Bulletin 287 June 1957

PRICE RELATIONSHIPS IN THE WESTERN LETTUCE INDUSTRY

SUMMARY

LETTUCE producers are faced with wide fluctuations in the prices which they receive for their product. The purpose of this analysis is to explain as much of this variation as possible in terms of volume of shipments, income and other factors, in order that producers and others connected with the industry may gain some understanding of the factors behind changes in lettuce prices.

A certain amount of seasonal variation in price can be expected, due to changes in the volume of production and the level of consumer demand. The average monthly f.o.b. price reaches a seasonal peak in November, during the Salt River Valley fall deal, and declines to a seasonal low in June, despite the fact that demand appears to be strongest during the spring season. This is accounted for by the fact that there is a large volume of local production in the northern states during the spring and summer which is not included in data pertaining to shipments.

The average monthly wholesale price for lettuce is affected both by the monthly volume of shipments and by average monthly temperatures. If the volume of shipments were to remain stable from month to month, we could expect the average monthly price to increase as the temperature rises, indicating that demand becomes stronger during the warmer months.

In addition to seasonal variation in prices, there are marked variations in average prices received during the various lettuce deals in California and Arizona. A separate analysis has been made of wholesale prices in New York for each season of the year, and by area and season for f.o.b. prices.

At the wholesale level, 78 to 92 per cent of the variation in lettuce prices, depending on the season, can be attributed to changes in carlot unloads, per capita income, and other changes in prices over time not accounted for by the first two factors. The results show the extent to which the average wholesale price can be expected to change during each of the four seasons with a given change in each of the three factors listed. Estimating equations are shown which can be used to forecast future prices within certain limits. In addition, it is shown that the consumption of lettuce has been increasing steadily over the years as incomes go up.

Factors found to be associated with changes in the f.o.b. price for lettuce are: The acreage available for harvest during a given season, average daily shipments from the currently dominant area, average daily shipments from competing areas during periods of overlapping, production of lettuce outside the western region, per capita income, and other changes over time not accounted for by the other factors. Not all of these factors were found to have a significant effect on price in each deal. However, from 74 to 86 per cent of the variation in the f.o.b. price for western lettuce was found to be associated with changes in some combination of these six factors. The result again varies according to the season, and also by area.

One of the more significant results of this analysis is the association found between average daily shipments of lettuce, both from a given area and from competing areas, and f.o.b. prices. Further consideration of some form of orderly marketing for western lettuce seems to be indicated. It appears that at least part of the fluctuation now common to f.o.b. prices could be avoided in this manner.

The nature of the factors found to be associated with changes in f.o.b. prices

makes it extremely difficult to use these relationships in forecasting future prices. However, some advantage may be gained from predicting wholesale prices by seasons and then relating this wholesale price to the f.o.b. price, based on historical relationships between the two sets of prices. Wholesale and f.o.b. prices are shown by season for the past 25 years. In addition, f.o.b. prices are shown as a percentage of wholesale prices for the same period.

Table of Contents

PRICE RELATIONSHIPS IN THE WESTERN LETTUCE INDUSTRY

by

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The western lettuce industry is characterized by wide fluctuations in price. This has led to a certain amount of instability in the industry. The major objective of this analysis has been to isolate the factors responsible for these fluctuations and to measure their effect on lettuce prices. Certain statistical procedures, notably regression analyses, are used to accomplish this objective.

We are concerned primarily with the lettuce industry in California and Arizona. Data used to represent prices received by producers are f.o.b. prices at the various shipping points within these two states. Prices at the wholesale level are for western lettuce only. The period included in the analysis is from 1930 to 1955. The war years from 1942 through 1946 are excluded because of the abnormal conditions which existed during that period.

The analysis of f.o.b. prices has been separated on the basis of seasonality and geographic location. Major lettuce producing areas in the West are the Salinas-Watsonville-Hollister area in central California, the Imperial Valley of southern California, the area around Yuma in southwestern Arizona, and the Salt River Valley in central Arizona. Each of these areas ships lettuce during one or more of the winter, spring, summer, and fall seasons. The Yuma and Imperial Valley deals have been combined because of their proximity, geographically, and because the shipping season is the same for both areas.

Seasonal Variations in Production and Price

A seasonal pattern has been derived for commercial shipments of lettuce and f.o.b. prices (Figure 1). Both shipments and prices show a marked fluctuation from month to month, due to seasonal changes in production and demand. Figure 1 also shows the periods during which one or more of the lettuce producing areas of Arizona and California are shipping lettuce. There is considerable overlapping between these areas. It is felt that this is a significant factor contributing to fluctuations in both monthly and season average prices.

The f.o.b. price reaches a seasonal peak in November during the Salt River Valley fall deal. Although shipments are still being made from the Salinas-Watsonville area as late as December 15, it is not until the Yuma and Imperial Valley areas begin to ship that the price declines again. Until this time, about December 1, monthly shipments are still below average. However, with the beginning of the winter deals, monthly shipments climb to 110 per cent of average in January and remain above average until June. Average monthly prices continue to decline until February, then rise again during the spring months after the winter deals have ended. The decline in prices during the winter months results both from a relatively large volume of shipments and a lower level of demand.

Although monthly shipments reach a seasonal peak in April, when both the

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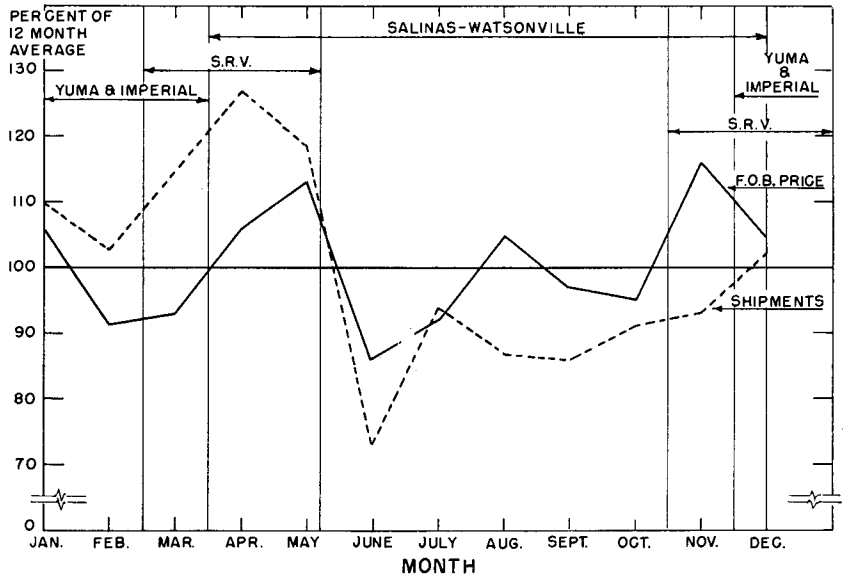

Figure I.—Monthly United States lettuce shipments and F.O.B. prices as a percentage of the 12 month average.

Salt River Valley and Salinas-Watsonville spring deals are in progress, demand during the spring months apparently is strong enough that prices continue to rise until early summer. Both shipments and f.o.b. prices fall to a seasonal low in June. There appears to be a good reason for this.

Available data pertaining to shipments include only shipments from the commercial lettuce producing areas. Thus, much small scale local spring and summer production outside the commercial areas is not accounted for by these data. In addition, accurate data concerning truck shipments from many of the smaller commercial areas are unavailable. This omission seems more serious during the late spring and summer months than during other seasons because of a larger volume of production in the middle eastern and northeastern states. Since the demand for lettuce is strongest during the warmer months, the relatively low prices during these months must result from a larger volume of production than is accounted for in Figure 1. As local production begins to taper off later in the summer, prices again rise, even though monthly shipments also rise in late summer and early fall.

An analysis of the seasonal variation in wholesale prices for western lettuce in New York showed that a large part of this variation could be attributed to two factors: Changes in average monthly carlot receipts and seasonal changes in temperatures. We can expect an increase of about three cents per crate[2] in the average monthly wholesale price for lettuce for every one degree rise in the average monthly temperature (with no change in lettuce receipts). When temperature remains the same, an increase in lettuce receipts in New York of 100 cars per month is accompanied by a decrease of over 11 cents per crate in the average monthly wholesale price for western lettuce.[3]

[2]Although the two-dozen size carton has replaced the wooden crate for the most part, most of the historical data are based on the old container. A conversion can be made by considering the crate as roughly equivalent to two cartons.

[3]Those interested in the specific statistical analyses upon which these and many of the following statements are based are referred to the statistical appendix at the end of this bulletin.

The relationship between temperature and lettuce prices reflects the seasonal nature of demand for foods such as lettuce. There appears to be a tendency on the part of consumers to eat more of these green leafy vegetables during the warmer months of the year.

FACTORS AFFECTING SEASON AVERAGE PRICES

The analysis of season average lettuce prices has been approached from two points, the f.o.b. and wholesale levels. Wholesale prices were divided into four seasons — winter, spring, summer, and fall — because of seasonal differences in production and demand. In the case of f.o.b. prices, however, further distinction has been made on the basis of areas of production. This was necessary because, with one exception, no individual producing area falls completely within a single season, but overlaps into two or more seasonal categories. In addition, shipments from competing areas of production appear to have a marked influence on local f.o.b. prices in most producing areas. For these reasons the analysis of f.o.b. prices was separated into six parts: Yuma and Imperial Winter; Salinas-Watsonville Spring, Summer and Fall; and Salt River Valley Spring and Fall.

Wholesale Prices

The analysis of wholesale prices for western lettuce is confined to the New York market. Only the Chicago market approaches the volume of trading found in New York, and it is believed that the results obtained in the analysis of New York wholesale prices will generally apply to other major outlets. Figure 2 shows the relationship between annual average wholesale lettuce prices in the New York and Chicago markets. The price differential between these two markets represents the difference in freight rates. The increased spread between these prices after 1952 was partially caused by the introduction of the new two-dozen size carton. This carton was first used in the New York market.

In order to be as consistent as possible with the analysis of f.o.b. prices, four seasons —-winter, spring, summer, and fall — are considered. These seasons approximate those found in the producing areas, although a certain amount of overlapping is unavoidable.

Only three factors are shown to have a major effect on wholesale prices at New York. These factors are carlot unloads,[4] consumer income, and time. The combined effect of these variables explains from 78 to 93 per cent of the variation in the wholesale price for lettuce, depending upon the season.

Carlot Unloads

As can be seen in Figure 3, the relationship between quantity and price changes somewhat with the season. The price for western lettuce appears to be considerably more sensitive to changes in the quantity available during the spring and summer months than it is in the fall and winter. This undoubtedly results primarily from the fact that almost the entire fall and winter supply of lettuce comes from the southwest. Since there are no substitutes in the form of locally produced lettuce, a relatively small change in the quantity of western lettuce available results in a greater change in price than would occur during the spring and summer months when consumers can purchase locally produced lettuce at a lower price. It takes a somewhat larger change in the spring and summer supply of western lettuce to effect the same change in price, because consumers are able to purchase local lettuce as the available quantity of western lettuce declines.

This variation in the net relationship between quantity and price may be of interest when considering the increased overlapping of harvesting dates in the producing areas. Most of this overlapping occurs during the winter, spring and fall seasons,[5] most noticeably in the fall

[4]Over 90 per cent of these rail receipts come from the western region.
[5]Hillman, J. S., "Seasonal and Interarea Shifts in the Western Lettuce Industry." Ariz. Agri. Exp. Sta. Report No. 123, October, 1955.

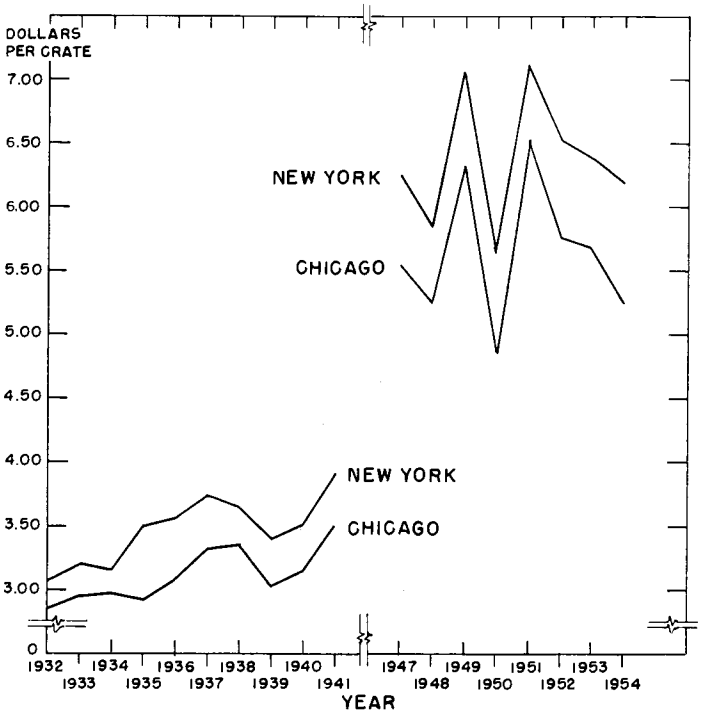

Figure 2.—New York and Chicago wholesale lettuce prices, 1932 to 1954. (1942-47 omitted).

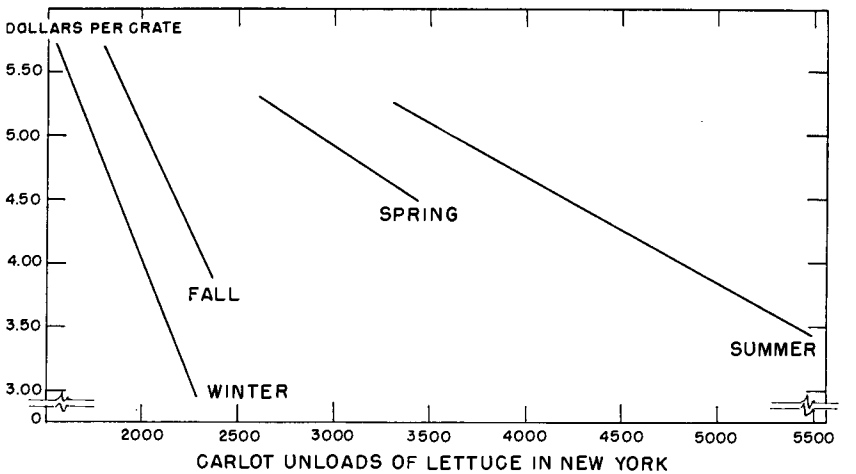

Figure 3.—Net relationship between the price for lettuce in New York and carlot unloads of lettuce in New York.

when harvesting in the Salinas-Watsonville-Hollister area overlaps with that in the Salt River Valley of Arizona. During this period an increase in New York lettuce receipts of 2.5 cars per week would, on the average, be accompanied by a decrease of 10 cents per crate in the wholesale price. It would take an increase of 8.4 cars per week to effect the same reduction in price during the spring season.[6] This means that, insofar as increased overlapping results in a larger total volume of shipments, the effect on price would be less marked in the spring than during the fall or winter deals.

The extent to which variations in price during the summer season are associated with changes in supply, consumer income, and time is somewhat less than during the three remaining seasons. This has resulted in part from the instability of lettuce production in the northeastern states during the late spring and summer months. The scarcity of accurate data pertaining to movements of lettuce from these states makes it nearly impossible to measure precisely the effects of these movements on price. Nearly all of the lettuce produced in this area moves to market by truck, but it has been only since 1953 that data on truck shipments have become available on other than an annual basis. Although estimates of these truck movements were incorporated into the supply variable where possible, the results are not as reliable as they might otherwise be.

Income

Income reflects the purchasing power of consumers, and is used to measure the relationship of changes in that purchasing power to the wholesale price for lettuce.

As would be expected, income plays an important role in the determination of lettuce prices. However, the relationship varies from season to season. It takes a larger change in income during the spring season to bring about a given change in price than in any of the other three seasons (Figure 4). This would seem to indicate that as the temperature begins to rise in the spring, people tend to consume more lettuce and similar foods, and that during this period incomes have less effect on price and consumption than in other seasons. This is borne out by the relationship discussed earlier between the seasonal variation in lettuce prices and changes in temperature. Additional support is offered by the fact that the demand for lettuce becomes more elastic in the spring; that is, it takes a larger change in quantity to effect a given change in price. Apparently, the relationship returns to its previous (winter) level gradually during the summer and fall seasons. As will be seen below, the spring price for western lettuce in New York has increased since 1930, when other factors are held constant, while the price during each of the three remaining seasons has decreased.

In relating changes in income to changes in the per capita consumption of lettuce during the four seasons of the year, it was found that consumption is most responsive to income during the winter months. On the average, an increase of 10 per cent in winter income from one year to the next is accompanied by a 5.43 per cent increase in per capita lettuce consumption. Currently, consumption during these three months is about 4.7 pounds per person. At the other extreme, a 10 per cent increase in income during the spring months results in just less than a 2 per cent increase in consumption. The current rate of consumption during the spring months is about 5.1 pounds per person. This is a higher rate of consumption than occurs during any other season of the year. In addition, spring lettuce consumption was found to be more stable than consumption during any of the remaining seasons. These facts also tend to support the statements made above concerning the response of spring lettuce prices to changes in income. During the summer and fall seasons we can expect 4.93 and 3.23 per cent increases in consumption for every 10 per cent increase in per capita income.

[6]This assumes that income and other factors which change over time are held constant.

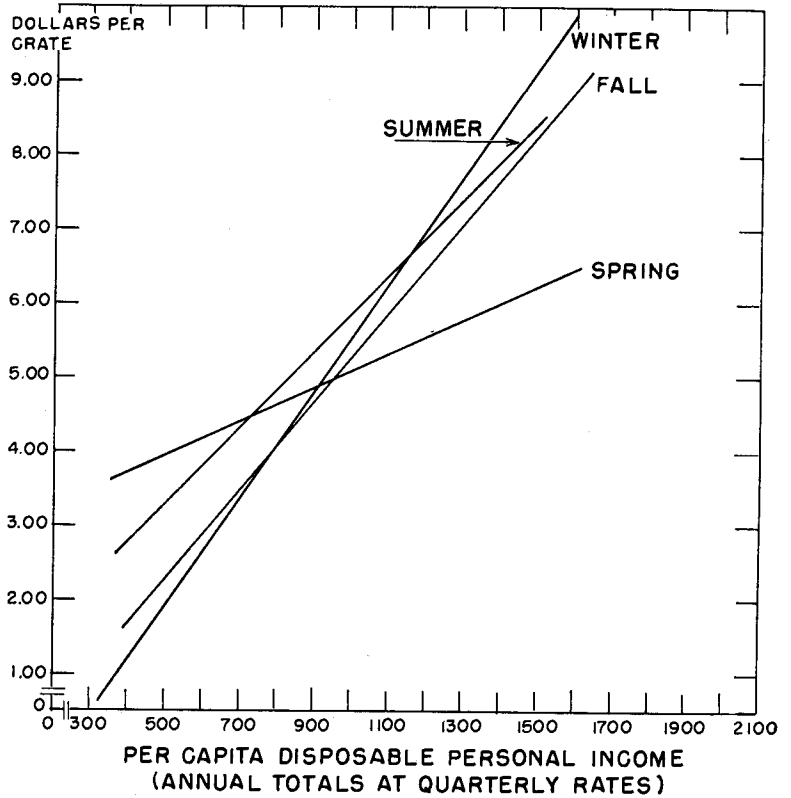

Figure 4.–Net relationship between the price for lettuce in New York and per capita disposable income.

Annual per capita consumption of lettuce has been running to about 18 pounds.

It should be remembered that these consumption responses to changes in income represent an average relationship over the past 20 years. After the level of income passes a certain point — the average for the entire period — we can expect a smaller and smaller increase in consumption for each additional increase in income. The response is greatest at the lower income levels and falls below the average quoted above when income reaches the levels attained in recent years. However, there are still a great many low income consumers. Lettuce consumption among this group will increase at a fairly rapid rate as their income level rises.

Time

The variable called time in this analysis includes many factors, such as changes in tastes and preferences of consumers and technological changes, none of which lend themselves to individual measurement. This composite variable shows the trend in New York wholesale prices over the period of years 1930-1955 which is attributable to these somewhat elusive factors.

Except for the spring season, this analysis showed New York wholesale lettuce prices to be decreasing over time (from year to year) when income and supply

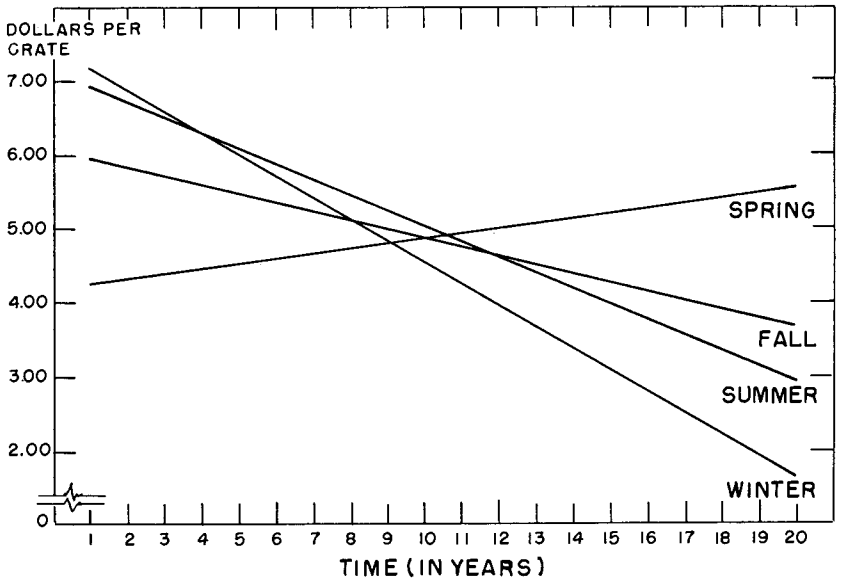

Figure 5.– Net change in the New York wholesale price for lettuce over time.

are held constant (Figure 5). In fitting a trend line to the deflated[7] season average f.o.b. prices, ignoring income and supply, the same result was obtained, except that the trend in the spring price was also downward (Figure 6). This relationship could indicate several things, as discussed below.

It should be remembered that the prices quoted here are for California and Arizona lettuce in New York, so that the relationship described above indicates that the price for western lettuce in the New York market is decreasing over time, except in the spring.[8] Western lettuce has characteristically commanded a premium in eastern markets, but apparently this premium is decreasing in the area served by the New York wholesale market. Figure 6 also shows the relationship between trends in the prices for eastern and western lettuce for the period 1930-1955. This change is probably accounted for by the introduction of new varieties and improved cultural practices, which have resulted in a higher quality product than was previously marketed by eastern producers.

In addition, the over-all quality of western lettuce has probably been lowered in recent years by an increase in diseases such as tip burn, rib dislocation, and pink rib. The continued popularity among western growers of the Great Lakes variety, considered by some to be a lower quality lettuce, may also have contributed to a general decline in the quality of western lettuce, as compared to lettuce grown in the northeast.

Spring lettuce from the west apparently finds a stronger market in New York than lettuce marketed during other seasons, as witnessed by the fact that the spring price continues to rise over time (when income and supply are held constant). Here again, it appears that the demand for lettuce in the spring is strong enough to absorb a slightly increasing volume of shipments from the west, in

[7]Adjusted for changes in the general price level.
[8]Again assuming that other factors are held constant.

addition to larger receipts from local producers, and still result in a slight rise in the spring price over time.

If supply and income had remained constant over the 21-year period studied, the New York wholesale price for western lettuce would have fallen by an average of 29 cents per crate per year for winter lettuce, 21 cents per year for summer lettuce, and 12 cents per year for

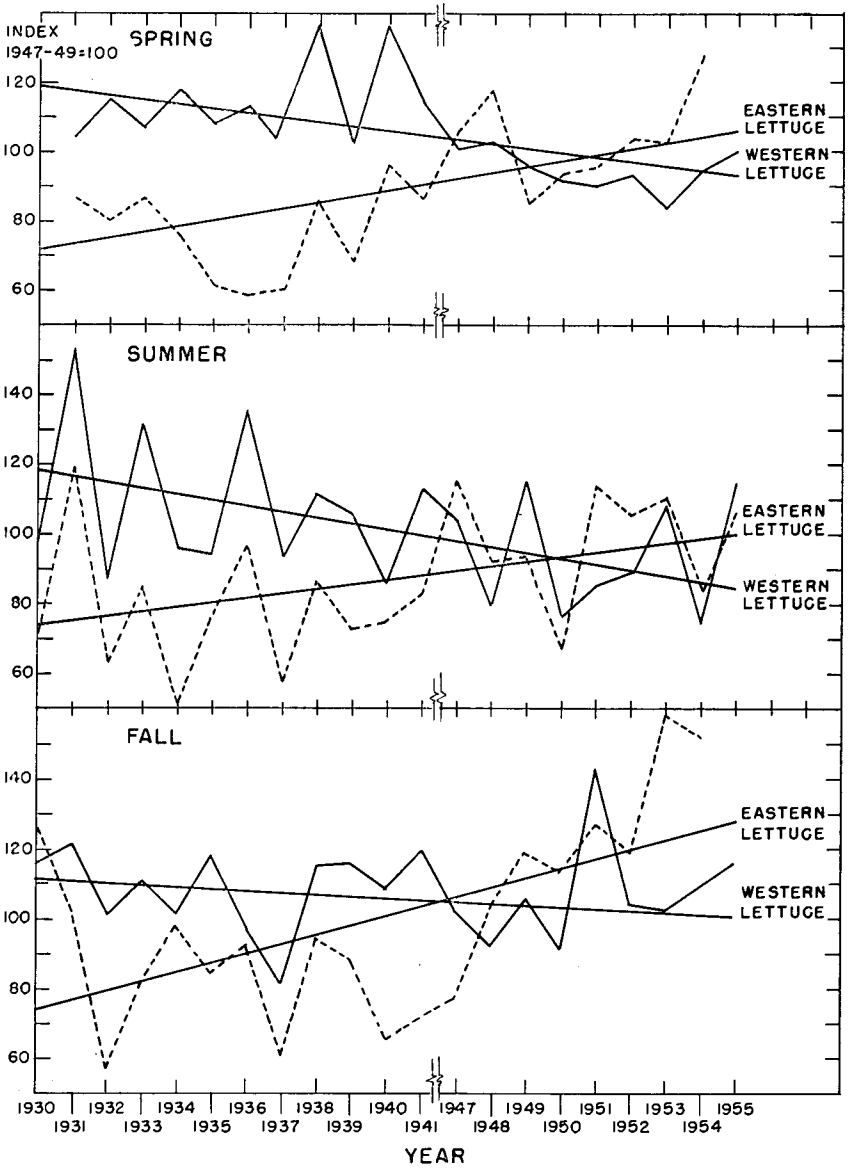

Figure 6.-Trends in prices of Eastern and Western lettuce in the New York market.

Forecasting Changes in Wholesale Prices

It is possible to use the relationships just described to derive estimating equations for use in forecasting wholesale lettuce prices in New York. This has been done for each of the four seasons. The equations are as follows:

1. Winter: Estimated price = $842.85 - .3738x_1 + .7206x_2 - 29.0472x_3$
2. Spring: Estimated price = $510.73 - .1007x_1 + .2295x_2 + 7.0538x_3$
3. Summer: Estimated price = $428.01 - .0832x_1 + .5233x_2 - 20.7382x_3$
4. Fall: Estimated price = $720.41 - .3243x_1 + .6050x_2 - 11.7262x_3$

Where:

a. the first term is a constant value;
b. x_1 represents total carlot unloads of lettuce in New York during a particular season;
c. x_2 represents consumer purchasing power in the form of disposable income per person; and
d. x_3 represents the year (a value of one is added for each additional year, 1956 would be the twenty-first year).

If values can be estimated for supply and income for a coming season, a price forecast can be made. So long as these factors continue to have the same effect on price as shown above, the reliability of the forecast is also known. The estimated future price for a winter season will fall within 79 cents per crate (40 cents per carton) of the actual price about 70 per cent of the time. The figures for the spring, summer, and fall seasons are 42 cents per crate (21 cents per carton), 87 cents per crate (43 cents per carton), and 61 cents per crate (30 cents per carton), respectively. The greatest value of these forecasts lies more in anticipating the direction of major price changes than in giving us an exact price for a future crop.

Figure 7 shows a comparison of actual season average prices and prices estimated from the equations shown above for the period 1930 to 1954-55 (1942-1946 omitted). These estimated prices fall within 9 to 18 per cent of the actual price two-thirds of the time, depending upon the season, and within 18 to 36 per cent of the actual price 95 per cent of the time. The largest error of estimate occurs during the winter and summer seasons, and the smallest during the spring season. This is experimental error and may result from errors in the data, omission of certain factors from the analysis, or both.

As an example of the use of these equations, an estimated price is derived below for the winter season of 1956, then compared with the actual price received. There were about 2,200 cars of lettuce unloaded in New York during the winter season of 1956. Per capita disposable income was $1,675. As mentioned earlier, 1956 would be the 21st year used in the analysis. Substituting these values in the equation shown above for winter prices we get: $843.85 - .3738(2200) + .7206(1675) - 29.0472(21)$. Solving this equation gives an estimate of $6.17 per crate (or $3.08 per carton) for western lettuce in New York during the winter of 1956. The actual price averaged about $5.60 per crate ($2.80 per carton), a decline of $2.40 per crate from the previous winter season. The equation shows a decline of $1.83 per crate from the previous year.

fall lettuce. The fact that such changes did not occur can be attributed primarily to a continual increase in consumer income. Under the same conditions (no changes in supply or income) the spring price would have increased by an average of 7 cents per crate per year over the 21-year period. A stronger rise in prices during the spring season would also be due to higher consumer incomes, a short supply, or both.

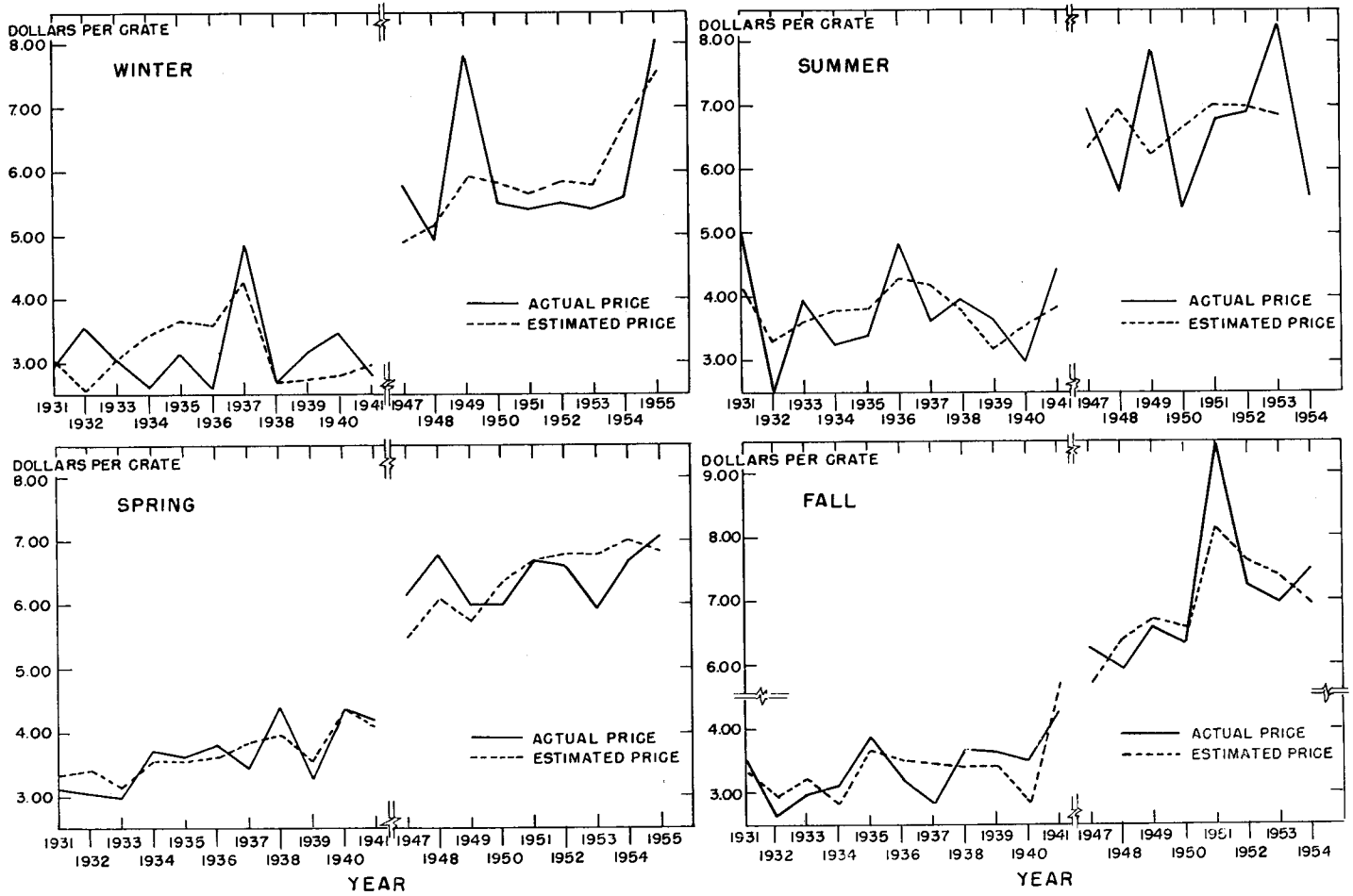

Figure 7.- Actual and estimated season average prices for Western lettuce in New York, 1931 to 1954-55 (1942-46 omitted).

ANALYSES OF F.O.B. PRICE MOVEMENTS

A total of six independent variables have been used in the following analysis, although in most cases not more than four appear at the same time. These factors are acreage available for harvest, per capita disposable personal income, average daily shipments from the area in question, average daily shipments from competing areas during periods of overlapping, production in other areas of the United States, and time. These factors, taken together, can be used to explain from 74 to 90 per cent of the total variation in western lettuce prices. Each factor will be considered individually.

Acreage Available for Harvest

While acreage alone is not generally accepted as a measure of supply, it was felt that, because of the discontinuous nature of lettuce production, acreages available for harvest would influence the season's opening price. In this event, because of the probable "stickiness" of the opening price, acreage would influence the season average price.

The relationship of acreage to the season average price appeared statistically significant in only one case, the Salinas-Watsonville summer deal. However, this in itself may be a significant point, since this is the only season during the year when only one of the western areas is shipping lettuce (Figure 10). This might well indicate that, were it possible to completely isolate the association between acreage and price, a statistically significant relationship could be shown. The fact that several different areas are shipping for varying lengths of time during all but the summer season apparently makes it difficult, if not impossible, to show the true relationship.

Alternatively, acreage may receive serious consideration by buyers and shippers only when accurate estimates of acreage are available. Such estimates are difficult to make when more than one area is involved, because of varying planting and harvesting dates. Differences in weather conditions in the various areas during growing and harvesting seasons add to the uncertainty as to the total number of acres available for harvest during a specified period. Only during the summer season, when production is all in one area, can accurate estimates of acreage be formulated, and these estimates used in "discovering" price.

On the average, the summer price for Salinas-Watsonville lettuce falls one cent per crate for each additional 161 acres available for harvest, other factors remaining constant. In other areas it takes an increase of from 2.57 to 12.58 acres to bring about the same change in price, but these results are too inconclusive to be statistically reliable.

These relationships are shown graphically in Figure 8. The graph indicates the effect on price of increases in acreage available for harvest when other factors remain unchanged.

It should be noted here that when total production, both by area and for all areas, was substituted for acreage in the analysis, the results were no better than those obtained when acreage was used. The reasons for this are probably the same as those set forth above in connection with acreage. For instance, during the winter season (December through March), only production in the Yuma and Imperial areas appears in the total production figure. But in addition to this, considerable quantities are shipped from other areas (Figure 10). Reported production, then, is no more accurate than acreage in reflecting total supply. The only available data reflecting the extent of this overlapping are those pertaining to daily carlot shipments. This factor is discussed below.

Average Daily Carlot Shipments

When dealing with price movements for a highly perishable commodity such as lettuce, a supply factor other than total production must be taken into account. This is the rate of harvest of the current crop. Lettuce must be consumed soon after harvest in order to avoid loss through spoilage. Once the total acreage

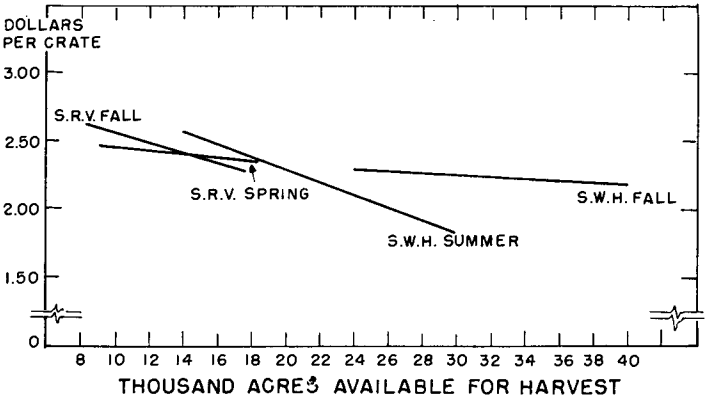

Figure 8.– Net effect of changes in the acreage available for harvest in the F.O.B. price for Western lettuce.

has been determined and the crop planted, the speed with which it is harvested depends almost entirely on weather conditions at harvest time. When the crop is mature, it must be harvested and marketed within a relatively short period (assuming none of the crop is left in the field for economic reasons). In the absence of some type of marketing agreement, short-term volumes are essentially pre-determined, and are thought to have a significant influence on season average prices. Average daily shipments from the currently dominant producing area is the variable chosen to measure this relationship. The association between prices and average daily shipments from competing areas during periods of overlapping is discussed in the next section. These two variables were not incorporated into one for reasons discussed below.

The net relationships between average daily shipments and season average f.o.b. prices are shown graphically in Figure 9. It takes a decrease of from 0.47 to 1.42 cars per day, on the average, to effect a one cent per crate increase in price, when other factors remain unchanged. Although these results could have occurred some 10 to 20 per cent of the time purely by chance, it is believed that this is an important factor in determining local f.o.b. prices.

It appears that the California areas dominate in the market whenever there is competition between these areas and Arizona producers. Shipments from California make up some 70 per cent of total shipments in the United States, compared to 20 to 25 per cent from Arizona.[9] During the Salt River Valley spring season it appears that shipments from California completely overshadow the effect of local shipments on prices. Because total production can be more accurately estimated during the summer season, and because the volume of shipments is relatively constant, changes in average daily shipments are not important enough to affect price.

Average Daily Shipments from Competing Areas

This variable was included for the same reasons set forth in connection with average daily shipments from the currently dominant area. There appears to be good reason for considering the two separately. Shipments from one or more competing areas usually last for only a portion of the season being investigated. If the total of these shipments were to

[9]Hillman, op. cit.

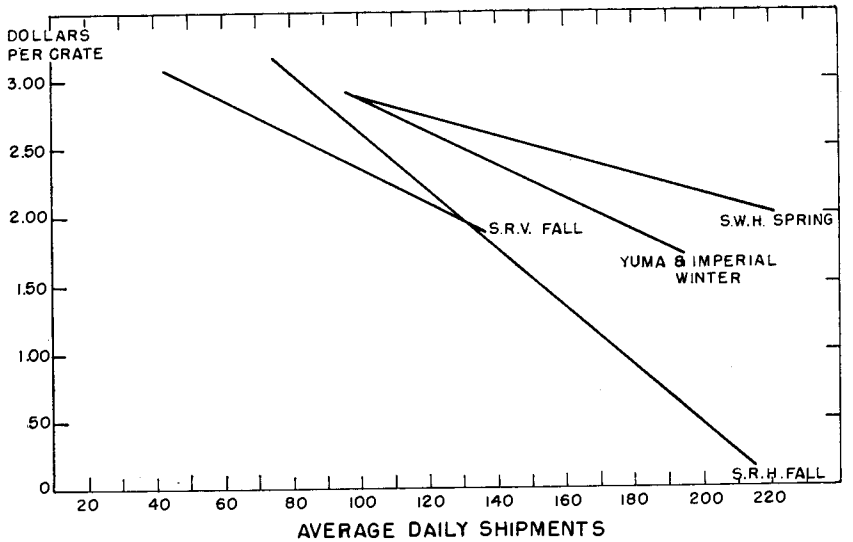

Figure 9.-Net effect of changes in average daily carlot shipments on the F.O.B. price for Western lettuce.

be added to the total of shipments from the currently dominant area, the short-term (day to day) effect on price would be eliminated. However, it is the *daily* volume of shipments that is important, and this factor should be considered separately from total shipments or production. Since it is not possible, due to variations in shipping dates, to include these competing shipments with average daily shipments from the currently dominant area, the two are considered separately.

The only two places where no association was found between this variable and the f.o.b. price were the Salinas-Watsonville summer and fall deals. As previously noted, there are no competing shipments from the western lettuce areas during the summer season. There is, however, a certain degree of overlapping between Salinas-Watsonville and the Salt River Valley at the end of the Salinas fall deal (Figure 10). Although the trend appears to be toward a longer overlap period during this season, results of this analysis do not show any relationship between shipments from Arizona and the Salinas average fall price. However, if the overlapping continues to become more pronounced, Salinas shippers may begin to feel the effects of shipments from other areas on the price received for their lettuce.

A decrease in competing shipments of from 0.80 cars per day during the winter season to 1.25 cars per day during the Salt River Valley late fall season is accompanied by an increase of one cent per crate in the season average f.o.b. price. Figure 11 shows these relationships for the four areas in which they exist.

This association of price with average daily shipments, both for a given area and from competing areas, gives rise to further speculation concerning the probable effect on prices of some form of orderly marketing for western lettuce. The success of marketing agreements has already been demonstrated for other fresh fruits and vegetables. The author sees no reason to believe that similar results could not be obtained by lettuce producers, through organized efforts to control the volume of shipments. This would prevent

a glutting of the market during certain seasons of the year, as frequently happens under existing conditions, and help to avoid the more violent fluctuations in f.o.b. prices. Decisions regarding this type of program must, of course, be made by the growers and shippers concerned. But, based on the results obtained here, serious consideration might profitably be given to an organized marketing program.

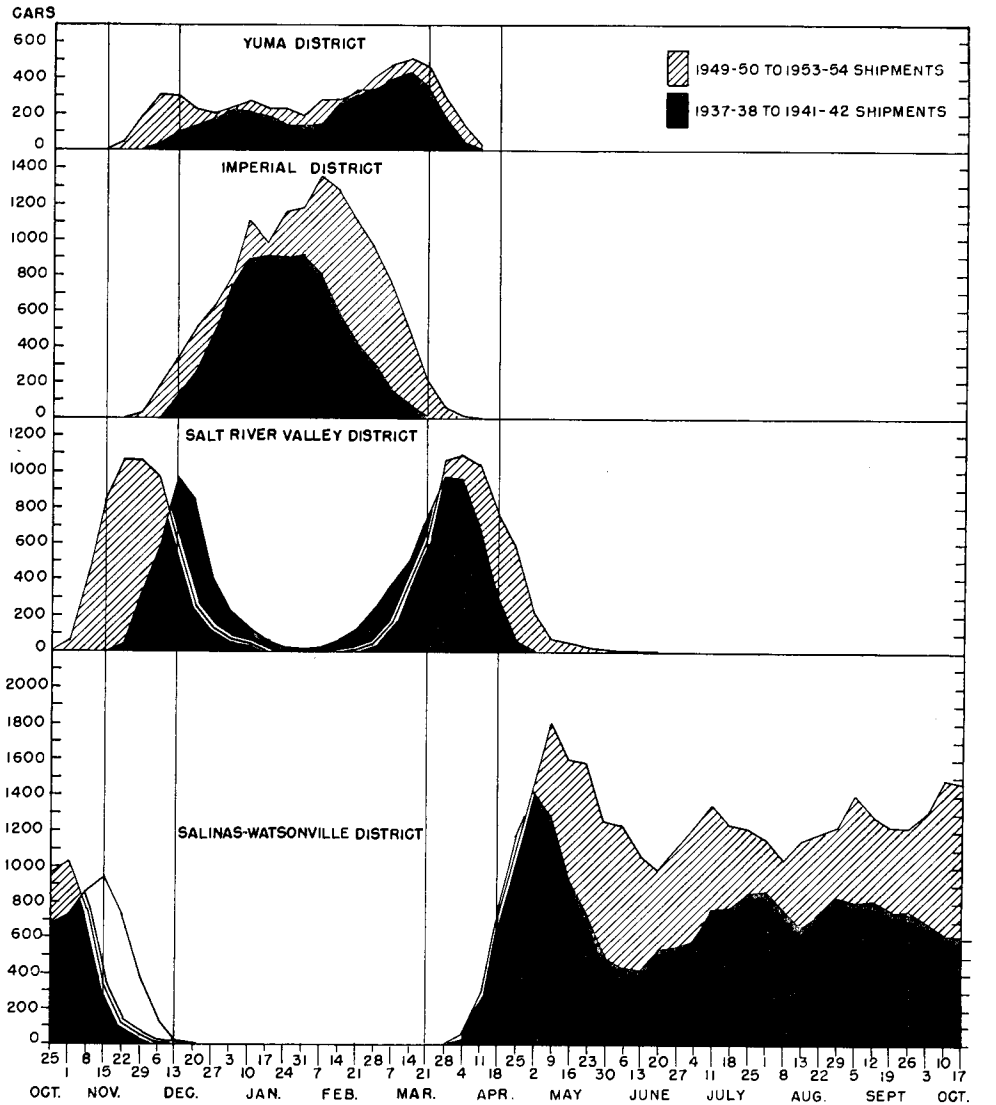

Figure 10.- Average weekly carlot shipments of lettuce, six major districts 1937-38 to 1941-42 and 1949-50 to 1953-54.

SOURCE: J.S. HILLMAN, "SEASONAL AND INTER-AREA SHIFTS IN THE WESTERN LETTUCE INDUSTRY" ARIZONA AGR. EXP. STA. REPORT NO. 123.

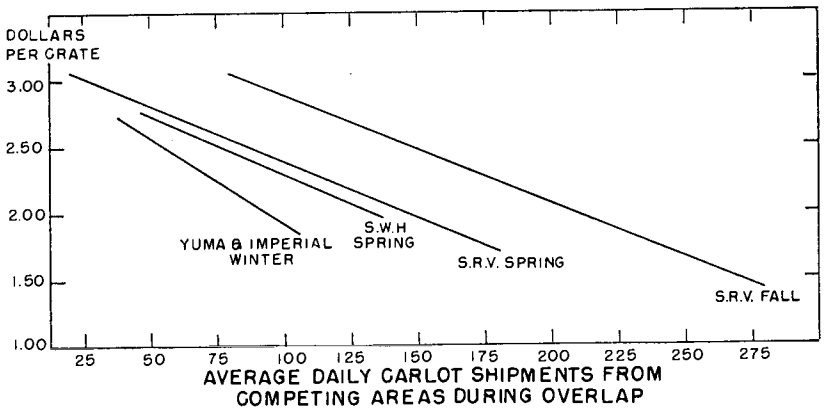

Figure 11.- Net effect of changes in the average number of cars shipped daily from competing areas on the F.O.B. price for Western lettuce.

Production Outside the Western Lettuce Areas

California and Arizona ship some 90 per cent of the total annual commercial shipments of lettuce in the United States.[10] During certain seasons of the year, however, other areas contribute considerable quantities to the total supply. The middle eastern and northeastern states are producing increasing quantities during the spring and summer months, and Texas and Florida during the winter season. Data showing carlot shipments from these areas are not available, so production figures have been used in their place.

This analysis indicates that production outside the western region has a marked influence on f.o.b. prices for western lettuce during the winter, spring and summer seasons. Although some relationship was found between this factor and price during the fall season, the results were not conclusive. On the average, a decrease in production outside the western region ranging from 4,131 crates during the spring season to 8,944 crates during the summer season was accompanied by a one cent per crate increase in the f.o.b. price for western lettuce. These relationships are shown in Figure 12.

Consumer Income

One of the major factors affecting any commodity price is consumer demand. In the short run, that is, from one year to the next, consumer income offers a fairly accurate yardstick for the measurement of this demand. Although other factors, such as changes in dietary habits, may also cause changes in demand, these changes usually occur much more slowly and are difficult to measure. All of these factors can be incorporated into one variable, time, and are discussed in the next section. The measure of consumer income used here was annual per capita disposable personal income.[11] As would be expected, this factor contributes heavily to changes in lettuce prices, although the relationship varies from season to season. Prices appear to be most responsive to changes in income during the winter season and least responsive in early spring (Figure 13). While an increase of $3.83 in per capita income per year was accompanied by an increase in the early spring price of one cent per crate, the same result is obtained during the

[10]Ibid.
[11]Income after taxes.

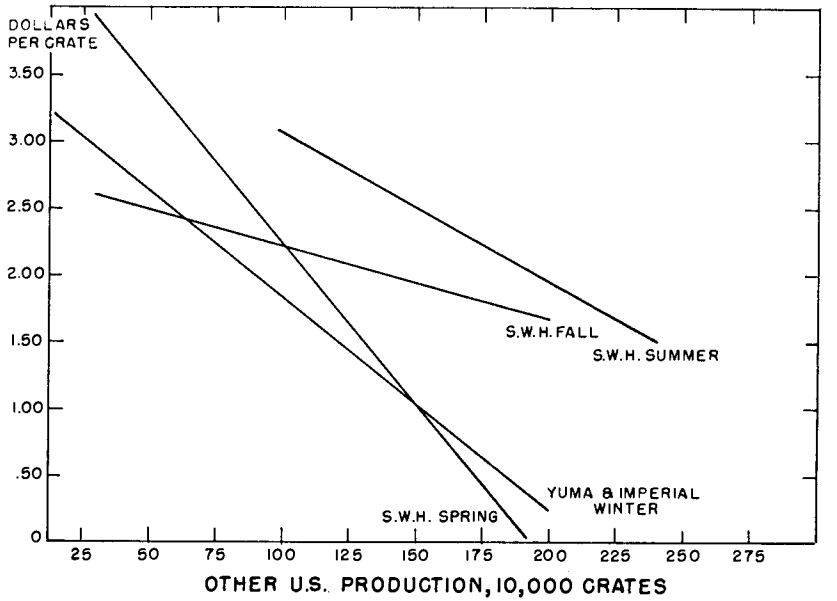

Figure 12.- Net effect of changes in the production of lettuce outside the western region on the F.O.B. price for Western lettuce.

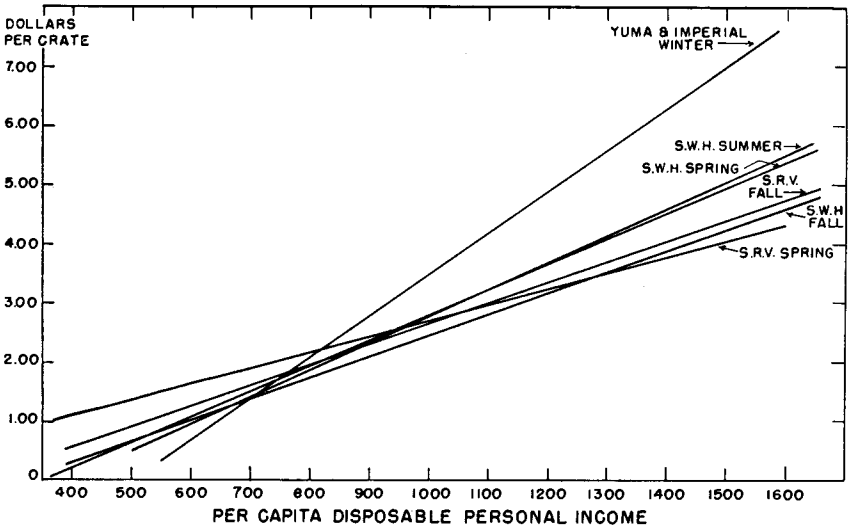

Figure 13.- Net effect of changes in per capita income on the F.O.B. price for Western lettuce.

winter season by an increase in income of only $1.43. There could be several reasons for this difference. The major outlets for western lettuce are in the north and northeast. Local production in these states, commercial or otherwise, is negligible during the winter months. Consumers who, during the spring and summer months, purchase locally grown lettuce, or even grow it themselves, now must rely on lettuce shipped in from the south or southwest. This imported lettuce is normally much higher in price than locally produced lettuce, sometimes as much as 100 per cent higher, making lettuce a more important item in the winter food budget than during other seasons of the year, particularly for low income groups. For this reason consumption of lettuce during the winter months is likely to be more responsive to changes in income, especially among lower income groups, than it is when the lower priced local product is available. Then again, in the spring local supplies of lettuce become available at a somewhat lower price than that paid for lettuce from the more distant western shipping points. This, plus the fact that diets normally contain more green leafy foods during the warmer seasons, results in a slower response of prices to changes in income.

Between the extremes found during the winter and spring seasons, summer and fall f.o.b. prices increase one cent per crate for each additional $2.20 to $2.89 in per capita consumer income (Figure 13).

Time

In addition to the variables discussed above, certain other factors often cause demand to change over a relatively long period of time. Changes in consumer tastes and preferences, changes in dietary habits, and a growing population are factors which might be included under this heading. The rate of change in these factors is relatively slow, but occurs steadily over a period of years. Time is the variable used to reflect this type of change in demand. It is a composite variable which may include several factors, none of which can be accurately measured individually. Furthermore, it is assumed that this variable includes any factor not reflected in any of the other variables used in the analysis.

This analysis shows that the f.o.b. price for western lettuce produced during the winter and summer seasons is decreasing over time when production and income are held at a constant level. Stated differently, if no changes were to occur in either production or income, the f.o.b. price would be decreasing year by year. This indicates that the factors included in the variable have the combined effect of decreasing the winter and summer demand for western lettuce over time. It is

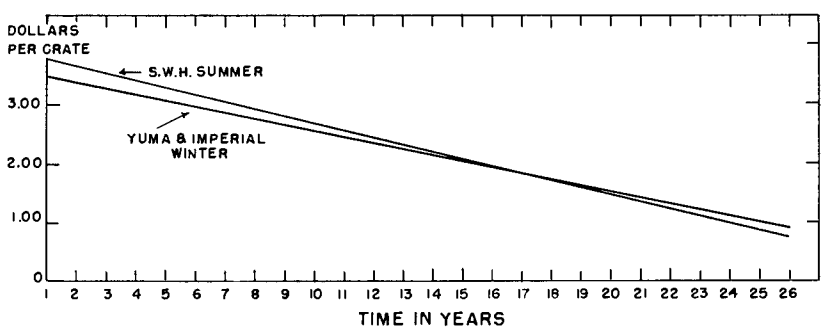

Figure 14.–Net changes in Western F.O.B. lettuce prices over time.

believed that the availability of lettuce from other areas during these months, although partially measured by another variable, is one of the factors responsible for this change. This is especially true of the summer months when local production in many areas is not reflected in total production figures.

As shown in Figure 14, the average f.o.b. price for winter and summer lettuce decreases slightly less than a cent per crate from one year to the next when other factors are held constant. Although the analysis showed slight increases in the other season average prices over time, the changes were so small that they were inconclusive and are not shown. This indicates either that no significant changes of this type have occurred, or that the changes which would increase price have been offset by changes in other factors which tend to decrease price.

Forecasting Changes in F.O.B. Prices

It would be possible to formulate estimating equations, similar to those shown for wholesale prices, from the relationship shown above in the analysis of f.o.b. prices. This could be done by season for each of the major lettuce producing areas. However, the practical value of such equations is questionable, because their use is based on the user's ability to formulate estimates of future values for each of the several factors used in the analysis. It is extremely doubtful that satisfactory values could be determined beforehand for those variables showing the average volume of shipments from competing areas of production. Even if planting dates are known for each area, the beginning of the harvest and the length of the harvest season depend almost entirely on weather conditions and will vary considerably from year to year. Since a major part of the analysis of f.o.b. prices has been based on the effect of competing shipments on local prices, this limitation placed on the use of the analysis to forecast future prices negates its value for that purpose. However, it is felt that one of the major values of this analysis of f.o.b. prices is in showing the basic relationships which exist between season average prices in the major producing areas and the average daily volume of shipments from these and competing areas. Knowledge of thees relationships is essential if consideration is ever to be given to an orderly marketing program which would limit total shipments of lettuce from the western region.

An alternate approach to predicting future f.o.b. prices might be to forecast season average wholesale prices, using the estimating equations shown above, then attempt to derive an estimate of the f.o.b. price from the predicted wholesale price. The accuracy of such a procedure depends not only upon the accuracy of the estimating equations used to forecast wholesale prices, but also on the stability of the relationship between wholesale prices and local f.o.b. prices. The error involved in forecasting wholesale prices has already been discussed.

Figure 15 shows the relationship between wholesale and f.o.b. prices for each of the four seasons. The top portion of each section shows actual prices, while the lower graph shows local f.o.b. prices as a percentage of wholesale prices. Unfortunately, there is more variation in this relationship between wholesale and f.o.b. prices than would be hoped for if the procedure outlined above is to be used to predict changes in f.o.b. prices.

The average f.o.b. price has ranged from 44 to 55 per cent of the wholesale price for the period since 1947, depending on the season (Figure 16). It is highest, relative to the wholesale price, during the winter season, and lowest during the summer season. This again could result from the increased level of local production near consuming centers during the spring, summer, and early fall months. During the late fall and winter seasons nearly all of the available lettuce comes from the southwestern lettuce areas of California and Arizona. It appears that when jobbers and wholesalers have to rely entirely on these areas for lettuce with which to fill their orders, they are willing, and able, to pay a higher price relative to the price at which they can

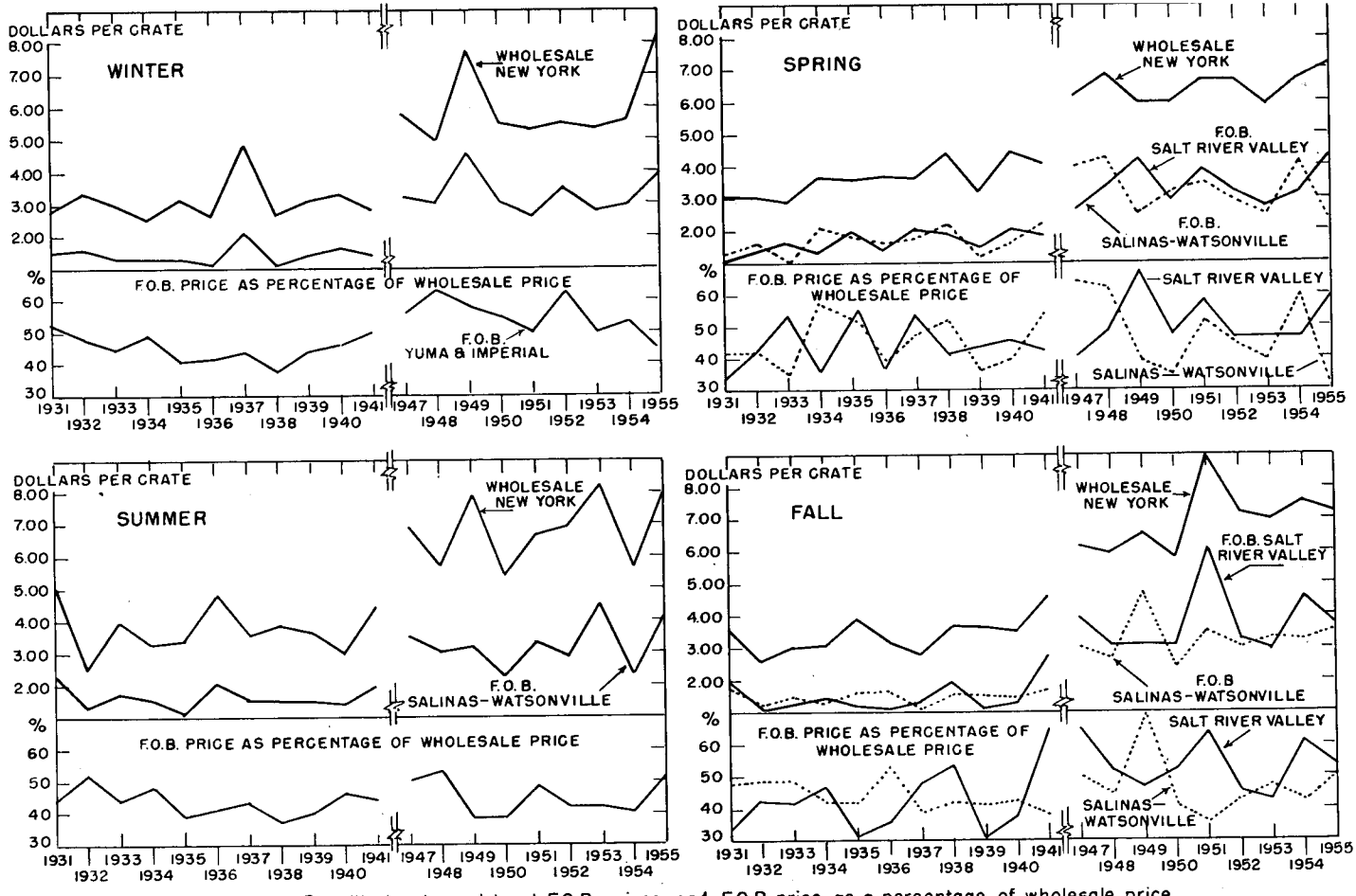

Figure 15. - Wholesale and local F.O.B. prices, and F.O.B. price as a percentage of wholesale price.

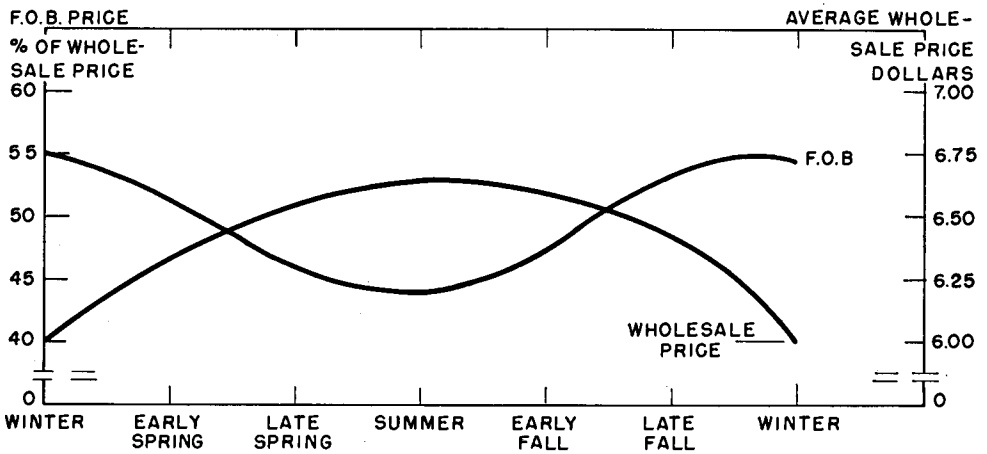

Figure 16.– F.O.B. lettuce price as per cent of New York wholesale price, and wholesale price level by seasons. Average, 1947-55.

sell, than when lettuce supplies from the west are supplemented by local production. Furthermore, in-transit cooling costs are lower in late fall and winter, and there is less spoilage from hot weather.

In addition, the average price for lettuce is lowest during the winter months and highest in the summer and early fall (Figure 15). This, together with the fact that the f.o.b. price is highest relative to the wholesale price during the winter, and lowest during the summer, seems to indicate that seasonal variations are more marked for wholesale prices than for f.o.b. prices. It appears that when lettuce prices begin their seasonal decline in late fall, wholesale prices fall further than f.o.b. prices, and when seasonal increases in prices occur, wholesale prices rise more rapidly than f.o.b. prices (Figure 16). This means that a different adjustment factor would have to be used for each season where wholesale price movements are used to predict changes in f.o.b. prices.

An estimate was derived above for the winter wholesale price for western lettuce in New York in 1956. This estimate was $6.17 per crate ($3.08 per carton). The f.o.b. price averages about 55 per cent of the New York winter wholesale price. Applying this percentage figure to the estimated wholesale price gives an average f.o.b. price of $3.39 per crate, or $1.69 per carton. The actual f.o.b. price received during the winter of 1956 averaged about $1.41 per carton.

Due to the instability of the relationship between wholesale and f.o.b. prices, however, any estimate of future f.o.b. prices arrived at by this procedure would at best be a rough approximation. However, in the absence of a more precise method, such an estimate has some value, if only to bring attention to the relationships which have been shown to exist.

STATISTICAL APPENDIX

The purpose of this section is to indicate some of the statistical results upon which the preceding analysis was based. Those interested in the coefficients obtained in measuring the various relationships discussed will find them listed in the tables below.

Table 1. Net Change in Relevant Variables Accompanying a One Cent Per Crate Increase in the New York Wholesale Price for Western Lettuce.*

Season	INDEPENDENT VARIABLE†			Coefficient of Determination	Standard Error of Estimate
	Carlot Unloads	Per Capita Disposable Income	Time		
		dollars			cents per crate
Winter	— 2.675535	1.387754	— .034427	.82	79
	(— 2.6099)	(4.2849)	(—2.3429)		
Spring	— 9.927135	4.356720	.141767	.93	42
	(— 1.9476)	(4.0516)	(1.4532)		
Summer	—12.023855	1.911099	— .048220	.78	87
	(— 1.5351)	(3.7794)	(—1.6444)		
Fall	— 3.084031	1.652374	— .085279	.92	61
	(— 2.6025)	(5.7762)	(—1.7214)		

*These are the reciprocals of the partial regression coefficients.
†Figures in parentheses represent "t" ratios.

Table 2. Coefficients of Elasticity Derived from Data Pertaining to the New York Wholesale Market for Lettuce.*

Season	Elasticity of Demand	Income-Price Elasticity	Income — Consumption Elasticity†
Winter	—1.0162	.3105	.5426
Spring	—1.9942	4.3446	.1836
Summer	—2.1455	1.1537	.4934
Fall	— .9532	.6792	.3223

*All coefficients based on data for the period 1930 to 1955 (1942-1946 omitted).
†Based on United States consumption.

Table 3. Net Changes in Relevant Independent Variables Accompanying a One Cent Per Crate Increase in the F.O.B. Price for Western Lettuce.*

Area	Independent Variable†						Coefficient of Determination	Standard Error of Estimate
	100 Acres Available for Harv.	Avg. Daily Shpmts.	Avg. Daily Shpmt. from Compt. Area	Production‡ Other Areas 10,000 crts.	Per Cap. Dispsble. Income	Time		
		cars	cars		dollars			cents per crate
Yuma & Imperial Valley, Winter Deal		— .83 (−1.57)	— .80 (−1.65)	— .63 (−3.27)	1.43 (3.84)	— .10 (−1.85)	.86	45
Salt River Valley, Early Spring Deal	— 9.30 (— .17)		−1.18 (−2.47)		3.83 (6.54)		.84	43
Salinas-Watsonville, Spring Deal		−1.42 (−1.15)	−1.10 (−1.57)	— .41 (−2.68)	2.36 (4.07)		.74	55
Salinas-Watsonville, Summer Deal	— 1.61 (— 2.54)			— .89 (−3.09)	2.20 (4.91)	— .82 (−2.74)	.86	35
Salinas-Watsonville, Fall Deal	−12.58 (— .20)	— .47 (−1.60)		−1.85 (— .84)	2.80 (3.02)		.79	51
Salt River Valley, Fall Deal	— 2.57 (— .35)	— .80 (−1.25)	−1.25 (−1.83)		2.89 (5.93)		.81	69

*These are the reciprocals of the partial regression coefficients.

†Figures in parentheses represent "t" ratios.

‡Areas outside the western lettuce region, including Texas, Florida, and the northeastern states.

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