FACTORS AFFECTING OREGON FARM PRICES

by

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<table>
<thead>
<tr>
<th>CHAPTER I.</th>
<th>INTRODUCTION</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scope</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Method</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Limitations</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER II.</th>
<th>SUPPLY</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Conscious Planning</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Weather, Insects, and Disease</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Changing Technology</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER III.</th>
<th>DEMAND</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income and Consumption</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Dietary Habits and Levels</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Population Growth</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Competing Products</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Derived Demand for Farm Products</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER IV.</th>
<th>MONETARY-FISCAL POLICY</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Policy</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Taxation</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Government Spending</td>
<td></td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER V.</th>
<th>EGG PRICES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal Movements</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>Average Annual Price</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>The General Price Level</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Per Capita Consumption</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Estimated Prices</td>
<td></td>
<td>47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER VI.</th>
<th>STRAWBERRY PRICES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Income and Consumption</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>The General Price Level</td>
<td></td>
<td>53</td>
</tr>
<tr>
<td>Other Factors</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>Estimated Prices</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Chapter</td>
<td>Subject</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>VII</td>
<td>Potato Prices</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Seasonal Price</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Average Annual Price</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Production</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>The General Price Level</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>Other Factors</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Estimated Prices</td>
<td>67</td>
</tr>
<tr>
<td>VIII</td>
<td>Summary and Conclusions</td>
<td>71</td>
</tr>
</tbody>
</table>

**BIBLIOGRAPHY** | 75
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change in Technology with Demand Constant</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Change in Technology with Change in Demand</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Trend in Per Capita Consumption of Selected Food Items. Five-Year Moving Average (1910-14 = 100)</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>Seasonal Price and Production Relatives for Eggs in Oregon</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>Parity Ratio and Relative Purchasing Power of Eggs in Oregon (1935-39 = 100)</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
<td>Trend in Annual Egg Production for Oregon and the United States (1935-39 = 100)</td>
<td>48</td>
</tr>
<tr>
<td>7</td>
<td>Actual and Estimated Average Annual Farm Price for Eggs in Oregon, 1925 to 1952</td>
<td>48</td>
</tr>
<tr>
<td>8</td>
<td>Parity Ratio and Relative Purchasing Power of Strawberries in Oregon (1935-39 = 100)</td>
<td>56</td>
</tr>
<tr>
<td>9</td>
<td>Actual and Estimated Farm Price for Processing Strawberries in Oregon, 1924 to 1953</td>
<td>56</td>
</tr>
<tr>
<td>10</td>
<td>Monthly Price Relatives for Oregon Potatoes, 1921 to 1939 and 1940 to 1952</td>
<td>59</td>
</tr>
<tr>
<td>11</td>
<td>Monthly Carlot Shipments of Potatoes from Washington, Oregon, Idaho, and California</td>
<td>59</td>
</tr>
<tr>
<td>12</td>
<td>Parity Ratio and Relative Purchasing Power of Potatoes in Oregon (1935-39 = 100)</td>
<td>68</td>
</tr>
<tr>
<td>13</td>
<td>Actual and Estimated Farm Price for Potatoes in Oregon</td>
<td>68</td>
</tr>
<tr>
<td>Number</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>Percentage Distribution of Families in the United States by Income Classes, 1949</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>Average Change from Previous Month in the Farm Price for Eggs in Oregon, and Number of Times that Price Moved Up or Down from the Previous Month, 1909 to 1945 and 1946 to 1952</td>
<td>41</td>
</tr>
<tr>
<td>3</td>
<td>Gross and Net Changes in Relevant Independent Variables with One Cent Per Dozen Increase in the Farm Price for Eggs in Oregon</td>
<td>43</td>
</tr>
<tr>
<td>4</td>
<td>Gross and Net Changes in Relevant Independent Variables with One Cent Per Pound Increase in the Farm Price for Strawberries in Oregon</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>Gross and Net Changes in Relevant Independent Variables with One Cent Per Bushel Increase in the Farm Price for Potatoes in Oregon</td>
<td>63</td>
</tr>
</tbody>
</table>
The farmer in Oregon, as elsewhere, is faced with a large degree of uncertainty concerning the prices which he will receive for his products. In the absence of perfect knowledge about future conditions the farmer must be in a position to change his plans as his knowledge becomes more complete or accurate. Storage, for instance, may be used as a means of postponing decision as to when to sell a product. In areas where specialization would afford the greatest advantage, diversification may be used to compensate for inadequate knowledge concerning relative commodity prices during the marketing season. These plans, conceived to counterbalance uncertainty, may not result in the most efficient use of resources.

Producers need more complete information about price determination and price movements if they are to utilize their resources more efficiently. This efficient use of resources benefits not only the producer, but the whole of society as well. While there is no known scientific method for eliminating uncertainty, much can be done, through research, to lessen its impact. This is especially true in the area of agricultural prices.
The objective of this study, then, is to provide more complete information as to why Oregon farm prices change, so that production and marketing can be planned more efficiently. This involves the determination of factors which cause prices to change, and the establishment of relationships between these factors and price movements.

Agricultural prices are influenced, primarily, by a few major factors underlying supply and demand. Supply is determined by current production, carry-over from previous production periods, and imports and/or exports. Production is important for any commodity, while the relative importance of the last two factors will depend upon the commodity being studied. There are also three factors which cause demand to change through time. These factors are income, prices of competing products, and changes in tastes and preferences. This of course ignores price supports and any oligopsony which may exist.

Scope

This study will deal only with Oregon farm prices, although data on such independent variables as income will be taken at the national level. This cannot be otherwise, since prices are not set in a few local markets, but rather in a multitude of markets over the country, and in some cases over the world. Further, only a few of the many
agricultural products produced in Oregon will be dealt with here. The method is, however, applicable to any commodity, with variations in the relative importance of the independent variables affecting price. Commodity prices analyzed in this study are those for eggs, strawberries, and potatoes.

Price movements can be classified as secular, seasonal, cyclical, or irregular. Cyclical variations in agriculture apply primarily to livestock, except for the effect of the general price level, and will not be dealt with here. Irregular variations are brought about by abnormal, sometimes non-recurrent, conditions, such as war, drought, floods, or other unforeseeable phenomena. This type of variation can be eliminated from the data. Only the first two sources of variation, secular and seasonal, will be considered in this dissertation.

Generally speaking, secular variation, or trend, is the steady growth or decline of prices over a long period of time. The concern here is with both long time movements and annual variations about this trend. Much of the following analysis will deal with the latter as it is caused by short run changes in the factors underlying supply and demand. Trend in itself is brought about by growth or decline in population and/or changes in technology.
The trend of most prices has been upward, due largely to a generally rising price level. Some commodity prices, however, have moved upward less than others, due to a decline in their relative importance to the consuming public, or because of generally large supplies.

Seasonal variations in price are attributable to climate as it affects production and to custom. Where seasonal price movements are significant, production of the commodity varies considerably from month to month or is usually concentrated in a relatively short period within the years. In addition to changes in supply, some additional cost is incurred in storage and risk taking, which accounts for part of seasonal price variations. Consumption of certain commodities, such as turkey, is highly seasonal and does not always coincide with the production period. These changes in demand, together with variations in supply and storability, cause some commodity prices to change markedly within the year.

**Method**

There are two general approaches to the analysis of price movements, and although they are not mutually exclusive, emphasis can be placed on one or the other. One approach is to indicate probable relationships among variables by means of logical deductive reasoning; the other is to establish statistical relationships among
relevant variables. This study employs both approaches, with emphasis on statistical relationships after development of the theoretical framework.

In the econometric investigation, four major steps were involved: (1) specifying the system of relationships believed to have produced the observed data; (2) ascertaining whether these relationships can be identified for purposes of statistical analysis; (3) making the statistical analysis; and (4) interpreting the results (9, p. 8).

"If the purpose of an analysis is to estimate the expected price associated with given values for such variables as size of crop and consumer income, the best answer can be obtained by a least-squares regression with price dependent and other variables independent." (9, p. 9). Since demand elasticity was not of primary concern, this was the method applied to annual, and in some cases seasonal, data.

A centered twelve-month moving average will be used to establish seasonal patterns. The significance of seasonal variations will be tested by an analysis of variance applied to the monthly price relatives. Simple and multiple correlation analysis will be used in explaining seasonal movements.

Trend lines will be fitted to time series by the least squares method. This approach uses a simple linear equation, which is satisfactory for the data being studied.
Simple and multiple correlation analysis is used to establish relationships among the variables causing deviations from the long time price trends.

The limitations of any mutually exclusive statistical analysis of data through time is shown in the next section of this study. It is important to keep in mind that a statistical analysis of prices, while useful, may be used only as a general guide in decision-making by farmers.

Limitations

Statistical methods and tests of significance were designed for use with data which meet certain basic requirements. These requirements are: (1) data must come from a normal and homogeneous population; (2) the observations must be independent of each other; and (3) the sample must be randomly drawn. If inferences are to be drawn about a population, these conditions must be approximated.

Economic data, especially time series, present a serious problem with respect to the assumptions implicit in statistical procedures. These data may often approach normalcy, but are seldom strictly homogeneous. Change is the rule rather than the exception in economic data so that homogeneity is rare. However, these changes are usually more evolutionary than revolutionary, and often are included in the data. Thus, an analysis which
includes the factors which change over time actually may deal with a homogeneous population. It is changes in factors not included in the analysis which render tests of significance unreliable (14, p. 189).

Care must be exercised when dealing with price data over time if the requirement calling for independent observations is to be met. It is not unusual to find that two or more observations are influenced by the same value of a second variable. It is possible, however, to eliminate this interdependence when it is recognized.

Strictly speaking, economic time series often cannot be selected at random. The observations may necessarily begin whenever the data first become available. There are, however, large random elements in agricultural economic data. This is especially true of production data where random changes in exogenous factors, such as weather, exert a major influence on yields. Fluctuations in demand are less clearly random in nature.

These limitations indicate that price analysis and forecasting are fully as dependent upon conformity with economic theory, and upon recognition of commodity characteristics, as they are on objective statistical tests (14, p. 190). The formula or analysis is not the chief limitation, as it can be proven reasonably accurate once the values of the factors which go into the formula
are known. Ability to forecast these values is a great problem, but is no reflection on the method.

Price estimates derived by statistical procedures should only be used as guides to supplement good logical reasoning. Formulas do not give single-valued estimates, but averages which fall within a range specified by the goodness of fit obtained in the analysis. This range, or error of estimate, is often ignored, yet in many cases it may be so large as to render the estimate valueless. Once the essentials of the method are understood, however, allowances can be made for abnormal conditions and indications of future prices can be computed. These estimates can be continually revised as the relevant time period is approached and the independent variables estimated with more accuracy.

One further limitation of this study needs to be recognized. Prices used here are taken at the farm level because the relevant retail price data are not available on a state basis, and because the primary concern is with the price received by the producer. Because farm prices are used, it is necessary to mention that the demand measurements actually reflect a derived demand for farm products. This arises from the fact that a relatively small quantity of agricultural products is purchased directly by consumers, yet much of the analysis is based upon data having to do with consumer demand. It should
also be recognized that oligopsony may exist between producer and consumer. In most instances the relationship between farm and retail prices is sufficiently direct to permit use of the farm price, but due recognition needs to be given this limitation.
Price can be expected to vary inversely with the quantity of a commodity, and of closely competing commodities, that consumers are able and willing to purchase. The greater the amount of a given commodity offered for sale in a given market at a given time, the lower will be the price per unit at which the commodity can be sold. Conversely, a larger quantity of a given commodity will be offered for sale as prices rise. At a given time in a given market the amount of a good offered for sale will increase as the price rises and decrease as the price declines.

The relationship between supply and price has, however, been obscured in recent years by a rapidly rising general price level. We have witnessed a phenomenon whereby the supply of many agricultural commodities and the prices for these commodities have both increased at a rapid rate. The demand for some commodities has increased more rapidly than the supply of these commodities. This has been due, primarily, to population growth and rising incomes.

It is appropriate to note at this point that certain commodities have been priced out of the market by continued high price supports. This is a special case
where an expanded supply has been accompanied, and in some cases caused, by a guaranteed high price, rather than a price set by existing market conditions.

The total supply of a given commodity available in the domestic market in any marketing period is determined by current production, carry-over from previous production periods, and net foreign trade movements. The relative importance of these last two factors will depend upon the commodity being studied.

**Production**

The quantity of inputs committed to production in agriculture in the United States is relatively stable in the short run, and total agricultural production varies little from year to year (12, p.210). This total output is the net effect of production decisions made by millions of individual producers. Experience shows that total production in the short run does not vary more than five percent from year to year. A large degree of variation does exist, however, in the production of individual commodities within agriculture. This variation is caused by conscious planning, exogenous factors such as weather, insects and disease, and by changes in technology.
Conscious Planning

Conscious planning is practiced by the individual producer, and also by the government. In attempting to increase income, producers tend to adjust their planning, with respect to enterprise combinations, in accordance with the relative prices of alternative commodities. To the extent that production decisions are based on inadequate or incomplete knowledge, the expected price relationships may not materialize. This may result in further disequilibrium in production for the next production period. The relative importance of conscious planning on the part of the individual is determined by the commodity being studied, and by the ratio of fixed to variable factors necessary in the production of the commodity. It is much more difficult to vary the production of tree fruits, for instance, than to vary the production of eggs.

Government planning for agriculture has increased in importance in recent years. This means farmers must take into account the policies of government in making decisions on the farm. Farm programs have varied in form from price supports on certain commodities to production controls, or acreage allotments. It is beyond the scope of this thesis to appraise or evaluate national agricultural policies. The advisability of attempting to
replace market forces with planned production on a national scale has been the subject of intense debate in recent years and cannot be adequately dealt with here. It may suffice to say that, under the present law, the Federal Farm Program is very likely a major source of uncertainty, in spite of the fact that one of the objectives of policy makers was to reduce uncertainty in agriculture.

Weather, Insects, and Disease

Experience has shown that violent fluctuations in production occur in some areas, even when the total number of acres planted continues at the same level. Fortunately for the consumer, disastrously low yields in one area are often offset by bumper crops in other areas, so that total production remains relatively constant. In this case the producer with an abnormally small crop may not realize a much higher price to compensate for the low yield. This is particularly the case when there are satisfactory substitutes for any given product. If, however, the total supply of a commodity is significantly decreased, a higher price will usually result, provided again that other things such as the general price level, available substitutes, and technology, remain fairly constant.
Only insofar as these variations are evident in annual production data can their effect on price be isolated. Since production figures must usually be taken on a national basis when dealing with price changes, the effect may be either hidden or negligible, or both.

**Changing Technology**

Technological advances have been regular and quite rapid since the early part of the century. The Bureau of Agricultural Economics reports that the output per man hour of labor in agriculture has increased by 130 per cent since 1910 (21, p.19). This increase has been due primarily to the increased use of capital in the form of machinery, fertilizers, insecticides, and herbicides. Other contributing factors have been the development of higher yielding and disease resistant plant and livestock varieties. Hybrid corn in the corn belt is perhaps the most outstanding example of this, having increased corn yields by about 20 per cent.

Closely related to the above developments are the improvements which have occurred in the transportation, storage, processing, and retailing of agricultural commodities. These improvements make it possible to get a larger proportion of total production to the consumer through reduced waste and spoilage. This is illustrated
by the vast improvements made in the freezing industry in recent years.

The effect of improved techniques is to increase the supply of agricultural commodities, i.e., to shift the supply curve downward and to the right. This is illustrated by Figure 1. Before the change occurs, equilibrium is achieved at the intersection of DD and SS. Under existing conditions the quantity sold is OL and the price is OP. When the innovation has had time to exert its full effect, a new equilibrium is established at the intersection of DD and S'S'. Quantity ON is now sold at price OR. It is assumed that demand does not change.

In some cases, however, as with frozen strawberries, the demand for a commodity will also change. Here a perishable product is preserved in such a manner that it is available to consumers throughout the year rather than for only a limited time during the harvest season. For reasons of simplicity it is assumed that the two sets of curves in Figure 2 do not change slope. This is a case where the supply curve has shifted, due both to increased productivity and new methods of preservation, and the demand curve has also moved to a new position. Let SS be the supply curve before the change and S'S' the supply curve after the change has had time to exert its full effect. Likewise, DD is the original demand curve and D'D' the new demand curve. This new demand curve accounts
Figure 1. Change in technology with constant demand.

Figure 2. Change in technology with change in demand.
for both the fresh and the frozen product. With a change
in the supply curve only, the new price would be OR with
quantity OM being taken. When the demand curve also shifts,
price will fall only by SP, rather than RP, the new price
being OS. Quantity ON will be sold at this price. Total
revenue is increased from OPFL to OSCN.

These illustrations are over-simplified; the reactions
would be much more complex in practice. This is
ture because a static concept has been applied to dy-
namic phenomena, and because the elasticities of supply
and demand were held constant. The purpose is only to
illustrate the general aggregative effect of changes in
technology. It should also be mentioned that improved
technology may reduce cost and leave output unchanged.
CHAPTER III

DEMAND

Consumer demand is the second major factor, or classification of factors, which must be taken into account in price determination. Effective demand can be defined as the desire for a good, plus the willingness and purchasing power to acquire that good. This effective demand is in a constant state of flux, due to changes in income, dietary habits and levels, and the number of consumers in the economy. Where a specific commodity is concerned, prices of competing products must also be considered.

Changes in demand are often used to describe two separate and distinct phenomena. In one case the term is used to describe movements up or down a given demand curve, at other times it is used in referring to shifts in the entire demand schedule. Care must be taken to distinguish between these phenomena when discussing changes in demand. As used here the term refers to shifts in the demand curve, unless otherwise stated. Price changes due to shifts in the demand for a specific commodity, or changes in the composition of total consumer demand for agricultural products, are, of course, important in making production decisions.

Discussion of the forces causing changes in consumer demand can be conveniently divided under the following
headings: (1) income and consumption; (2) dietary habits and levels; (3) population growth; and (4) prices of competing products (12, p.12 and 15, pp.42-54).

Income and Consumption

Income is usually the most important single factor affecting price through its influence on demand. When the level of economic activity is high, the ability of consumers to satisfy their wants is greater than when economic activity is low. If a large share of the labor force is unemployed, purchasing power is greatly reduced. Every person is a consumer of agricultural products, which means that if farm prices are to be maintained at a satisfactory level consumer incomes must be maintained. This refers to real income, or the quantity of goods and services that a given amount of productive endeavor will purchase. If consumer incomes and the general level of prices increase at a one to one ratio, no increase in purchasing power results. It is only when the productivity of the economy is increased that consumers are enabled to increase their purchases. Per capita non-farm income, deflated by the general price level, has increased from an average of $510 in 1933 to $903 in 1953. This is an average increase of 77 per cent (20, 1953 p.615).
Income Elasticity

The manner in which purchases of specific commodities react to changes in income is useful in explaining price variations. Engels recognized this and was a pioneer in work on income-consumption elasticity (5, p.122). Research in the area of income elasticity shows that as the income of a family increases, a smaller percentage of that income is spent for food. More important, however, is the manner in which the composition of food expenditures changes with income.

Income elasticity is defined as the percentage change in quantity purchased divided by the percentage change in income.\(^1\) The higher the income elasticity, the greater are the differences in expenditures on the commodity at different income levels. A negative coefficient indicates that consumption of a good decreases as income rises.

Income elasticity varies widely between commodities and groups of commodities. One author has shown a range from -1.168 for salt pork to 1.262 for fresh pineapple (22, p.41). Most commodities fall somewhere between

\[ e = \frac{dq/q}{di/i} \]

The term \( dq/q \) is the rate of change in consumption and \( di/i \) the rate of change in income.
these extremes. The magnitude, and in some cases the sign, of the coefficient will also vary between income groups for any given commodity. Thus, in a very low income class the income elasticity for potatoes may be positive and relatively large, yet for an average or high income class it is negative. This indicates that, after a certain income level is reached, further increases in income actually reduce the consumption of potatoes.

The propensity of lower income groups to consume more and higher quality foods is relatively high. These consumers save little of their incomes which means that any increases are almost immediately spent for food and other necessities. This emphasizes the importance of the distribution of income changes, as well as the extent of these changes. Table 1 shows the distribution of income classes for the 31.1 million families in the United States in 1949 (5, p.140). In referring to the income elasticity for a commodity these differences in income levels need to be recognized. A composite coefficient can be computed to obtain an average elasticity for more than one income class. Generally, as income rises the consumption of

2. Mathematically:

\[ e = \frac{q_0 - q_1}{q_0 + q_1} \cdot \frac{10 - i_1}{10 + i_1} \]

The symbol \( q_0 \) indicates the quantity at the high-income level, \( q_1 \) the quantity at the low-income level, \( i_0 \) the family income at the high-income level, and \( i_1 \) the family income at the low-income level.
fresh fruit, fresh vegetables, and meat products increases most rapidly. Consumption of grain products and potatoes increases less rapidly, and after a certain point actually declines (22, p.7).

Table 1. Percentage distribution of families in the United States by income classes, 1949

<table>
<thead>
<tr>
<th>Family income</th>
<th>Per cent of families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $1000</td>
<td>12.0</td>
</tr>
<tr>
<td>$1000 - $1999</td>
<td>14.8</td>
</tr>
<tr>
<td>$2000 - $2999</td>
<td>20.8</td>
</tr>
<tr>
<td>$3000 - $3999</td>
<td>20.0</td>
</tr>
<tr>
<td>$4000 - $4999</td>
<td>12.0</td>
</tr>
<tr>
<td>$5000 - $5999</td>
<td>7.9</td>
</tr>
<tr>
<td>$6000 - $6999</td>
<td>4.9</td>
</tr>
<tr>
<td>$7000 - $9999</td>
<td>5.1</td>
</tr>
<tr>
<td>$10,000 and over</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Dietary Habits and Levels

The composition, or quality, of the diet is closely related to the level of income, as was indicated above. There are, however, other important factors which influence eating habits. Some of these have been the shift from physical to sedentary occupations, an increasing awareness of minimum dietary standards and other health criteria, and increased spending on food away from home. Figure 3 shows the combined effect of these factors on the consumption of groups of food commodities.

These changes could have resulted entirely from shifts in the supply of the different foods, causing the supply curves to cut the demand curves at different points, demand
Figure 3. Trends in per capita consumption of selected food items. Five-year moving average (1910-14 = 100).
remaining unchanged. This does not appear, however, to have been the case. Increases in productivity have been most rapid for field crops, such as grain and potatoes, and slowest for fruits and vegetables, so that changes in supply alone do not seem to explain the changes in eating habits (14, pp.12-14). This supports the conclusion that changes in demand have had much to do with the changes shown in Figure 3.

Population Growth

Much of the increase in productivity in agriculture has been absorbed by population growth, even though the rate of growth has been declining. Population has increased at an average rate of 14.9 million people per decade for the 50 year period from 1900 to 1950. If the abnormally low rate of growth of the 1930's is excluded the figure is raised to 16.6 per cent, or an average of 16.4 million people per decade (5, p.156). In addition to this, the death rate has declined steadily during the same period.

The effect of these trends is to continually shift the demand curve for agricultural products and raise the price of those products if supply remains unchanged or increases less rapidly than demand. However, if worker productivity in agriculture increases at a proportionately faster rate than population, prices will decline.
Shepherd has predicted that this is likely to happen in agriculture, which indicates that increases in the supply of farm products will outrun increases in population and per capita consumption (14, pp. 18-19). What he does not point out, however, is that per capita income in agriculture need not fall as a result of declining prices attributable to increased productivity. If the rate of migration from agriculture is sufficient to offset increased productivity, then per capita income will not be adversely affected. A further point apparently overlooked by Shepherd is the possible effect of changes in other demand factors. He has implied that population growth is the only significant determinant of demand, while actually prices may rise, due to changes in the distribution of incomes and in other demand factors, even with productivity increasing more rapidly than population.

Competing Products

The majority of agricultural products have one or more closely competing products. For each combination of products a price ratio is established, depending upon the marginal rate of substitution of one for the other. This price ratio will tend to remain a fairly constant value. If the supply of one of the commodities increases while the other remains constant, the price of
the first commodity will fall temporarily changing the price ratio. The demand for the second commodity will shift downward, and its price must also fall until the two prices again stand at the equilibrium ratio dictated by the marginal rates of substitution. To the extent that a given commodity has satisfactory substitutes, these relationships are useful in helping to explain price changes.

In the absence of a competitive relationship there may exist either a complimentary or an independent relationship between two commodities. When two goods are used together to satisfy a want they are said to be complimentary. Where complimentary relationships exist, a rise in the price of one commodity will result in a rise in the price of the other. If two goods are so remotely connected in their uses as to have no appreciable influence upon the price of the other they are considered independent.

Relationships between most agricultural commodities are competitive. Beef competes with pork, eggs with cheese and meat products, and potatoes with wheat flour products and other vegetables. Complimentary relationships are of minor importance in agriculture, although some examples may be bacon and eggs or strawberries and cream.

The relationship between the demands for two commodities can be conveniently discussed in terms of cross
In mathematical terms:

\[ e = \frac{dq_1}{q_1} \frac{dp_1}{p_1} \]

Where \( dq_1 \) is the difference in quantity for the first commodity, \( q_1 \) is the original quantity, \( dp_1 \) is the difference in price for the second commodity, and \( p_1 \) is the original price.

elasticities. Cross elasticity for a commodity is defined as the ratio of the rate of change in the quantity of that commodity to the rate of change in the price of the commodity being compared. This is a measure of the change in quantity of a commodity as related to changes in the prices of other commodities. The price of the first commodity is assumed to remain constant. A positive coefficient indicates a competitive relationship, while a negative coefficient represents a complimentary relationship.

**Derived Demand for Farm Products**

Demand at the farm level is actually a derived demand. It consists of consumer demand minus a schedule of marketing charges. Since these marketing charges are largely independent of consumer demand, they may not always change in proportion to changes in retail prices and quantities marketed.

If the marketing charge is a flat rate per unit, the price received by producers would be the retail price minus the marketing charge.
minus a uniform absolute rate. Where the marketing charge is computed as a constant percentage of the retail price, however, the charge per unit would change in proportion to changes in the retail price. In practice, a combination of flat-rate and percentage mark-ups will usually be found between producers and consumers (26, pp. 63-64). Where oligopsony exists, the middleman may partially control the amount of services rendered, and thus influence the marketing margin. Factors such as wage rates, which are largely beyond the control of the middleman, may cause changes in retail prices to result in relatively larger, or smaller, changes in the farm price.

To the extent that marketing charges approximate a flat rate per unit, the farm demand curve is to the left of, and parallel to, the consumer demand curve. In this case the farm price can be used in place of the retail price with some confidence because a constant difference exists between the farm and retail prices. It is assumed in this study that the above relationship is approximated closely enough to permit the use of farm prices in the analysis.
CHAPTER IV

MONETARY-FISCAL POLICY

Government action has become increasingly important to the economy of this nation. National economic policies, independent of a farm program per se, exert a powerful influence on farm prices. This is true even though the influence may not be quite so obvious as that of a farm program designed to cope with specific agricultural problems. Included are such things as monetary and credit policy, taxation, and public spending, including deficit financing.

In fiscal year 1953, government expenditures comprised nearly 28 per cent of the total national income (2, pp. 652-653). National income was $306 billion and total state and federal expenditures $85 billion. Because income is a primary determinant of price, it is appropriate at this point to investigate more fully one of the major factors affecting national income, namely monetary-fiscal policies of our government.

Credit Policy

The federal government has several tools at its command with which to influence credit and the quantity of money in circulation. These include such things as reserve requirements for commercial banks, bank rediscoun
rates, and open market operations (4, pp.121-144). All of these may be used to influence the level of demand deposits held by banks. Demand deposits, or checking accounts, make up 85 to 90 per cent of the media used to complete transactions in the economy, so that control of these deposits can be quite effective in limiting or encouraging economic activity. These controls are instituted by the Board of Governors of the Federal Reserve Bank.

If the policy of the Federal Reserve Bank is to encourage expansion of credit, the effect on agricultural prices will be a favorable one. Economic activity will be stimulated by increased borrowing and investment. Consumer incomes will rise and spending will increase by some percentage of the increase in consumer incomes, depending on the marginal propensity to consume. This marginal propensity to consume is relatively stable at 75 to 80 per cent over the long run (4, p.175 and 5, pp. 164-178).

Since low-income groups spend a relatively larger share of increments in income for food, the distribution of increases in consumer incomes is also important. If these low-income groups realize a sizeable share of any increase in consumer incomes, agricultural prices will react even more favorably. The effect on the price for a specific commodity, or group of commodities, will depend upon the relevant income elasticities. Those
commodities for which the income elasticity is positive and relatively high will enjoy greater increases in price.

If an expansion of credit is accompanied by an increase in the supply of agricultural products, farm prices may rise little or not at all. This, of course, will vary by commodities. An increased supply of farm products accompanied by expansion of credit will, however, result in a smaller price decline than would have occurred without the credit expansion, or perhaps in no price decline at all.

When the policy of the Federal Reserve Bank has been to discourage further expansion of credit, or to curtail credit, agricultural prices have declined. If the program of credit curtailment is effective, the general level of prices falls. Farm prices are the first to fall in the face of a lower general price level. To the extent that real consumer incomes are decreased, specific commodity prices may suffer even more, depending on the income elasticity for those commodities. Commodities with negative income elasticities, such as potatoes in certain income groups, suffer relatively smaller price declines.

The degree of success enjoyed by the Federal Reserve Banks in their attempts to encourage or limit credit expansion depends upon several factors. Among these are: (1) the size of excess reserves held by commercial
banks; (2) the extent to which commercial banks rely on reserve banks for loans; and (3) the psychological effect on commercial bankers of changes in reserve bank policies.

**Taxation**

Reaction of the prices for agricultural commodities to taxes in general is quite complex. The effect of a specific tax is determined by its incidence, or the degree to which the impact of the tax falls on consumers in various income groups. A progressive tax is less detrimental than one that is regressive.

**Progressive Taxation**

State and Federal income taxes are perhaps the best example of a progressive tax. A proportionately larger share of these taxes are paid by higher income groups. Even with this form of taxation, however, the degree of progressiveness is not uniform throughout the tax schedule. The rate progresses most rapidly for the extremely high-income groups, but still the average and below average income groups pay a relatively large share of the tax. Be that as it may, the income tax serves to illustrate the effect of a progressive type tax on agricultural prices.

When the burden of a tax falls on high income groups, the tax has little or no effect on food prices. The proportion of income spent for food at this level is much
more fixed than food expenditures at lower income levels. Thus, an increase in a truly progressive tax would have a relatively minor effect on the prices received by producers of agricultural commodities. This would be true both for farm prices in general and for specific commodity prices. Total consumption and the composition of food expenditures would remain relatively constant.

If, however, the tax possesses only token progressiveness at the lower end of the tax scale, forcing average and below average income groups to pay a larger share of the tax than would be the case with a uniformly progressive tax, the effect would be quite different. In this case an increase in tax rates will lower disposable income for lower income groups and the demand for food commodities will decline accordingly.

It is important to keep in mind that if the tax is highly progressive, i.e., takes away too much from high income groups, there is danger of curtailing investment by lessening the availability of risk capital. This tends to lower consumer incomes and will decrease food expenditures by an amount dependent upon the distribution of the decrease in income.

Regressive Taxation

Taxes such as local property taxes, federal, state and local sales and excise taxes, and social security
taxes have a regressive effect. They are generally collected on a "flat rate" basis, regardless of ability to pay. A tax so enforced takes a proportionately larger share of the purchasing power of low-income consumers than of high income consumers. In so doing it reduces food expenditures by a larger degree than would a progressive tax because it widens the gap even more between high and low income consumers. Prices for agricultural commodities will therefore be adversely affected by taxes such as these. Conversely, lowering or abolishing property, sales, or social security taxes would benefit producers of agricultural commodities more, price-wise, than would a general lowering of income taxes.

In conclusion, any tax which encourages a large spread in consumer incomes will place a greater burden on producers in agriculture than will a tax which tends to lessen the spread in consumer incomes.

**Government Spending**

The role of government with respect to economic activity, including deficit financing, has been the subject of much debate in recent years. This debate has been the result of the tendency of the federal government to assume greater and greater responsibility in the national economy. A relatively new school of thought in economic theory takes the view that government plays a critical
role in achieving a more stable economy. Such activity will have a marked effect on agricultural prices and, therefore, needs to be examined at this point.

Federal spending may vary in nature and scope from direct subsidies to publicly financed projects, such as multiple-purpose dams, to say nothing of defense expenditures and other more "normal" operating expenses. Regardless of the nature of the expenditure, the impact on farm prices will be determined by the status of the recipients of this added source of income. An examination of one type of government spending, a public works project, will serve to illustrate the point.

Suppose that the government decides, in a period of declining economic activity and increasing unemployment, to invest public funds in some useful undertaking. Funds for such an undertaking may come either from the treasury or from the sale of bonds, or both. This money will be added to the income stream through the hands of otherwise idle workers, who previously had been living on past savings and unemployment insurance. An immediate effect will be an increase in the total consumption of food, since a proportionately larger share of the income of this group is spent for food and other necessities. In the face of this increased demand prices for agricultural commodities will tend to rise independent of other more complex reactions within the economy.
Because of the multiplier effect of investment expenditures the total amount added to the income stream will be some multiple of the original investment. This multiplier is a function of the marginal propensity to consume in the economy. If the marginal propensity to consume is 75 per cent, the multiplier will be four; i.e., if the original investment was 10 million dollars, the total amount added to the income stream would be 40 million dollars (4, pp.174-175). Of this, 30 million would be spent on consumption goods and 10 million invested. Prices in general would react favorably, with prices for agricultural commodities recovering first, assuming that the same historical relationships continue to prevail.

Finally, the marginal efficiency of capital, or the expected percentage return on new investments, will likely rise. This will lead to increased private investment and further increases in consumer incomes, with the same effect on prices as that indicated in the preceding paragraph.
CHAPTER V

EGG PRICES

This and the following two chapters will consist of a statistical analysis of the prices for three Oregon farm products. This chapter deals with eggs and the next two with strawberries and potatoes, in that order. It will be seen that a particular technique is not equally satisfactory for all conditions. It will also be seen that some series are more difficult to analyze than others.

Eggs are one of Oregon's leading agricultural products. In 1952 eggs were fourth in order of importance for individual commodities, being exceeded in income only by beef cattle, dairy products, and wheat (23,p.31). This source of income is particularly important when the part that it plays in the individual farm household is fully recognized. Sale of eggs is often a major factor in household budgeting because they are frequently traded directly to the grocer for food and other household items.

The average annual purchasing power of eggs, in terms of farm costs, shows much less variation from year to year than that of the other commodities studied (Figure 5). It follows the parity ratio (average purchasing power of all farm products) quite closely. Egg prices, however, exhibit considerably more variation within the year than do the other two commodity prices. This
Figure 4. Monthly price and production relatives for eggs in Oregon (12-month moving average = 100).

Figure 5. Parity ratio and relative purchasing power of eggs in Oregon (1935-39 = 100).
seasonal price variation is discussed below, followed by a discussion of annual variations in price.

Seasonal Movements

Seasonal variation in egg prices is quite marked (Figure 4). Price and production relatives shown were computed on the basis of monthly data running from 1909 to 1952, representing a twelve-month moving average of these data. Egg prices during this 44 year period varied from an average low of 73.8 in April to an average high of 139.9 in November (twelve-month moving average price equals 100). This means the April price is typically 26.2 per cent below the trend-cycle value and the November price is nearly 40 per cent above it.

Figure 4 shows the relationship between the average monthly price and average monthly production. Nearly 90 per cent of the variation in price can be explained in terms of monthly changes in production. The production index ranges from a high of 143.5 in April to a low of 63.9 in November (twelve month moving average of production equals 100). It can be seen that the variation in production during the year corresponds closely to the variation in prices.

4. Significant at the 99 per cent level of F.
There has been a change in the seasonal pattern of egg prices since about 1946. The average monthly price begins its seasonal decline about two months earlier than it did before the Second World War. As shown in Figure 4, production now begins its seasonal increase in August, also two months earlier than in the previous period. It is apparent that this has been the primary cause of the earlier decline in average monthly price. The change in seasonal production has apparently been a result of the development of flocks which begin laying earlier in the fall. Production is shown to begin its seasonal decline about a month earlier, indicating that the laying period also has been lengthened.

The magnitude of seasonal price movements has been reduced in this same post war period. This is probably a result of improved management practices and cold storage facilities, which have tended to stabilize the seasonal supply of eggs to a certain extent.

It needs to be mentioned at this point that, since about 90 per cent of the seasonal variation in egg prices is associated with changes in monthly production, only those producers who first adopted improved laying flocks realized a significant price advantage. As soon as the practice was generally adopted the seasonal price pattern shifted.
The consistency with which egg prices follow this seasonal pattern is illustrated in Table 2. It shows the average change in egg prices between months and the number of times that price moved up or down from the preceding month during two periods, 1909 to 1945 and 1946 to 1952. Only rarely did the movement of monthly prices deviate from the established pattern. This pattern is remarkably consistent, and one on which producers can depend in most years.

Table 2. Average change from previous month in the farm price for eggs in Oregon, and number of times that price moved up or down from the previous month, 1909 to 1945 and 1946 to 1952.

<table>
<thead>
<tr>
<th>Month</th>
<th>1909-1945</th>
<th>1946-1952</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Change</td>
<td>Number years up or down</td>
</tr>
<tr>
<td></td>
<td>cts./doz.</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>-6.87</td>
<td>32 [-8.37]</td>
</tr>
<tr>
<td>February</td>
<td>-7.14</td>
<td>37 [-5.91]</td>
</tr>
<tr>
<td>March</td>
<td>-4.26</td>
<td>34 [-1.76]</td>
</tr>
<tr>
<td>April</td>
<td>-6.67</td>
<td>27 [-0.13]</td>
</tr>
<tr>
<td>May</td>
<td>1.02</td>
<td>34 [1.33]</td>
</tr>
<tr>
<td>June</td>
<td>1.07</td>
<td>33 [2.80]</td>
</tr>
<tr>
<td>July</td>
<td>2.45</td>
<td>36 [7.06]</td>
</tr>
<tr>
<td>August</td>
<td>2.83</td>
<td>36 [4.99]</td>
</tr>
<tr>
<td>September</td>
<td>3.50</td>
<td>36 [1.90]</td>
</tr>
<tr>
<td>October</td>
<td>5.12</td>
<td>36 [0.53]</td>
</tr>
<tr>
<td>November</td>
<td>4.92</td>
<td>37 [-0.96]</td>
</tr>
<tr>
<td>December</td>
<td>-1.98</td>
<td>25 [-2.29]</td>
</tr>
</tbody>
</table>

An average price for a given month, based upon actual prices in preceding months of the same year, can be computed by using percentage changes in the monthly price relatives. The average price declines by 10.20 per cent.
from January to February; the average price in January, 1952, was 50 cents, the estimated February price 44.9 cents. The actual price in February, 1952, was 45 cents. This procedure can be used for any combination of months.

**Average Annual Price**

Several factors were found to influence the average annual farm price for eggs in Oregon. Average annual production in the state, per capita non-farm income, the general price level, and per capita consumption are the most important.

**Production**

Production of eggs in Oregon has increased steadily during the past 25 years, although not as rapidly as United States production (Figure 6). It is normally expected that price will fall as production (supply) increases, other factors remaining constant. Table 3 shows the relationship which exists between egg production and the farm price for eggs. The first item in column 4 is the average change in production associated with a one cent per dozen increase in price, ignoring other factors. It can be seen that price has increased even more rapidly than production, due to increases in per capita egg consumption and to a steadily rising general price level. The effect has been to hide the
true relationship between production and price.

It has already been shown in the preceding section that supply explains most of the variation in egg prices when monthly data are related. The real relationship between price and supply is obscured by other forces when annual data are related, unless the effect of these other forces is held constant.

Table 3. Gross and net changes in relevant independent variables with one cent per dozen increase in the farm price for eggs in Oregon.1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Gross Coefficient of Determination</th>
<th>Gross Change</th>
<th>Net Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Millions</td>
<td>.75</td>
<td>0.4606</td>
<td>-1.3385</td>
</tr>
<tr>
<td>Real Income</td>
<td>Dollars</td>
<td>.67</td>
<td>13.2580</td>
<td>24.1832</td>
</tr>
<tr>
<td>Wholesale Price Index</td>
<td>1935-39=100</td>
<td>.94</td>
<td>3.1997</td>
<td>3.2460</td>
</tr>
<tr>
<td>Per Capita Consumption</td>
<td>Eggs</td>
<td>.90</td>
<td>3.0730</td>
<td>----------</td>
</tr>
</tbody>
</table>

1. These are the reciprocals of the gross and partial regression coefficients. All of the coefficients are significant at .01.

The first item in Column 5 of the same table shows the net effect of production on price when income and the general price level are held constant. Under these conditions an increase in price of one cent per dozen is associated with an average decrease in production of 1.34 million eggs (or an average increase in production of
1.34 million eggs is associated with an average decrease in price of one cent per dozen. This relationship suggests an average elasticity of about 0.730, or an inelastic demand for eggs.

Income

Income as used here refers to real income, i.e., per capita non-farm income deflated by the general price level. This was done so that the effect of the general price level could be isolated and measured, and because changes in real income, rather than in absolute income, cause changes in effective demand.

Referring again to Table 3, there is a substantial difference between the average gross relationship (Column 4) and the average net relationship (Column 5) between real income and price. The gross relationship suggests that it takes an increase in real income of $13.26 to increase price one cent per dozen. The net relationship indicates a one cent per dozen increase in price with each $24.18 increase in real income. The difference in these values is a result of inter-relationships between real income and the other factors involved. It takes a smaller increase in real income to bring about a given increase in price when this increase is re-enforced by changes in other factors, e.g., by an increase in the general price level.
The General Price Level

The level of economic activity is a factor affecting the prices of all agricultural commodities, with the degree of influence depending on the particular commodity. In the case of eggs, the general price level explains 88 per cent of the variation in the farm price for eggs in Oregon. This influence on egg prices is not changed significantly by holding the effect of other factors constant.

If the effects of other factors are ignored, an average change in the wholesale price index of 3.20 points is associated with a change in price of one cent per dozen (Table 3). When the other factors are held to a constant value, a change of 3.25 in the wholesale price index produces the same change in price. Thus, it appears that the general price level exerts an important and largely independent influence on the price of eggs.

It should be noted that changes in the price of a commodity attributable to this source will be accompanied by similar changes in the prices of other commodities. However, this type of price change is important in farm planning because it shows the extent to which the movements of a particular commodity price are relatively stronger, weaker, or of the same magnitude as movements of other commodity prices.
Per Capita Consumption

A part of the increase in egg production has been absorbed by population growth and another part by increased per capita consumption. Since changes in per capita consumption are primarily due to changes in real income the effect of this factor with real income held constant should be insignificant. This is verified by the relationships shown in Table 3. When other factors are ignored, the relationship between per capita consumption and price is statistically significant. An average change in consumption of about three eggs per capita produces a one cent per dozen change in price (Column 4). However, when real income and other forces are held constant, the relationship between per capita consumption and price is not significant. Under these conditions it would take an increase in per capita consumption of about 30 eggs per year to produce a one cent per dozen change in price. Because changes in consumption are reflected through other factors, this variable was deleted from the estimating equation. As previously indicated, this is a logical result in view of the fact that real income was held constant.

These data indicate that the income elasticity of demand for eggs is positive and relatively low. As real income increases by ten dollars egg consumption increases
by about two eggs per capita, an income elasticity of 0.3602. This is consistent with estimates by other writers, who have set the income-consumption elasticity for eggs at 0.217 to 0.550 (14, p.69 and 25, p.41). Egg consumption moves in the same direction as real income, but at a slower rate.

**Estimated Price**

It is possible to derive an estimating equation for Oregon egg prices based on the relationships discussed above. The equation involves three independent variables--average annual production in Oregon, per capita non-farm real income, and the wholesale price index. The latter is a measure of the general price level. These combined factors account for 93.40 per cent of the variation in the average annual farm price for eggs in Oregon. The estimated price, using the equation shown in Figure 7, plus or minus 3.52 cents per dozen, will include the actual price 68 per cent of the time. The same estimated price plus or minus 7.04 cents per dozen will include the actual price 95 per cent of the time. If, for instance, the estimated price was 55 cents per dozen, the range from 51.48 cents to 58.52 cents would include the actual price 68 per cent of the time; or the range from 47.96 cents to 62.04 cents would include the actual price 95 per cent of the time.
Figure 6. Trend in annual egg production, Oregon and United States (1935-39 = 100).

Figure 7. Actual and estimated average annual farm price for eggs in Oregon, 1925 to 1952.
As was mentioned above, an increase in annual production of 1.34 million eggs, an increase in real income of $24.18 per year, or an increase in the wholesale price index of 3.25 will increase the average price of eggs one cent per dozen. The computed estimates of average annual egg prices are shown in Figure 7, together with the actual price for the same period. Only in one year, 1947, did the estimated price vary from the actual price by as much as seven cents per dozen. By inserting estimated values for each of the three variables into the equation an estimated average price can be arrived at for any given year.

It should be kept in mind that a price so estimated is an average price for the year. Monthly prices will vary from this estimate according to the seasonal price pattern analyzed earlier in this chapter. Estimates of monthly prices may be derived by using the seasonal price relatives, multiplying the estimated annual price by the relative for a given month. This, however, will be a rough estimate because both the annual estimate and the monthly relatives are based on averages. For estimating short run price changes, as between months, the use of seasonal price relatives and actual monthly prices will usually be more accurate than the use of regression coefficients derived from annual data.
CHAPTER VI

STRAWBERRY PRICES

Strawberries are a major fruit crop in Oregon. In terms of cash receipts, they were exceeded in importance by only the pear crop in 1951 and 1952 (23, p.31). Most of the strawberries grown in Oregon are sold to processors, less than 10 per cent of total production going into the fresh market. Because of this, the seasonal average farm price is very likely a more accurate estimate than is the case with most commodities. Once the price of strawberries is set by processors it tends to become a general price. Any change from this price is generally retroactive, so that one price prevails for an entire crop. Variations from this general price are caused only by differences in quality. In view of the fact that processing is the dominant factor in the strawberry industry in Oregon, the price used in this analysis is an average price for strawberries sold for processing.

The major factors found to influence strawberry prices in Oregon were United States production, income, and the general price level. Still another factor, carryover, exerted a minor influence.

Production

It was found that the average Oregon price for the
period 1924 to 1953 was more closely related to United States production during the previous crop year than to current production. It is believed that this is largely a result of the great uncertainty in weather conditions which prevails during the current harvest season. Estimates as to the size of the current crop can be rendered completely erroneous by a sudden adverse change in weather conditions. In the face of this uncertainty it appears that processors tend to base the opening price on the size of the crop in the previous year, but of course consideration also is given to current year crop prospects whenever any real tangible evidence is available.

Ignoring the effect on price of factors other than production, a reduction in the previous year's crop of 561 thousand crates is associated with a one cent per pound increase in the current price. If income and the general level of prices are held constant, the same change in price is caused by a reduction of 856 thousand crates in the previous year's crop. These relationships are shown in Table 4.

**Income and Consumption**

Strawberries are often considered a luxury item in the diet. When incomes are high the consumption of fresh and frozen strawberries is relatively high, when incomes are low consumption declines relative to other food items.
The income elasticities of all fresh fruits and of frozen fruits and vegetables have been set at 1.20 and 1.061, respectively (14, p.69 and 25, p.41). Data used in this analysis indicate that the income elasticity for strawberries is 0.6506.

Table 4. Gross and net changes in relevant independent variables with one cent per pound increase in the farm price for strawberries in Oregon.¹

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Gross coefficient of Determination (3)</th>
<th>Gross² Change (4)</th>
<th>Net² Change (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Million crates</td>
<td>.41</td>
<td>-0.5610</td>
<td>-0.8564</td>
</tr>
<tr>
<td>Income</td>
<td>Dollars</td>
<td>.50</td>
<td>22.3686</td>
<td>84.9690</td>
</tr>
<tr>
<td>Wholesale Price Index</td>
<td>1935-39=100</td>
<td>.60</td>
<td>8.5530</td>
<td>12.2856</td>
</tr>
<tr>
<td>Consumption</td>
<td>Pounds</td>
<td>.71</td>
<td>0.1606</td>
<td>---</td>
</tr>
<tr>
<td>Carry-over</td>
<td>Million pounds</td>
<td>.03</td>
<td>Not significant</td>
<td></td>
</tr>
</tbody>
</table>

1. Reciprocals of the gross and partial regression coefficients.

2. All coefficients are significant at 99 per cent level of t, with the exception of that for carry-over.

Strawberry producers enjoy the greatest relative advantage when real consumer incomes are high. Figure 8, page 56, shows the relative purchasing power of strawberries in terms of prices paid by farmers for factors of production. The relatively high price for strawberries from 1943 to 1951 was due both to high consumer incomes
and low production during the war years. Frozen strawberries have become increasingly important since about 1940. This too has had its effect on the total demand for strawberries.

An increase of $28.37 per capita in real income increases the average farm price for strawberries in Oregon one cent per pound, or thirty-six cents per crate, when other factors are ignored. If production and the general price level are held constant, it takes an increase of $84.97 in per capita real income to bring about a one cent per pound increase in price (Table 4). This again reflects the fact that the demand for fresh strawberries increases as real income moves upward.

The General Price Level

Movements in the general price level account for a large share of the variation in strawberry prices. If changes in production and income are ignored, changes in the general price level explain 59.91 per cent of the fluctuation in the farm price for strawberries in Oregon. When income and production are held constant, this is reduced to 41.65 per cent.

Referring again to Table 4, a change of 8.55 points in the wholesale price index will cause the farm price for strawberries to move one cent per pound in the same direction, when the effects of other variables are ignored.
If production and income are held constant, it takes a somewhat larger change in the wholesale price index, 12.29 points, to bring about the same change in price.

This source of variation may appear to be relatively unimportant because it only reflects the general level of all prices in the economy. It is important that it be isolated, however, if the effects of other factors are to be measured. Once this source of variation has been eliminated, the relative importance of changes in supply and demand, as they effect price, can be measured.

Other Factors

Two other factors which may cause variation in strawberry prices are per capita consumption, and storage stocks of frozen strawberries. Since these factors are either relatively less important than those discussed above or are implicitly measured in one or more other factors, they were not included in the multiple regression analysis.

The simple relationship between per capita consumption and price is shown in Table 4. An increase in consumption of 0.18 pounds per capita is, on the average, associated with an increase in price of one cent per pound. As would be expected, however, the relationship becomes statistically insignificant when income is held constant. This would leave only increases in per capita
consumption which were independent of changes in real income.

No significant relationship was found between the farm price for strawberries in Oregon and storage stocks of frozen strawberries. It is believed, however, that this factor is reflected to a certain extent in the production figure used above. Since this figure was for production in the previous crop year, storage movements would be implicit in these data.

**Estimated Price**

An estimating equation was derived, using the three factors which proved to be most important in explaining variations in the farm price for strawberries in Oregon. These are production in the previous year, per capita real income, and the general price level. The combined effect of these factors explains 85.21 per cent of the variation in price.

Figure 9 shows the actual and estimated farm price from 1924 to 1953. As was stated above, any one of the following will cause a one cent per pound increase in price when the remaining factors are held constant: (1) a decrease in production during the previous year of 856 thousand crates; (2) an increase in per capita real income of $84.97; or (3) an increase in the wholesale price index of 12.29 points. It is assumed that these
Figure 8. Parity ratio and relative purchasing power of strawberries in Oregon (1935-39 = 100).

Figure 9. Actual and estimated farm price for processing strawberries in Oregon, 1924 to 1953.

Cents Per Pound

\[ Y = 3.278937 - 1.167668X_1 + 0.11769X_2 + 0.081396X_3 \]

- \( X_1 \) = Production previous year
- \( X_2 \) = Per capita real income
- \( X_3 \) = Wholesale price index
effects are additive, so that when simultaneous changes occur in two or more of the independent variables, proportionately larger, or smaller, changes will occur in price. The effect of any one variable may be either to reinforce or negate that of the other variables.

A price estimated by use of this equation is not a single valued solution. There is an estimating error of 2.5 cents per pound. The actual price will fall within a range of the estimated price plus or minus 2.5 cents about 68 per cent of the time.
CHAPTER VII

POTATO PRICES

Oregon is one of the nation's major producers of late potatoes. As a source of farm income, the potato enterprise has been exceeded in importance in recent years only by wheat and the major livestock industries (23, p.31).

It has become necessary during the past two decades to differentiate between early and late crops when speaking of the nation's potato supply. Oregon is classified as a late-potato state, marketing its crop from about mid-July on into the summer. However, early potatoes have become increasingly important in the past few years.

Price movements for Oregon potatoes will be discussed under two general headings, seasonal variation and annual, or long-time, variations.

Seasonal Prices

There was a marked change in the pattern of monthly potato prices in Oregon, beginning about 1939 (Figure 10). During the time that this change was occurring, California production of early potatoes more than tripled (11, p.9). Acreage increased by 343 per cent and yields by 60 per cent. California now produces nearly two-thirds of the nation's total supply of early potatoes.
Figure 10. Monthly price relatives for Oregon potatoes, 1921 to 1939 and 1940 to 1952 (12-month moving average price = 100).

Figure 11. Monthly carlot shipments of potatoes from Oregon, Washington, Idaho, and California (12-month moving average = 100).
Prior to this sudden increase in early potato production in California, Oregon potatoes marketed in July and August commanded a seasonally high price. Approximately 70 per cent of the Oregon potato crop is usually sold in California and other western states. In recent years the phenomenal increase in early potato production in California has caused Oregon potato prices to drop to a seasonal low in July and August. At the time the Oregon crop is ready for market the price has usually been broken by California early potatoes, so that Oregon producers no longer have an advantage in California markets. In addition to this, the California crop competes both in Oregon markets and in major eastern outlets. This change in the monthly pattern of potato shipments from the far western states is shown in Figure 11.

It appears that Oregon producers might profit by a storage program whereby Oregon potatoes are withheld from the market during the time when the early potato crop has depressed prices to a seasonal low. The practice has been to harvest some eastern Oregon potatoes before they are sufficiently mature to store well. These potatoes are storable, however, if allowed to mature. The bulk of the California crop is marketed during the two months immediately preceding the Oregon harvest (10). Idaho and Washington crops are marketed at about the same time as the Oregon crop. The price begins to rise
again in August, but is not above the seasonal average until November or December (Figure 10). It then remains above the seasonal average until the following June.

It is beyond the scope of this thesis to examine fully the possible desirability, or profitability, of controlled marketing. This will depend, among other things, upon the availability and cost of storage, and the effect of storage on quality.

**Average Annual Price**

Here again it was found that three factors, production in the far western states, real income per capita, and the general price level, are the primary determinants of price. Together, these factors explain some 66 percent of the variation in the average annual price for Oregon potatoes. These factors will be discussed below in the order listed.

**Production**

Although Oregon potatoes are sold in markets throughout the nation, thus competing with all of the potato producing states to a greater or lesser degree, the Oregon price appears to be more closely related to production

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5. This actually is the average price for the months of July to March, when the bulk of the Oregon potato crop is marketed. The war years, 1943 to 1946, omitted.
in the states of California, Idaho, Washington, and Oregon, than to total production in the United States.\(^6\) As was previously indicated, a large share of the Oregon potato crop is sold in western markets, so that this seems to be a logical result.

Potato production in the four major Far-West potato states has increased from an annual average of 39.34 million bushels during the period from 1931 to 1935, to an average of 69.83 million bushels from 1948 to 1952 (10). This is an increase of 77.50 per cent, as compared with a comparable increase in total United States production of only 3.65 per cent. Thus, the western states have become increasingly important in their contribution to the nation's potato supply. This would at least partially explain why price in this area is more sensitive to local production than to total production. Rapid population growth in the Pacific West, relative to other areas, has also had its effect.

Gross and net relationships between production and price are shown in Table 5. When other forces are ignored, this relationship is positive, which indicates that production and price have risen together, and that

\(^6\) The partial correlation coefficient for United States production and price is \(-0.529\), and that for production in the four major western states and price \(-0.637\); price level and income are held constant.
forces attributable to other factors have hidden the true relationship between production and price. Price has increased one cent per bushel for every 421 thousand bushel increase in production. If price changes due to movements in the general price level and/or changes in real income are eliminated, a more logical relationship appears between production and price. Under these conditions a decrease in production of 374 thousand bushels is associated with a rise in price of one cent per bushel.

Table 5. Gross and net changes in relevant independent variables with one cent per bushel increase in the farm price for potatoes in Oregon.1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Gross Coefficient</th>
<th>Determination</th>
<th>Gross Change^2</th>
<th>Net Change^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Million bushels</td>
<td>.33</td>
<td></td>
<td>0.4210</td>
<td>-0.3740</td>
</tr>
<tr>
<td>Per capita Income</td>
<td>Dollars</td>
<td>.51</td>
<td></td>
<td>2.9310</td>
<td>6.9407</td>
</tr>
<tr>
<td>Wholesale Price Index</td>
<td>1935-39=100</td>
<td>.76</td>
<td></td>
<td>1.1198</td>
<td>0.8256</td>
</tr>
</tbody>
</table>

1. Reciprocals of the regression coefficients.
2. All coefficients significant at t.01.

**Income**

As with most food commodities, changes in real income have an important role in the determination of demand for potatoes. Unlike most food commodities, however, the consumption of potatoes is inversely related to income, i.e.,
potato consumption declines as real income increases. Data used here indicate an income-consumption elasticity for potatoes of \(-0.0835\).\(^7\) This was computed on the basis of changes in average annual per capita consumption and in per capita real income, between the periods 1931-1935 and 1948-1952. Average per capita consumption decreased by 4.89 per cent\(^8\) and per capita real income increased by 43.08 per cent. Since this is an average figure, including all income classes, the income elasticity will vary, depending upon the original income level and the magnitude of the change in income.

The purchasing power of potatoes, relative to other farm commodities, is highest during those periods when real incomes are relatively low. Conversely, after incomes have risen to a certain level, the purchasing power of potatoes drops. This is illustrated by Figure 12, which shows the purchasing power of potatoes and that of all agricultural commodities over the past 18 years. After the depression of the 1930's, incomes rose steadily until 1944, then declined somewhat until about 1947, at which time they continued to increase. The purchasing

\(^7\) This is consistent with estimates made by Waite and Trelogan, which set the income-consumption elasticity for potatoes at \(-0.096\) (25, p.41).

\(^8\) Adjusted for trend in consumption, and for price changes caused by other factors than income.
power of potatoes declined at about the same time that real consumer incomes began to rise. It remained low until the war years, during which it is believed that the inability of consumers to obtain certain other vegetables kept the relative purchasing power of potatoes high, in spite of higher incomes. When incomes rose again, after 1947, potato producers lost their favorable position. Thus, potato producers enjoyed the greatest relative advantage during periods when consumer incomes were falling.

Potato prices appear to be more sensitive to changing conditions than are the prices for eggs or strawberries. There is a marked difference in the purchasing power of these commodities over time. The coefficient of variation for the purchasing power of potatoes during the period from 1931 to 1952 is 34.42 per cent, as compared with 19.49 per cent for eggs and 17.66 per cent for strawberries. Thus potato producers can expect relatively large changes in the purchasing power of their product with a given change in income or other relevant factors. Uncertainty as to future prices, then, is greatest for potato producers, and relatively smaller for producers of eggs and strawberries.

9. War years from 1943 to 1946 omitted.
Table 5 shows average gross and net relationships between income and potato prices. Without considering the effect of any factor other than income, an increase of one cent per bushel in price is associated with an increase in real income of $2.93 per capita, per year. When production and the general price level are held constant, a change of $6.94 in income is necessary to bring about the same change in price. This arises from the fact that changes in income over time implicitly reflect similar changes in other variables, so that a larger change in income is required to produce a given change in price when this change is independent of other forces.

**The General Price Level**

Potato prices are quite sensitive to changes in the wholesale price index. This is important to potato producers only to the extent that potato prices are more or less sensitive to the general price level than other commodity prices. An advantage is gained if potato prices move up more rapidly than other prices, or if they move downward more slowly. Because potatoes have a negative income elasticity, only the latter case is likely to obtain.

Referring again to Table 5, the average gross relationship between price and the wholesale price index
has price moving one cent per bushel with a change of 1.120 points in the index of wholesale prices, and in the same direction. The net effect is somewhat greater, requiring a change of only 0.826 in the wholesale price index to bring about a one cent change in price.

Other Factors

While the above factors are of primary importance in the determination of potato prices, certain other factors are also significantly related to price. Both per capita consumption of potatoes and per capita consumption of wheat flour products are of some importance in their effect on price, but these effects cannot be isolated from other factors to an extent which will permit their use in a single estimating equation. No significant relationship was found between price and carry-over from the previous crop year. All but a small quantity of the previous year's crop is sold before the new crop is marketed.

Estimated Prices

Figure 13 shows actual and estimated annual average potato prices for the years 1931 to 1952, with the exception of the war years, 1943 to 1946. These war years were omitted because of the abnormal conditions which prevailed during that period.
Figure 12. Parity ratio and relative purchasing power of potatoes in Oregon (1935-39 = 100).

Figure 13. Actual and estimated farm price for potatoes in Oregon (1942-46 omitted).
In arriving at an estimated price, the equation combines the effects of production in Oregon, Washington, Idaho, and California, per capita real income, and the general price level. This estimated price follows the actual price quite closely, except for the depression years of the 1930's and some of the post-war years. In years such as these, where conditions are somewhat "abnormal", the variables used in the estimating equation do not reflect actual conditions as accurately as desired. This is at least partially due to psychological reactions to changing conditions, which cannot be empirically measured. In 1949 and 1950, for instance, the combined historical influence of the levels of production, income, and general prices did not indicate that prices would decline to the level that actually occurred. It is generally conceded that 1949 marked the beginning of a post war "let-down", and that the Korean War in mid-1950 staved off at least a minor recession. This is one of the reasons that statistical estimates should only be used as a guide, and only after they have been adjusted for "abnormal" situations not reflected in the data.

To summarize briefly the following changes are associated with a net increase of one cent per bushel in the farm price for potatoes in Oregon: (1) a decrease in far west production of 374 thousand bushels; (2) an
increase in per capita real income of $6.94; or (3) an increase of 0.826 points in the wholesale price index. These variables together explain 85.7 per cent of the variation in Oregon potato prices. The combined effects may tend to push price in the same direction, or there may be countervailing effects with the result that there may be little or no change in price.

10. Standard error of estimate is nearly 20 cents per bushel.
Producers in agriculture must cope with various sources and degrees of uncertainty in the decision-making process. One of these sources of uncertainty pertains to future prices for agricultural commodities. In order to utilize their resources more efficiently, producers need more complete information about price determining factors and changes in the relative prices for farm products. Price movements can be analyzed by means of deductive reasoning, or by application of statistical procedures to the relevant data. These approaches are not mutually exclusive, however, but should be used simultaneously in the establishment of meaningful relationships among pertinent economic variables.

Centered twelve-month moving averages were applied to monthly data in deriving seasonal patterns. This proved to be relatively simple for the data pertaining to eggs, both because marked seasonality of price and production does exist and because the available data reflect this seasonality more accurately than for certain other commodities. This, however, was not the case with potatoes. Considerable difficulty was encountered here, due primarily to two factors. The first was a lack of adequate data, a second, and somewhat related,
factor was the radical change which took place in the Pacific Western potato industry after 1930. This change has caused the seasonal pattern of potato prices and marketings to change drastically. Inability to obtain data which would reflect these changes seriously hampered attempts to derive accurate seasonal patterns. After the changes in seasonal production and price were recognized, however, and taken into account in the analysis, a new and reasonably accurate seasonal pattern became apparent. This emphasizes the importance of having some knowledge concerning the characteristics of a commodity when attempting to analyze price changes for that commodity.

Statistical procedures were applied to the data in an attempt to isolate specific relationships between the farm prices for eggs, potatoes, and strawberries and a number of independent variables. Strongest relationships were found, in the case of all three commodities, with production of the commodity, per capita real income, and the general price level. Relationships with other variables, such as storage stocks and per capita consumption, were either insignificant, eliminated because of interdependence with other factors, or both. The strength of the relationship between price and a given independent variable was seen to vary with the commodity involved.

In terms of percentage changes, production appeared to be the more important factor in the case of strawberries,
nearly so for potatoes, and least important for eggs. Real income was second in importance for eggs, and least important for potatoes and strawberries. Finally, the general price level appeared to be the most important factor affecting potato and egg prices, and second in importance for strawberries. This illustrates the divergence found in the relative importance of various independent variables between commodities.

Egg prices increased an average of one cent per dozen with: (1) a decrease in Oregon production of 1.34 million eggs; (2) an increase of $24.18 per year in per capita real income; or (3) an increase of 3.25 points in the wholesale price index, other factors constant. The estimating equation is \( Y = -9.03333 - .747084X_1 + .041351X_2 - .308068X_3 \). Changes in these three factors explained 93.4 per cent of the variation in Oregon egg prices during the period from 1925 to 1952, with a standard error of estimate of 3.52 cents per dozen.

The average annual farm price for Oregon strawberries increased an average one cent per pound between 1924 and 1953 with: (1) a decrease in the previous years production in the United States of 856 thousand crates; (2) an increase in real per capita income of $84.97; or (3) an increase in the wholesale price index of 12.28 points. The estimating equation is \( Y = 3.278937 - 1.167668X_1 + .011769X_2 + .081396X_3 \); the multiple
coefficient of determination is 85.21 per cent, with a standard error of estimate equal to 2.5 cents per pound.

Average annual potato prices in Oregon increased one cent per bushel during the period 1931 to 1952 with: (1) a decrease in combined production in Washington, Idaho, California, and Oregon of 374 thousand bushels; (2) an increase in per capita real income of $6.94; or (3) an increase in the wholesale price index of .8256 points. These effects may be separate, additive, or countervailing in the case of potato price determination or any other commodity price analysis using this method. The estimating equation for the average Oregon potato price is \( Y = -29.410752 - 2.673895X_1 - 1.144077X_2 - 1.211298X_3 \). The multiple coefficient of determination is 35.7 per cent, with a standard error of estimate of about 20 cents per bushel.

These estimating equations need to be used with some discretion. Due consideration must be given economic theory and commodity characteristics in interpreting the solution. Abnormal conditions usually are not taken into account by the equation, but necessitate adjustment in the data. It needs to be emphasized again that the estimating equation does not offer a single-valued solution, but only a range set by the standard error of estimate. The true value will fall somewhere within this range in a specified proportion of cases.
BIBLIOGRAPHY


