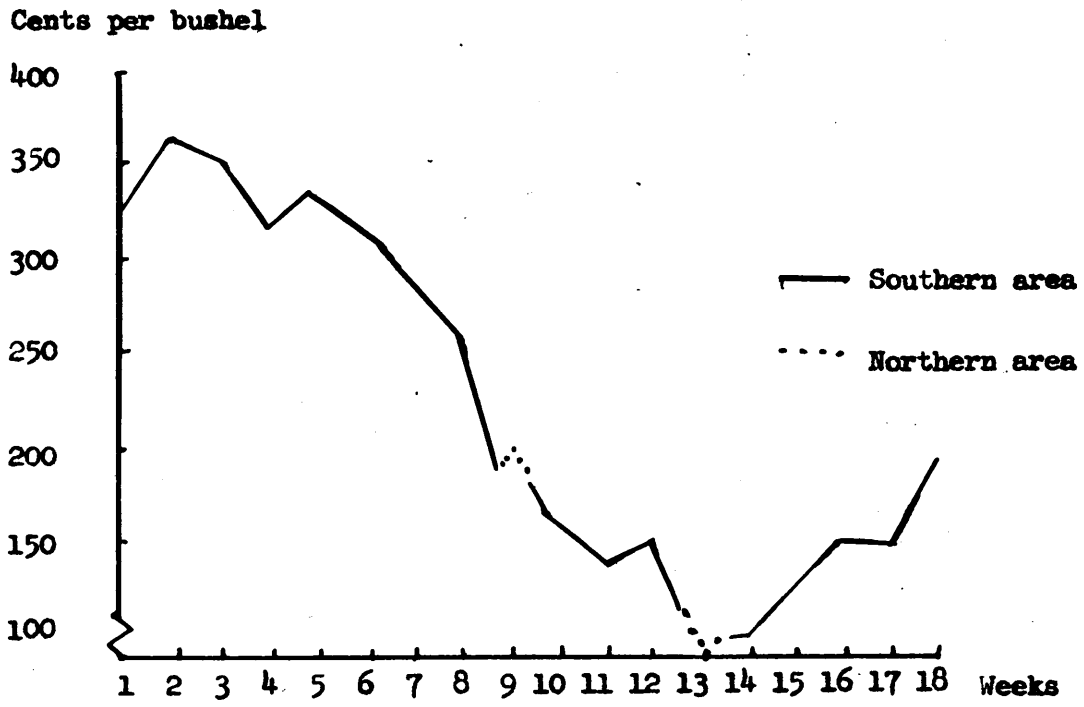

Figure 18 - PEPPERS: Market area and period of highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

was the case with cucumbers. Therefore, the pooled error mean square was calculated. The analysis of variance test indicates there was a significant difference in the yearly price levels of peppers between both years and markets at the 1 percent confidence level. The F values obtained from the orthogonal contrast indicate that there was a significant difference between the price levels of the Northern and Southern markets and that no difference existed between the price levels within the Northern area. Since the price variances were heterogeneous, the non-significant F value for New York City versus Baltimore may possibly be significant and not be shown by the analysis.

Table IX. Analysis of Variance for Peppers Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta during 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Squares	F
Years	2	239,038	119,519	9.091**
Markets	2	137,959	68,979	5.247**
Atlanta vs. New York City and Baltimore	1	103,291	103,291	7.857**
New York City vs. Baltimore	1	34,668	34,668	2.637
Experimental Error	4	2,151	538	
Sampling Error	153	2,062,000	13,477	
Pooled Error	157	--	13,147	
Total SS	161	2,441,148		

** Denotes significance at the 1 percent confidence level.

The highest net price to Virginia vegetable growers during each week and the market area in which this price occurred are shown in Figure 18.

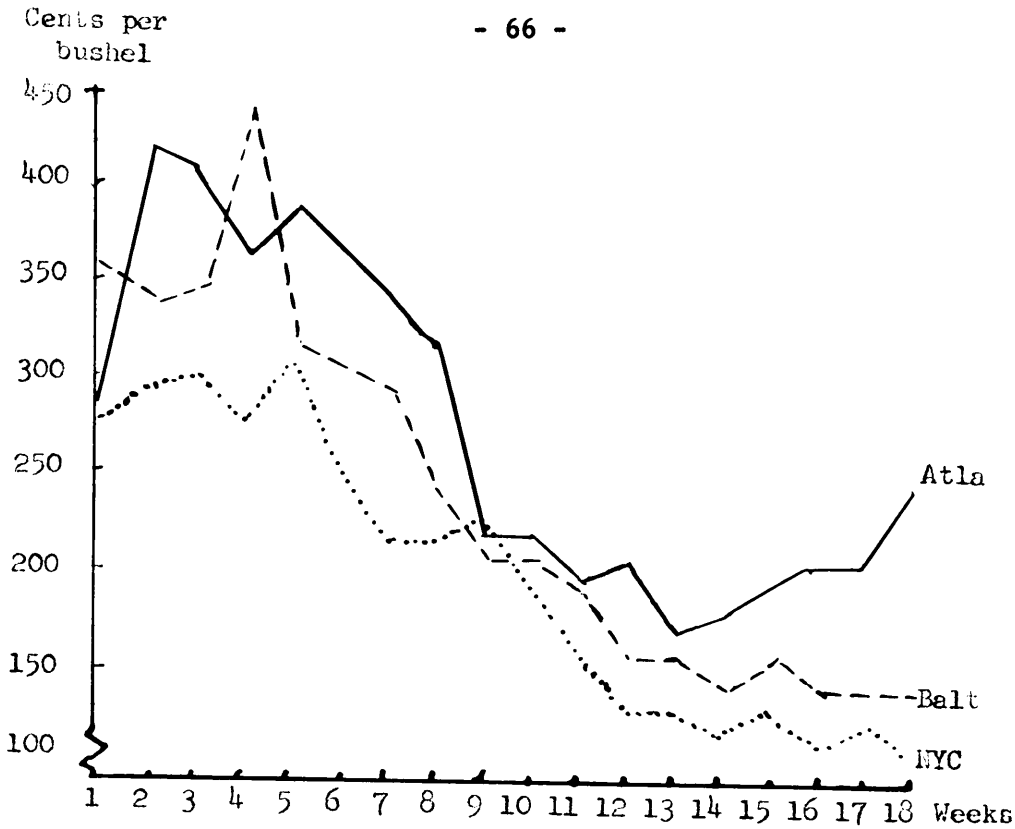

Figure 19 - PEPPERS: Average 3-year seasonal prices in New York, Baltimore and Atlanta.

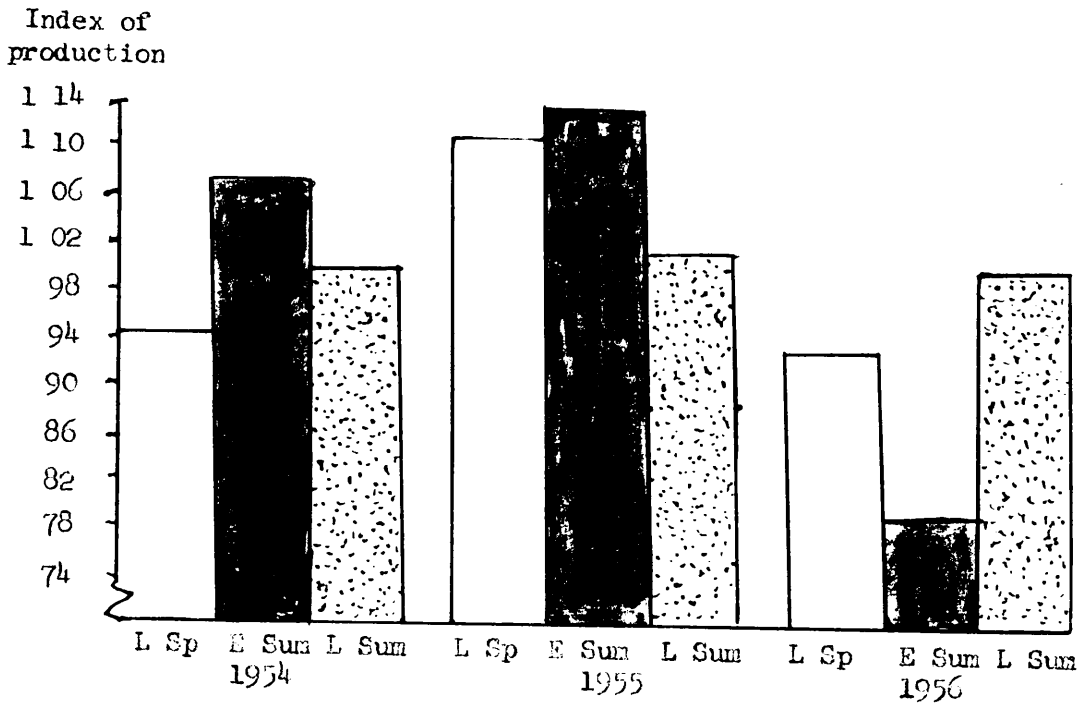

Figure 20 - PEPPERS: Seasonal Volume of United States Production expressed as a percent of the 3-year average seasonal production.

The highest net price for peppers was available in the Southern market 11 of the 18 weeks after adjusting for transportation cost.[1/]

The relationship between total production of peppers and the market price was generally inverse during the Late Spring (Figures 9 and 20). The 1954 production was below average and the price was slightly above average. The 1955 production of peppers was well above average and the price level was the lowest of the three years. The relatinnship was reversed in 1956 when production was well above average and prices were high also.

During the Early Summer, the relationship between price and production was not clearly defined. The highest production and the lowest level of prices occurred in 1955. The production during 1956 was very low and the price level was about average. The production in 1954 was somewhat above average and the prices were high.

There was virtually no change in the yearly production during the Late Summer period. The price level was a little lower in 1954 than during the other two years; however, no relationships between price and production could be established.

Tomatoes[2/]

The price level of tomatoes in New York and Baltimore remained fairly close to each other throughout the season during each of the

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1/ Transportation cost per bushel: Atlanta - $.50, Baltimore - $.25, and New York - $.30.

2/ See Appendix A for additional graphs relating to this discussion.

three years. The price level in Atlanta averaged from $2.00 to $3.00 higher than the Northern market price level during each year. These price differences between the Northern and Southern markets must be accepted with some reservation. The Atlanta prices were arrived at by converting the prices of tomatoes in a 40-pound container to 60-pound equivalents. It is possible that the unit value of tomatoes in a 40-pound package is higher than that in the 60-pound box. If so, the difference may be explained in part by this factor. The difference in unit value may be caused by differences in the cost of the container, differences in the quality of the produce, or other factors. Regardless of the reason, the price of the 60-pound equivalent computed by adjusting the smaller package prices using a direct weighted ratio is not fully comparable to that of a 60-pound container.

The general trend of carlot arrivals on all three markets declined throughout the season over the three years as shown in Figure 21.

The F values obtained from the analysis of variance test for tomato prices indicate that there was no difference between the price levels of the three years (Table X). The F values further show that there was a difference in the price levels of the markets.

An orthogonal contrast was performed to subdivide the market sums of squares in order to determine if there was a significant difference between the price levels of the markets. From this test it was found that the difference in the price levels of the Northern and Southern

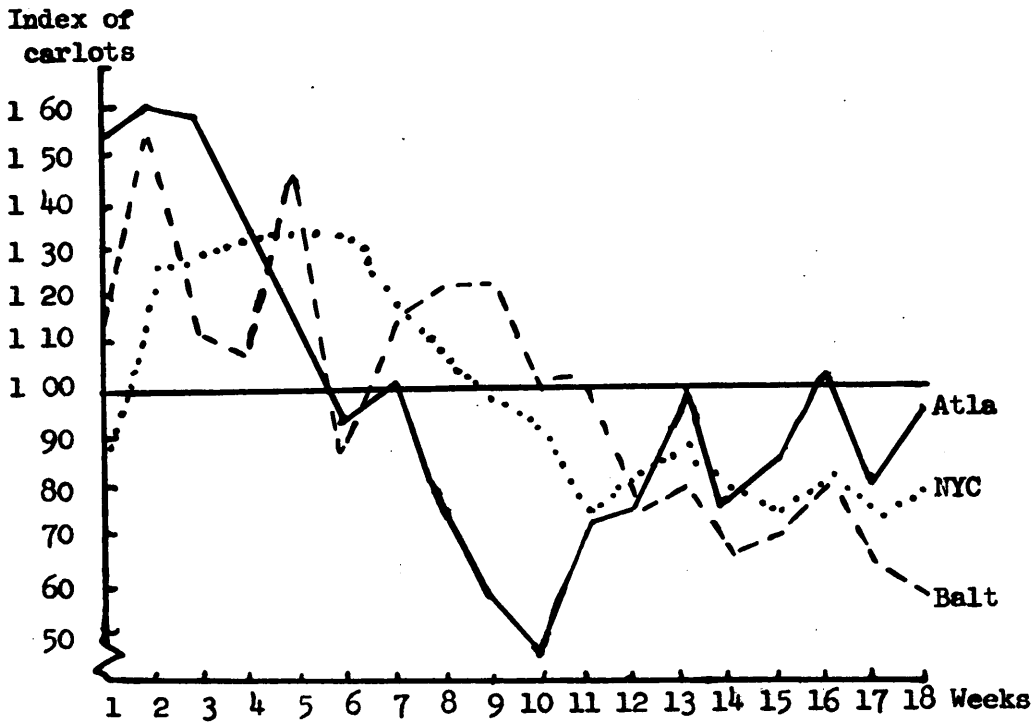

Figure 21 - TOMATOES: Weekly carlot arrivals expressed as a percent of the 3-year average weekly arrivals in New York, Baltimore and Atlanta.

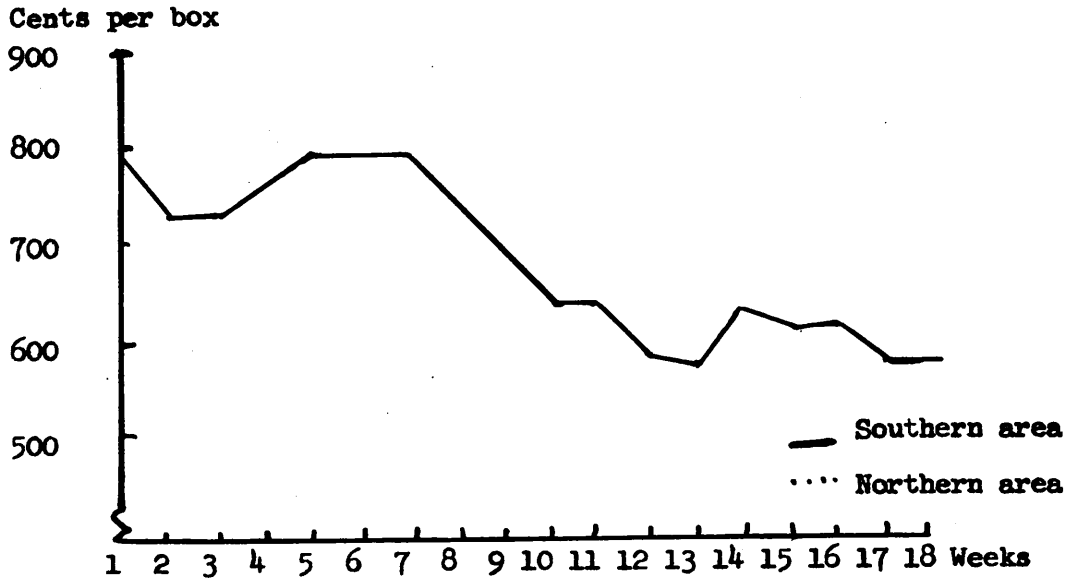

Figure 22 - TOMATOES: Market area and period in which highest net price for Virginia Growers after adjusting the 3-year average price for transportation cost.

marketing area was highly significant. The analysis of variance also indicates there was no difference in the price levels within the Northern area. Because of the heterogeneous variances the difference in price levels within the Northern marketing area may possibly be significant; however, this seems unlikely with the low calculated F value.

Table X. Analysis of Variance for Tomato Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast for New York City, Baltimore, and Atlanta during 1954-55-56.

Source	Degrees of Freedom	Sums of Squares	Mean Square	F
Years	2	323,267	161,634	2.444
Markets	2	4,840,387	2,420,194	36.591**
Atlanta vs. New York City and Baltimore	1	4,830,716	4,830,716	73.036**
New York City vs. Baltimore	1	9,671	9,671	.146
Experimental Error	4	264,567	66,142	
Sampling Error	153	8,144,111	53,229	
Total SS	161	13,572,332		

** Denotes significance at the 1 percent confidence level.

With the wide difference between the price levels of the Northern and Southern markets, the highest net price after adjusting the three-year average prices for transportation cost could have been received in the Atlanta market throughout the season.1/ The curve in Figure 22 indicates

1/ Transportation cost per 60-pound box to: Atlanta - $.80, Baltimore - $.35, and New York - $.45.

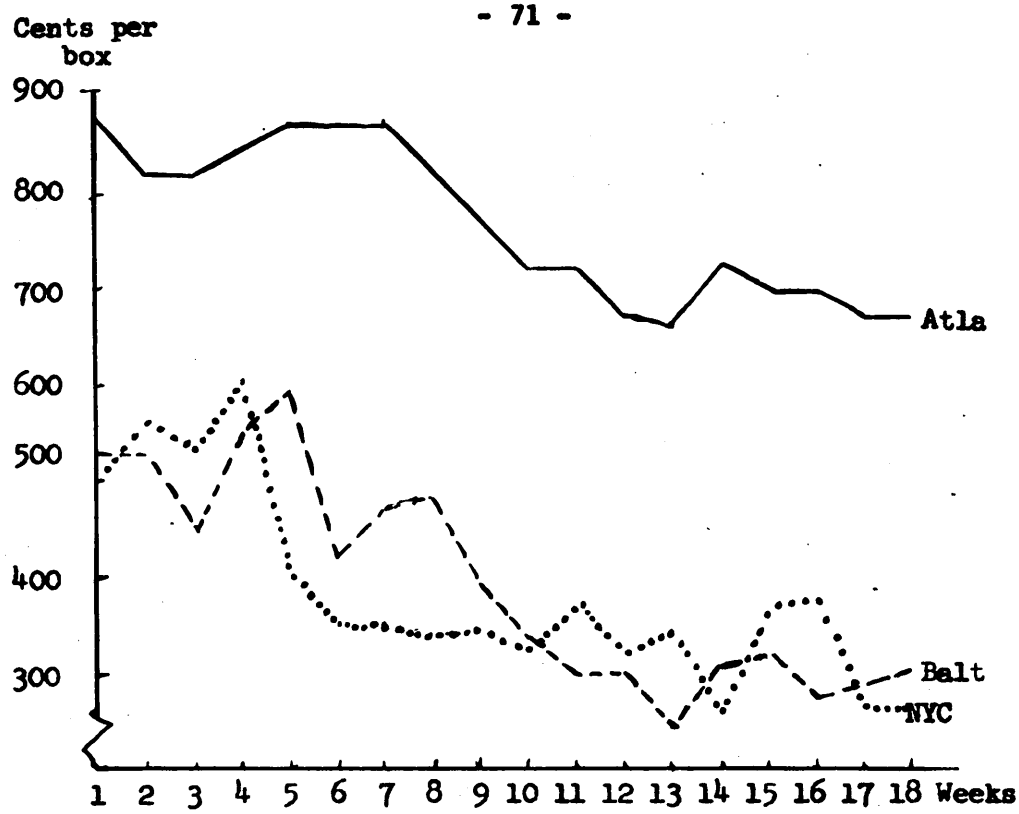

Figure 23 - TOMATOES: Average 3-year seasonal prices in New York, Baltimore and Atlanta.

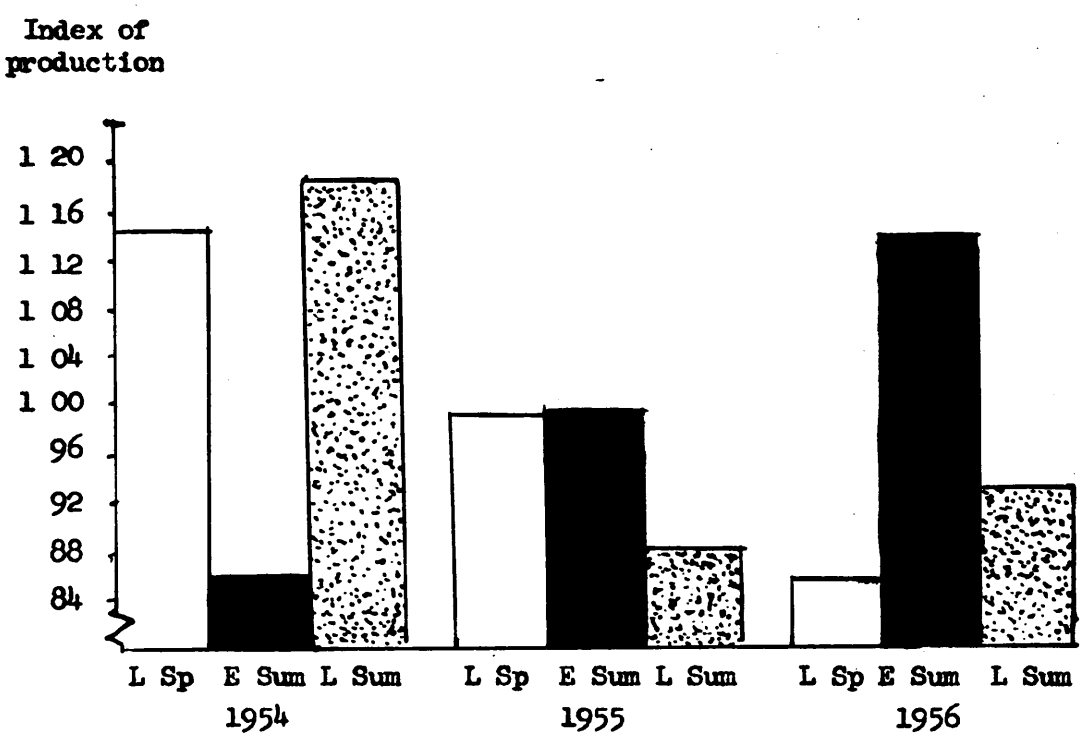

Figure 24 - TOMATOES: Seasonal volume of United States production expressed as a percent of the 3-year average seasonal production.

the average net return to Virginia shippers for 60 pounds of tomatoes in 40-pound containers from the Atlanta market.

The relationship between prices and total production of tomatoes in the United States was inverse during the late spring period (Figures 11 and 24). The production was highest and the price lowest in 1954. In 1955, the production was about average and the price level was slightly higher than in 1954. Production was low in 1956 and the price level was highest.

Although no relationship was very apparent during the early summer period, there was some tendency for price and production to move in the same direction. In 1954, production and price were both at their lowest levels. In 1956, production and price were both at their highest level.

There was some indication of an inverse relationship in the late summer period. The price level was highest and the production was lowest in 1955. There was practically no difference in the price levels of 1954 and 1956; however, production was above average in 1954 and slightly below average in 1956.

COMPARISON BETWEEN THE VIRGINIA SHIPPING PATTERN AND THE COMPUTED PATTERN OF HIGHEST NET PRICE

Four crops, snap beans, cabbage, cucumbers, and tomatoes, were used to compare the shipping pattern of Virginia vegetable growers with the computed pattern of highest net price. Sweet corn and peppers could not be used for the reasons discussed in the price comparison section.[1/]

Snap Beans

The snap bean crop from Eastern Virginia was marketed during two periods, the spring and fall.[2/] During the years 1954 through 1956, the spring crop included an average of 36.3 percent of the shipments from Virginia and the remaining 63.7 percent of the shipments were made during the fall season.

An average of only 2.1 percent of the total shipments of spring snap beans was made to Southern markets over the three-year period. Small percentages of the spring snap beans shipments went to Southern markets during 1954 and 1955, and none in 1956 as may be seen in Figure 25. The price level of snap beans in the Southern market during June of 1956 was very low in relation to the Northern markets and may explain the absence of spring shipments to that area.

1/ See page 35.

2/ The marketing period for the spring crop normally includes weeks 1 through 5 and the fall crop includes weeks 15 through 18.

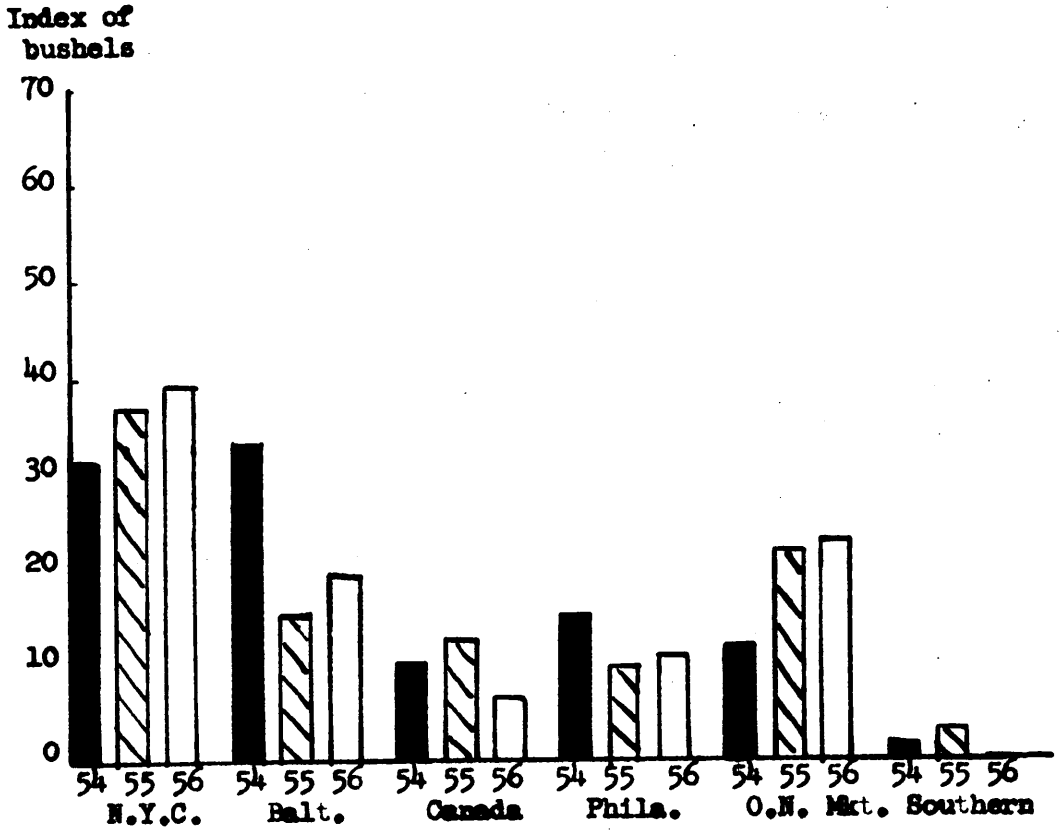

Figure 25 - SNAP BEANS: Destination of Spring shipments from some Eastern Virginia Growers during 1954, 1955, and 1956 expressed as a percent of the yearly seasonal shipments

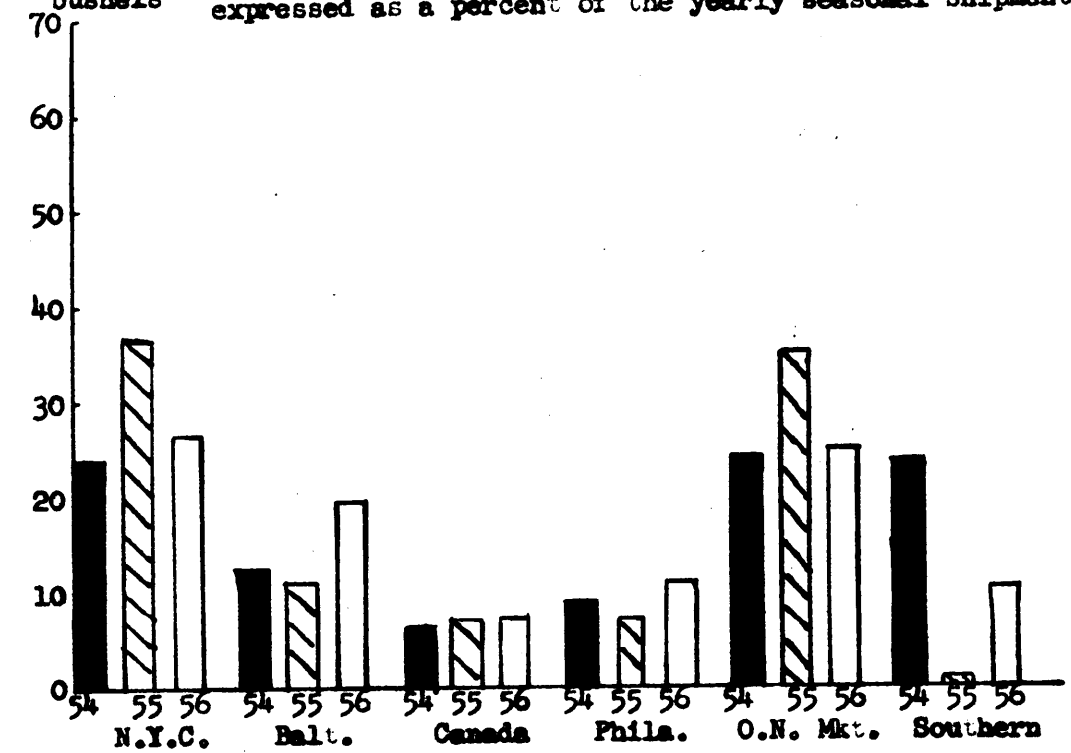

Figure 26 - SNAP BEANS: Destination of Fall shipments from some Eastern Virginia Growers during 1954, 1955, and 1956 expressed as a percent of the yearly seasonal shipments.

The highest net price available to Virginia shippers for snap beans was in New York during the first week of June and in Atlanta during the next four of the five weeks when the Virginia spring crop was marketed. Even though higher net prices existed in the Southern market for four of the five weeks, only 2.1 percent of the spring crop was shipped there.

During the fall marketing season, 13 percent of the snap bean shipments went to Southern markets as compared to only 2.1 percent of the spring shipments. The distribution of the remaining 87 percent of the fall crop is shown in Figure 26 for each year.

Some relationship seemed to exist between the marketing pattern of the fall snap bean crop and the price level in the Northern markets. During 1954, the price level was very low in the Northern markets, relative to the Southern market, and almost one-fourth of the fall crop was shipped South. During 1955, the price level of the Northern markets was well above the three-year average of each market and only a very small percentage of the crop was shipped South. During 1956, the Northern price level was about average, and just slightly more than ten percent of the crop was shipped South.

The highest net price to Virginia shippers was available in Atlanta for all four weeks of the fall marketing season. Even though shippers did take advantage of the higher prices in the Southern market to a greater extent in the fall, it appears that higher returns could have been received if an even greater proportion of the crop had been diverted to Southern markets.

Cabbage

An average of 1.3 percent of the total cabbage shipments of Virginia growers was shipped to Southern markets over the three years. During 1954, only 0.5 percent of the cabbage was shipped to Southern markets (Figure 27). In 1955, 2.5 percent and, in 1956, 1.0 percent of the cabbage was shipped to Southern markets.

A larger percent of the cabbage shipments moved into the small markets than did the shipments of other crops. An increasing number of shipments were sent to these small markets each year until in 1956 over half the total shipments moved into small markets. Canada received a large percentage of Virginia's cabbage shipments during 1954 and 1956, but no shipments were reported there in 1955. In 1955, prices during the first weeks of June were high in the domestic Northern markets. These higher prices probably made it uneconomical to ship past the domestic markets to Canada.

The markets yielding the highest net price during the weeks when cabbage was shipped from Virginia were New York during the first week and Atlanta during the second and third weeks.[1/] Since such a small percent of the cabbage crop was shipped South, it appears that Virginia growers did not take full advantage of the higher prices that existed in the Southern markets.

1/ Weeks 1, 2, and 3 are normally included in the Virginia marketing period.

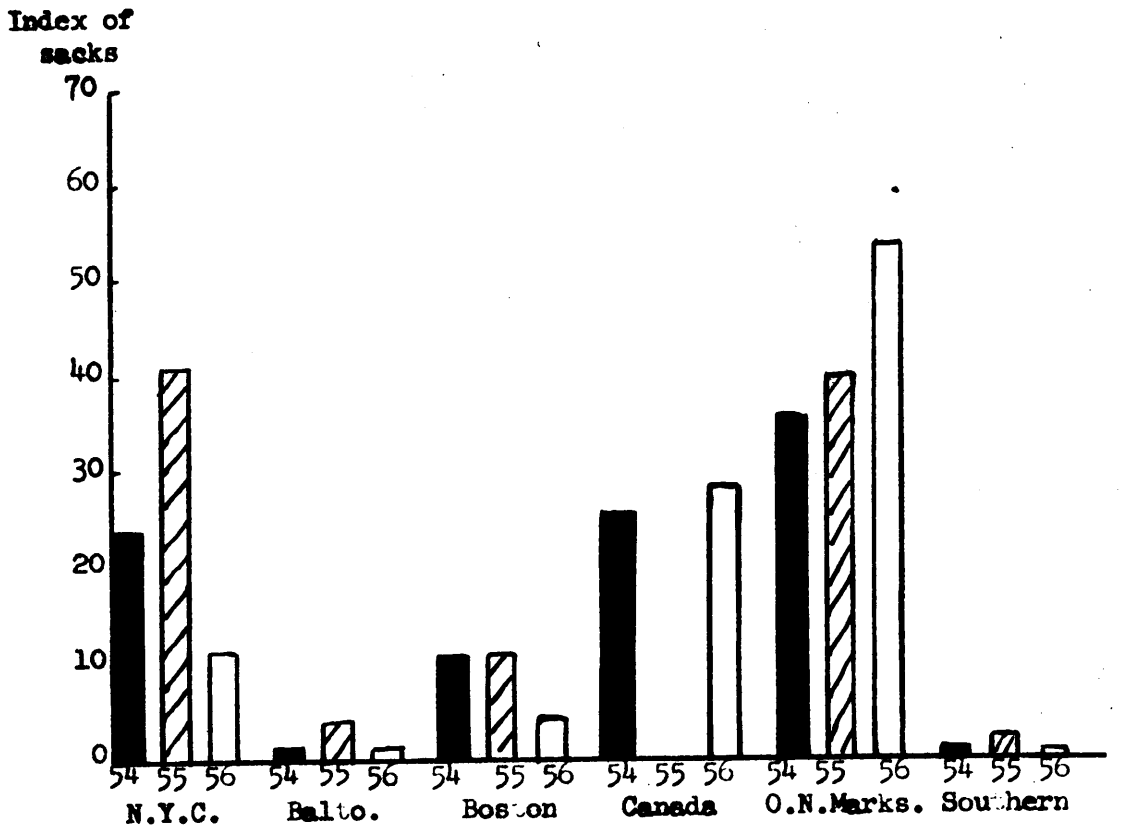

Figure 27 - CABBAGE: Destination of shipments from some Eastern Virginia Growers during 1954, 1955, and 1956 expressed as a percent of the yearly shipments.

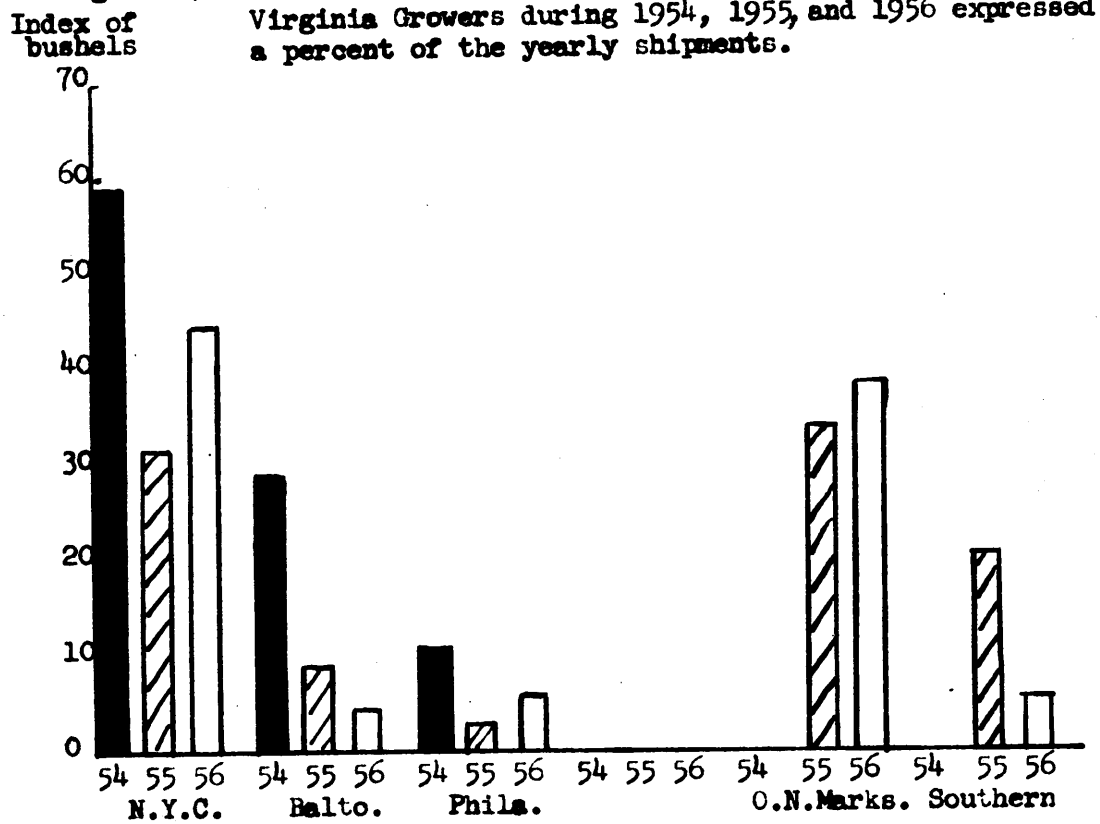

Figure 28 - CUCUMBERS: Destination of shipments from some Eastern Virginia Growers during 1954, 1955, and 1956 expressed as a percent of the yearly shipments.

Cucumbers

An average of 10.1 percent of the total cucumber shipments of Virginia growers was shipped to Southern markets. Some relationship seemed to exist between the price level of cucumbers in all markets and the direction of movement. On the basis of the limited data, the tendency was for cucumbers to move South when prices were low. During 1954 with prices high in all markets, no cucumber shipments were made to Southern markets as may be seen in Figure 28. In 1955, the price level was low and slightly more than 20 percent of the shipments were diverted to Southern markets. During 1956 when the price level was near average, about 5 percent of the shipments went to Southern markets.

The highest net price available to Virginia growers for cucumbers existed in the Southern market during the weeks this crop was shipped from Virginia.[1/] It appears that the returns from cucumbers could have been increased if more of the shipments had been shifted from Northern to Southern markets since the price level was higher in the Southern market during all weeks.

Tomatoes

No shipments of green tomatoes from Virginia to Southern markets were reported over the three-year period. The distribution of the

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1/ Weeks 5 through 8 are normally included in the Virginia marketing period.

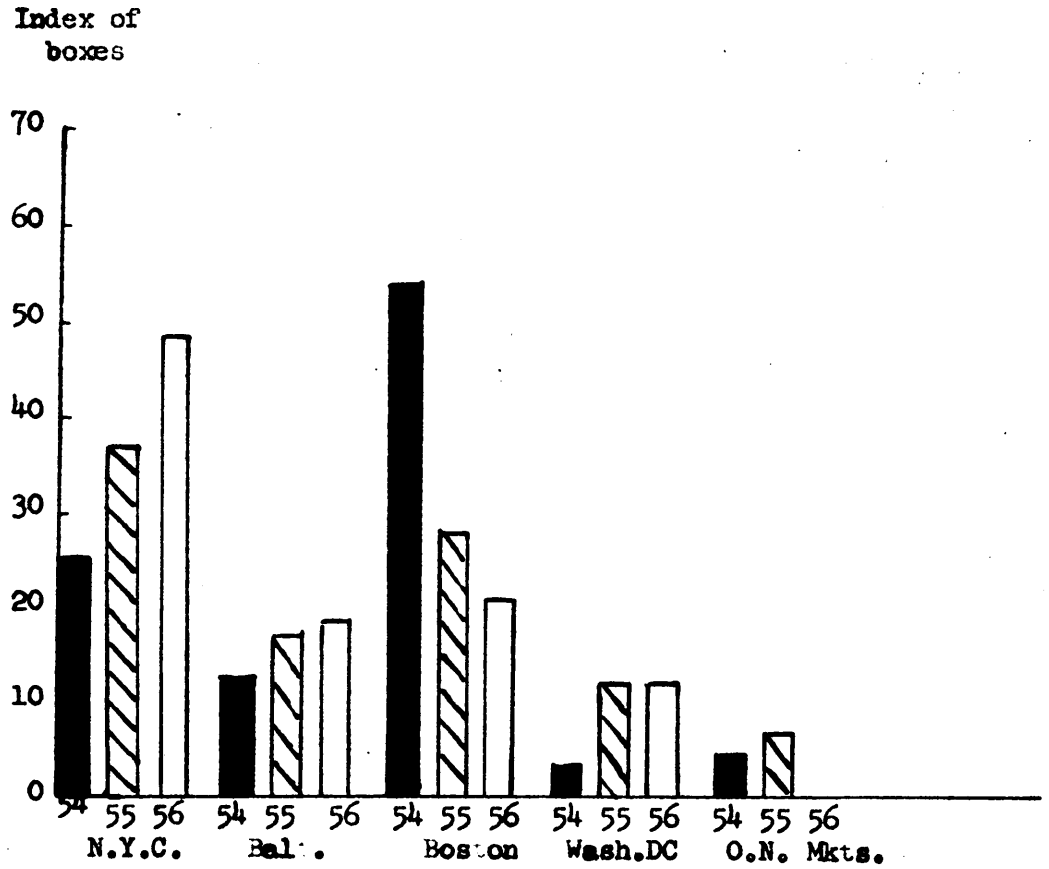

Figure 29 - TOMATOES: Destination of shipments from some Eastern Virginia Growers during 1954, 1955, and 1956 expressed as a percent of the yearly shipments.

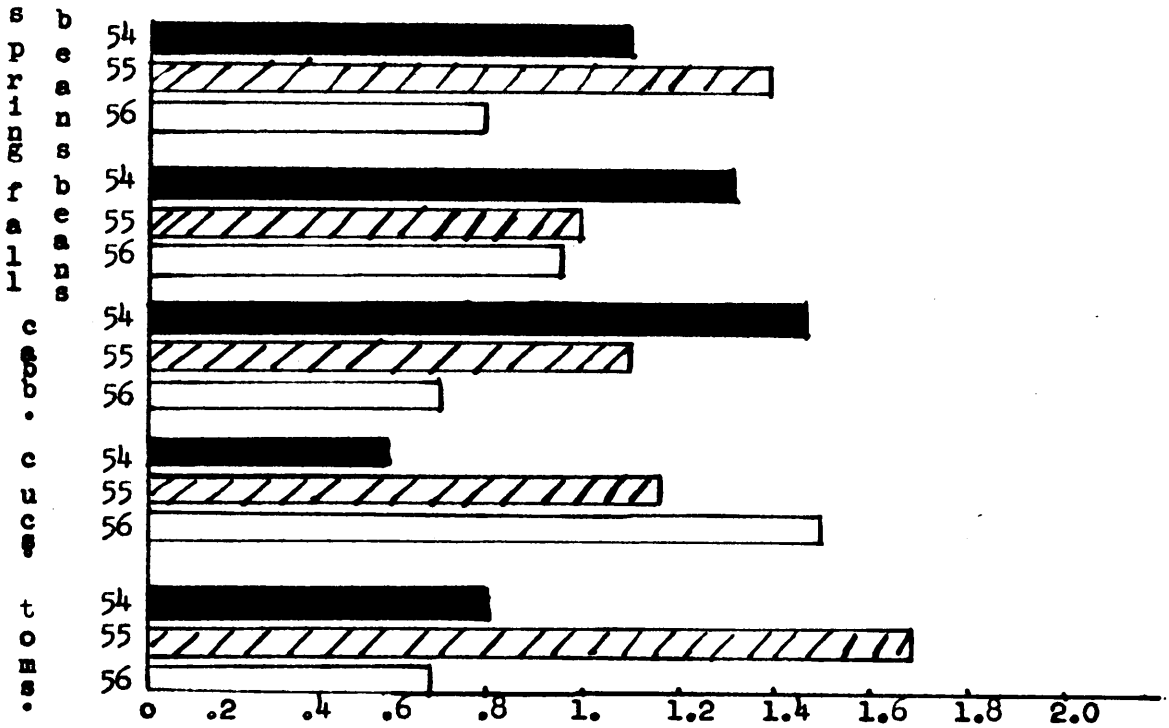

Figure 30 - Shipments of Spring and Fall Snap Beans, Cabbage, Cucumbers, and Tomatoes during 1954, 1955, and 1956 expressed as a percent of their average 3 year shipments.

shipments among the primary Northern markets is shown in Figure 29.

Conclusions relative to the marketing pattern of tomatoes cannot be made because the prices in the two areas were not directly comparable. The prices were not comparable because of the different package size used in the markets as discussed earlier. Green tomato prices would not be expected to be high in the South during this period because at the time green tomatoes are harvested in Virginia, the Southern markets can buy pink or ripe tomatoes locally.

INTERRELATIONSHIP BETWEEN PRICE AND CARLOT ARRIVALS ON THE MARKETS

In order to determine the relationship between the terminal market price and the quantity arriving on the market, a correlation analysis between these two factors was carried out for the individual crops during each year. The calculated correlation coefficients were found to be inconsistent. Table XI indicates the number of significant positive and negative correlation coefficients at the 5 and 1 percent confidence levels that were obtained from the 54 correlation analyses.1/

Table XI. Number of Significant Correlation Coefficients Between Price and Carlot Arrivals for Six Vegetables in New York City, Baltimore, and Atlanta during 1954-55-56*

Crop	1 Percent		5 Percent	
	Positive	Negative	Positive	Negative
Snap beans	0	2	0	3
Cabbage	1	1	1	0
Sweet corn	0	2	0	4
Cucumbers	0	0	0	1
Peppers	0	1	0	2
Tomatoes	1	0	3	1
Totals	2	6	4	11

* See Appendix C for table of the actual correlation coefficient values.

1/ Eighteen weeks are included over three years in three markets for six crops or a total of the 54 correlations.

Even though five of the correlation coefficients were significant for snap beans, not more than 40 percent of the variance in price could be accounted for by variations in quantity shipped to the market. Other significant values accounted for as little as 21 percent of the variance.

The positive correlation coefficients for cabbage are difficult to explain. Some outside factors may have affected the market and caused the price and arrivals on the market to vary together during parts of the season. Tomatoes were similar to cabbage in that both positive and negative correlations between price and arrival on the markets occurred.

Some relationship between perishability and the calculated correlation coefficients seems to exist when considering sweet corn in contrast to cabbage and tomatoes. More significant negative coefficients are apparent for sweet corn, which is very perishable, than for any of the other crops while cabbage and tomatoes are the only crops which have significant positive coefficients. Since cabbage and tomatoes can be held in storage for several days, the possibility that the current prices may have been affected by quantity arriving during an earlier period was explored. A preliminary analysis to determine if the quantity arriving on the market during the previous week affects price during the current week gave little or no improvement over the current weekly correlation.

Another factor that may affect the relationship between price and carlot arrivals is local production near the market. Table XII shows the number of significant correlation coefficients when the period of local production around each market was excluded from the eighteen-week season in each market.

Table XII. Number of Significant Correlation Coefficients Between Price and Carlot Arrivals with Periods of Local Production Excluded for Six Vegetables in New York City, Baltimore, and Atlanta during 1954-55-56*

Crop	1 Percent		5 Percent	
	Positive	Negative	Positive	Negative
Snap beans	0	2	0	3
Cabbage	1	0	2	1
Sweet corn	0	0	0	2
Cucumbers	0	0	0	0
Peppers	0	2	0	0
Tomatoes	2	1	0	1
Totals	3	5	2	7

* See Appendix C for table of the actual correlation coefficient values.

The results of the analysis as presented in Table XII are even more inconclusive than those of the entire eighteen-week period. The significant correlation coefficients at the 5 percent level decreased from 4 positive and 11 negative values to 2 positive and 7 negative values. One additional positive and one less negative significant correlation coefficient were obtained at the 1 percent level when the local production period was omitted.

Graphic analysis of some crops indicated that positive correlations may have resulted from shifts in supply or demand during the season. A shift in supply or demand would in turn affect the overall level of price or quantity arriving on the market. When a shift in supply or demand of this nature is not taken into consideration, results may be obtained which are distorted. Once the price or quantity reaches the new plateau

caused by the change in supply or demand, the normal inverse relationship between price and the arrivals on the market may return.

Such a phenomenon is demonstrated by tomatoes during 1954 in New York as shown in Figure 31. The eighteen weeks of the season were divided by line OM so that weeks 1 through 9 fell above this line and weeks 10 through 18 fell below it. When the entire season was used in one analysis, a positive sloping curve as shown by line CR was obtained. When each of these periods was considered separately two negative sloping curves were obtained as shown by lines AP and BQ.

The link relative index was used to minimize the effects where different price levels occurred. The regression line AB in Figure 32 was calculated from the link relative index values for tomatoes in New York during 1954. The slope of this curve is reversed from that in Figure 31. This indicates that an inverse relationship did exist between price and arrivals on the market and that it was probably being masked by the difference in the price levels within the season.

Even though less significant correlation coefficients were obtained by using the modified method of computation than by the direct correlation method, no significant positive values were obtained (Table XIII). It is contrary to economic theory and logic to say that the more of a crop that arrives on a market, the higher the price will be. Since positive correlation coefficients suggest a relationship of this nature, the link relative correlation values may be more reliable than the coefficients obtained by the direct correlation method.

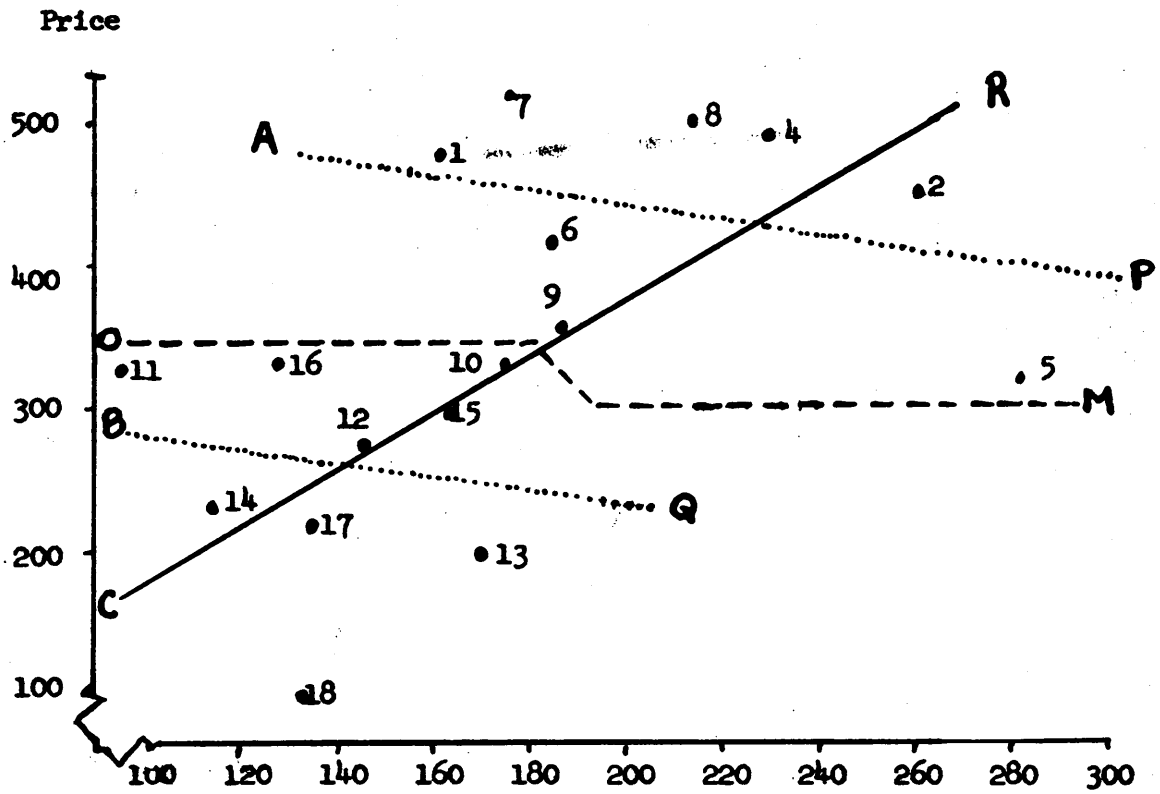

Figure 31 - TOMATOES: Regression line of price and carlot arrivals for New York during 1954 indicating the effect of a seasonal shift in demand of a market.

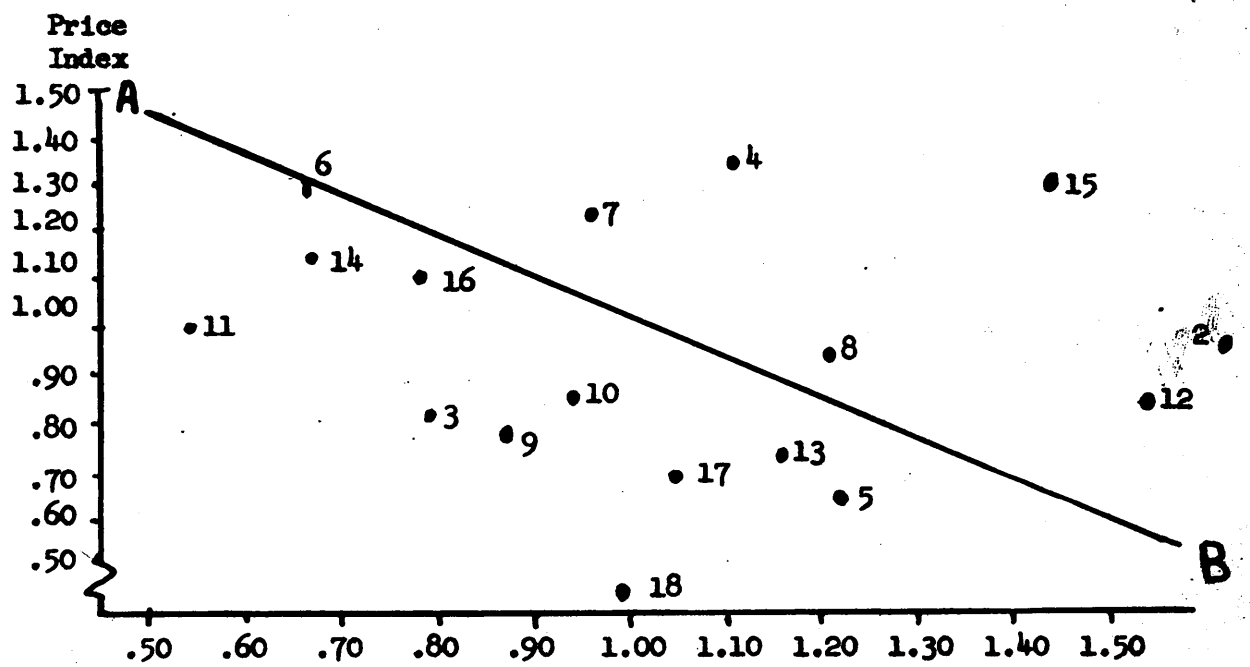

Figure 32 - TOMATOES: Link relation regression line of price and carlot arrivals in New York during 1954.

Table XIII. Number of Significant Correlation Coefficients Between Price and Carlot Arrivals Through Use of the Link Relative Index Method for Six Vegetables in New York City, Baltimore, and Atlanta during 1954-55-56*

Crop	1 Percent		5 Percent	
	Positive	Negative	Positive	Negative
Snap beans	0	0	0	1
Cabbage	0	0	0	0
Sweet corn	0	1	0	0
Cucumbers	0	1	0	0
Peppers	0	0	0	2
Tomatoes	0	0	0	2
Totals	0	2	0	5

* See Appendix for table of the actual correlation coefficient values.

A three-year correlation coefficient for each crop was computed by combining the observations for all three years from each market. The results of the three-year combination analysis are shown in Table XIV. Even though more of the correlation coefficients were significant in the three-year correlation than in the yearly correlations, principally because of the increase in degrees of freedom from 17 to 53, the percent of total variation explained was low. The highest coefficient of determination was in New York market for sweet corn where only 35 percent of the variation was explained. The remaining significant values explained only between 8 and 25 percent of the total variation. Tomatoes and cabbage are the only crops that have any significant positive correlation coefficients. All of the remaining significant coefficients

are negative, which connotes the normal inverse relationship between price and quantity arriving on the market.

Table XIV. Three-Year Combination Correlation Coefficients and Coefficients of Determination of Price and Carlot Arrivals for Six Vegetables in New York City, Baltimore, and Atlanta during 1954-55-56

Crop	New York City		Baltimore		Atlanta	
	r	r^2	r	r^2	r	r^2
Snap beans	-.434**	.188	-.479**	.229	-.243	.059
Cabbage	.413**	.171	-.163	.027	-.042	.002
Sweet corn	-.591**	.349	-.490**	.240	-.197	.039
Cucumbers	-.285*	.081	-.137	.019	-.116	.013
Peppers	.032	.001	-.496**	.246	-.433**	.187
Tomatoes	.217	.047	.342*	.117	.409**	.167

** Denoted significance at the 1 percent confidence level.
* Denotes significance at the 5 percent confidence level.

There were only six significant correlation coefficients obtained from the three-year link relative index correlation analysis (Table XV). All the significant correlation coefficients computed from the link relative method were negative, whereas, three were positive from the direct analysis.

Only a small percent of the variance in price was explained by the link relative coefficients of determinations. Not more than 33 percent of the variance in price was explained by variation in quantity arriving on the market for any crop. In Atlanta, not more than 3.7 percent of the variance in price of any crop was explained by variations in quantity and none of the relationships between these factors were significant.

Table XV. Three-Year Combination Link Relative Index Correlation Coefficients and Coefficients of Determination Between Price and Carlot Arrivals for Six Vegetables in New York City, Baltimore, and Atlanta during 1954-55-56

Crop	New York City		Baltimore		Atlanta	
	r	r^2	r	r^2	r	r^2
Snap beans	-.331*	.110	-.353*	.125	-.193	.037
Cabbage	.106	.011	-.569**	.324	-.156	.024
Sweet corn	-.339*	.115	-.215	.046	.056	.003
Cucumbers	-.460**	.212	-.045	.002	.021	.000
Peppers	-.267	.071	-.311*	.097	.002	.000
Tomatoes	-.038	.001	.001	.000	-.058	.003

** Denotes significance at the 1 percent confidence level.
* Denotes significance at the 5 percent confidence level.

Through use of the graphic approximation method, multiple correlations were performed on several crops with the median price of the crop being the dependent variable. The three independent variables consisted of: (1) arrivals during the present week, (2) arrivals during the previous week, and (3) total arrivals on the market of all the six crops included in this study. The preliminary multiple correlation analysis did not increase the explained variation enough to merit performing the mathematical analysis on these data.

PRICE RESPONSIVENESS OF THE MARKETS

The point elasticity for each crop in each market was calculated as a partial basis for estimating the effect on price of changes in quantity arriving on the market. Depending on which explained the highest percent of the inverse relationship, either the three-year regression equation of price and carlot arrivals or the three-year regression equation of the link relative indexes of price and carlot arrivals was used to calculate the point elasticity of demand.

The method of calculating the elasticity for snap beans in New York is shown to illustrate the method used for the crops in each market.

Regression equation for snap beans

$$Y = 351.31 - 1.973X$$

Elasticity function[1/]

$$E = \frac{Y}{X} \quad \frac{1}{\frac{dy}{dx}}$$

$$E = \left(\frac{351.31 - 1.973X}{X}\right) \quad \left(\frac{1}{1.973}\right)$$

$$E = \frac{351.31 - 1.973X}{-1.973X}$$

Point elasticity at three-year average carlot arrivals in New York

$$\bar{X} = 66.724$$

$$E = \frac{351.31 - 1.973\ (66.724)}{1.973(66.724)} = -1.67$$

1/ Where E is the point elasticity, y represents the price in cents, X represents the number of arrivals in carlots and $\frac{dy}{dx}$ is the derivative of Y with respect to X.

The fact that this point elasticity is applicable only to the level of arrivals at the three-year average should be stressed. When the quantity of arrivals on the market is changed the elasticity will also change. To obtain the new elasticity, the new quantity of carlot arrivals is substituted into the point elasticity equation to determine the elasticity at that level.

The link relative index elasticity equations were used to calculate the point elasticity for cabbage, cucumbers, peppers, and tomatoes in New York and for tomatoes in Atlanta because more of the inverse relationship between price and carlot arrivals was explained by these equations. The elasticity equations derived from the unadjusted price and arrival data were used for the remaining crops in the two markets.1/

A positive elasticity equation was obtained for cabbage over a three-year period by both the unadjusted and the link relative methods of calculation. This odd price and quantity relationship may be caused by outside factors which could not be determined from the data in this study. Because of this deviation from logical relationships, cabbage will not be considered in further calculations.

The Southern market was found to be generally more elastic than the Northern market (Table XVI). Care must be observed, however, in applying elasticity comparisons between markets. Comparable elasticities for two markets do not directly indicate the responsiveness of price to

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1/ See Appendix C for the point elasticity equations used to calculate the elasticity of each crop in each market.

comparable changes in quantities arriving on the markets. An additional carload of produce in one market may cause a larger proportional change in the total quantity on that market than one additional carload on another market. Since the Southern market is smaller than the Northern market, even though the Southern market was generally more elastic than the Northern market, it is not necessarily less responsive to the arrival of a given quantity of produce.

Table XVI. Point Elasticity of Demand for New York and Atlanta at the Level of the Three-Year Average Carlot Arrivals in Each Market of Six Vegetable Crops During 1954-55-56.

Crop	New York	Atlanta
Snap beans	- 1.67**	- 4.91
Cabbage	8.13	- 7.22
Sweet corn	- 1.15**	-14.10
Cucumbers	- 2.30**	-14.12
Peppers	- 4.67**	- 1.56**
Tomatoes	-25.65	-41.42

** Denotes significance at the 1 percent confidence level.

Cucumbers are a good illustration of this phenomenon. One additional carlot shipment to both New York and Atlanta was assumed in order to determine the effect on price of a given increase in quantity on each market. The point elasticity at 1/2 carlot above the average level of carlot arrivals on the respective markets was -2.28 in New York and

-12.20 in Atlanta.[1] In the less elastic New York market, one additional carlot would have decreased price only 0.39 percent while one additional carlot in Atlanta would have decreased the price by 2.38 percent.[2] This difference in the percent decrease in price was not caused by the difference in the elasticities, but by the difference in the percent change of quantity represented by one additional carlot.

Snap beans and tomatoes, like cucumbers, were more elastic in the Southern markets. The percent change in prices resulting from a given change in quantity of these crops was also greater in the Southern market. The elasticity of snap beans was -1.65 in New York and -4.77 in Atlanta. One additional carlot of produce in each market would have caused a price decrease of 0.91 percent and 1.00 percent respectively. The elasticity of tomatoes in New York was -25.59 and in Atlanta it was -40.89; yet, the added carload in each market would have decreased the price by only 0.02 percent in New York as compared to 0.06 percent in Atlanta.

1/ The point 1/2 carlot above the average was used because one additional carlot was added to the average quantity on the market. This point will then be the most representative elasticity of the shift in quantity.

2/ Percent change in price in New York

$$\frac{\Delta p}{p} \quad \frac{\frac{\Delta q}{q}}{E} = \frac{\frac{1}{112.43}}{-2.28} = -0.0039$$

Percent change in price in Atlanta

$$\frac{\Delta p}{p} = \frac{\frac{\Delta q}{q}}{E} = \frac{\frac{1}{3.45}}{-12.20} = -0.0238$$

Sweet corn illustrates a case where the difference in the elasticities between the small Southern and the large Northern markets was large enough to overcome the difference in the proportional change in quantity that one additional carlot in each market represents. The point elasticity of sweet corn was -1.16 in New York and -13.85 in Atlanta. With this difference in elasticity, one additional carlot in each market would have caused the price to decline 0.85 percent in New York and only 0.24 percent in Atlanta.

Peppers were more inelastic in the Southern markets. The elasticity in New York was -4.61 and the elasticity in Atlanta was -1.27. One additional carlot on the New York market would have caused the price to decrease only 0.37 percent while in Atlanta it would have dropped 20 percent.

SUMMARY

This study was designed to compare the price levels of the Northern and Southern marketing areas and to determine if the returns to Virginia vegetable growers would be increased if more shipments were made to the Southern area. Six crops, snap beans, cabbage, sweet corn, cucumbers, peppers, and tomatoes, were studied during 1954, 1955, and 1956. Eighteen consecutive weeks beginning near the first of June were studied during each year. Price and quantity data were collected from the daily market reports of New York, Baltimore, and Atlanta. Additional data on shipments of the six crops from Virginia were collected from Eastern Virginia vegetable producers.

The prices which Virginia vegetable growers received for their produce in the terminal markets were found to be within a 25 percent range of the weekly terminal market median prices for 74 percent of the shipments where comparisons could be made.

The price level in the Southern market was significantly higher than in the Northern market for snap beans, cucumbers, peppers, and tomatoes. There was no difference between the Northern and Southern market price levels for cabbage and sweet corn at the desired confidence level, but the Southern market price level was found to be higher at the 20 percent confidence level.

The analysis of the two Northern markets indicates that no significant difference existed in the price levels of these markets for any of the crops. This relationship could not be accepted at the desired confidence level for cabbage, peppers, and tomatoes because the price variances were not homogeneous.

After deducting transportation costs from Virginia to the respective markets, the highest net price to Virginia vegetable growers for most crops was available more often from the Southern market than in the Northern market. The study of these net prices in conjunction with the shipments by Virginia growers during the same period indicated that even though higher returns could have been realized from shipments to the Southern marketing area, Virginia growers generally did not take advantage of them.

Some significant relationships between price and quantity arriving on the market were found. However, a few of the relationships did not conform to the traditional inverse relationships of the factors as expressed in economic theory. Such results indicate that the data may not have been suitable for this type analysis. Complete data on the price of each unit and the total number of units in the markets should give a more reliable supply and demand relationship.

Although the weekly period proved satisfactory for determining the differences in price levels of the markets, the use of such a period imposes serious limitations on the analysis of price and quantity relationships. If marketing decisions generally are made on the basis of the relative prices of the previous day or two days on the markets, the weekly period may average out many of the pertinent differences.

Even though the demand in the Southern market was usually more elastic than in the Northern market, the price in the Southern market was found to generally be more responsive to a given change in quantity arriving on the market. This responsiveness of price to varying quantities arriving on the market was primarily a function of the difference in the

size of the markets. The elasticity of demand of the markets was found to be of secondary importance in determining the responsiveness of price. The greatest difference in price responsiveness between the markets was for peppers. They were much more responsive to changes in the quantity arriving in the Southern market than in the Northern market. The prices of snap beans, cucumbers, and tomatoes are also more responsive to quantity changes in the Southern market. The price of sweet corn was found to be more responsive to additional carlot arrivals in the Northern market. Cabbage was not used in the calculations because the preliminary results did not conform to economic theory.

CONCLUSIONS

Based on the findings of this study, it is concluded that Virginia vegetable growers could receive higher returns from snap beans, cabbage, peppers, and tomatoes if some of the Northern shipments were diverted to Southern markets. There was no evidence at the desired confidence level that Virginia growers could increase their returns from cabbage and sweet corn by shifting more of their shipments of these crops to either the Northern or Southern markets. The extent which Virginia vegetable growers could shift their marketing pattern to the Southern markets in order to take advantage of the higher prices for the four crops is limited. This limitation results from the high responsiveness of the Southern market prices to additional arrivals of produce. If additional quantities of produce were to arrive in the Southern market, the price would be decreased more than if the same quantity were added to the Northern market.

Since the prices which Virginia vegetable growers receive for their produce generally fell within an acceptable range at the prices quoted in the daily market reports, Virginia growers should use the daily market reports as a guide in making their marketing decisions.

Indications of several relationships between market price and other factors were observed in this study; however, the data were not sufficient to substantiate these observations. More complete and detailed data are needed. Data for this purpose should include information on: (1) the quantity of produce in the market from all sources, (2) the price of each unit, and (3) an index to describe the quality of the produce. Additional work based on these data is needed to establish the relationship between the market price of the vegetable crops and factors that may affect this price.

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APPENDIX A

Yearly Terminal Market Median Price and Carlot Arrival Figures for Six Crops in New York City, Baltimore, and Atlanta during 1954-55-56

Figure 1 - SNAP BEANS: Weekly median prices in New York, Baltimore and Atlanta during 1954, 1955, and 1956.

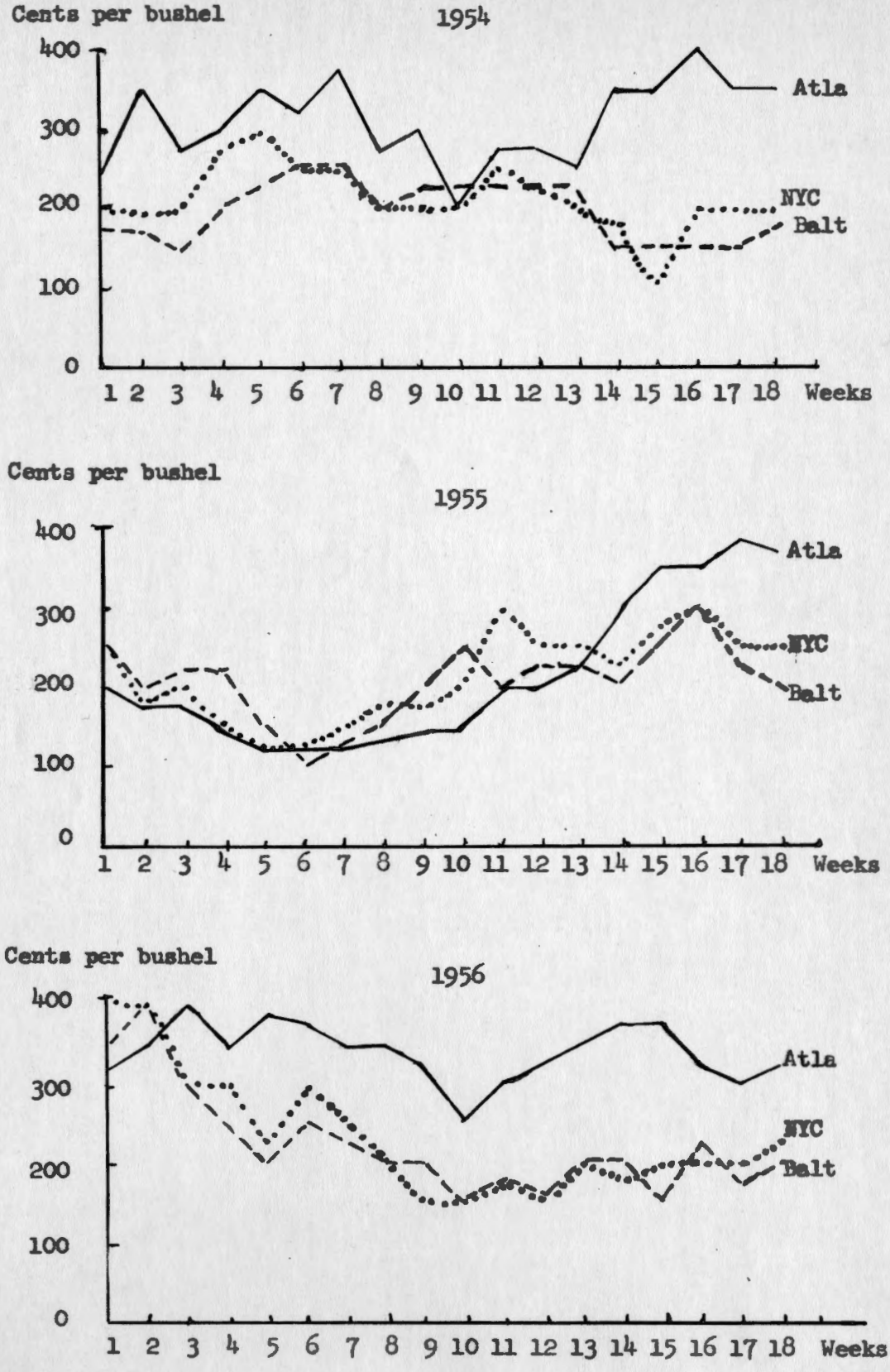


Figure 2 - SNAP BEANS: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

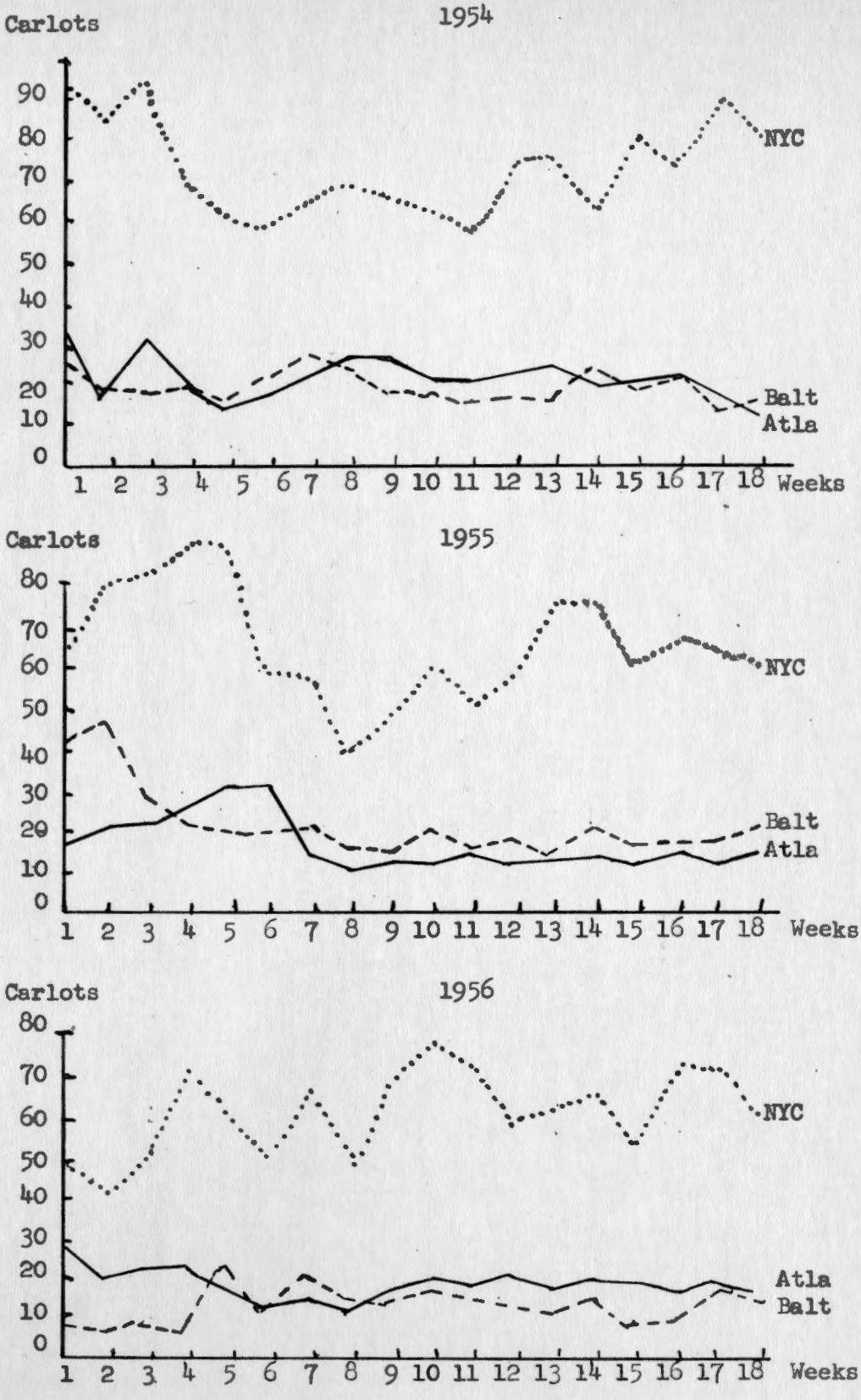


Figure 3 - CABBAGE: Weekly median prices in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

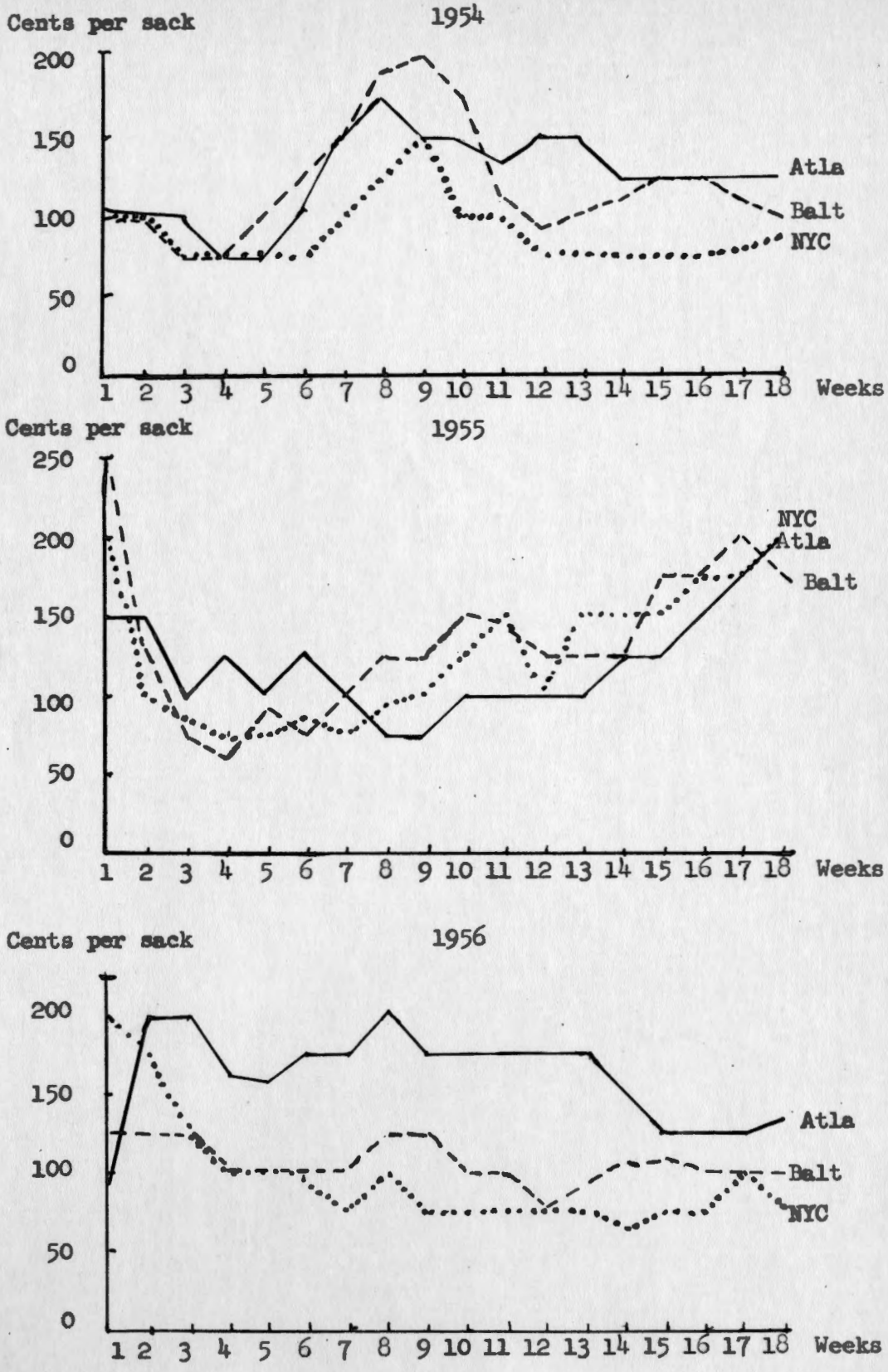


Figure 4 - CABBAGE: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

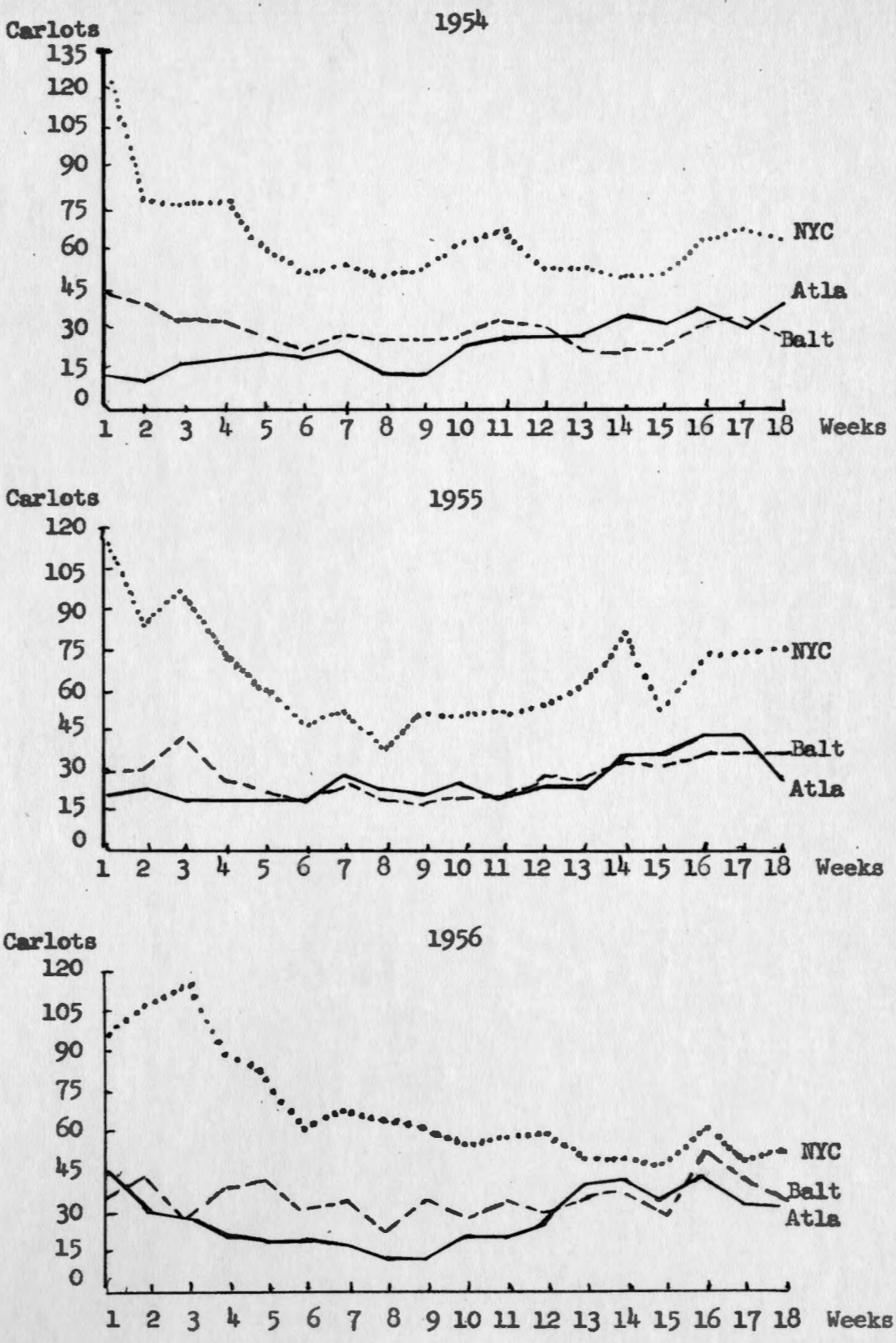


Figure 5 - CORN: Weekly median prices in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

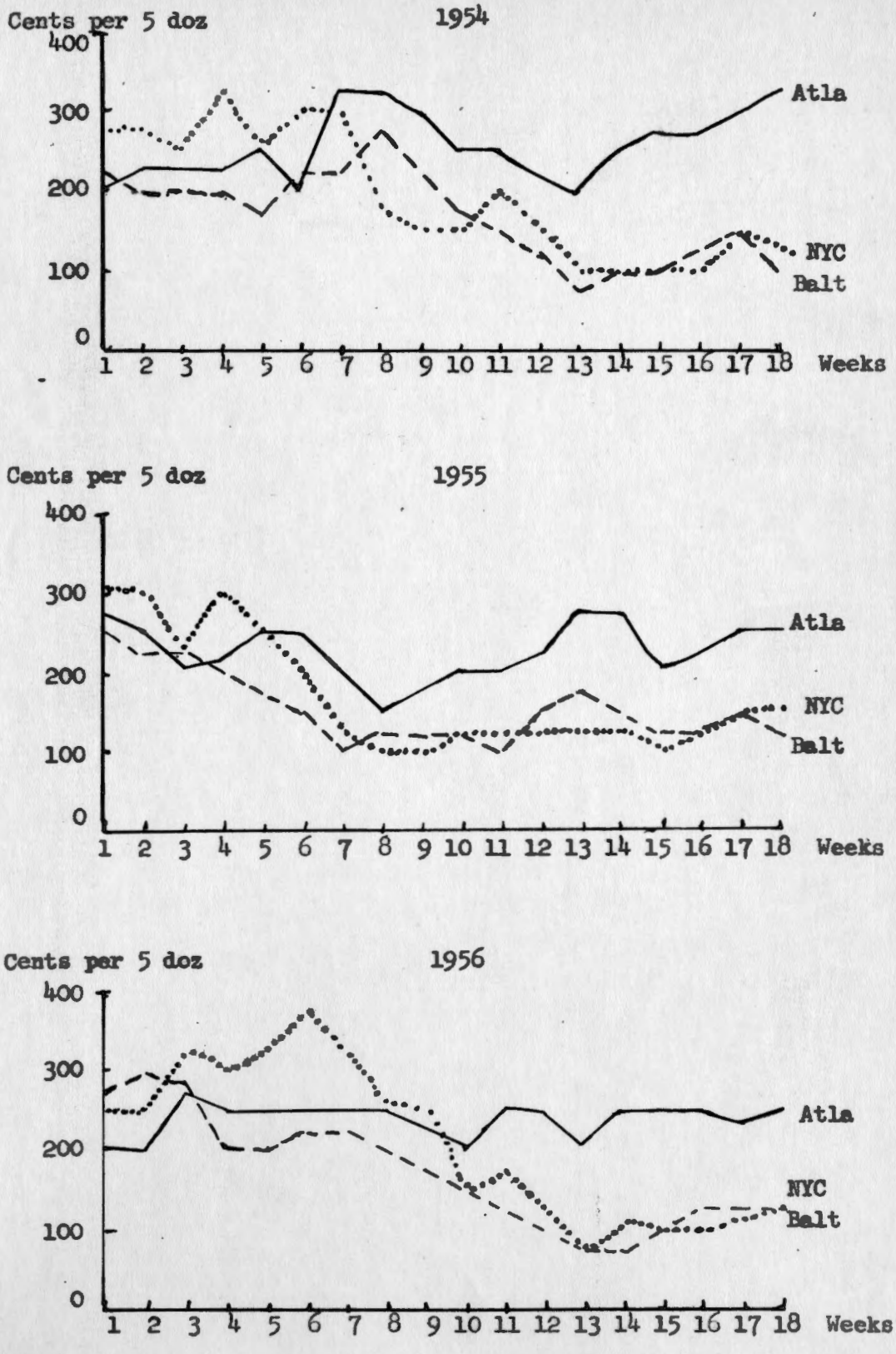


Figure 6 - CORN: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

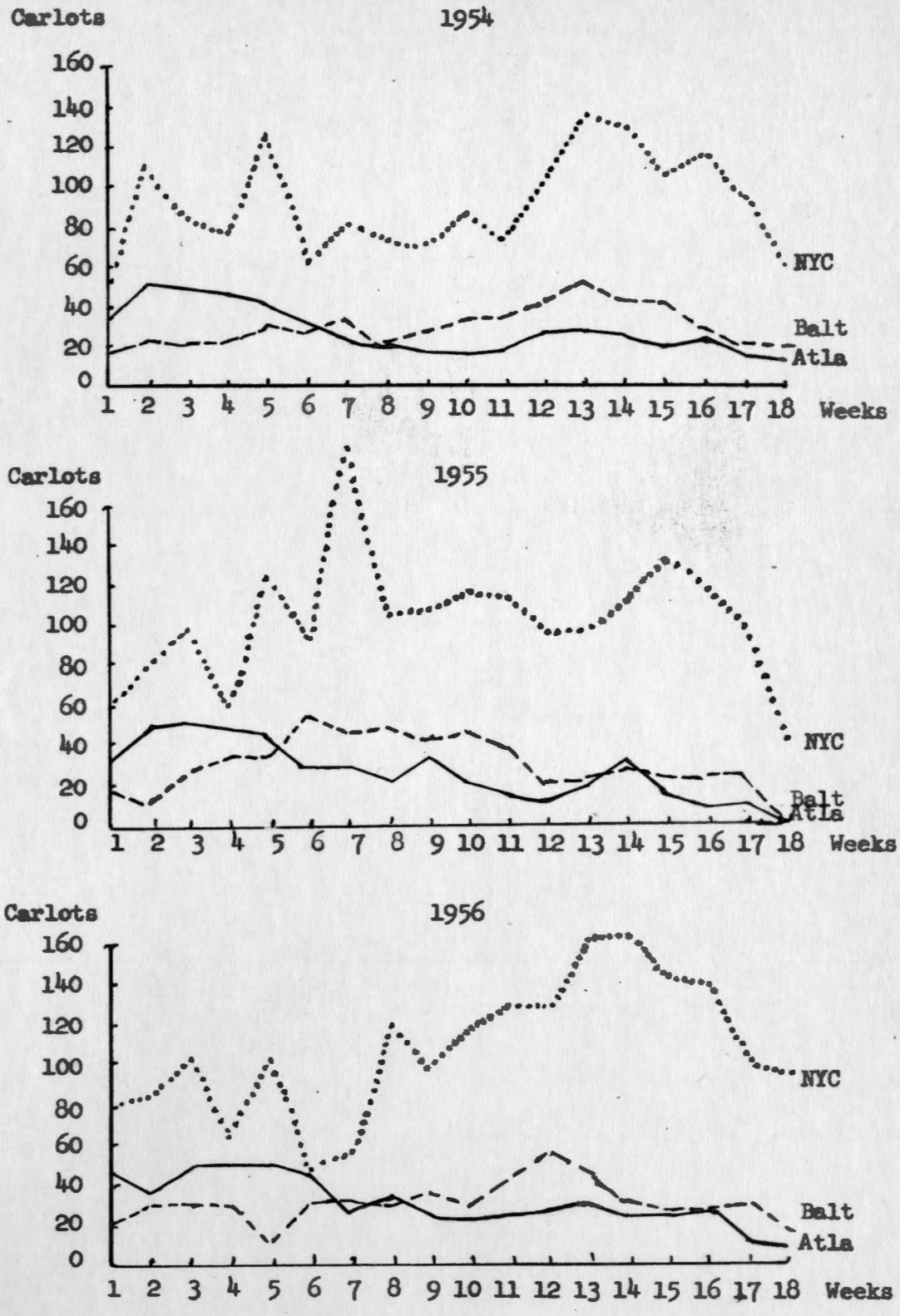


Figure 7 - CUCUMBERS: Weekly median prices in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

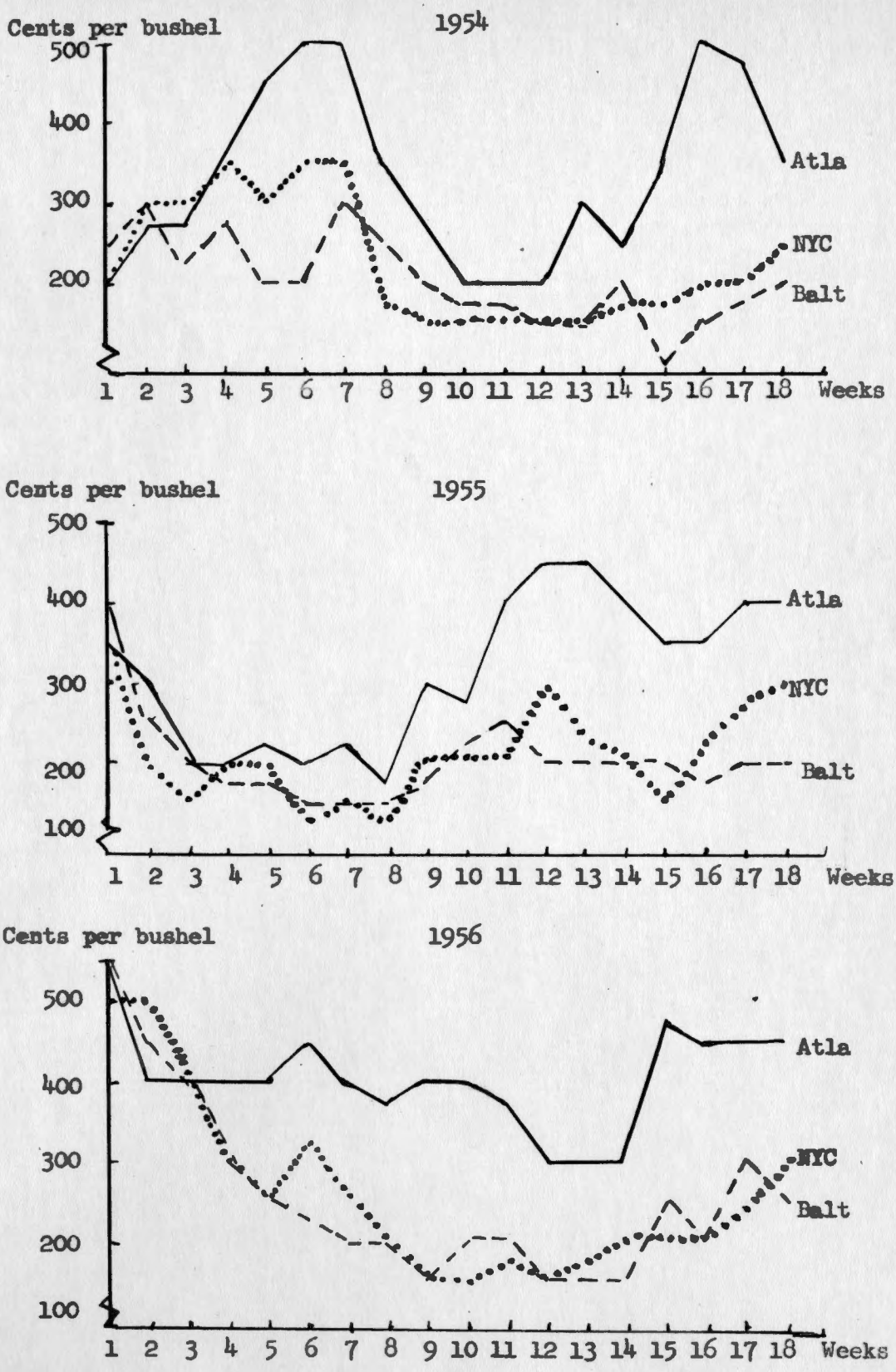


Figure 8 - CUCUMBERS: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

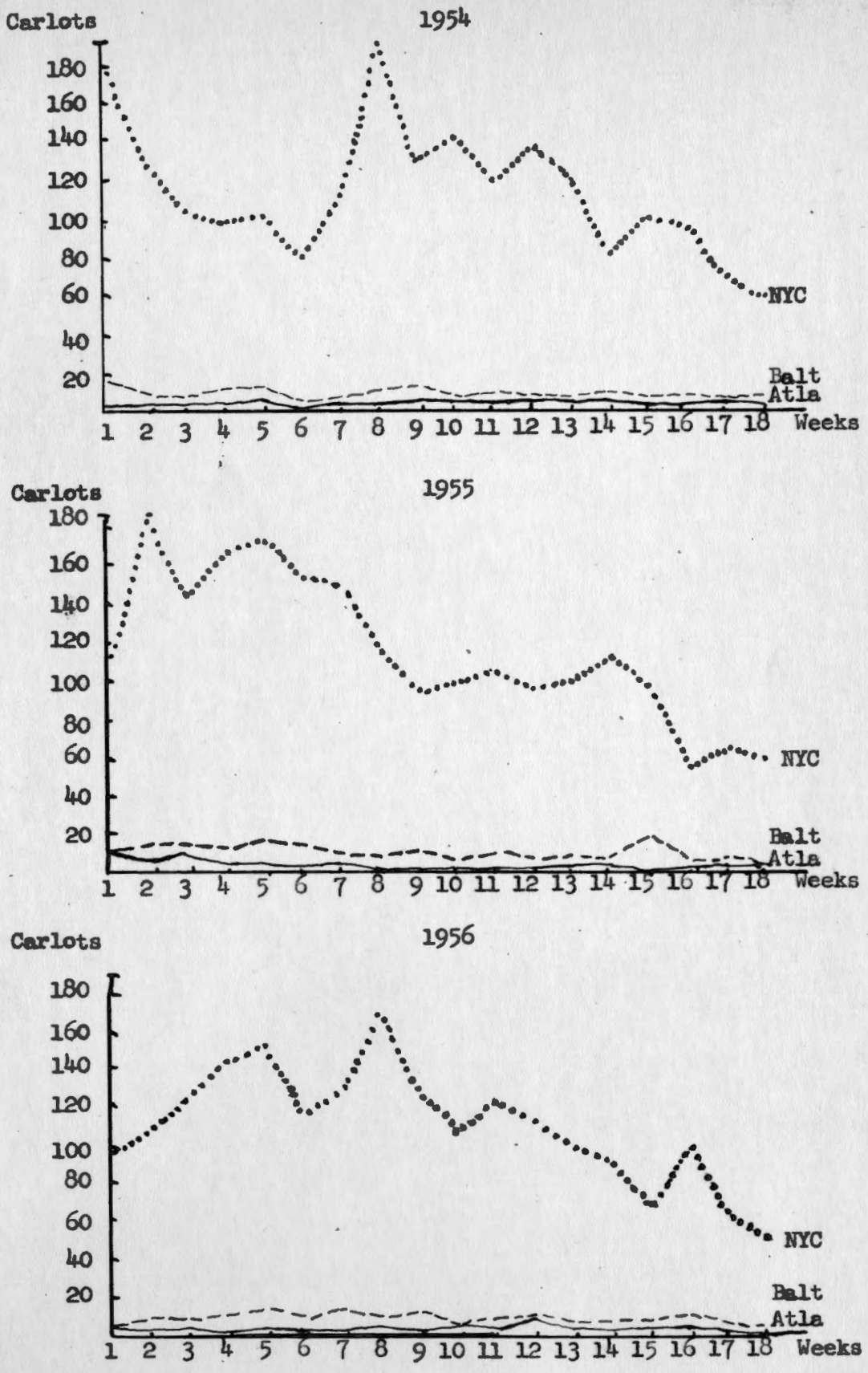


Figure 9 - PEPPERS: Weekly median prices in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

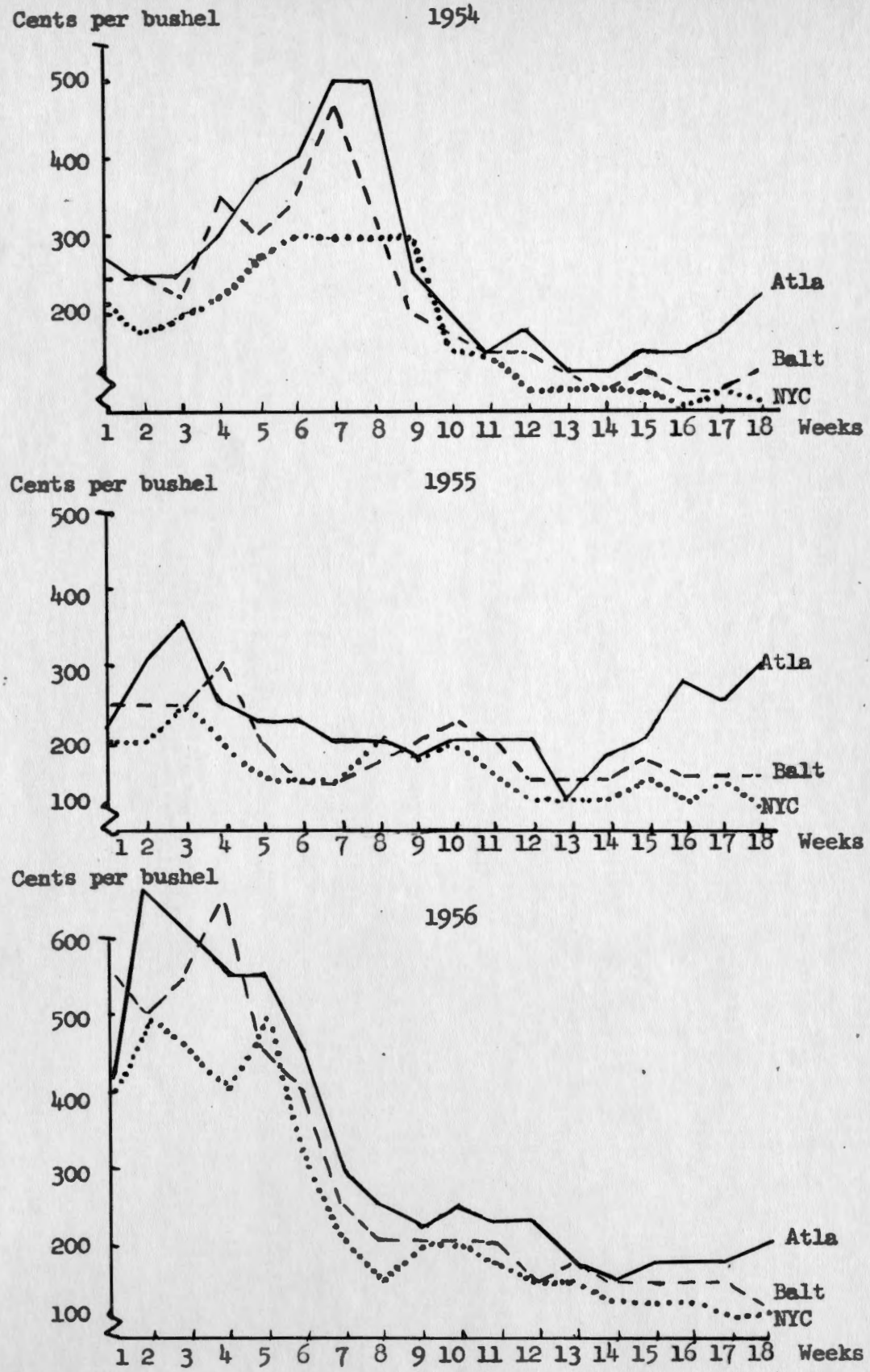


Figure 10 - PEPPERS: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

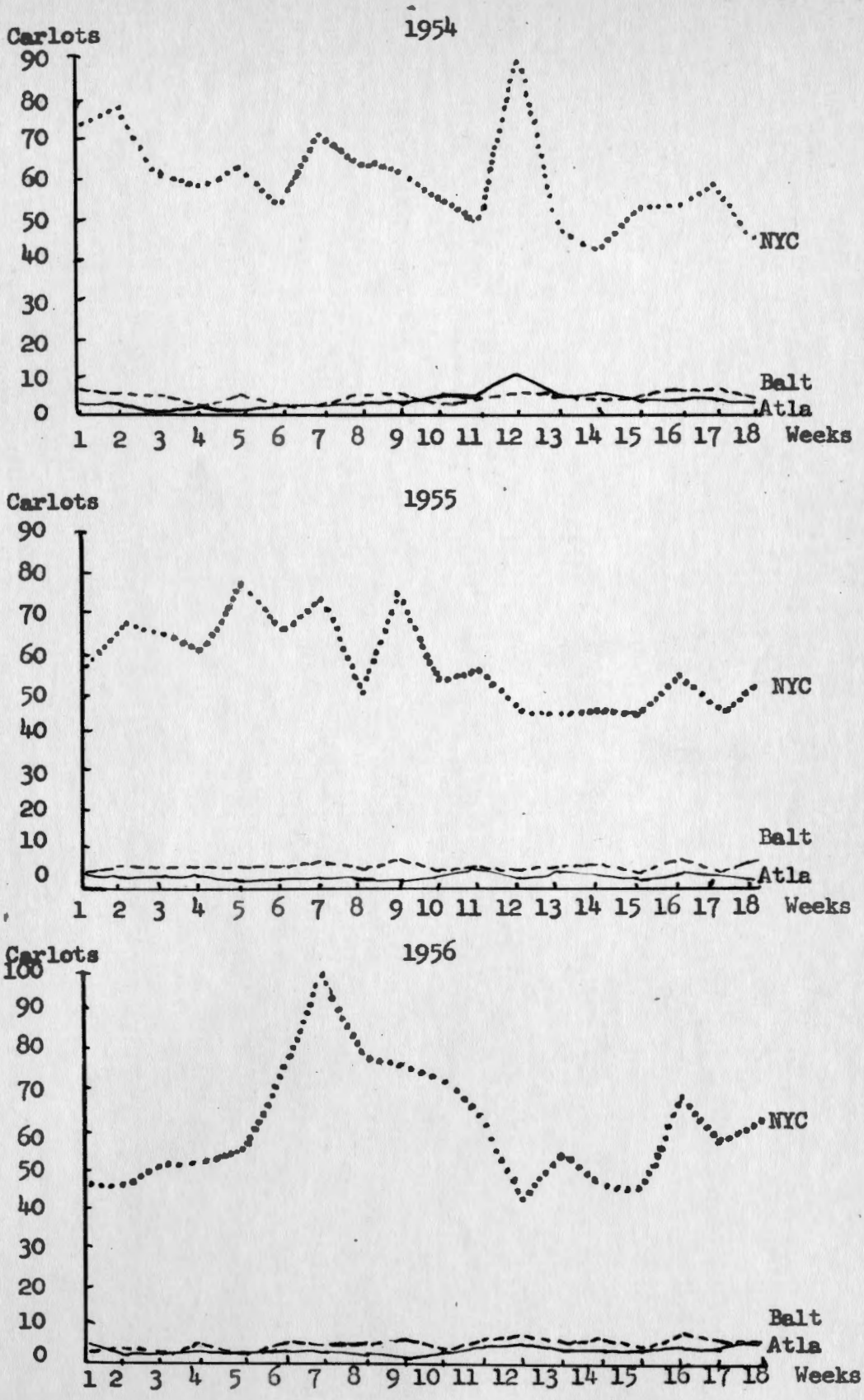


Figure 11 - TOMATOES: Weekly median prices in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.

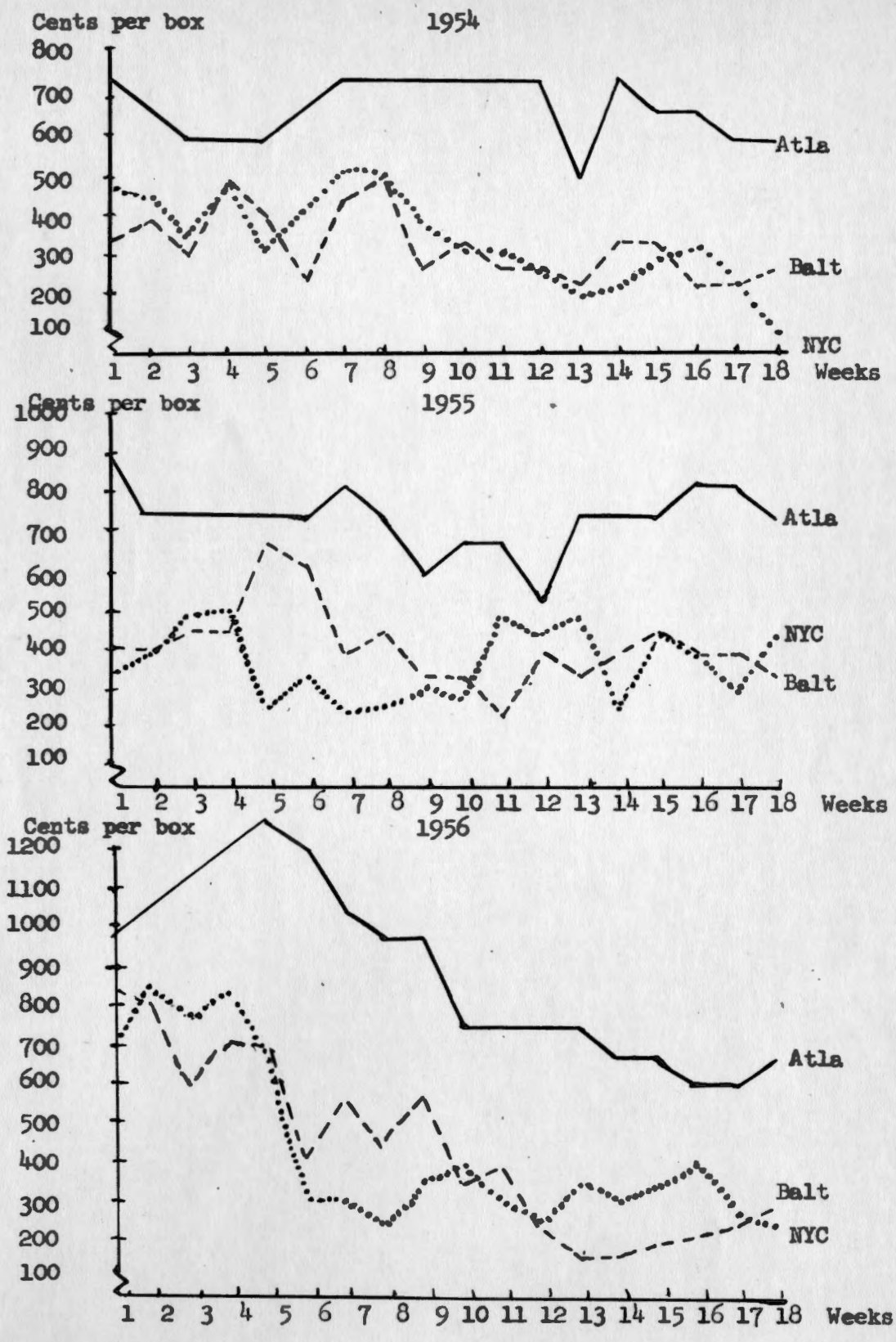
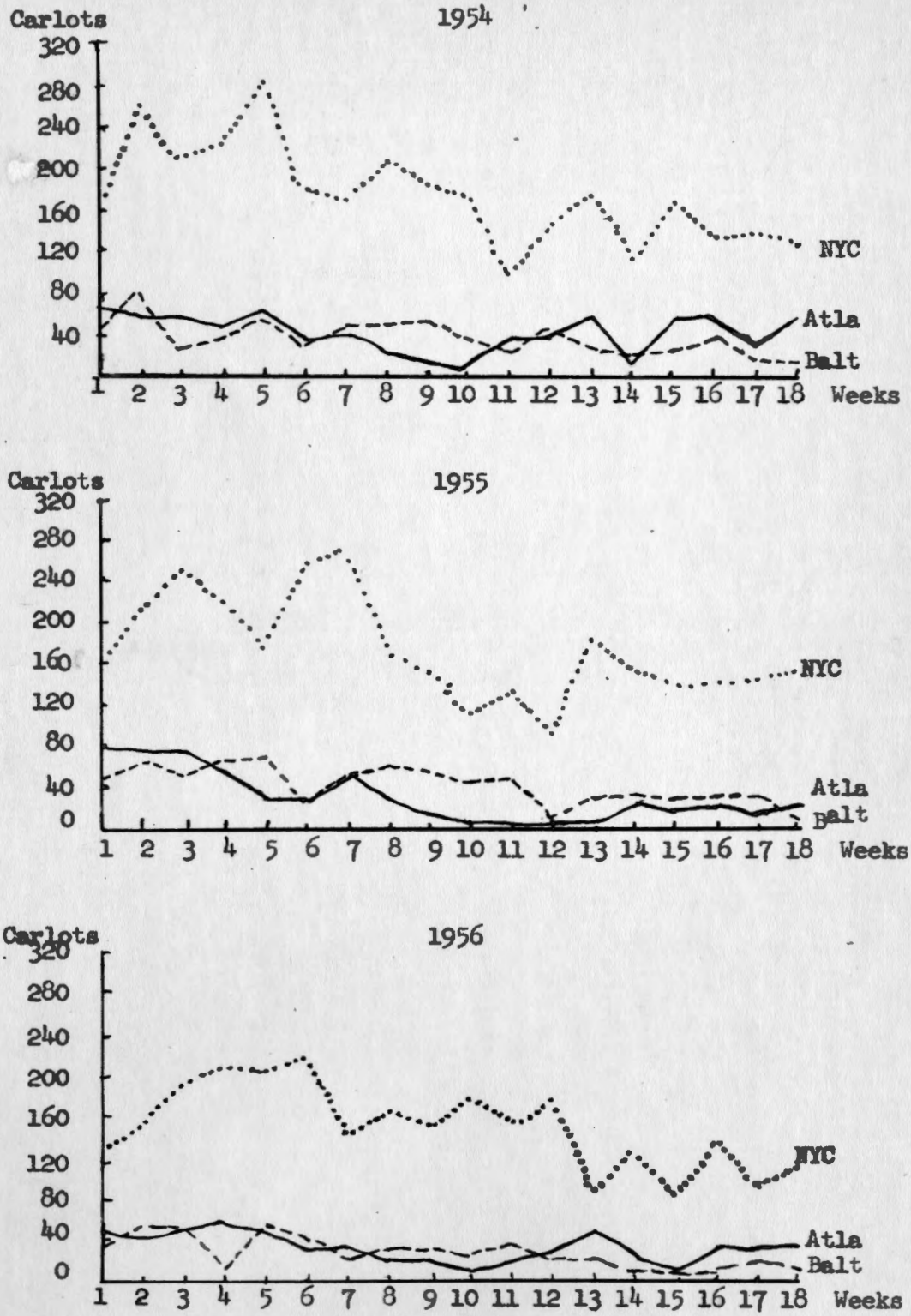


Figure 12 - TOMATOES: Weekly carlot arrivals in New York, Baltimore, and Atlanta during 1954, 1955, and 1956.



APPENDIX B

Example of Bartlett's Test and the Analysis of Variance Test in the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast from New York City, Baltimore, and Atlanta during 1954-55-56

Example of the Bartlett's Test for Homogeneity of Price Variances

Snap Bean Prices

$Ho = \sigma_T = \sigma_o$

Yearly number of observations in each market = 18

Market - Year	Sums of Squares	Variance	log S^2
NYC - 54	318	18.706	1.271984
NYC - 55	544	32.000	1.505150
NYC - 56	1,020	60.000	1.778150
Balt - 54	232	13.647	1.135034
Balt - 55	406	23.882	1.378068
Balt - 56	797	46.882	1.671008
Atla - 54	465	27.353	1.437008
Atla - 55	1,356	79.765	1.901815
Atla - 56	220	12.941	1.111964
Totals	---	315.176	13.190181

Basic Equations of the Bartlett's Test

$$\chi^2_{crude} = 2.3026\ (N-1)\left[a \log\left(\frac{\Sigma s^2}{a}\right) - \Sigma \log S^2\right]$$

$$\chi^2_{corrected} = \frac{\chi^2_{crude}}{1 + \frac{a+1}{3a(N-1)}}$$

Where:

χ^2_{crude} is the uncorrected chi square value

$\chi^2_{corrected}$ is the corrected chi square value

N is the number of observations in each market during each year

a is the number of price variances being tested

S^2 is the variance of the prices

$$\chi^2_{crude} = 2.3026(17)(13.898763-13.190181)$$
$$= 27.736876^{**}$$

$$\chi^2_{corrected} = \frac{27.736876}{1+\frac{9+1}{3(9)(17)}}$$
$$= 27.145^{**}$$

Subdivided Bartlett's Test for Homogeneous Variances Within Each Market

New York

$$\chi^2_{crude} = 2.3026(17)(4.701090 - 4.555284)$$
$$= 5.708$$

Baltimore

$$\chi^2_{crude} = 2.3026(17)(4.347825 - 4.184110)$$
$$= 6.408$$

$$\chi^2_{corrected} = \frac{6.408}{1.222} = 5.244$$

Atlanta

$$\chi^2_{crude} = 2.3026(17)(4.806840 - 4.450787)$$
$$= 13.937$$

$$\chi^2_{corrected} = \frac{13.937}{1.222} = 11.405^{**}$$

** Denotes significance at the 1 percent level.

Example of Analysis of Variance for Prices from the Completely Randomized Block Design with Sub-sampling and Orthogonal Contrast

Basis design for the completely randomized block design with sub-sampling where markets represent treatments and years represent blocks. Each X.. represents the summation of the 18 weekly prices for the particular market and year.

Year	Markets			$\Sigma X_{.j}$
	New York City	Baltimore	Atlanta	
1954	X_{11}	X_{12}	X_{13}	ΣX_{1j}
1955	X_{21}	X_{22}	X_{23}	ΣX_{2j}
1956	X_{31}	X_{32}	X_{33}	ΣX_{3j}
$\Sigma X_{i.}$	ΣX_{11}	ΣX_{12}	ΣX_{13}	$\Sigma\Sigma X_{ij}$
$\Sigma X^2_{i.}$	ΣX^2_{11}	ΣX^2_{12}	ΣX^2_{13}	$\Sigma\Sigma X^2_{ij}$
$\Sigma\Sigma\Sigma X^2_{i...}$	—	—	—	$\Sigma\Sigma\Sigma X^2_{ijk}$

Snap Bean Prices

Year	Markets			$\Sigma X_{.j}$
	New York City	Baltimore	Atlanta	
1954	3,825	3,525	5,600	12,950
1955	3,825	3,500	4,085	11,410
1956	4,200	4,000	6,160	14,360
$\Sigma X_{i.}$	11,850	11,025	15,845	38,720
$\Sigma X^2_{i.}$	46,901,250	40,675,625	85,992,825	173,569,700
$\Sigma\Sigma\Sigma X^2_{i..}$	—	—	—	10,179,250

Symbols used in calculations to determine the sums of squares for the analysis of variance table

Y = Number of years

M = Number of markets

N = Number of observations in each market each year

SS = Sums of squares

Ct = Correction term

C = Orthogonal values

$$Ct = \frac{(\Sigma X_{ij})^2}{MYN} = \frac{(38,720)^2}{(3)(3)(18)} = 9,254,558$$

$$\text{Market SS} = \frac{1}{YN} \Sigma X_{i.} - Ct$$

$$= \frac{1}{3(18)} \left[(11,850)^2 . . . + (15,845)^2\right] - 9,254,558$$

$$= 246,130$$

$$\text{Year SS} = \frac{1}{MN} \Sigma X_{.j} - Ct$$

$$= \frac{1}{3(18)} \left[(12,950)^2 . . . + (14,360)^2\right] - 9,254,558$$

$$= 80,631$$

$$\text{Experimental Total SS} = \frac{\Sigma\Sigma X_{ij}}{N} - Ct$$

$$= \frac{173,569,700}{18} - 9,254,558$$

$$= 388,203$$

Experimental Error SS = Experimental total SS - Market SS - Year SS

= 388,203 - 246,130 - 80,631

= 61,442

$$\text{Total SS} = \Sigma\Sigma\Sigma X^2_{ijk} - Ct$$

$$= 10,179,250 - 9,254,558$$

$$= 924,692$$

$$\text{Sampling Error SS} = \text{Total SS} - \text{Experimental total SS}$$

$$= 924,692 - 388,203$$

$$= 536,489$$

Orthogonal Contrast where New York and Baltimore Versus Atlanta (Contrast 1) and New York Versus Baltimore (Contrast 2)

Items	Markets		
	New York City	Baltimore	Atlanta
$\Sigma X_{i.}$	11,850	11,025	15,845
Contrast 1	+ 1	+ 1	- 2
Contrast 2	+ 1	- 1	0

$$\text{NYC and Balt vs. Atla SS} = \frac{(\Sigma C_{ij}\Sigma X_{i.})^2}{MN(\Sigma C^2_{ij})}$$

$$= \frac{(11,850)(1) \ldots + (15,845)(-2)^2}{(3)(18)(6)}$$

$$= 239,828$$

$$\text{NYC vs. Balt SS} = \frac{(11,850)(1) + (11,025)(-1)}{3(18)(2)}$$

$$= 6,302$$

APPENDIX C

Correlation Coefficients, Coefficients of Determination, and Elasticity Equations for Six Crops from New York City, Baltimore, and Atlanta during 1954-55-56

Explanation of Terms

The abbreviations used in Tables I, II, and III to indicate the method of calculation used to obtain the corresponding coefficient are as shown below:

UC - Unadjusted correlation between market price and carlot arrivals.

SC - Seasonal correlation between market price and carlot arrivals adjusted for periods of local production.

LC - Link relative correlations between price and carlot arrivals.

Table I. Correlation Coefficients and Coefficients of Determination Between Market Price and Carlot Arrivals for New York City.

Year	Calculation Method[1]	Weeks Included	Degrees of Freedom	r	r^2
		Snap Beans			
1954	UC	1-18	17	-.456*	.208
1954	SC	1-5, 10-18	13	-.420	.176
1954	LC	2-18	16	-.420	.176
1955	UC	1-18	17	-.219	.048
1955	SC	1-5, 10-18	13	-.808**	.654
1955	LC	2-18	16	-.360	.130
1956	UC	1-18	17	-.649**	.421
1956	SC	1-5, 10-18	13	-.699**	.489
1956	LC	2-18	16	-.251	.063
		Cabbage			
1954	UC	1-18	17	.018	.000
1954	SC	1-6, 13-18	9	.701*	.491
1954	LC	2-18	16	.017	.000
1955	UC	1-18	17	.387	.150
1955	SC	1-6, 13-18	9	.312	.097
1955	LC	2-18	16	.224	.050
1956	UC	1-18	17	.811**	.658
1956	SC	1-6, 13-18	9	.804**	.646
1956	LC	2-18	16	-.109	.012
		Corn			
1954	UC	1-18	17	-.215	.046
1954	SC	1-10, 17-18	11	.009	.000
1954	LC	2-18	16	-.300	.090
1955	UC	1-18	17	-.531*	.282
1955	SC	1-10, 17-18	11	.478	.228
1955	LC	2-18	16	-.458*	.210
1956	UC	1-18	17	-.817**	.667
1956	SC	1-10, 17-18	11	-.617*	.381
1956	LC	2-18	16	-.281	.079

Table I. (Continued)

Year	Calculation Method	Weeks Included	Degrees of Freedom	r	r^2
		Cucumbers			
1954	UC	1-18	17	-.361	.130
1954	SC	1-9, 16-18	11	-.400	.160
1954	LC	2-18	16	-.652**	.425
1955	UC	1-18	17	-.464*	.215
1955	SC	1-9, 16-18	11	-.520	.270
1955	LC	2-18	16	-.362	.131
1956	UC	1-18	17	-.319	.102
1956	SC	1-9, 16-18	11	-.114	.013
1956	LC	2-18	16	-.443	.196
		Peppers			
1954	UC	1-18	17	.330	.109
1954	SC	1-11, 18	11	.449	.202
1954	LC	2-18	16	-.160	.026
1955	UC	1-18	17	.390	.152
1955	SC	1-11, 18	11	-.115	.013
1955	LC	2-18	16	-.565*	.319
1956	UC	1-18	17	-.241	.058
1956	SC	1-11, 18	11	-.701**	.491
1956	LC	2-18	16	-.167	.028
		Tomatoes			
1954	UC	1-18	17	.501*	.251
1954	SC	1-11, 18	11	.356	.127
1954	LC	2-18	16	-.589*	.347
1955	UC	1-18	17	-.060	.003
1955	SC	1-11, 18	11	.002	.000
1955	LC	2-18	16	.195	.038
1956	UC	1-18	17	.374	.140
1956	SC	1-11, 18	11	.272	.074
1956	LC	2-18	16	-.089	.008

* Denotes significance at the 5 percent level.
** Denotes significance at the 1 percent level.
1/ See Page 121

Table II. Correlation Coefficients and Coefficients of Determination Between Market Price and Carlot Arrivals for Atlanta.

Year	Calculation Method[1]	Weeks Included	Degrees of Freedom	r	r^2
		Snap Beans			
1954	UC	1-18	17	-.564*	.318
1954	SC	4-7, 17-18	5	-.023	.001
1954	LC	2-18	16	-.356	.127
1955	UC	1-18	17	-.211	.045
1955	SC	4-7, 17-18	5	-.803*	.645
1955	LC	2-18	16	-.540*	.292
1956	UC	1-18	17	-.165	.027
1956	SC	4-7, 17-18	5	-.417	.174
1956	LC	2-18	16	-.327	.107
		Cabbage			
1954	UC	1-18	17	.126	.016
1954	SC	1-7, 12-18	13	.460	.212
1954	LC	2-18	16	-.289	.084
1955	UC	1-18	17	.523*	.274
1955	SC	1-7, 12-18	13	.443	.196
1955	LC	2-18	16	.131	.017
1956	UC	1-18	17	-.676**	.457
1956	SC	1-7, 12-18	13	-.612*	.375
1956	LC	2-18	16	-.279	.078
		Corn			
1954	UC	1-18	17	-.547*	.299
1954	SC	6-18	12	-.647*	.419
1954	LC	2-18	16	-.227	.052
1955	UC	1-18	17	.030	.001
1955	SC	6-18	12	-.087	.008
1955	LC	2-18	16	.196	.038
1956	UC	1-18	17	.073	.005
1956	SC	6-18	12	.031	.001
1956	LC	2-18	16	.169	.029

Table II. (Continued)

Year	Calculation Method	Weeks Included	Degrees of Freedom	r	r^2
		Cucumbers			
1954	UC	1-18	17	.249	.062
1954	SC	4-18	14	.471	.222
1954	LC	2-18	16	.177	.031
1955	UC	1-18	17	-.424	.180
1955	SC	4-18	14	-.476	.227
1955	LC	2-18	16	-.073	.005
1956	UC	1-18	17	-.109	.012
1956	SC	4-18	14	-.436	.190
1956	LC	2-18	16	-.080	.006
		Peppers			
1954	UC	1-18	17	-.568*	.323
1954	SC	1-2, 8-18	12	-.529	.280
1954	LC	2-18	16	-.090	.008
1955	UC	1-18	17	-.095	.009
1955	SC	1-2, 8-18	12	-.294	.086
1955	LC	2-18	16	-.200	.040
1956	UC	1-18	17	-.563*	.317
1956	SC	1-2, 8-18	12	-.458	.210
1956	LC	2-18	16	.142	.020
		Tomatoes			
1954	UC	1-18	17	-.456*	.208
1954	SC	6-18	12	-.642**	.412
1954	LC	2-18	16	-.385	.148
1955	UC	1-18	17	.494*	.244
1955	SC	6-18	12	.716**	.513
1955	LC	2-18	16	.299	.089
1956	UC	1-18	17	.137	.019
1956	SC	6-18	12	.316	.100
1956	LC	2-18	16	.149	.022

* Denotes significance at the 5 percent level.
** Denotes significance at the 1 percent level.
1/ See Page 121

Table III. Correlation Coefficients and Coefficients of Determination Between Market Price and Carlot Arrivals for Baltimore.

Year	Calculation Method 1/	Weeks Included	Degrees of Freedom	r	r^2
		Snap Beans			
1954	UC	1-18	17	-.016	.000
1954	SC	1-2, 10-16	8	-.699*	.489
1954	LC	2-18	16	-.174	.030
1955	UC	1-18	17	-.505*	.255
1955	SC	1-2, 10-16	8	-.373	.139
1955	LC	2-18	16	-.424	.180
1956	UC	1-18	17	-.604**	.365
1956	SC	1-2, 10-16	8	-.757*	.573
1956	LC	2-18	16	-.395	.156
		Cabbage			
1954	UC	1-18	17	-.439	.193
1954	SC	4-18	14	-.443	.196
1954	LC	2-18	16	-.277	.077
1955	UC	1-18	17	.250	.063
1955	SC	4-18	14	.579*	.335
1955	LC	2-18	16	-.110	.012
1956	UC	1-18	17	-.024	.001
1956	SC	4-18	14	-.070	.005
1956	LC	2-18	16	.136	.018
		Corn			
1954	UC	1-18	17	-.632**	.399
1954	SC	1-8, 14-18	12	-.466	.217
1954	LC	2-18	16	-.760**	.578
1955	UC	1-18	17	-.461*	.213
1955	SC	1-8, 14-18	12	-.391	.153
1955	LC	2-18	16	-.128	.016
1956	UC	1-18	17	-.466*	.217
1956	SC	1-8, 14-18	12	-.209	.044
1956	LC	2-18	16	.067	.004

Table III. (Continued)

Year	Calculation Method	Weeks Included	Degrees of Freedom	r	r^2
		Cucumbers			
1954	UC	1-18	17	.404	.163
1954	SC	1-3, 10-18	11	.510	.260
1954	LC	2-18	16	.211	.045
1955	UC	1-18	17	-.117	.014
1955	SC	1-3, 10-18	11	.215	.046
1955	LC	2-18	16	.074	.005
1956	UC	1-18	17	-.339	.115
1956	SC	1-3, 10-18	11	-.349	.122
1956	LC	2-18	16	-.344	.118
		Peppers			
1954	UC	1-18	17	-.270	.077
1954	SC	1-18	17	-.220	.048
1954	LC	2-18	16	-.513*	.263
1955	UC	1-18	17	-.114	.013
1955	SC	1-18	17	-.114	.013
1955	LC	2-18	16	-.237	.056
1956	UC	1-18	17	-.714**	.510
1956	SC	1-18	17	-.714**	.510
1956	LC	2-18	16	.026	.001
		Tomatoes			
1954	UC	1-18	17	-.495*	.245
1954	SC	1-7, 14-18	12	.535*	.286
1954	LC	2-18	16	.330	.109
1955	UC	1-18	17	.211	.044
1955	SC	1-7, 14-18	12	.307	.094
1955	LC	2-18	16	-.506*	.256
1956	UC	1-18	17	.637**	.406
1956	SC	1-7, 14-18	12	.661**	.437
1956	LC	2-18	16	-.047	.002

* Denotes significance at the 5 percent level.
** Denotes significance at the 1 percent level.
1/ See Page 121

Point Elasticity of Demand Equations for Each Crop in the Southern Market.[1/] These Equations Were Calculated by the Method Outlined in Chapter VII.

Snap Beans

$$E = \frac{353.24 - .0046x}{-.0046x}$$

Cabbage*

$$E = \frac{118.38 - .144x}{-.144x}$$

Corn

$$E = \frac{256.46 - .00115x}{-.00115x}$$

Cucumbers

$$E = \frac{376.76 - .01605x}{-.01605x}$$

Peppers

$$E = \frac{438.59 - .0634x}{-.0634x}$$

Tomatoes*

$$E = \frac{101.80 - .024x}{-.024x}$$

1/ The dependent variation used in the regression equation to calculate this elasticity equation represents price in cents and the independent variation represents the arrivals in carlot equivalents (snap beans, 640 bu., etc.).

* These equations were calculated from the three-year link relative index values and they were selected for use rather than the unadjusted price and arrival equations, because more of the inverse relationships between the two variables was explained.

Point Elasticity of Demand Equations for Each Crop in the Northern Markets.[1/] These Equations Were Calculated by the Method Outlined in Chapter VII.

Snap Beans

$$E = \frac{351.31 - 1.973x}{-1.973x}$$

Cabbage*

$$E = \frac{87.66 + .123x}{.123x}$$

Corn

$$E = \frac{357.15 - 1.649x}{-1.649x}$$

Cucumbers*

$$E = \frac{145.32 - .441x}{-.441x}$$

Peppers*

$$E = \frac{118.99 - .210x}{-.210x}$$

Tomatoes*

$$E = \frac{103.96 - .039x}{-.039x}$$

1/ The dependent variable as used in the regression equation to calculate this elasticity equation represents prices in cents, and the independent variable represents the arrivals in carlots.

* These equations were calculated from the three-year link relative index values and they were selected for use rather than the unadjusted price and arrival equations, because more of the inverse relationship between the two variables was explained.