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PRICING PERFORMANCE IN MARKETING FRESH WINTER LETTUCE

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ABSTRACT

Price analysis was used to determine if the behavior of weekly lettuce prices at shipping points and wholesale terminal markets is generally consistent with a competitive marketing system. Results indicated that the winter lettuce market in 1966-68 performed in an orderly and competitive manner. Prices at different locations were established that were consistent with marketing costs--transportation, storage, and handling. Prices at all locations in the marketing system were closely correlated. Margins were related to the distance transported and the price of the commodity. Shipping-point prices of lettuce were inversely related to the supply of product available. Wholesale terminal market prices directly responded to shifts in shipping-point prices. The marketing system for fresh winter lettuce generally performed efficiently in establishing prices that cleared the supply of perishable produce each day and week of the marketing season.

Key Words: Vegetables, Lettuce, Market, Pricing performance, Price analysis, Marketing system, Margins, Shipping point, Wholesale terminal markets.

PREFACE

This report is based on a research project entitled "An Equilibrium Analysis of the Production, Distribution, and Marketing of Winter Vegetables." The project was a joint effort involving direct cooperation between the North Carolina Agricultural Experiment Station, represented by Richard A. King, Department of Economics, North Carolina State University at Raleigh, and the Economic Research Service (ERS), U.S. Department of Agriculture. Two other ERS publications analyzing pricing performance in the marketing of carrots and tomatoes are planned.

Primary sources of data for this report were the Federal-State Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture; and the U.S. Department of Commerce.

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SUMMARY

The system for marketing winter lettuce operates in an orderly and competitive manner, setting prices which clear a supply of highly perishable produce daily during the season. Weekly price changes for fresh winter lettuce at shipping points and at 12 major wholesale terminal markets were analyzed for the winter months of 1966-68. Prices were lowest at shipping points (90 percent of the crop originated in Yuma County, Ariz., and Imperial and Riverside Counties, Calif.), and rose consistent with distance and time to wholesale terminal markets. Average prices for lettuce packed in cartons of 24 heads increased from $2.31 in California-Arizona to $3.19 in San Francisco and $3.95 in New York.

Prices of winter lettuce were closely correlated among all locations in the marketing system. The correlation between California-Arizona lettuce prices at the shipping point and prices at wholesale in San Francisco was nearly perfect at 0.98. Similar correlations between shipping-point prices and wholesale prices were 0.95 for Dallas, 0.94 for Detroit, and 0.89 for New York.

Based on the physical flow of produce and on buying practices, the shipping point was identified as the focal point in the marketing system where prices first change. Wholesale terminal market prices directly responded to shifts in shipping-point prices in the lettuce market. In Chicago, for example, the price of California-Arizona lettuce could be predicted by adding $1.34 to the result of 1.02 times the shipping-point price. Similar relationships held for most other wholesale terminal markets.

Weekly shipping-point lettuce prices were inversely related to the supply of produce available. In addition, price estimates were significantly improved by adding proxy variables to reflect the distribution of quality and size of lettuce and by adding a variable to allow for the buildup of supplies in marketing channels. Eighty percent of the variation in the price of California-Arizona lettuce was explained by the volume of current shipments, the previous week's average high temperature at Yuma, Ariz., total rainfall at Yuma the previous November and December, and the size of the current week's California-Arizona shipments, compared with the average for the preceding 2 weeks. For several short periods, weekly prices of winter lettuce were equal to harvesting and packing costs, indicating that shipping-point prices were at competitive levels.

A few areas were observed where possible "poor" performance was indicated and adjustments in institutions and market information systems may be in order. Foremost was Seattle, where the residual margin for lettuce was 76 cents above the average of the 12 study cities.

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INTRODUCTION

This report focuses on the shortrun weekly behavior of winter lettuce prices at shipping points and wholesale terminal markets. Because marketing channels in this important industry have been changing in recent years, growers, shippers, wholesalers, retail organizations, and others concerned with the lettuce industry are especially interested in how prices are established and, in turn, how they are reflected throughout the marketing system.

Over time, there has been a shift toward increased direct buying on the part of large retail organizations and a reduction in the number of ownership transfers between shipping points and retail outlets. Consequently, the price-making function has tended to move from the wholesale terminal market to the point of production.

Lettuce prices often fluctuate widely over relatively short periods of time. For example, lettuce prices for the week ending January 12, 1968, were $5.20 per carton of 24 at Yuma, Ariz.; $6.45 in New York; and $6.51 in Seattle. 1/ For the week ending February 2, 1968, or 3 weeks later, the Yuma price per carton had decreased 78 percent to $1.61; in New York and Seattle, the prices per carton were down to $3.30 and $3.32, respectively.

Theoretically, prices will be established through the interaction of demand (derived from the retail demand for lettuce by consumers) and the supply of lettuce available. Under competitive conditions, the price of lettuce at the shipping point and at the wholesale terminal market will differ by no more than the marketing costs; that is, transportation, storage, and handling costs. 2/

With a shift in lettuce prices at the shipping point or at the wholesale terminal market, prices at all other locations in the marketing system should vary accordingly. For example, a change in the price of lettuce in the Imperial

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1/ Winter lettuce is typically packed in fiberboard or similar-type cartons holding 24 heads each. Large heads are packed 18 to a carton and small heads, 30 to a carton.

2/ R.W. Bohall. Pricing Performance of the Marketing System for Selected Fresh Winter Vegetables. Unpublished Ph.D. thesis, N.C. State Univ., 1971. (Univ. Microfilms, Ann Arbor, Mich.)

Valley of California should be reflected by shifts in wholesale terminal market prices at New York and San Francisco. In practice, buyers and sellers may not become aware of price changes for several hours, and a number of days may elapse before fresh supplies can move from point of production to point of consumption. In addition, if shifts in shipping-point prices are imperfectly relayed to wholesale terminal markets, prices at different locations may not change (or only partially adjust) and get out of line with marketing costs.

To evaluate if lettuce prices in the short run behaved in a manner consistent with a competitive marketing system, it was necessary to determine: (1) The price structure of the lettuce market as measured by the level of shipping-point and wholesale terminal market prices; (2) the relationship of observed price differences between the shipping point and the wholesale terminal market and actual costs of transporting, handling, and storing lettuce; (3) the relationship between lettuce prices at the shipping point and wholesale terminal markets; and (4) the reasons for shortrun variations in lettuce prices at the shipping point.

The study was limited to winter lettuce marketed in 12 major consuming centers geographically dispersed across the United States. 3/ The basic data for the study included Market News quotations of weekly average prices for lettuce of good quality and condition at shipping points and at the 12 wholesale terminal markets. The time period covered the months of January, February, and March during the three winter seasons of 1966, 1967, and 1968.

Secondary data available on winter lettuce prices consisted primarily of daily reports published by the Market News Service of the Fruit and Vegetable Division, Consumer and Marketing Service, U.S. Department of Agriculture. At the shipping point, the daily report included the f.o.b. prices of the common sizes and containers of lettuce of good quality and condition, unless otherwise specified. At wholesale terminal markets, similar price series were quoted for produce available from first or primary receivers.

Daily prices of lettuce were tabulated, using the midpoints of the "mostly" range in price; that is, the price at which "most" of the lettuce of good quality and condition was sold. A weekly unweighted average price was then computed by averaging the daily prices. Similar procedures were used at each consuming-center market except that tabulations took into consideration the shipping point or State of origin.

THE WINTER LETTUCE INDUSTRY

Winter lettuce production is concentrated in Imperial and Riverside Counties, Calif., and in Yuma County, Ariz. These three counties provided 90 percent of the 1966-70 winter lettuce shipments from California and Arizona. For the same years, California and Arizona were the sources for 94 percent of the winter shipments and 91 percent of the unloads reported by the Market News Service (table 1). Texas, Florida, and a few other States provided the remainder. California was the main source of lettuce for west coast cities such as Los Angeles

3/ The terms "consuming center" and "wholesale terminal market" are used interchangeably throughout this report.

Table 1.--Lettuce unloads in 41 cities and reported shipments, by State of origin, January, February, March 1966-70

Item	Winter season					Total 1966-70	
	1966	1967	1968	1969	1970		
Origin of unloads:	Carlots	Carlots	Carlots	Carlots	Carlots	Carlots	Percent
Arizona	3,064	3,304	3,600	2,549	2,684	15,201	18.2
California	12,818	11,932	12,460	11,184	12,776	61,170	73.2
Texas	473	619	242	668	555	2,557	3.1
Florida	446	458	413	607	588	2,512	3.0
Other States	428	472	428	372	379	2,079	2.5
Total	17,229	16,785	17,143	15,380	16,982	83,519	100.0
Shipments:							
Arizona	6,530	6,546	7,494	5,552	5,856	31,978	25.7
California	17,592	16,842	17,282	15,792	17,709	85,217	68.6
Texas	966	987	435	1,073	978	4,439	3.6
Florida	441	440	413	719	580	2,593	2.1
Other States	---	---	---	---	---	---	---
Total	25,529	24,815	25,624	23,136	25,123	124,227	100.0

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

and San Francisco (table 2). However, in the winter of 1970, Seattle obtained most of its unloads from Arizona. With the exception of Washington, D.C., and Dallas, cities east of the California-Arizona shipping point received 70 percent or more of their lettuce unloads from California and 10 to 20 percent from Arizona. Texas provided 30 percent of the Dallas unloads and 11 percent of the Washington, D.C., unloads in 1970.

In 1964, the Census of Agriculture reported 194 farmers raising lettuce in Imperial, Riverside, and Yuma counties, with an average of 309 acres each. These growers accounted for all the acreage of winter lettuce reported for California and Arizona by the Crop Reporting Board in 1964. A count of production units was not available for 1968, but an estimated 85 percent of the 1968 winter lettuce crop was produced by less than 150 California and Arizona growers.

In Imperial County, Calif., agricultural extension agents indicated about 100 lettuce growers were active, with operations ranging from over 3,000 acres to less than 100 acres. Eleven growers had over 1,000 acres each, but the overall average was approximately 400 acres. The larger growers harvested, packed, and sold their own produce, whereas the smaller producers were apt to contract these functions to shippers and large grower-shippers. The fee of $1.10-$1.15 commonly charged for harvesting, packing, and selling lettuce acted as a lower limit on the shipping-point price. The shippers usually had field and harvest supervisors to oversee the production and harvest operations of their smaller producers.

In the Imperial County area, it was estimated that there were 25-30 shippers and large grower-shippers and about the same number of brokers and sales agents. This count corresponded reasonably well with advertisements in the local trade paper listing 48 shippers and 25 brokers and agents for Imperial Valley lettuce.

Iceberg lettuce production in Riverside County was centered in the Palo Verde Valley near Blythe, Calif. The area extension agent estimated that 12 grower-shippers were active, with operations ranging from 80 to 800 acres and an overall average of 250 acres. The remaining lettuce produced in Riverside County consisted of the broadleaf types grown in the Coachella Valley near Indio, Calif.

In Yuma County, Ariz., lettuce production was concentrated around the city of Yuma, with some acreage 100 miles north in the Parker Valley. Located near Yuma were 18-20 large grower-shippers, about half of which handled all of their own growing operations; the rest contracted or purchased additional acreage outright. Operations were as large as 1,400 acres, but the average was about 500 acres of owned production, with another 300 acres of production handled on contract or purchased outright. The 10 or more smaller growers in the region, who raised from 40 to 200 acres of lettuce each, either harvested, packed, and sold their production for a charge of approximately $1.10-$1.15 per carton ($1.25 by 1969), sold it outright, or handled it on shares with a grower-shipper. As in Imperial County, Calif., several buying brokers and agencies were active in the area.

Table 2.--Absolute and relative shares of lettuce unloads by State of origin and city of destination, January, February, March 1970

City of destination	California		Arizona		Texas		Florida		Other States		Total, United States	
	Carlots	Percent	Carlots	Percent	Carlots	Percent	Carlots	Percent	Carlots	Percent	Carlots	Percent
Los Angeles	1,933	95	99	5	---	---	---	---	---	---	2,032	100
San Francisco	868	85	158	15	---	---	---	---	---	---	1,026	100
Dallas	223	57	45	12	117	30	1	1/	2	1	388	100
Seattle	5	1	462	99	---	---	---	---	---	---	467	100
St. Louis	339	80	40	10	10	2	17	4	16	4	422	100
Chicago	965	72	287	21	6	1	10	1	73	5	1,341	100
Atlanta	266	77	36	10	29	8	12	4	5	1	348	100
Detroit	536	71	148	20	21	3	7	1	37	5	749	100
Pittsburgh	349	70	73	15	---	---	22	4	57	11	501	100
Washington, D.C.	202	61	68	20	36	11	28	8	---	---	334	100
New York	1,529	73	399	19	19	1	144	7	3	1/	2,094	100
Boston	509	74	142	21	---	---	35	5	3	1/	689	100

1/ Less than 0.5 percent.

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

PRICE STRUCTURE

In a competitive marketing system, the lowest prices for produce occur at the shipping point. Because of transportation, storage, and handling costs, prices increase with distance and time to wholesale terminal markets.

In the winter lettuce market, Arizona and California were treated as a single production area. A small but statistically insignificant difference was noted between lettuce prices in the two areas, with California having slightly higher average f.o.b. prices (table 3). The relationship between Arizona and California prices is as follows:

$$Y_A = \underset{(0.082)}{0.067^{**}} + \underset{(0.032)}{0.965^{**}}\ Y_C \qquad (R^2 = 0.96) \qquad \text{S.E. Estimate} = 0.225$$

where

Y_A = weekly price at Yuma, Ariz., for cartons of 24's of Iceberg lettuce

Y_C = weekly price in the Imperial Valley, Calif., for cartons of 24's of Iceberg lettuce

Figures in parentheses below the coefficients represent standard errors. Two asterisks represent statistical significance at the 1-percent level.

Thus, the Arizona f.o.b. price can be predicted by adding 6.7 cents to the product of 0.965 times the California f.o.b. price. Market News lettuce prices for the Imperial Valley of California and Yuma, Ariz., were weighted by shipments to obtain a composite California-Arizona price.

Market News average weekly prices for winter lettuce were lowest at the California-Arizona shipping point. The California-Arizona average price per carton of 24's was $2.31 for 39 weeks during the winters of 1966, 1967, and 1968 (fig. 1). Average prices at consuming centers were higher, generally increasing with distance and time from the shipping point. Wholesale terminal market average prices were $4.22 in Seattle, $3.95 in New York, and $3.18 in Los Angeles. In San Francisco, Atlanta, Washington, D.C., and Boston, average prices were low, relative to cities closer to the Imperial Valley and Yuma.

In Atlanta and Washington, D.C., prices were not always available for lettuce of good quality and condition. On several occasions, the available supplies of lettuce were of "fair" or "fair to good" quality, resulting in low weekly average prices. An estimate of the above effect indicated that the average weekly price of lettuce in the two cities would have been at least 10-15 cents higher for the three winters of 1966 to 1968 if lettuce of "good" quality and condition had always been available.

In figure 1, the dotted line represents an approximation of the level of consuming-center market prices for sites at various distances from El Centro, Calif. The base of the cone-shaped price function was not shown to be equal to the California-Arizona blend f.o.b. price. Certain charges are incurred in

Table 3.--Weekly average f.o.b. shipping-point prices of lettuce, cartons of 24's, selected points, January, February, March 1966-68

Week ending	Lettuce		
	Imperial Valley, Calif.	Yuma, Ariz.	Weighted blend price 1/
	Dollars		
1966:			
Jan. 7	3.70	3.90	3.75
14	3.60	3.60	3.60
21	3.73	3.79	3.74
28	3.12	3.00	3.10
Feb. 4	3.43	3.35	3.42
11	3.45	3.00	3.36
18	4.35	3.90	4.26
25	3.56	3.62	3.57
Mar. 4	3.05	2.80	3.01
11	3.28	3.15	3.25
18	1.88	1.87	1.88
25	1.48	1.50	1.49
Apr. 1	1.53	1.47	1.48
Avg., winter 1966	3.09	3.00	3.07
1967:			
Jan. 6	1.28	1.40	1.31
13	2.29	2.50	2.33
20	2.81	2.87	2.82
27	2.67	2.75	2.68
Feb. 3	1.19	1.24	1.20
10	1.05	1.06	1.05
17	1.05	1.05	1.05
24	1.05	1.05	1.05
Mar. 3	1.28	1.27	1.28
10	1.50	1.60	1.53
17	2.18	2.40	2.27
24	1.37	1.40	1.39
31	1.50	1.46	1.47
Avg., winter 1967	1.63	1.70	1.65
1968:			
Jan. 5	3.22	3.81	3.39
12	4.85	5.20	4.94
19	4.17	3.50	4.05
26	1.94	1.52	1.88
Feb. 2	1.21	1.16	1.20
9	1.22	1.22	1.22
16	1.24	1.15	1.23
23	1.18	1.10	1.17
Mar. 1	1.10	1.12	1.11
8	1.25	1.39	1.31
15	1.31	1.60	1.47
22	2/2.45	2.30	2.35
29	2/3.40	3.30	3.34
Avg., winter 1968	2.20	2.18	2.20
Avg., winters 1966-68	2.31	2.29	2.31

1/ Weighted by shipments from each area.
2/ Palo Verde Valley.

Source: Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

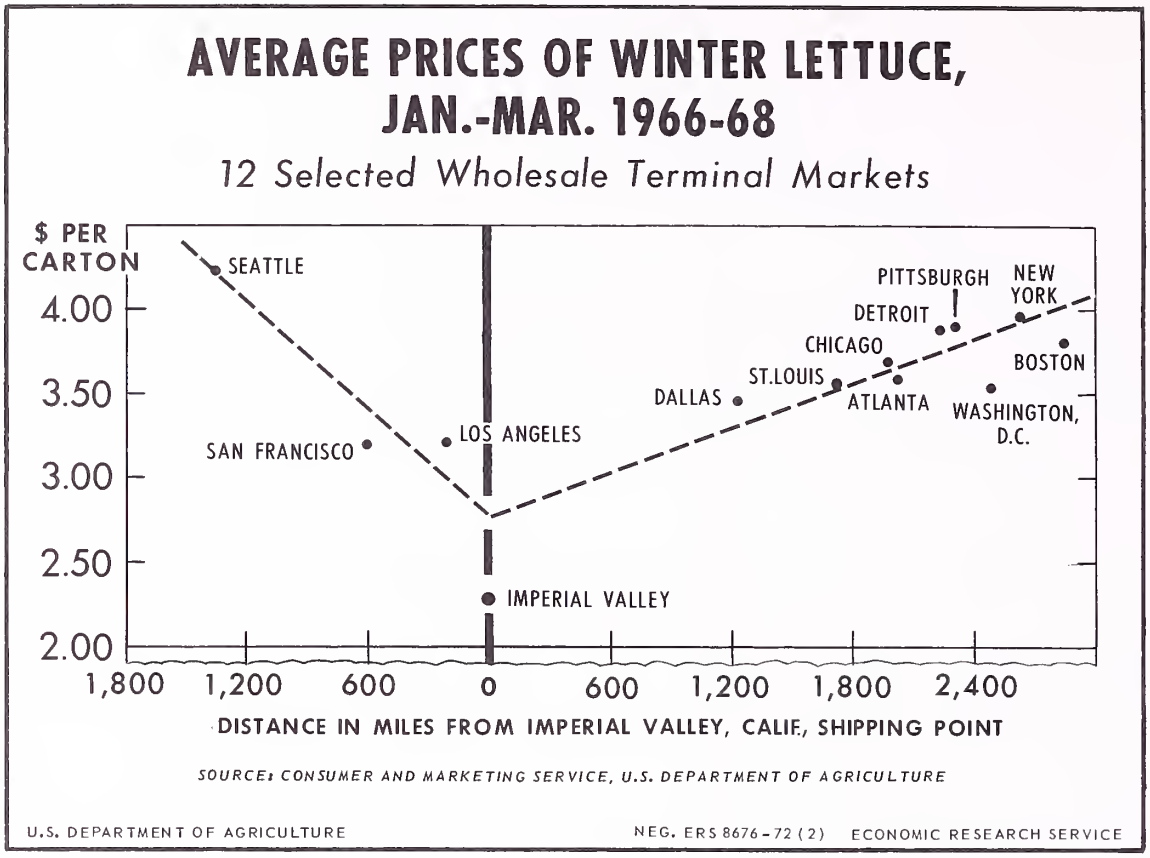

Figure 1

handling lettuce, including precooling and loading, that are not directly associated with time or distance but are a part of shipping expenses.

The price structure of the winter lettuce industry was generally consistent with a competitive market. Prices of lettuce of good quality and condition were lowest at the f.o.b. shipping point and increased with distance and time required for shipment to the wholesale terminal market.

COMPARISON OF COSTS AND MARGINS

In a competitive marketing system, the difference between shipping-point and consuming-center prices--the gross margin--is directly related to the cost of transporting, handling, and storing produce. For winter lettuce the gross margin is the difference between California-Arizona shipping-point blend prices and wholesale terminal market prices. 4/ For the winters of 1966-68, gross lettuce margins ranged from $0.87 at Los Angeles to $1.91 at Seattle (table 4).

4/ The term "gross margin," as used in this report, differs from the marketing margin used in many USDA studies. The marketing margin refers to the difference between the shipping point and the retail price. Here, the gross margin does not include the wholesale-retail portion of the total price spread.

Table 4.--Breakdown per carton of the average weekly gross margin between lettuce prices in California-Arizona and 12 selected cities, January, February, March 1966-68

City	Mean price	Gross margin 1/	Cooling fee 2/	Transportation 3/			Residual margin 4/
				Truck	Rail/truck	Rail	
	Dollars						
Los Angeles	3.18	0.87	0.20	0.28	--	--	0.39
San Francisco	3.19	.88	.20	.41	--	--	.27
Dallas	3.46	1.15	.20	.55	--	--	.40
Seattle	4.22	1.91	.20	.95	--	--	.76
St. Louis	3.54	1.23	.20	--	0.78	--	.25
Chicago	3.69	1.38	.20	--	.78	--	.40
Atlanta	3.58	1.27	.20	.95	--	--	.12
Detroit	3.88	1.57	.20	--	--	0.96	.41
Pittsburgh	3.90	1.59	.20	--	--	1.00	.39
Washington, D.C.	3.53	1.22	.20	--	--	1.03	-.01
New York	3.95	1.64	.20	--	--	1.03	.41
Boston	3.80	1.49	.20	--	--	1.03	.26
Simple average	--	--	--	--	--	--	.34
Weighted average 5/	--	--	--	--	--	--	.37

1/ Gross margin = mean weekly consuming-center market price for 1966-68 winter seasons minus $2.31, the average weekly California-Arizona price.

2/ Effective March 15, 1967; prior to that, 18 cents.

3/ Most common method used winter 1967.

4/ Gross margin minus cooling fee and transportation costs.

5/ Weights based on unloads.

Source: Mean price derived from Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Gross lettuce margins were divided into precooling costs, transportation costs, and residual margins. The procedure used was to determine precooling costs and transportation costs from California-Arizona to selected consuming centers. Gross margins minus precooling and transportation costs equaled residual margins.

Precooling costs were not included in the f.o.b. price. According to a 1968 Market News report on central Arizona lettuce: "All lettuce was vacuum cooled prior to loading. The vacuum cooling charge per carton was 18 cents until March 15, 1967, and 20 cents after this date. There was an additional charge of 5 cents per carton when cooled on official holidays. In all f.o.b. shipping-point prices in this report the buyer pays the vacuum cooling charge, in addition to the f.o.b. shipping-point price shown."

Transportation costs are a major component of gross margins. From January through March 1966-70, Market News reported the unloading of 47,809 carlots of California-Arizona winter lettuce in 41 cities. Of these, 49 percent moved by truck and 51 percent by railcar, including 13 percent by piggyback or truck vans loaded onto rail flatcars (table 5). Typically, trucks were used to haul to nearby cities, while rail transportation dominated for long distances. Trucks were used in most instances for hauling to Los Angeles, San Francisco, Dallas, Seattle, and Atlanta. Rail transportation by either railcars or piggyback was commonly used for all other selected cities. In St. Louis, rail/truck or piggyback transportation predominated in the winters of 1966-70.

The type of transportation used generally reflected the relative cost of the various services (table 6). In the winter of 1968, truck rates from Yuma, Ariz., to western consuming-center markets were less than for rail service. Conversely, rail service was less expensive than truck transport for shipments from Yuma to eastern cities, particularly those along the eastern seaboard. Competition was especially keen for cities such as Chicago, St. Louis, Atlanta, and Dallas. In Chicago and St. Louis, where rail and rail/truck or piggyback rates were competitive, either mode of service was used, depending on local circumstances. In the winter of 1970, piggyback was used for 52 percent of the Chicago unloads and 43 percent of the St. Louis unloads. Lettuce unloads received in Atlanta and Dallas moved for the most part by truck, although piggyback rates in the winter of 1968 were competitive. Atlanta truck rates were especially flexible and truck brokers indicated that negotiated rates were commonly 10-15 cents below quoted standard rates. Trucks were used almost exclusively to move California-Arizona lettuce to Dallas, although in the winter of 1968 piggyback rates were 52 cents per carton, compared with 55 cents per carton by truck. An advantage in delivery time from Yuma and the Imperial Valley evidently offset the 3-cent premium required for truck service.

The remaining component of the gross lettuce margin is the residual margin. The residual margin goes to wholesale receivers and other first handlers to compensate for unloading and breaking large lots of produce into smaller wholesale units and to compensate for risks and uncertainty in holding produce through time.

The size of the residual lettuce margin for the three winter seasons ranged from a negative 1 cent in Washington, D.C., to 76 cents in Seattle (table 4). In nine of the 12 selected cities, the residual margin ranged between 25 and 41

Table 5.--Selected city unloads of lettuce originating in California and Arizona, January-March 1970, and total unloads, 1966-70 1/

City of destination	Winter 1970				Total, winters 1966-70			
	Rail	Piggy-back	Truck	Total	Rail	Piggy-back	Truck	Total
	Carlots							
Los Angeles	---	---	2,032	2,032	---	---	11,089	11,089
San Francisco	---	---	1,026	1,026	---	---	5,445	5,445
Dallas	3	14	251	268	20	34	1,561	1,615
Seattle	23	---	444	467	209	---	2,262	2,471
St. Louis	117	162	100	379	589	970	520	2,079
Chicago	551	649	52	1,252	2,962	2,527	370	5,859
Atlanta	42	7	253	302	163	44	1,321	1,528
Detroit	550	106	28	684	2,634	507	178	3,319
Pittsburgh	373	22	27	422	1,637	130	129	1,896
Washington, D.C.	219	---	51	270	1,111	---	176	1,287
New York	1,148	578	102	1,828	6,181	1,720	295	8,196
Boston	604	18	29	651	2,687	270	68	3,025
Total, 41 cities	3,630	1,556	4,395	9,581	18,193	6,202	23,414	47,809

1/ Factor used to convert truck to rail carlot equivalents was 825 cartons, winter seasons of 1966-68; 1,000 cartons, winter seasons of 1969 and 1970.

Source: Consumer and Marketing Service, U.S. Department of Agriculture.

Table 6.--Transportation rates of lettuce, carton of 24's, from Yuma, Ariz., to selected cities, winter 1968

City	California-Arizona origin		
	Rail	Piggy-back	Truck
	Dollars		
Los Angeles	---	---	0.28
San Francisco	---	---	.41
Seattle	---	---	.95
Dallas	0.67	0.52	.55
St. Louis	.82	.78	1/1.00
Chicago	.82	.78	1.05
Atlanta	1.02	.99	1/.95
Detroit	.96	.95	1.25
Pittsburgh	1.00	.98	1.50
Washington, D.C.	1.03	1.04	1.65
New York	1.03	---	1.65
Boston	1.03	1.01	1.75

1/ Often as low as $0.85.

Sources: Southern Pacific Railroad Company, Phoenix, Ariz., and Colton, Calif.; survey of truck brokers, Phoenix, Ariz., and El Centro, Calif.

cents per carton of 24's. In 5 cities--Los Angeles, Dallas, Chicago, Pittsburgh, and New York--the residual margin was 39-41 cents.

An average residual margin of 37 cents per carton of 24's, or approximately $380 per carlot, to cover the first handler's expenses at consuming centers appeared reasonable. According to Manchester, receivers in 1958 required a residual margin of $250 per carlot for all fruits and vegetables. 5/ Primary handlers, it was estimated, received a gross margin of 13.2 percent of the consuming-center price, broken down as follows: 6.7 percent for salaries and wages, 5.4 percent for other costs, and 1.1 percent for net income, including 0.2 percent corporate income tax. Allowing for increases in the cost of labor and other services between 1958 and 1966-68 and the price of lettuce at the shipping point, an indicated margin of 35-40 cents per carton of 24's was not out of line.

Residual margins for lettuce in cities close to the shipping point tended to be nearly as high as cities farther from the shipping point, or even higher. Average residual margins were 39 cents in Los Angeles, 40 cents in Dallas and Chicago, and 41 cents in Detroit and New York (table 4). On the west coast, residual margins for Seattle topped those in San Francisco and Los Angeles.

5/ A.C. Manchester. The Structure of Wholesale Produce Markets. U.S. Dept. Agr., Agr. Econ. Rpt. No. 45, Apr., 1964.

In Seattle, the residual margin was 76 cents, or 39 cents above the average of the 12 cities. The higher residual margin in Seattle apparently reflected the institutional arrangements for procuring supplies from shipping point. Many wholesalers in the consuming center purchased less than carload lots of produce through terminal buying brokers located in Seattle. A fee of approximately 25 cents per package was commonly charged for this service. In terms of market efficiency, it appeared that wholesalers in Seattle, relative to other consuming-center markets, were incurring an extra expense in procuring fresh supplies.

The residual margin differed considerably between cities and years (tables 7, 8, and 9). The weighted average residual margin for the winter of 1966 was 55 cents per carton of 24's, compared with 28 and 33 cents in the winters of 1967 and 1968. Since lettuce prices at consuming centers were, on the average, much higher in the winter of 1966, compared with 1967 and 1968, the residual margin was evidently proportional to the consuming-center price. As shown in table 10, the residual margin as a percentage of the consuming-center price averaged 12.1 percent in the winter of 1966 and 10.1 and 9.5 percent, respectively, in 1967 and 1968. Thus, the weighted average residual margin increased with the price of winter lettuce.

Higher consuming-center lettuce prices are associated with higher residual margins for the following reasons: First, relatively high prices for winter lettuce occur when quality is poor and supplies of lettuce of good quality and condition are limited. With poor quality, the probability of losses due to spoilage is liable to increase at wholesale terminal markets. As a result, higher residual margins are needed to cover handling costs. Residual margins appear to vary according to the perishability of the commodity. For the winters of 1966-68, the weighted average residual margin for lettuce was 10.6 percent. Similar analysis during the same period indicated the average residual margin for Texas carrots was 5.1 percent and for southern Florida tomatoes, 11.4 percent. 6/ Since tomatoes and lettuce are considered relatively more perishable than carrots, residual margins apparently are related to the perishability of the produce item.

Second, the capital or investment needed to handle lettuce is directly associated with price. Hence, relatively higher residual margins would be needed to cover higher investment costs when prices of winter lettuce increase.

Third, commission merchants and other primary or first handlers of lettuce in wholesale terminal markets often base charges for their services upon selling prices; that is, a commission or percentage of selling price. As a result, residual margins and wholesale terminal market prices are directly correlated.

Costs of precooling and transporting lettuce accounted for over 55 percent of the gross margins between shipping point and wholesale terminal markets for all 12 selected cities in the study. Transportation costs were less for trucks than for rail on short distances; the reverse was true for long distances.

Residual margins were not related to the time lettuce was in transit but were related to the price of lettuce and the perishability of the commodity. The average residual margin for lettuce was 37 cents per carton of 24 heads. While a detailed study of handling and storage costs was not possible, previous

6/ See footnote 2.

Table 7.--Breakdown per carton of the average weekly gross margin between lettuce prices in California-Arizona and 12 selected cities, January, February, March 1966

City	Winter 1966			
	Consuming-center market price	Gross margin 1/	Transportation and cooling	Residual margin
	Dollars			
Los Angeles	4.09	1.02	0.46	0.56
San Francisco	4.03	.96	.59	.37
Dallas	4.39	1.32	.73	.59
Seattle	5.10	2.03	1.13	.90
St. Louis	4.41	1.34	.96	.38
Chicago	4.57	1.50	.96	.54
Atlanta	4.40	1.33	1.13	.20
Detroit	4.90	1.83	1.14	.69
Pittsburgh	4.84	1.77	1.18	.59
Washington, D.C.	4.56	1.49	1.21	.28
New York	4.90	1.83	1.21	.62
Boston	4.84	1.77	1.21	.56
Simple average	---	---	---	.52
Weighted average 2/	---	---	---	.55

1/ Gross margin = average consuming-center market price minus average shipping price of $3.07, winter 1966.

2/ Weights based on unloads.

Source: Consuming-center market prices derived from Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Table 8.--Breakdown per carton of the average weekly gross margin between lettuce prices in California-Arizona and 12 selected cities, January, February, March 1967

City	Winter 1967			
	Consuming-center market price	Gross margin 1/	Transportation and cooling	Residual margin
	Dollars			
Los Angeles	2.47	0.82	0.46	0.36
San Francisco	2.51	.86	.59	.27
Dallas	2.80	1.15	.73	.42
Seattle	3.54	1.89	1.13	.76
St. Louis	2.79	1.14	.96	.18
Chicago	2.89	1.24	.96	.28
Atlanta	2.82	1.17	1.13	.04
Detroit	3.00	1.35	1.14	.21
Pittsburgh	3.08	1.43	1.18	.25
Washington, D.C.	2.67	1.02	1.21	-.19
New York	3.07	1.42	1.21	.21
Boston	3.04	1.39	1.21	.18
Simple average	---	---	---	.25
Weighted average 2/	---	---	---	.28

1/ Gross margin = average consuming-center market price minus average shipping price of $1.65, winter 1967.

2/ Weights based on unloads.

Source: Consuming-center market prices derived from Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Table 9.--Breakdown per carton of the average weekly gross margin between prices of lettuce in California-Arizona and 12 selected cities, January, February, March 1968

City	Consuming-center market price	Gross margin 1/	Transportation and cooling	Residual margin
	Dollars			
Los Angeles	2.99	0.79	0.48	0.31
San Francisco	3.03	.83	.61	.22
Dallas	3.21	1.01	.75	.26
Seattle	4.02	1.82	1.15	.67
St. Louis	3.43	1.23	.98	.25
Chicago	3.63	1.43	.98	.45
Atlanta	3.51	1.31	1.15	.16
Detroit	3.72	1.52	1.16	.36
Pittsburgh	3.77	1.57	1.20	.37
Washington, D.C.	3.35	1.15	1.23	-.08
New York	3.88	1.68	1.23	.45
Boston	3.53	1.33	1.23	.10
Simple average	---	---	---	.29
Weighted average 2/	---	---	---	.33

1/ Gross margin = average consuming-center market price minus average shipping price of $2.20, winter 1968.
2/ Weights based on unloads.

Source: Consuming-center market prices derived from Market News Service, Consumer and Marketing Service, U.S. Department of Agriculture.

Table 10.--Residual margin as a percentage of consuming-center market price of lettuce, 12 selected cities, January, February, March 1966-68

City	Winter 1966	Winter 1967	Winter 1968	Weighted average, 3 winters 1/
		Percent		
Los Angeles	13.7	14.6	10.4	12.9
San Francisco	9.2	10.8	7.3	9.1
Dallas	13.4	15.0	8.1	12.2
St. Louis	8.6	6.5	7.3	7.5
Chicago	11.8	9.7	12.4	11.2
Detroit	14.1	7.0	9.7	10.3
Pittsburgh	12.2	8.1	9.8	10.1
New York	12.7	6.8	11.6	10.4
Boston	11.6	5.9	2.8	6.9
Seattle	17.6	21.5	16.7	18.6
Atlanta	4.5	1.4	4.6	3.6
Washington, D.C.	6.1	-7.1	-2.4	- .6
Simple average	11.3	8.4	8.2	--
Weighted average 1/	12.1	10.1	9.5	10.6

1/ Weights based on unloads.

Sources: Derived from tables 7-9; Consumer and Marketing Service, U.S. Department of Agriculture.

research indicated a 37-cent residual margin was not out of line with marketing costs.

Residual margins were low in Washington, D.C., and Atlanta, reflecting correspondingly low estimates of wholesale market prices. This was due to a lack of lettuce of good quality and condition during some weeks of the three winter seasons. In Seattle, residual margins were high relative to other consuming centers in the study.

Overall, the relationship of observed differentials between shipping-point and wholesale terminal-market lettuce prices and actual costs of precooling, transporting, handling, and storing lettuce, while not perfect, was generally consistent with a competitive marketing system.

RELATIONSHIP OF WHOLESALE TERMINAL MARKET AND SHIPPING-POINT PRICES

The shipping point represents a produce market center in which there is interaction between buyers and sellers, especially with the larger and more important chain stores and other direct wholesale buyers. Hence, in the short run, price changes first occur at the shipping point, then are reflected at other locations in the marketing system. At wholesale terminal markets, direct buyers will have a portion of their weekly supplies arriving from the shipping point, and hence only need to supplement their direct receipts with supplies from the local terminal. As a result, direct buyers are keenly aware of the price differential between the wholesale terminal market and the various shipping points with which they have contact.

Four possibilities exist when firms obtain some of their produce direct:

(1) When extra supplies are required to fill expected needs of customers and the shipping-point price is high relative to the wholesale terminal market price, the buyer will purchase from the local wholesale terminal;

(2) When extra supplies are required to fill expected needs of customers and the shipping-point price is low relative to the price at the wholesale terminal market, the buyer will delay or cancel some local purchases and buy extra direct from shipping point;

(3) When extra supplies are not needed to fill expected needs of customers and the shipping-point price is high relative to the wholesale terminal market price, the buyer may make some purchases locally for future use but decrease direct buying;

(4) When wholesale terminal market supplies are not required to fill expected needs of customers and the shipping-point price is low relative to the wholesale terminal market price, buyers will not purchase from the local wholesale terminal and make some purchases direct from shipping point for future use.

The reaction of direct buyers to the relative price differential between the wholesale terminal market and the shipping point will be felt at the shipping point as soon as direct purchases are moved or not moved to the wholesale terminal.

In addition to the possibility of obtaining supplies from the shipping point, local wholesale handlers and retail organizations may have an additional option of buying uncommitted supplies (rollers) en route to wholesale terminal markets. These supplies, if available, may be (1) in the hands of brokers; (2) assigned to commission merchants on the local terminal market; or (3) ap-

proaching major diversion points for eastern lettuce buyers such as St. Louis or Chicago and still be uncommitted by the shipper. Still another option is to obtain supplies from nearby wholesale terminal markets.

The ability of direct buyers to purchase lettuce from the shipping point, from uncommitted supplies en route, and from other wholesale terminal markets suggests that prices at all locations in the marketing system will be closely related. As a test, the relationship between the f.o.b. shipping point and selected city lettuce prices was measured for the winters of 1966-68. Market News data were used to derive a weekly blend of the f.o.b. shipping-point price of California and Arizona iceberg lettuce and the weekly price of California lettuce in each of the 12 selected cities. Correlation analysis was used to compare prices, and regression analysis was used to measure the relationship between prices at the shipping point and at wholesale terminal markets.

Current Prices

In general, shipping-point and consuming-center market prices were closely related. In all cities the correlation between pairs of prices was 0.86 or better, indicating that increases in shipping-point lettuce prices were, on the average, positively associated with changes in consuming-center market prices of winter lettuce, and vice versa.

Consuming-center market	Correlation with shipping-point price
Los Angeles	0.99
San Francisco	.98
Dallas	.95
Seattle	.95
St. Louis	.94
Chicago	.93
Atlanta	.94
Detroit	.94
Pittsburgh	.91
Washington, D.C.	.87
New York	.89
Boston	.86

Distance, and hence time, was related to the degree of correlation between consuming-center and shipping-point lettuce prices. The highest coefficients were obtained for Los Angeles and San Francisco, both located close to shipping points at Imperial Valley, Calif., and Yuma, Ariz. Conversely, the correlation between shipping-point and consuming-center lettuce prices for cities farther from the Imperial Valley and Yuma areas (Pittsburgh, Washington, D.C., New York, and Boston), while still relatively high, was definitely lower than for the two California cities. As a result of the above analysis, consuming-center prices for lettuce were concluded to be significantly related to the weekly California-Arizona shipping-point price.

The influence of distance on the closeness of the relationship between consuming-center and shipping-point prices was consistent with expectations. It was also true that city to city lettuce prices for cities located near each other are strongly correlated, compared with cities farther apart.

Correlation coefficients between all possible pairs of weekly city to city prices verified the strong interrelationships between prices in 12 selected cities across the United States (table 11). In addition, the cities were listed in order of their distance from Yuma, Ariz., which was used as the center of the California-Arizona shipping point. The only correlation coefficients less than 0.90 were computed for Boston versus Los Angeles; Washington, D.C. versus Los Angeles; and Boston versus San Francisco. On the other hand, correlation coefficients on the diagonal were all 0.96 or better, indicating a close relationship between prices in cities close together. Of special interest were the set of city to city price relationships for several sites intermediately close to the shipping point. Prices of winter lettuce in Dallas, Seattle, St. Louis, Chicago, Atlanta, Detroit, and Pittsburgh were found to be closely associated.

For all 12 selected cities, the correlation with prices of at least one or more nearby cities was 0.96 or better. In general, the whole set of consuming-center prices was closely correlated. The correlations were the strongest for cities located close together and also for seven cities located 1,000 to 2,300 miles from the shipping point.

Lagged Prices

As a further test, California-Arizona prices were lagged 1 week, and correlations were run with consuming-center prices (table 12). Consuming-center prices were then lagged 1 week and compared with shipping-point prices.

When California-Arizona prices were lagged 1 week, correlations decreased for cities close and intermediately close to the shipping point, but increased for cities farthest from the shipping point. This indicated a time lag between the shift of California-Arizona prices and the shift of consuming-center prices, suggesting that while wholesale prices may be conditioned by local shortrun supply and demand conditions, wholesalers basically follow a cost-plus pricing policy. The lag was approximately consistent with the time required for transportation between the California-Arizona production area and consuming centers. Slightly more than a week was required for shipments to the east coast; lagging prices 1 week improved price correlations for Pittsburgh, New York, Boston, and Washington, D.C.

On the other hand, correlations between consuming-center prices and California-Arizona shipping-point prices 1 week ahead were in the range of 0.6 to 0.7. This was considerably below current or lagged correlations, providing additional evidence that current supply and demand conditions that establish the overall price level are focused at the shipping point. Lettuce prices in individual terminal markets are modified by local supply and demand conditions, but the fundamental price discovery takes place at the shipping point--not in the individual terminal markets. Price changes in the short run tend to move from shipping point to consuming centers consistent with the physical flow of produce.

Table 11.--Correlation coefficients between weekly prices of lettuce, cartons of 24's, in 12 consuming markets, January, February, March, 1966-68

City	San Francisco	Dallas	Seattle	St. Louis	Chicago	Atlanta	Detroit	Pittsburgh	Washington D.C.	New York	Boston
Los Angeles	0.99	0.96	0.96	0.95	0.94	0.94	0.94	0.92	0.88	0.90	0.88
San Francisco		.98	.98	.97	.96	.95	.96	.94	.90	.91	.89
Dallas			.99	.98	.96	.97	.97	.96	.94	.94	.92
Seattle				.98	.97	.98	.97	.97	.94	.95	.93
St. Louis					.98	.98	.98	.97	.94	.95	.93
Chicago						.97	.98	.97	.94	.96	.92
Atlanta							.97	.98	.96	.96	.92
Detroit								.98	.96	.97	.94
Pittsburgh									.96	.98	.94
Washington, D.C.										.97	.94
New York											.96

Table 12.--Correlation coefficients 1/ between current consuming-center prices of lettuce and California-Arizona shipping-point prices, weekly averages, cartons of 24's, January, February, March 1966-68

Consuming center	Shipping-point prices used in--		
	Current week (t)	Previous week (t-1)	Following week (t+1)
Los Angeles	0.99	0.80	0.75
San Francisco	.98	.84	.71
Dallas	.95	.90	.68
Seattle	.95	.92	.66
St. Louis	.94	.92	.67
Chicago	.93	.90	.68
Atlanta	.94	.93	.67
Detroit	.94	.90	.70
Pittsburgh	.91	.94	.67
Washington, D.C.	.87	.91	.66
New York	.89	.92	.67
Boston	.86	.91	.66

1/ Based on 39 observations for current week correlations and 36 observations for other correlations.

In term of risks and uncertainty, it is evident that today's change in the price of lettuce at the shipping point will soon be felt at the wholesale terminal market. This week's wholesale terminal market price, on the other hand, has only a limited impact on next week's shipping-point price. 7/ Thus, direct buyers in wholesale terminal markets can reduce risks by being aware of prices in both the local wholesale terminal market and the shipping point. Shifts in f.o.b. shipping-point prices will soon be reflected at wholesale terminal markets.

7/ In a longer run context, wholesale terminal market prices will, of course, influence production decisions at the shipping point and, in turn, shipping-point prices.

Price Prediction

Based on the physical flow of produce and on buying practices, it was expected that shipping-point and wholesale terminal market prices would be directly related. Direct buyers, particularly large retail organizations and consuming-center receivers, deal extensively with shippers and grower-shippers in production areas. Hence, shipping-point prices are representative of the fresh winter lettuce market. Consuming-center prices should equal the California-Arizona price, plus precooling, transportation, handling and storage costs, and a random error. In a regression framework, this may be written as:

$$Y_{ij} = a_i + b_i Y_{CAj}$$

where

Y_{ij} = consuming-center market price for California iceberg lettuce in cartons of 24's for consuming-center market i, week j;

Y_{CAj} = the blend f.o.b. price of California and Arizona iceberg lettuce in week j;

i = Atlanta, Boston, Chicago, Dallas, Detroit, Los Angeles, New York, Pittsburgh, St. Louis, San Francisco, Seattle, and Washington, D.C.

j = weeks 1-39 with 1-13 = winter 1966; 14-26 = winter 1967; 27-39= winter 1968.

The null hypothesis tested was that b_i or each regression coefficient associated with Y_{CAj} is equal to 1.0 or H_0: B = 1. For 11 of the 12 selected cities in the study, this hypothesis was not rejected (table 13). In Los Angeles, using the 1-percent level of probability, and for Atlanta and Detroit, using the 10-percent level, the alternative that $b \neq 1$ was accepted. In general, for the period studied it was concluded that the consuming-center market price of winter lettuce was equivalent to the California-Arizona f.o.b. shipping-point price plus a constant transportation, storage, and handling charge.

Hence, in a city such as Chicago, the price of California-Arizona lettuce could be predicted by taking $1.34 plus the result of 1.02 times the shipping-point price in California-Arizona. If the California-Arizona price was $2.40, the expected price in Chicago would be $3.79.

It was concluded, therefore, that wholesale terminal market and shipping-point lettuce prices were very closely related consistent with a competitive marketing system.

PRICE PREDICTION AT SHIPPING POINT

California-Arizona lettuce prices were found to be closely associated with wholesale terminal market prices at all other locations in the marketing system.

Table 13.--Results of regressing selected city prices of lettuce on the California-Arizona blend price, weekly data, January, February, March 1966-68

City	Constant term "a"	Regression coefficient "b"	Standard error "b"	t for H_0: B = 1 1/	r^2
Atlanta	1.51	0.90	0.056	2/1.84	0.87
Boston 3/	1.39	1.01	.078	4/.06	.83
Chicago	1.34	1.02	.065	.31	.87
Dallas	1.28	.95	.053	1.02	.90
Detroit	1.29	1.12	.068	2/1.77	.88
Los Angeles	.66	1.09	.030	3.04**	.97
New York 3/	1.44	1.05	.080	4/.65	.84
Pittsburgh 3/	1.37	1.07	.068	4/1.03	.88
St. Louis	1.39	.93	.054	1.22	.89
San Francisco	.87	1.01	.036	.14	.95
Seattle	1.97	.98	.055	.45	.90
Washington, D.C. 3/	1.21	.98	.075	4/.26	.83

1/ $t = \frac{b-1}{\text{standard error "b"}}$ computed values may vary slightly due to rounding; $t_{.05}$ 37df is significant at 2.027.

2/ Significant at the 10-percent level.

3/ Lagged California-Arizona blend price.

4/ $t_{.05}$ 34df is significant at 2.033.

** Significant at the 1-percent level.

Hence, if the price level and variations in prices could be predicted or explained at the shipping point, then prices or shifts in price for the entire marketing system would be predictable.

In the short run, week-to-week variations in shipping-point lettuce prices result from shifts in the available supply of lettuce. The quantity of lettuce available in any given week is determined by plantings scheduled several weeks previously. Shipments cannot be held back since it is not feasible to delay harvest once maturity is reached; moreover, storage of the perishable crop is impractical for more than a day or two. With predetermined weekly supplies, predicting lettuce prices becomes a problem of estimating the relationship

between the shipping-point price and the quantity of lettuce available. 8/

Weekly observations on price and quantity were used to estimate prices for winter lettuce at the f.o.b. shipping point. Quantity data were adjusted to a standardized carlot of 1,030 cartons each. 9/ For the winters of 1966-68, standardized shipments of lettuce averaged 1,763 carlots a week, including 483 from Arizona and 1,181 from California (appendix table 1).

The heaviest shipments of 2,302 carlots occurred during the week ending February 3, 1968; the lightest, 1,362 carlots, during the week ending January 13, 1968.

Ideally, price and quantity data for lettuce of good quality and condition in cartons of 24's would have been available to estimate the price of lettuce of good quality and condition. Although price data were available (table 3), data on the quantity shipped did not distinguish between grade and size of produce. The quantity of lettuce of good quality and condition in cartons of 24's was considered a portion of total lettuce shipments.

Climatic conditions and damage from disease and insects during planting, growing, and harvesting have an impact on the distribution of size and quality of lettuce. The distribution of lettuce between good, fair, and poor quality and condition influences the price reported by Market News but may not influence quantity. For example, if weather conditions resulted in a high proportion of smaller size lettuce and/or poor quality lettuce, the price of lettuce of good quality and condition would be expected to be higher than for a comparable period when the crop was nearly all of good quality and condition.

The 1966 lettuce crop was adversely affected by rain in December and cold weather in January and February; hence, a higher than normal proportion of smaller sizes and poor or fair quality lettuce was marketed during the period. Growing conditions in the winter season of 1967 were more favorable, while those in 1968 were somewhat intermediate.

Two variables were added to the estimating equation. One was designed to act as a proxy for the size distribution of the crop and the other as a proxy for quality to allow for disease problems during the growing season.

The size variable selected was the average high temperature of the previous week at the shipping point. The data consisted of the average daily high

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8/ The demand at the shipping point for winter lettuce was assumed fixed over the winter seasons of 1966-68. This implies that the net effect of changes in consumer tastes and preferences, population, consumer income, the prices of related goods, and the range of goods available did not cause a shift in the relationship between shipping-point price and quantity of lettuce during the study period.

9/ See the appendix for a discussion of adjustments in Market News data.

temperature at Yuma International Airport for the previous week; that is, week t-1. 10/ Low daytime maximum temperatures slow maturity of lettuce and result in a larger proportion of small (size 30) heads; higher daytime temperatures have the opposite effect.

The quality variable selected was a constant for each winter season consisting of the total rainfall recorded at Yuma International Airport for the previous months of November and December. According to agricultural extension agents, periods of cloudy, damp weather greatly increase disease problems. Diseases affecting lettuce include damping-off, big vein, downey mildew, sclerativia or drop, anthracnose (sometimes called shot hold or ring spot), bottom rot, and botrytus or gray mold. 11/ Values for the November-December rain variable were 2.25 inches in 1965, 0.02 inches in 1966, and 2.1 inches in 1967.

To allow for a buildup of supplies in marketing channels, an additional variable was introduced--the ratio of average shipments over the previous 2 weeks to the current week's shipments. According to agricultural extension agents in California and Arizona, large lettuce growers coordinated their planting operations to permit an even flow to market; that is, they attempted to plant about the same acreage of lettuce each day during the planting season. However, external conditions, such as rain and cold weather during the growing season or unusually good weather, often resulted in the speeding up or slowing down of plant growth.

Some of the relatively high prices received in the winter of 1966 came after a week or two of light shipments. In 1967, the reverse was observed, with low prices continuing after periods of heavy shipments. As mentioned previously, lettuce is a highly perishable commodity that has to be marketed as it reaches maturity. In periods of surplus, heavy shipments move sluggishly through the marketing system because consuming-center markets are well supplied with produce. Therefore, there is a lag effect on prices due to an inventory or accumulation of produce in marketing channels during periods of surplus and an opposite effect during periods of light supplies.

A multiple regression equation was used to estimate how f.o.b. shipping-point lettuce prices varied with changes in the quantity of lettuce available:

10/ The U.S. Weather Bureau station in the lettuce production area is located in Yuma, Ariz. In addition, a seasonal weather station is maintained at El Centro, Calif., during the late fall and winter months. Conversations with Weather Bureau employees confirmed that temperature and rainfall data for the two stations are closely related, especially the weekly average daily high temperatures (correlation 0.991 for the winters of 1966 and 1967) and the rainfall variable. The average daily low temperature at Yuma was introduced into the equation and was found to be inversely related to lettuce prices, although not statistically significant. Wind velocity data, available for the Yuma station only, was not tested.

11/ T.W. Whitaker, E.J. Ryder, and O.A. Hills. Lettuce and Its Production. U.S. Dept. Agr., Agr. Hdbk. No. 221, Agr. Res. Serv., U.S. Govt. Print. Off., Wash., D.C., 1962.

$$Y_{CAj} = 14.61 - \underset{(0.00055)}{0.00398^{**}} X_{CAj} + \underset{(0.086)}{0.434^{**}} R_j - \underset{(0.018)}{0.040^{*}} T_{j-1} - \underset{(0.76)}{3.35^{**}} P_j$$

$$R^2 = 0.80 \qquad S.E. = 0.54$$

where

Y_{CAj} = the blend f.o.b. price of California-Arizona lettuce, cartons of 24's, in week j;

X_{CAj} = total standardized carlot equivalents of 1,030 cartons shipped from California and Arizona in hundreds, rail and trucks, in week j;

R_j = total previous November-December rainfall at the Yuma, Ariz., International Airport = 2.25 inches in 1965 for winter season 1966; 0.02 inches in 1966 for winter 1967; and 2.10 inches in 1967 for winter 1968;

T_{j-1} = previous week's average high temperature at Yuma, Ariz., International Airport;

P_j = ratio of average total standardized carlot equivalents of 1,030 cartons of 24's shipped from California and Arizona the previous 2 weeks to the current week's shipments; and

j = weeks 1-39 with 1-13 = winter 1966, 14-26 = winter 1967, and 27-39 = winter 1968.

The results of the equation indicate that quantity, rainfall, temperature, and inventory effects all exerted significant influences on the California-Arizona f.o.b. shipping-point price of lettuce. The estimated relationship implies that a 100-carlot increase in weekly standardized shipments would be expected to decrease shipping-point price by 40 cents. 12/

The equation also indicated that the price of lettuce of good quality and condition was related to the previous week's average high temperature. Data were not available to indicate the direct causal relationship between temperature and quality or size. However, since low temperatures tend to delay growth, some lettuce matures without reaching the 24 size. The temperature variable used was highly significant and indicated that the price of cartons of 24's in California-Arizona declined 4.0 cents for a 1-degree rise in the weekly average high temperature. The average weekly high temperature for the period studied was 72 degrees.

The rainfall variable as a price shifter for each winter season was very significant at the 1-percent level. Results indicate that the average price of 1966 winter lettuce was $0.97 more than in 1967, but only $0.065 more than in

12/ The predicted price for cartons of 24's was $3.66, using mean values for the independent variables. The corresponding direct price flexibility was - 1.81, indicating a 1-percent decrease in available shipments at the mean would increase price 1.8 percent.

the winter of 1968, presumably as a result of the disease problems caused by damp rainy weather in November and December of 1965 and 1967.

A buildup of supplies in the marketing system decreases the shipping-point price. The estimated effect of an increase of 0.1 in the inventory ratio was to decrease the current week's price 33.5 cents. Conversely, if average shipments were relatively light during the previous 2 weeks, the current week's predicted price would increase.

The equation explained 80 percent of the variation in weekly average California-Arizona shipping-point lettuce prices.

Shortrun prices for winter lettuce were influenced by the quantity of shipments. Climatic variables and an inventory variable improved price estimates since total shipment data did not take into account differences in either the distribution of quality and size of lettuce or in the supply of lettuce in marketing channels.

The estimating equation can be used to predict shipping-point price. For example, if it was assumed that the current week's shipments, X_{CAj}, were 1,606 carlots; R_j was 2.0 inches; T_{j-1} was 75 degrees; and P_j was 1.1, then the predicted California-Arizona blend price, Y_{CAj}, for a particular week would be \$2.40. $Y_{CAj} = 14.61 - 0.00398\ (1606) + 0.434\ (2.0) - 0.040\ (75.0) - 3.35\ (1.1) = 2.40$.

It was concluded that variations in shipping-point prices of lettuce were related to the quantity of produce available as expected in a competitive market. However, the question remains as to whether the level of observed shipping-point prices is consistent with competitive prices. In the short run, shipping-point prices for lettuce were consistent with a competitive market for a few weeks during the three winter seasons. In a competitive market, prices will not fall below the variable costs of harvesting and packing. Competitive producers will abandon the crop if prices fall below the level of harvesting and packing costs. Theoretically, if shippers had monopoly power, they could withhold produce from the market to obtain a price in excess of harvesting and packing costs.

Extension agents in the Imperial Valley of California reported packing and harvesting costs for lettuce were \$1.05 per carton in 1967 and slightly higher in 1968. F.o.b. shipping-point prices of lettuce of \$1.06, \$1.05, and \$1.05 per carton were observed for weeks ending February 10, 17, and 24, 1967, respectively; a price of \$1.10 per carton was observed for the week ending February 23, 1968. During the three winter seasons studied, no economic abandonment of winter lettuce occurred. 13/ Thus, in the short run, observed shipping-point prices of lettuce were consistent with a competitive market for several weeks during the 1966-68 winter seasons.

13/ Crop Reporting Board, Statistical Reporting Service. Vegetables for Fresh Market, Annual Summary, Acreage, Production, and Value. U.S. Dept. Agr., Vg. 2-2, U.S. Govt. Print. Off., Wash., D.C., 1967, 1968, 1970.

APPENDIX

Adjustments in Market News Shipments

Quantity data on railcar and trucklot shipments of lettuce for the 1966-68 winter seasons were considered reliable in terms of the number of carlots shipped. Data for railcars were based on a count of actual waybills reported by station agents to Market News. For trucklots, data were standardized to a load of 825 cartons of lettuce weighing 40-45 pounds net. Since all lettuce was precooled before shipment and Market News obtained its information through the precooling firms, an accurate count of cartons was obtained. By standardizing trucklots, problems with mixed loads of produce, which often go by truck, were avoided.

The problem with shipments data arose with regard to railcars. No attempt was made to convert to a standardized carlot as was the case with trucks. The result was an overestimate of the number of carlots delivered by trucks relative to rail transportation. A quotation from a 1968 Arizona Market News report illustrates the problem:

"A rail shipment as used in this summary is on the basis of an actual car, regardless of its size or the number of cartons it contained. Railcars were loaded from 520 cartons, which is the minimum load in a regular refrigerator car, to as high as 1,280 cartons in the biggest mechanical cars. Most common loads were as follows:

Regular refrigerator cars	704 cartons
Smallest mechanical cars	840 "
Medium-size mechanical cars	980 to 1,000 "
Largest mechanical cars	1,064 to 1,280 "

"There has been a steady switch in the past few years from the use of regular refrigerator 'iced' cars to the use of mechanical cars. Mechanicals, the largest size car which holds up to 1,280 cartons, are becoming the principal ones used."

Based on Market News reports on the marketing of lettuce from Yuma, Ariz., and the Imperial Valley and Blythe Districts of California, all data on shipments were converted to a standard carlot of 1,030 cartons. This was roughly the average-size rail carlot reported for all three areas in 1967 and 1968. A factor of 0.91 was used to convert 1966 railcars averaging 935 cartons into 1967-68 carlots. Similarly, a conversion factor of 0.80 was applied to convert trucklots into standard carlots for all winter seasons used in the study, 1966-68. The converted data appear in appendix table 1.

Appendix table 1.--Rail, truck, and total shipments of lettuce in standardized carlots of 1,030 cartons of 24's from Arizona, California, other States, and totals for the United States, by weeks, 1966-68 winter seasons

Year and week ending	Arizona			California			Other States			Total United States		
	Rail	Truck	Total	Rail	Truck	Total	Rail	Truck	Total	Rail	Truck	Total
1966:							Carlots					
January 8	229	202	431	635	642	1,277	5	130	135	869	974	1,843
15	150	138	288	612	600	1,212	32	127	159	794	865	1,659
22	144	137	281	609	580	1,189	12	131	143	765	848	1,613
29	96	104	200	608	525	1,133	19	108	127	723	737	1,460
February 5	134	111	245	701	566	1,267	5	82	87	840	759	1,599
12	139	166	305	599	575	1,174	3	57	60	741	798	1,539
19	117	157	274	578	534	1,112	21	117	138	716	808	1,524
26	104	115	219	753	606	1,359	8	111	119	865	832	1,697
March 5	131	142	273	790	625	1,415	14	114	128	935	881	1,816
12	218	175	393	806	615	1,421	6	95	101	1,030	885	1,915
19	415	231	646	611	562	1,173	26	129	155	1,052	922	1,974
26	627	404	1,031	389	406	795	7	112	119	1,023	922	1,945
April 2	953	484	1,437	318	314	632	1	72	73	1,272	870	2,142
Total, winter 1966	3,457	2,566	6,023	8,009	7,150	15,159	159	1,385	1,544	11,625	11,101	22,726
Avg., winter 1966	266	197	463	616	550	1,166	12	107	119	894	854	1,748
1967:												
January 7	308	131	439	631	537	1,168	27	94	121	966	762	1,728
14	286	92	378	668	522	1,190	27	96	123	981	710	1,691
21	170	96	266	453	451	904	73	134	207	696	681	1,377
28	143	120	263	664	506	1,170	59	143	202	866	769	1,635
February 4	181	130	311	1,043	610	1,653	40	111	151	1,264	851	2,115
11	203	125	328	964	626	1,590	33	95	128	1,200	846	2,046
18	138	92	230	951	588	1,539	10	89	99	1,099	769	1,868
25	104	78	182	807	545	1,352	10	74	84	921	697	1,618
March 4	206	135	341	917	550	1,467	16	72	88	1,139	757	1,896
11	303	178	481	636	463	1,099	30	82	112	969	723	1,692
18	506	222	728	513	418	931	27	86	113	1,046	726	1,772
25	637	358	995	283	373	656	8	80	88	928	811	1,739
April 1	741	388	1,129	211	347	558	14	77	91	966	812	1,778
Total, winter 1967	3,926	2,145	6,071	8,741	6,536	15,277	374	1,233	1,607	13,041	9,914	22,955
Avg., winter 1967	302	165	467	672	503	1,175	29	95	124	1,003	763	1,766
1968:												
January 6	249	162	411	421	518	939	7	34	41	677	714	1,391
13	205	133	338	461	522	983	1	40	41	667	695	1,362
20	141	132	273	687	596	1,283	1	33	34	829	761	1,590
27	162	122	284	1,190	723	1,913	6	39	45	1,358	884	2,242
February 3	190	112	302	1,223	685	1,908	32	60	92	1,445	857	2,302
10	174	132	306	1,115	582	1,697	15	59	74	1,304	773	2,077
17	140	90	230	805	502	1,307	4	42	46	949	634	1,583
24	172	118	290	859	542	1,401	11	34	45	1,042	694	1,736
March 2	314	142	456	780	525	1,305	4	40	44	1,098	707	1,805
9	587	250	837	524	487	1,011	6	22	28	1,117	759	1,876
16	645	320	965	375	390	765	4	36	40	1,024	746	1,770
23	654	392	1,046	241	291	532	21	54	75	916	737	1,653
30	647	346	993	213	375	588	20	69	89	880	790	1,670
Total, winter 1968	4,280	2,451	6,731	8,894	6,738	15,632	132	562	694	13,306	9,751	23,057
Avg., winter 1968	329	189	518	684	518	1,202	10	43	53	1,024	750	1,774
Avg., winters 1966-68	299	184	483	657	524	1,181	17	82	99	974	789	1,763

Source: Consumer and Marketing Service, U.S. Department of Agriculture. Conversion factors, rail, 1966 = 0.91; 1967 and 1968 = 1.0; truck, 1966, 1967, 1968 = 0.80.