Projections of Demand,
Supply and Marketing Patterns
for U.S. Potatoes in 1980
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# PROJECTIONS OF DEMAND, SUPPLY AND MARKETING PATTERNS FOR U.S. POTATOES IN 1980

by

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# CHAPTER I

# INTRODUCTION

Potatoes, like an increasing number of fruits and vegetables, have gone through an evolutionary process which has changed the form in which the product is marketed. Since 1950 there has been a dramatic increase in the volume of potatoes marketed in processed form. The resulting changes in marketing patterns have had a tremendous impact on potato production and marketing arrangements.

## Purpose

The study undertakes one part of a research project which is seeking to determine those changes in the potato marketing systems which would increase total revenue in the Michigan potato industry. This research report lays the foundation for the entire research project by examining past, present and projected future relationships in the total United States potato industry. The information in this study provides the background necessary for a full understanding of the important market relationships in the potato industry. This complete understanding is necessary if the impact of policy proposals is to be adequately analyzed.

## Objectives

To provide the background necessary for a thorough understanding of the potato industry, several objectives must be met. The objectives of this research report are:

1. Identify changes in potato consumption patterns over time, discuss the factors which may have led to these shifts and project these consumption patterns to 1980.
2. Identify major potato producing states in the United States, identify the shifts in location and seasonability of potato production, and discuss the factors which may have led to these shifts.
3. Identify the location of processors of potato products and discuss the possible rationale behind their location pattern.
4. Identify and describe the movements of raw potatoes in the United States.
5. Identify and describe the marketing channels for potatoes.
6. Project United States demand-supply relationships to 1980.
7. Identify the amount and shift of potato utilization patterns over time and project these utilization patterns to 1980.

8. Project the production of potatoes by state and season in 1980 and discuss the factors which may lead to these projected shifts.

## Procedure

To identify and examine past and present relationships in the potato industry, secondary data are collected for a sample period of twenty years from various U. S. Department of Agriculture, university, and potato industry publications. The data dealing with potato consumption, production and utilization are assimilated so the shifts which have occurred during the past two decades could be readily identified. All collected data are analyzed using U. S. Department of Agriculture, university and industry publications and knowledge of the market.

The projection of United States demand-supply relationship makes use of the same secondary data sources for a sample period of 1949-1970. A model of the demand-supply relationship is developed using statistical and economic theory. This recursive model has four behavioral equations and two identities. The structural relationship of the behavioral equations in the model is estimated by the ordinary least squares estimation procedure. The estimated regression coefficients of the variables in the behavioral equations are used in conjunction with the value of projected predetermined variables, the value of

variables determined within the recursive model and the identity equations to determine projected demand-supply relationships.

The projections of consumption, utilization and production by state and season in 1980 also make use of these sources of secondary data. The sample period for the projections of consumption and utilization is 1950-1970, while the sample period used to project potato production by state and season is 1955-1972. The projections for consumption, utilization and production are determined by extrapolation of the trends of the time series data.

# CHAPTER II

# POTATO CONSUMPTION, PRODUCTION, AND MARKETING

## Introduction

The evolutionary process which has changed the form in which the potato product marketed has had a major impact on potato consumption, production and marketing patterns. This chapter will identify these shifts and discuss the factors which may have led to these shifts. Also, the movements of raw potatoes will be analyzed.

## Potato Consumption

The evolution in potato processing was a major factor in the reversal of the potato consumption pattern. Through the thirties and forties per capita potato consumption decreased while total potato consumption remained constant due to population growth. The majority of the potatoes consumed were fresh, although there was a small amount of potatoes consumed as chips, starch and flour. In the late forties and through the fifties the potato processing evolution began to take place. Processors found that potatoes could be marketed successfully in processed forms. Processors found demand increasing for

frozen potato products (primarily french fries) and dehydrated potato products.

The acceptance of processed potato products had a major impact on the potato utilization patterns in the sixties. Where the fifties were the beginning period for the potato processing industry, the sixties were the period of rapid growth. The three major forms of processed potatoes grew substantially during the sixties.

TABLE 1.--Per Capita Consumption of Fresh Potatoes and Processed Potato Products, 1950, 1960, 1970.

| | Total Fresh and Processed | Fresh | Total Processed |
|---|---|---|---|
| 1950 | 106.3 | 100.0 | 6.3 |
| 1960 | 108.4 | 84.7 | 23.7 |
| 1970 | 118.6 | 59.6 | 59.0 |

Source: American Potato Yearbook, 1951, 1961, and 1971.

Table 1 shows the reversal of the downward trend in total per capita potato consumption during the fifties. This reversal of the fifties is due to the increase in consumption of processed potato products. From 1950 to 1960 the increase in per capita consumption of processed potato products was larger than the decrease in per capita consumption of fresh potato products. Most of this increase occurred in the late fifties when consumers became aware

of the processed product. This set the stage for the sixties, when the consumption of processed potato products increased by 35.3 pounds per person. During this same time span, the annual per capita consumption of fresh potatoes decreased by 25.1 pounds. Thus, there was an increase in the per capita consumption of potatoes.

This rapid rise in the consumption of processed potato products was the result of a combination of rising incomes and changing tastes. Consumer incomes had been rising since the depression. Prior to the fifties, fresh potatoes were an inferior good because as consumer incomes increased the consumption of fresh potatoes decreased. This was a major reason for the decreasing per capita consumption of potatoes during this period. However, during the fifties, as per capita incomes continued to rise, the consumer demanded more leisure time. This led to more eating out and use of convenience foods. Also, the rise in consumer involvement in activities outside the home led to the rapid growth in fast food outlets, restaurants, and other institutions. These outlets found that it was much more economical to purchase potato products in processed form than to purchase fresh potatoes and perform whatever operation was necessary themselves. Rising consumer incomes also produced greater demand for convenience foods which require less preparation time in the kitchen. With a rising number of housewives holding

jobs, processors of dehydrated potatoes and frozen potato products had another segment of the market which they could supply. The increase in consumption of snack foods was another taste factor of particular importance to potato chippers. These changes which developed in the fifties had a major impact on the market for fresh potatoes. Per capita consumption might have continued to decline through the fifties and sixties without the occurrence of all these factors simultaneously, but the decrease probably would not have been as rapid as it was in the late sixties. These factors have combined to speed the decline in per capita consumption of fresh potatoes and hasten the increase in per capita consumption of processed potato products.

## Potato Production

Potatoes have shifted from a secondary crop, with the amount of acres planted a function of the number of acres allocated to the major crop, to a highly specialized, primary crop in many areas of the United States. This evolution has led to a shifting of potato production to areas of the United States which are more suited to large scale production techniques.[1]

Although potatoes are produced commercially in all fifty states, there are nineteen states which accounted

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[1]Will M. Simmons, "An Economic Study of the U. S. Potato Industry," Agricultural Economics Report No. 6 (Washington, D.C.: U. S. Department of Agriculture, March, 1962) p.6.

for 94.1 percent of total potato production in 1970 (See Table 2). Idaho is the major potato producer. Idaho produces more than twice as many potatoes as Maine, the second largest producer, and Idaho produced 23.0 percent of the total U. S. potato production in 1970. The third largest producing state, Washington, is rapidly closing in on Maine, which has remained relatively stable over the last 15 years. The three states located in the Northwestern corner of the United States, Idaho, Washington, and Oregon, rank first, third, and seventh respectively in production and produced 38.0 percent of the total United States crop in 1970. If California is included in the grouping, these Western states produced 47.2 percent of the total U. S. potato production. Although its potato production has trended downward, California is a major producer of potatoes in all producing seasons except early spring.

The major producing states in the Midwest are North Dakota, Minnesota, Wisconsin and Michigan. The majority of potatoes produced in North Dakota and Minnesota are produced in the Red River Valley. These four Midwestern states accounted for 16.7 percent of the total United States production in 1970. Production in these states has been on the rise, although not as rapidly as the Northwestern states.

Besides Maine, New York and Pennsylvania are the only major producers of fall potatoes in the Eastern region

TABLE 2.--Total Potato Production By State for 1970.

| State | Production (1000 cwt.) | Rank | Percent of Total Production |
|---|---|---|---|
| Alabama | 2,127 | 18 | 0.7 |
| Arizona | 2,712 | 17 | 0.8 |
| California | 29,760 | 4 | 9.2 |
| Colorado | 12,916 | 10 | 4.0 |
| Florida | 5,936 | 13 | 1.8 |
| Idaho | 74,660 | 1 | 23.0 |
| Maine | 35,699 | 2 | 11.0 |
| Michigan | 10,550 | 11 | 3.2 |
| Minnesota | 13,380 | 8 | 4.1 |
| New Jersey | 3,380 | 16 | 1.0 |
| New York | 16,977 | 6 | 5.2 |
| North Carolina | 2,093 | 19 | 0.6 |
| North Dakota | 17,550 | 5 | 5.4 |
| Oregon | 15,229 | 7 | 4.7 |
| Pennsylvania | 8,280 | 12 | 2.5 |
| Texas | 4,593 | 14 | 1.4 |
| Washington | 33,590 | 3 | 10.3 |
| Wisconsin | 13,038 | 9 | 4.0 |
| Virginia | 3,990 | 15 | 1.2 |
| All Other States | 18,340 | | 5.9 |
| Total Production | 324,801 | | 100.0 |

Source: U.S.D.A., Statistical Reporting Service, Crop Reporting Board, Crop Production, 1972.

of the United States. New York was sixth and Pennsylvania was twelvth in total potato production in 1970, but potato production has been trending downward in both states. The other major potato producing states in the Eastern and Southern regions of the United States are major producers of seasonal potato crops. New Jersey is a major producer of late summer potatoes. North Carolina and Alabama are major suppliers of late spring potatoes. Texas and Florida produce early spring potatoes, while Florida is a major producer of winter potatoes. Potato production in the areas which produce early season crops is relatively small and has been trending downward in New Jersey and Florida.

## Shifts in Potato Production

The majority of the potato production was located near the major centers of population early in the 20th century for a variety of reasons. The technology had not yet been developed which would retard the spoilage of the fresh product, so production had to occur near major markets. Because transportation costs were high relative to value of potatoes, production was not feasible in more distant areas. The adaptability of potatoes to most all soils is another factor which led to potato production near major markets. The fact that there wasn't a highly developed processing industry also led to this concentration. With most major markets located in the Eastern

region of the United States, the majority of potato production was located in the Eastern region.[2] Many of the early potato chippers, operating before the evolution in potato processing during the fifties, located near the centers of population in the East which encouraged potato production.

As transportation improved and the potato processing industry developed, production moved into the more efficient producing areas. These producing areas were well adapted to the large scale, highly mechanized production techniques (such as mechanical harvesting) which are necessary for efficient production of potatoes. These new areas of production were well adapted to irrigation, which has been an important factor in increasing yields of potatoes.[3] The increasing value of land in producing states such as California, New York, Florida, New Jersey and Pennsylvania, and the competition for acreage by other crops in Michigan, California, Florida and North Carolina, has led to concentration of production in areas where land values are relatively low and there are few competitive crops. Storage has also played an important part in the shift of production westward. As processing became more prevalent, potatoes became storable for the entire year.

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[2] Ibid., pp.6-7.

[3] Ibid., pp.6-7

Also, as consumption of processed potato products increased, potato processors established their plants in the Northwest near the source of low cost raw materials.[4] This had a multiplier effect in the expansion of potato production on the major Western potato producing states. Storage has also had an impact on the fresh market. Fresh potatoes are now available from the fall crop almost all year long because of improved storage. This has reduced the need for the different seasonal potato crops. The relation of the better storage and higher land values in major producing states of seasonal crops has led to the downward trend of production in these states.

## Location of Processors

Potato producers are located in every state. The majority of the potato processors are located in the major potato producing states (Table 3). As expected, Idaho has the largest number of processors. Approximately 40 percent of all potato freezers are located in Idaho, while over half of all dehydrators are located in the state. Idaho also is the location of the largest number of starch and flour processors, approximately 40 percent. Maine and Washington are tied for the second largest number of potato freezers, with seven freezers located in each state. The ten starch and flour processors located in Maine are

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[4] Ibid., pp.6-7.

TABLE 3.--Potato Processing Plant Locations in the United States, 1972.

| State | Freezers | Dehydrators | Chippers | Canners | Starch and Flour | Total |
|---|---|---|---|---|---|---|
| Alabama | -- | -- | 1 | 1 | -- | 2 |
| Arizona | -- | -- | 3 | -- | -- | 3 |
| California | 1 | -- | 13 | 12 | 1 | 27 |
| Colorado | -- | -- | 7 | 1 | -- | 8 |
| Florida | -- | -- | 5 | 1 | -- | 6 |
| Idaho | 19 | 18 | 4 | -- | 12 | 53 |
| Maine | 7 | 1 | 4 | -- | 10 | 22 |
| Michigan | 1 | 1 | 15 | 4 | -- | 21 |
| Minnesota | 2 | 2 | 5 | 2 | 2 | 13 |
| New Jersey | 2 | -- | 1 | 3 | -- | 6 |
| New York | 2 | 2 | 13 | 5 | 1 | 23 |
| North Carolina | -- | -- | 3 | 3 | 1 | 6 |
| North Dakota | 1 | 4 | 1 | -- | 2 | 8 |
| Oregon | 4 | 1 | 3 | -- | -- | 8 |
| Pennsylvania | 2 | -- | 25 | 3 | -- | 30 |
| Texas | -- | -- | 18 | 2 | -- | 20 |
| Washington | 7 | 4 | 5 | 1 | -- | 17 |
| Wisconsin | 1 | -- | 8 | 7 | -- | 16 |
| Virginia | -- | -- | 6 | 4 | -- | 10 |
| Total | 49 | 33 | 140 | 49 | 30 | |

Source: U.S. Department of Agriculture, Potato Marketing Report. (September, 1972); G. H. Sullivan, The Potato Industry, Purdue Research Bulletin No.862, (1968).

33 percent of the total number of U. S. starch and flour processors.

The Northwestern corner of the United States is the location for a majority of the processors of frozen potato products and processors of dehydrated potatoes. If the one potato freezing plant in California, which is located near the Oregon border is counted in the Northwestern total, 31 of the 49 potato freezers, or 60 percent, are located in this area.

An even larger percentage of potato dehydrating plants are located in the Northwest, approximately 66 percent. The large amount of relatively cheap labor and the production of a good, high yielding processing potato have induced processors to locate in this area.

Potato chippers and potato canners show a somewhat different geographical dispersion than potato freezers, potato dehydrators and potato starch and flour processors. The majority of the potato chipping plants are located in the potato producing states with large population centers. Although potato chippers might like to make use of potatoes with high total solids content and reduce costs by using relatively cheap labor by locating in the Northwest, transportation costs make this prohibitive.[5] Potato chippers must locate near the final consumers to reduce

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[5]G. H. Sullivan, "The Potato Industry," Purdue Research Bulletin No. 862 (1968) p. 16.

distribution costs as much as possible. This is illustrated by the fact that states with ten or more potato chippers, California, New York, Michigan, Pennsylvania, and Texas, all have or are located near large population centers. Canners of potatoes are located throughout the United States wherever canners of vegetable products are located. The majority of the potato canners are located in California.

## Marketing Channels

The shift to a larger percentage of the potato crop being processed has had an impact on the marketing channels available to the primary producer. Prior to the fifties, the producer had one major outlet for his potatoes, the fresh market. Small amounts of potatoes were going to potato chippers, while cull potatoes were processed into starch and flour. A majority of these processors were located in the Eastern region of the United States. With the evolution of the potato processing industry, the spectrum of possible marketing channels for potato producers was significantly broadened, as shown in Chart 1. This is especially true in the Northwestern portion of the United States where a large number of the various types of potato processors have located.

The discussion of the marketing channel begins with the primary producer. Potatoes produced for processing

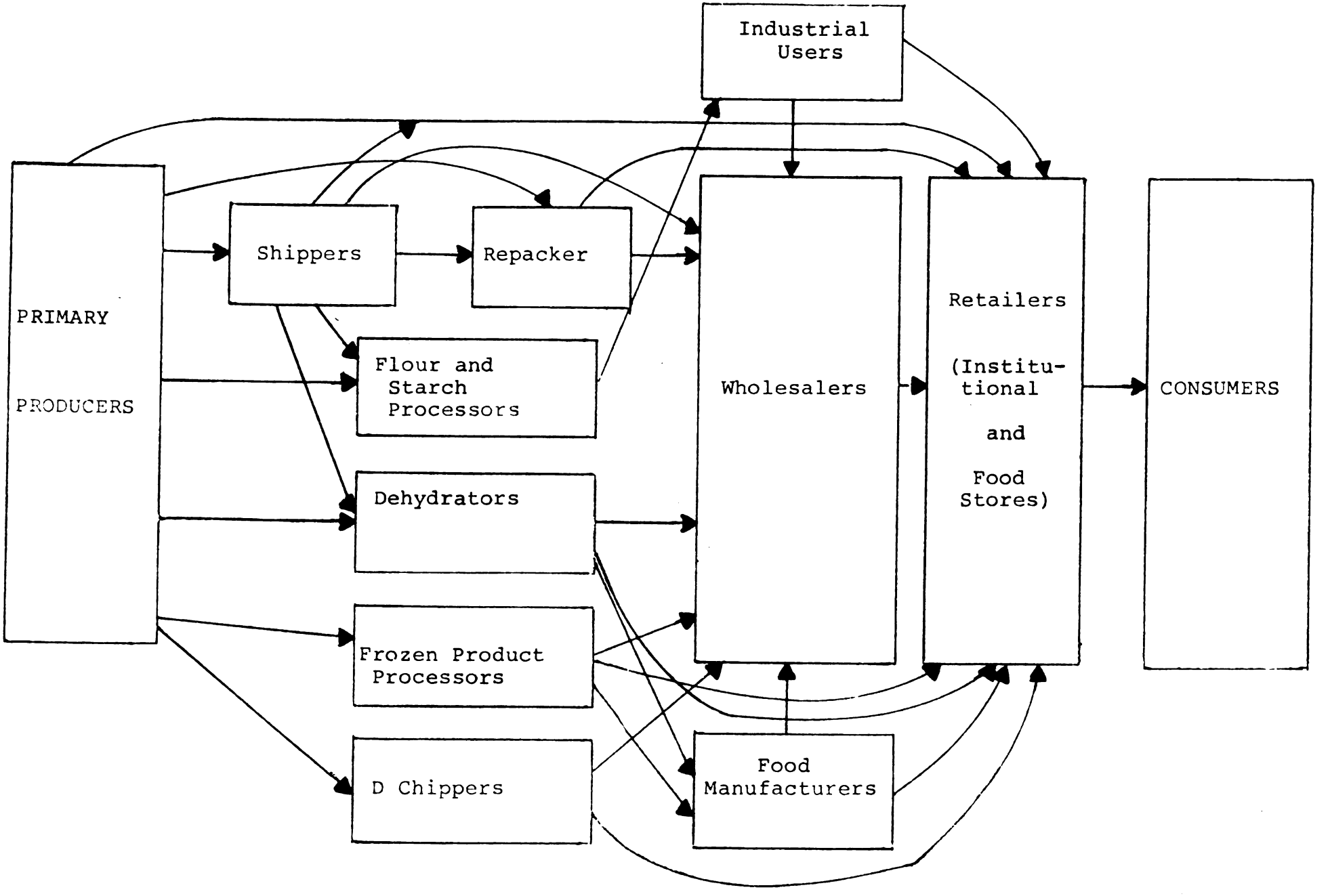


Chart 1.--A Flow Chart of Potato Marketing Channels.

purposes are taken directly from the field to the processing plant. The grower performs no other function except that of the producer. But, potatoes which go to the fresh market may be another story. Many of the smaller growers will send potatoes to shippers directly from the field. Shippers consolidate the production of these smaller growers. Shippers are usually located in or very near the production areas. Shippers perform the sorting function, segregating potatoes by size and quality. The next member of the channel, repackers, receive these sorted potatoes. Repackers are primarily located in or near major consuming markets. Repackers package potatoes for sale at retail food stores and package potatoes for use by institutional food establishments. From the repackers, potatoes may go to wholesalers or directly to retailers.

In reality it is doubtful that any fresh potatoes are actually handled by all the various members of the market channel. Although the number of handlers increases as distance to the market increases, as growers have become larger it has become more feasible for producers to perform other functions in the marketing channel. An increasing amount of growers of potatoes are taking over the function of the shipper. These growers are shipping sorted potatoes to repackers. Most of the larger growers are even by-passing the repacker, packaging the potatoes themselves and shipping the packaged potatoes to wholesalers

or directly to retailers. Some of the larger shippers have also taken on the packaging function. The shipment of fresh potatoes has been enhanced by the rise in the use of contracts by retailers, primarily large supermarket chains. The contract may be desirable from the primary producers standpoint because he knows exactly what price he will receive for his crop before it is planted. The contract may be desirable from the retailers standpoint because he knows exactly what the potatoes will cost him and because he has a specified supply. The contract may be desirable for both parties because the retailer and the producer can achieve a working relationship which will be to the advantage of both parties. At the present time a small percentage of the potatoes going to the fresh market are contracted, but because of the advantages the amount contracted is increasing.

Dehydrators of potatoes make greater use of contracts than do retailers of fresh potatoes. Evidence suggests that dehydrators contract directly with the grower for about half of the raw potatoes needed for processing. Although dehydrators like to process potatoes with the high total solids content, when there are not enough of these potatoes available or their price is too high, cull potatoes will be processed.[6] If cull potatoes

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[6]Ibid., p. 17.

are used, they are supplied by growers and shippers of fresh potatoes. After the potatoes have been processed, a large portion of the product goes to wholesalers or retailers. This movement may be facilitated by a food broker. The food broker acts on behalf of many different companies in the same role played by a salesman. A company will use a food broker if it isn't large enough to warrant its own sales force. Dehydrators have another option available. They can ship the processed potato product to food manufacturers. These food manufacturers use the dehydrated potatoes in other food products. For example, dehydrated potatoes may be used by the makers of frozen dinners or they may be processed into products which are similar to potato chips. The final processed product from the food manufacturers will also go to either wholesalers or retailers. Food brokers could also be involved in these movements.

Frozen potato product processors make even greater use of contracts for raw potatoes than do dehydrators. Somewhat over 50 percent of all potatoes processed into frozen products are obtained via the contract. The primary processed frozen product is french fries. The best french fries come from U. S. number one, two inch minimum potatoes which are high in total solids.[7] The demand for

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[7]Paul W. Wilkes, Procurement Manager for Ora-Ida Foods, Inc. A personal interview at Greenfield, Michigan, September, 1971.

a high quality potato product accounts for the large amount of contracting. Other frozen potato products which are processed from potatoes not meeting the standards for french fries are tater tots, hash browns, and other special products. After processing, frozen potato products can go to wholesalers or retailers of food manufacturers. Movements of frozen potato products from potato processors and food manufacturers to wholesalers or retailers many times involve food brokers.

Of the three major processors of potato products, potato chippers contract with the grower for the raw potatoes the least, somewhat less than 50 percent. Unlike frozen potato processors and potato dehydrators, potato chippers are located in almost all of the major potato producing areas throughout the United States. In many of these areas, the potato chipper is the only alternative to the fresh market. Also, many potato chippers are relatively small and do not use large quantities of raw potatoes. Thus, the potato chippers often can get the quality of potato necessary to make the best potato chips without the large use of contracts. Potato chippers will be forced to increase contracting in the future because of the decline in the production in many producing areas. Potato chippers ship the processed product to wholesalers and retailers. Again, food brokers may facilitate this movement.

The processors of potatoes for flour and starch deal primarily with cull potatoes. Flour and starch processors have decreased in importance with the rapid evolution of the other potato processors, the production of more high quality potatoes, and the ability to store potatoes longer. The supply of potatoes for starch and flour processors are the excess supply, cull potatoes of growers and cull potatoes of fresh potato shippers. Potato flour and starch is shipped to industrial users.

The final two members of the market channel are wholesalers and retailers. Wholesalers link potato processors and fresh potato distributors with retailers. There are many types of wholesalers in existence today. Independent wholesalers serve as a warehouse and a distributor for small retail food stores without a warehouse system. As these small retail food stores disappear, independent wholesalers will become less important. Another type is the cooperative wholesaler. This wholesaler services a number of independent retail food stores which are members of the cooperative organization. Many of the large retail food store chains have integrated backward in the market channel and perform the wholesaling function.

Most potato products go through retailers to reach the final consumer. Consumers can obtain potato products from two types of retailers, institutional and food stores. Institutional retailers prepare and sell potato products

in the ready to eat form. Institutional retailers are establishments such as restaurants, hotels, hospitals, cafeterias, cafes, military and other government agencies, caterers, and fast food outlets. Retail food stores may sell potato products in the ready to eat form, such as potato chips, but the potato products are not prepared by the retail food stores.

## Movements of Raw Potatoes in the United States

To analyze the flow of potatoes, the United States is broken into four major consumption regions, the Eastern region, the Southern region, the Midwestern region, and the Western region. These regions are developed directly from the flow data available in the Fresh Fruit and Vegetable Unloads for 41 Cities reports. These reports give the flow of fresh potatoes, in rail and truck unloads, from the state of production to the city of consumption. Regional consumption data is tabulated by consolidating the carlot or truckload shipments from a particular potato producing state to all the reporting cities within that region. So, flows to the four regions are determined by the cities within that region which are included within the unloads reports. These unload reports are not all-inclusive. Many large cities, such as Jacksonville, Florida; Las Vegas, Nevada; and Lansing, Michigan; are not included. The consumption of potatoes from these areas

is omitted. Table 4 lists the reporting cities within each particular region.

Before the flows of potatoes to a particular region are discussed, some of the limitations of the data used to determine these flows should be pointed out. First, the unload reports deal with raw potatoes. The data may not represent the actual flow of potatoes from one producing state to a consumption region. A potato producing state which has a large processing industry may not be totally represented by these reports. Second, there is no way of telling if the potatoes supplied are for fresh consumption entirely or if some of the unloads are processed. For example, unloads of potatoes in Detroit may go to the Frito-Lay plant which in turn distributes the processed potato product to the markets which the Detroit plant serves. The third limitation to the use of the data deals with the size of a carlot. For potatoes, the unloads report assumes that one carlot equals 50,000 pounds. But, the actual shipping weight per carlot for several states is heavier than 50,000 pounds. So, an exact comparison of carlot shipments to a particular consumption region from different producing states can not be made. Because of this variability of carlot weights, the data is left in unloads per consumption region. If the data were converted, the figures in many cases would be understatements

TABLE 4.-- Regional Listing of the Forty-one Cities.

| Eastern Region | Southern Region | Midwestern Region | Western Region |
|---|---|---|---|
| Albany, N.Y. | Atlanta, Ga. | Chicago, Ill | Denver, Colo. |
| Baltimore, Md. | Birmingham, Ala. | Cincinnati, O. | Los Angeles, Ca. |
| Boston, Mass. | Columbia, S.C. | Cleveland, O. | Portland, Or. |
| Buffalo, N.Y. | Dallas, Tex. | Detroit, Mi. | Salt Lake City, Ut. |
| New York, N.Y. | Ft. Worth, Tex. | Indianapolis, Ind. | San Francisco, Ca. |
| (Inc. Newark, N.J.) | Houston, Tex. | Kansas City, Mo. | (Inc. Oakland, Ca.) |
| Philadelphia, Pa. | Memphis, Tenn. | Louisville, Ky. | Seattle, Wash. |
| Pittsburg, Pa. | Miami, Fla. | Milwaukee, Wis. | (Inc. Tacoma, Wasj.) |
| Providence, R.I. | Nashville, Tenn. | Minneapolis, Minn. | |
| Washington, D.C. | New Orleans, La. | St. Louis, Mo. | |
| | Oklahoma City, Okla. | | |
| | San Antonio, Tex. | | |

Source: U. S. Department of Agriculture, Consumer Marketing Service, Fruit and Vegetable Division, Market News Branch, Fresh Fruit and Vegetable Unloads in Eastern Cities, 1971.

or overstatements of the actual amount of potatoes shipped from a producing state to a consumption region. Finally, the Fresh Fruit and Vegetable Unloads reports only count the number of unloads in 41 cities in the United States. Even though these 41 cities are the major consuming cities in the United States, there are a number of important cities excluded which could effect the conclusions about supplies by a particular potato producing state to a particular consumption region. For example, if unloads in Richmond, Virginia, or the Norfolk-Hampton-Newport News, Virginia, area were reported, the potato producing states of Virginia and North Carolina would have a greater impact on the Eastern consumption region. There are other cities excluded which could increase the amount of potatoes supplied by a particular state to a particular consumption region.

The Eastern Region

Keeping the limitations of the data in mind, the flows of raw potatoes, from the major producing states to the four major consumption regions can be analyzed. The first consumption region to be analyzed is the Eastern region. The 1971 total and monthly flows of raw potatoes to the Eastern region is shown in Table 5. Maine is the largest supplier of raw potatoes with more than twice as many unloads as any other major potato producing state.

to the Eastern Region in 1971.

| State | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maine | 967 | 1337 | 1829 | 2283 | 1904 | 1028 | 36 | | 77 | 346 | 1013 | 1017 | 11837 |
| Idaho | 590 | 602 | 708 | 671 | 608 | 428 | 56 | | 11 | 254 | 482 | 464 | 4874 |
| New York | 676 | 471 | 386 | 155 | 134 | 79 | 79 | 602 | 953 | 764 | 591 | 599 | 5489 |
| California | | | | 12 | | 1077 | 1413 | 687 | 69 | 21 | 10 | 19 | 3308 |
| Virginia | | | | | | 142 | 1196 | 260 | | | | | 1588 |
| Pennsylvania | 67 | 67 | 64 | 82 | 12 | | | 16 | 17 | 35 | 45 | 75 | 480 |
| Florida | | | 124 | 200 | 342 | 113 | | | | | | | 779 |
| North Carolina | | | | | | 91 | 109 | | | | | | 200 |
| Washington | | | | | | | | 299 | 450 | 201 | | | 950 |
| New Jersey | 11 | 13 | 12 | | | | 15 | 265 | 243 | 251 | 156 | 103 | 1069 |
| Wisconsin | | | | | | | | 23 | 95 | 120 | 109 | 29 | 376 |
| Other (Michigan, Oregon, North Dakota, Minnesota, Texas, Alabama) | 36 | | | | 27 | 26 | | 188 | 207 | 93 | 51 | 40 | 668 |
| Total | 2347 | 2490 | 3123 | 3403 | 3027 | 2984 | 2904 | 2330 | 2122 | 2085 | 2457 | 2346 | 31,618 |

Source: U. S. Department of Agriculture, Consumer Marketing Service, Fruit and Vegetable Division, Market News Branch, Fresh Fruit and Vegetable Unloads in Eastern Cities, 1971.

Besides being the second largest producer of potatoes, Maine has a geographical advantage in the Eastern region. Maine is the largest or very close to the largest unloader of raw potatoes in all the reporting Eastern cities, except Buffalo, which is located nearer to a major potato producing region in New York. Producing primarily fall potatoes, Maine does not supply the Eastern region the year round. Unloads from Maine begin to occur in September and October. The major impact on the market of the fall crop is from November through June.

The second largest supplier of potatoes to the Eastern region is New York. New York, like Maine, enjoys a geographical advantage in the Eastern region. New York supplies all the reporting cities except Philadelphia and Providence, with New York City being the largest market outlet. The seasonal supply pattern of New York is somewhat different from the seasonal supply pattern of Maine. New York is a major producer of late summer potatoes as well as fall potatoes. So, New York unloads a large number of raw potatoes in August, September and October, before the fall crop has had much impact on the market. The supplies of New York potatoes begin to decrease in February and continue to decline until June.

Unloads of raw potatoes from Idaho are an interregional flow of potatoes or a flow of potatoes into the Eastern region from the Western region. Although

the number of unloads of raw potatoes from Idaho is smaller than the number of unloads from New York, the actual amount of raw potatoes supplied by Idaho may be greater than the actual amount supplied by New York, if the actual carlot weights were measured.

Idaho supplies all of the reporting Eastern cities, but the majority of the unloads are in New York City and Philadelphia. The seasonal unload pattern of Idaho resembles the seasonal unload pattern of Maine. Unloads of the fall crop begin in September and October. The number of unloads increases to a peak in March and then declines.

There are several states which supply the Eastern region with seasonal production. The major unloader of seasonal potatoes is California. Although the major supply of raw potatoes by California is during only three months, June, July and August, California is still the fourth largest supplier in the Eastern region. California is the major supplier in these months to all the reporting Eastern cities, except Baltimore and Washington. The largest amount of California potatoes are unloaded in New York City and Boston. Virginia is another of these seasonal suppliers of the Eastern region in the summer months, with the majority of the unloads occurring in July. Virginia, like California, is taking advantage of the small number of unloads through these months by the largest three suppliers of this region. Unloads of raw potatoes from

Virginia exceed unloads from California in Washington and Baltimore because of the geographical advantage. Florida unloads raw potatoes from the winter and early spring crops in the Eastern region from March through June, with peak amount of unloads in May. The majority of the Florida unloads are split between Baltimore, Washington, Philadelphia and New York City. Washington and New Jersey supply the Eastern region with late summer potatoes through August, September and October, just before the fall crop is marketed. Washington primarily supplies New York City, Boston and Philadelphia, while New Jersey supplies New York City, Philadelphia and Washington. Wisconsin and Pennsylvania are small suppliers of fall potatoes. Wisconsin ships raw potatoes to New York City and Pittsburg. Almost all Pennsylvania potatoes are unloaded in Pittsburg. Pittsburg also receives unloads of potatoes from Michigan from August through November.

The Southern Region

The Southern region of the United States receives the smallest total number of unloads of raw potatoes of any region. This is due to the smaller population in the Southern reporting cities when compared to the population in reporting cities in the other regions of the United States. Another reason for the smaller number of unloads of raw potatoes in the Southern region is the composition

of the diet of the people in this region. Southern people do not include potatoes in their diet as much as people in other regions of the United States.[8] Finally, there is no major producer of fall potatoes in the Southern region. All the producing states within the region produce smaller, seasonal crops.

The major supplier of raw potatoes in the Southern region, Colorado, as shown in Table 6, primarily supplies the Texas and Oklahoma markets. The largest unloads of raw potatoes from Colorado occurs in Dallas and Oklahoma City. This emphasizes the second reason given for the smaller number of unloads in the Southern region. The Texas and Oklahoma markets have consumption patterns more like those found in the Southwestern portion of the United States, where potatoes are more important part of the population's diet, than the Southeastern region. Colorado also has a geographical advantage in these markets over other major fall potato producing states. Since Colorado produces fall potatoes and late summer potatoes, the seasonal supply pattern is similar to that of New York. Unloads of late summer potatoes begin to occur in August and September. October through May are the months in which the largest number of unloads of raw potatoes from Colorado occur.

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[8] "Homemakers Preferences and Buying Practices for Selected Potato, Rice and Wheat Products," Marketing Research Report No. 939, (October, 1971) p. 27.

| State | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | | | | | 95 | 407 | 230 | 242 | 18 | 12 | | | 1004 |
| California | 29 | 18 | 33 | 13 | 35 | 541 | 489 | 192 | 46 | 27 | 22 | 14 | 1459 |
| Arizona | | | | | 35 | 407 | 268 | 28 | | | | | 738 |
| Idaho | 340 | 336 | 435 | 455 | 405 | 524 | 131 | 11 | 34 | 169 | 327 | 346 | 3513 |
| Minnesota | 245 | 214 | 232 | 141 | 62 | 26 | | 11 | 168 | 318 | 335 | 357 | 1791 |
| North Dakota | 255 | 269 | 247 | 254 | 61 | | | | 124 | 338 | 319 | 292 | 2159 |
| Washington | | | | | | 10 | | 298 | 383 | 150 | 23 | | 864 |
| Florida | | | 115 | 158 | 295 | 37 | | | | | | | 605 |
| Maine | 102 | 74 | 84 | 136 | 110 | 70 | | | | | 41 | 34 | 649 |
| New York | 160 | 172 | 184 | 122 | 98 | 35 | | 33 | 121 | 117 | 121 | 134 | 1297 |
| Wisconsin | 259 | 185 | 141 | 81 | 24 | 11 | 18 | 179 | 405 | 266 | 249 | 297 | 2115 |
| Colorado | 649 | 458 | 716 | 638 | 309 | 33 | 17 | 128 | 238 | 370 | 326 | 358 | 4240 |
| Texas | 51 | 51 | | 59 | 148 | 124 | 294 | 420 | 420 | 126 | 119 | 74 | 1731 |
| Other (Oregon, New Jersey, Michigan, Virginia, Pennsylvania, North Carolina) | 80 | 80 | 15 | | 10 | 49 | 234 | 153 | 153 | 85 | 43 | 25 | 871 |
| Total | 2170 | 1820 | 2200 | 2057 | 1687 | 2274 | 1681 | 1695 | 1936 | 1978 | 1925 | 1931 | 23,036 |

Source: U. S. Department of Agriculture, Consumer Marketing Service, Fruit and Vegetable Division, Market News Branch, Fresh Fruit and Vegetable Unloads in Southern Cities, 1971.

Idaho is the second largest supplier of potatoes in the Southern region. Idaho ships potatoes to all reporting cities in the Southern region with no one particular city unloading a large amount of raw potatoes. The seasonal unload pattern is primarily the same as the Eastern region in the Southern region, except for the peak unload month. The peak number of unloads occur in June in the Southern region as compared to March is the Eastern region.

The number of unloads of raw potatoes from Wisconsin and North Dakota are almost equal in the Southern region. Both states supply the same cities in the Southern region, with Wisconsin unloading primarily in Atlanta, Birmingham, Memphis, Nashville, New Orleans and Oklahoma City. Seasonal unload patterns of these two states differ slightly. Unloads from the late summer crop in Wisconsin begin in August. From October to January the number of unloads is fairly stable. After January they begin to decline to a low point in June. Unloads of North Dakota raw potatoes begin in September. The peak supply period of North Dakota potatoes is From October to April.

Minnesota and New York supply the Southern region primarily with fall potatoes, although New York does supply this region with a small amount of late summer potatoes. The unload pattern of Minnesota potatoes closely follows the unload pattern of North Dakota potatoes, with the major market for Minnesota potatoes being Dallas. New York raw

potatoes are unloaded primarily in three Southern cities, Atlanta, Miami and Columbia. New York has a relatively stable number of unloads from September through December, a peak number in March, and then a decline to June.

There are a number of seasonal and small suppliers of the Southern region. California, as in the Eastern region, is one of the major seasonal suppliers. The major thrust of the California supply is again in June, and July and August. California supplies all reporting Southern cities except Memphis, with the largest number of unloads occurring in Houston. Alabama is another of these seasonal suppliers. The majority of Alabama potatoes are unloaded in Atlanta and Birmingham. Unloads of Texas raw potatoes occur not only in June, July and August, but also in May, September, October and November. The unloads of Texas potatoes outside the June, July and August period occur primarily in the four reporting Texas cities. Arizona ships raw potatoes from the Late Spring crop to the Southern region mainly in June and July. The major market for Arizona raw potatoes is Dallas. Florida again primarily unloads potatoes from the winter and early spring crops in March, April and May. The major market for Florida potatoes is Atlanta. Washington supplies the Southern region with raw potatoes from August through October. All reporting Southern cities unload Washington raw potatoes.

Maine is a small supplier of fall potatoes. The majority of the Maine raw potatoes are unloaded in Atlanta and Miami, with Maine being the major supplier in the latter city.

The Midwestern Region

Idaho is the major supplier of the Midwestern region, as shown in Table 7. Unloads of Idaho potatoes occur in all reporting cities in the Midwestern region. Idaho is the major supplier of potatoes in Cincinnati, Cleveland, Indianapolis and Louisville, and very close to the major supplier in Chicago. The largest number of unloads of Idaho raw potatoes occur in Chicago, Cleveland, Detroit, and Indianapolis. Although Idaho unloads potatoes in the Midwestern region in all months, the seasonal unload pattern is not drastically different from the Eastern region or the Southern region. From a low in August, the number of unloads increases as the fall crop is harvested and marketed. The three peak unload months are March, April, and May.

The second largest supplier of raw potatoes in the Midwestern region is Wisconsin. Being centrally located in this region gives Wisconsin a geographical advantage in many reporting Midwestern cities. Chicago is a good example of this. The unloads of Wisconsin potatoes in Chicago exceed all other supplying states. Wisconsin is also the major supplier of raw potatoes in Louisville and Milwaukee

| State | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | | | | | 53 | 359 | 153 | 61 | | | | | 626 |
| Arizona | | | | | 59 | 625 | 315 | | | | | | 999 |
| California | | | | | 92 | 1810 | 1684 | 232 | | | | | 3818 |
| Florida | | 18 | 165 | 306 | 596 | 283 | | | | | | | 1341 |
| Idaho | 723 | 710 | 912 | 903 | 923 | 855 | 235 | 135 | 245 | 449 | 633 | 650 | 7373 |
| Maine | 87 | 66 | 113 | 226 | 210 | 50 | | | | | 15 | 50 | 817 |
| Michigan | 539 | 506 | 453 | 272 | 54 | | 67 | 607 | 613 | 666 | 509 | 488 | 4774 |
| Minnesota | 389 | 324 | 405 | 342 | 227 | 81 | 51 | 263 | 566 | 571 | 540 | 474 | 4233 |
| North Dakota | 604 | 600 | 745 | 581 | 375 | 63 | | | 109 | 243 | 592 | 659 | 4541 |
| Washington | 11 | | 12 | | | 13 | 14 | 418 | 305 | 85 | | | 858 |
| Texas | | | | | 106 | 14 | 240 | 153 | | | | | 513 |
| Wisconsin | 615 | 460 | 496 | 323 | 211 | 100 | 11 | 531 | 966 | 847 | 611 | 432 | 5603 |
| Other (Oregon, North Carolina, Virginia, Pennsylvania, New York, Colorado) | 91 | 68 | 68 | 73 | 29 | 55 | 354 | 216 | 109 | 24 | 30 | 32 | 1149 |
| Total | 3059 | 2752 | 3369 | 3026 | 3008 | 4308 | 3124 | 2616 | 2913 | 2885 | 2900 | 2785 | 36,654 |

Source: U.S. Department of Agriculture, Consumer Marketing Service, Fruit and Vegetable Division, Market News Branch, Fresh Fruit and Vegetable Unloads in Midwestern Cities, 1971.

and is a close second to Idaho in Cincinnati. Because of the production of late summer potatoes, unloads of Wisconsin potatoes occur earlier in the year than unloads of a fall crop state like Idaho or Maine. The number of unloads of raw potatoes from Wisconsin begins to increase in August to a peak level in September. From October through March, the number of unloads is fairly stable. The number of unloads then decreases after March.

The number of unloads from the three remaining potato producing states in the Midwestern region are almost equal. These three states, Michigan, Minnesota, and North Dakota, are all within the Midwestern region so these are intra-regional flows, as are flows from Wisconsin. North Dakota and Minnesota are large suppliers of raw potatoes in Chicago, Cincinnati, Kansas City, Louisville, Minneapolis, and St. Louis. Almost all potatoes produced in Michigan are unloaded in Detroit, although there are unloads in Louisville, Cincinnati and Cleveland. The seasonal unload pattern in Minnesota and North Dakota is similar to the seasonal unload pattern in Michigan, which is similar to other states which produce late summer and fall potatoes, such as New York or Wisconsin.

The largest seasonal supplier of raw potatoes in the Midwestern region is California. California supplies raw potatoes from May through August, with unloads occurring in all reporting Midwestern cities. Unloads of

California potatoes are largest in Chicago, Cleveland, Detroit and Minneapolis. Alabama also supplies the Midwestern region during the May through August time period. The major markets for Alabama potatoes are Cincinnati and Louisville. Unloads of Arizona potatoes occur in the Midwestern region from May to July. Arizona primarily supplies Chicago, Cleveland, Detroit and Minneapolis. Texas is a supplier of early summer potatoes to the Midwest. The majority of the unloads of Texas potatoes are in Chicago, Cleveland, and St. Louis. Unloads of raw potatoes from Florida occur from March through June. Florida ships raw potatoes to all reporting Midwestern cities. Detroit is the largest market for Florida potatoes. Unloads of Washington potatoes occur primarily from August to October. Washington supplies most of the reporting cities, with Chicago being the largest market. A small number of unloads of the fall potato crops from Maine, Pennsylvania, and New York occur in Cleveland.

The Western Region

The Western region of the United States has a characteristic which distinguishes it from all other regions. All flows of raw potatoes are intra-regional. In other words, all major suppliers of raw potatoes are located within the region. There are two major factors which explain this occurrance. First, most of the reporting cities in

the Western region are located along the Pacific Ocean. The transport costs to ship raw potatoes into these Western areas from the other producing states outside the Western region make it impossible to compete with potatoes produced in the Western region. Second, the potato producing states in the Western region are ranked first, third, fourth, seventh, tenth and seventeenth in potato production. The Western potato growers produce more than enough to meet the demand within the region.

The largest unloader of raw potatoes in the Western region is California, as shown in Table 8. This is apparently due to the large urban consuming centers in California. In the other three regions California is primarily a seasonal supplier of raw potatoes. Even in the Western region, the largest number of unloads of California potatoes occur in June and July. But, in the Western region California is a major supplier of raw potatoes the year round. With California producing potatoes in five of the six growing seasons, there is a steady flow of raw potatoes for the entire year. The majority of unloads in the early and late months of the year occur in San Francisco and Los Angeles, the latter being the largest unloader of California potatoes.

Oregon is the second largest supplier of the Western region. Oregon, gains some competitive advantage over Idaho because of closer proximity to the major Western

TABLE 8.--Flows of Fresh Potatoes from Major Producing States by Months to the Western Region in 1971.

| State | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colorado | 391 | 383 | 419 | 392 | 304 | 16 | | 329 | 411 | 382 | 392 | 391 | 3800 |
| Arizona | | | | | 71 | 399 | 279 | | 23 | 21 | | | 793 |
| California | 1078 | 1071 | 1075 | 995 | 1029 | 2044 | 2322 | 1345 | 1166 | 865 | 834 | 766 | 14590 |
| Idaho | 239 | 255 | 424 | 392 | 476 | 327 | 62 | 113 | 72 | 347 | 717 | 653 | 4077 |
| Oregon | 668 | 581 | 566 | 590 | 449 | 301 | 45 | 246 | 197 | 341 | 432 | 454 | 4870 |
| Washington | 226 | 191 | 231 | 230 | 193 | 92 | 81 | 697 | 749 | 625 | 347 | 240 | 3884 |
| Other (North Dakota, Florida, Texas) | | | 31 | 32 | | | 132 | 60 | 13 | 11 | 28 | 10 | 317 |
| Total | 2602 | 2481 | 2746 | 2631 | 2522 | 3179 | 2921 | 2772 | 2631 | 2592 | 2750 | 2314 | 32,331 |

Source: U. S. Department of Agriculture, Consumer Marketing Service, Fruit and Vegetable Division, Market News Branch, Fresh Fruit and Vegetable Unloads in Western Cities, 1971.

markets. The majority of the unloads of raw potatoes from Oregon go to three cities, Los Angeles, Portland, and San Francisco. The seasonal unload pattern of Oregon, a producer of fall potatoes, resembles that of Idaho.

The third and fourth major supplier of potatoes in the Western region are Idaho and Washington. Idaho is a supplier of potatoes in all reporting Western cities, as is Washington. The number of unloads of Idaho potatoes are largest in Los Angeles, Salt Lake City and San Francisco. Washington is an important supplier of raw potatoes in Los Angeles and San Francisco during August, September and October. But, the largest number of unloads of Washington potatoes occur in Seattle. Washington supplies Seattle all twelve months. The seasonal unload pattern in Idaho in the Western region is similar to the seasonal unload pattern in the other consumption regions. The seasonal unload pattern in Washington is similar to the seasonal unload pattern of other states which produce late summer potatoes and fall potatoes.

Arizona is the one true seasonal supplier in the Western region. Arizona unloads raw potatoes from May to July. Almost all unloads of Arizona potatoes in the Western region are in Denver. All unloads of Colorado potatoes occur in Denver.

# CHAPTER III

# U. S. DEMAND-SUPPLY PROJECTIONS IN 1980

## Introduction

A recursive system is used to project the supply and demand for potatoes for all uses at the farm level throughout the United States. The four equations in the recursive system incorporate major behavioral variables which influence the supply and demand for potatoes. The first of these equations, the acreage equation, states that the yearly acreage of potatoes is a function of the farm price of potatoes in the previous period, the acreage of potatoes in the previous period and the farm price of wheat in the previous period. The average yield of potatoes is stated as a function of time. The average marketing margin of potatoes is stated as a function of marketing labor costs. The final equation, the average retail price of potatoes is a function of marketing margin, total production, per capita disposable income and time. Two identities are used in the model to tie the recursive system together.

Each of the equations in the system is estimated separately via the ordinary least square procedure of

estimation.[1] The ordinary least squares estimation procedure yields best linear unbiased estimates. The equations are estimated using time series data from 1949-1970.

Also, the shifts which have occurred in the fifties and sixties in potato consumption and utilization are examined in greater detail. Specifically, shifts in the consumption of the various processed potato products and shifts in the utilization of raw potatoes are examined. Projections of consumption and utilization are made by extrapolating trends of consumption and utilization time series data from 1950-1970.

## The Model Structure

### The Acreage Equation

The acreage equation explaining variations in the yearly acreage of potatoes in the United States for the current period. The acreage equation is:

$$A_t = a_1D_1 + b_1D_1FP_{t-1} + b_2D_1A_{t-1} + b_3D_1W_{t-1} + a_2D_2 + b_4D_2FP_{t-1} + b_5D_2A_{t-1} + e$$

where:

$A_t$ = Annual acreage in the current period (1,000 acres).

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[1] A simultaneous equation model was developed in the early stages of the study making use of both two stage least squares estimation procedures. Comparison of results from the simultaneous equation model and the recursive system lead to rejection of the simultaneous equation model because the results were significantly not different.

$FP_{t-1}$ = Average price of potatoes received by farmers in the previous period (dollars per cwt).

$A_{t-1}$ = Annual potato acreage in the previous period (1,000 acres).

$W_{t-1}$ = Average price of wheat received by farmers in the previous period (dollars per cwt.).

$D_1$ = Dummy variable, where $D_1 = 0$ if 1949-1953 and $D_1 = 1$ if 1954-1970.

$D_2$ = Dummy variable, where $D_2 = 0$ if 1949-1953 and $D_2 = 1$ if 1954-1970.

e = Statistical error term.

$a_1$, $a_2$ and $b_1$ to $b_5$ = Regression coefficients to be estimated.

The acreage equation states that the total potato acreage ($A_t$) is a function of three variables prior to 1954, the farm price of potatoes received in the previous year ($P_{t-1}$), the total potato acreage in the previous year ($A_{t-1}$), and price of wheat in the previous year ($W_{t-1}$), and two variables after 1954, the farm price of potatoes in the previous year, and the total potato acreage in the previous year.

The inclusion of farm prices in the previous period reflects the assumption that producers expect prices to be the same in the current year as they were in the previous year. It is expected that if farm prices for potatoes are high in the previous year producers will increase potato acreage and that both $b_1$ and $b_4$ will be positive.

Potato acreage in the previous period is included in the equation as a proxy for variables which cannot be

readily quantified, but are important determinates of the amount of potato acreage. Reflected through this variable is the crop rotation practice of potato producers, the amount of fixed assets used in potato production, and producer management habits. With the high level of fixed capital investment required to produce potatoes, especially since 1954, a producer is not likely to decrease or increase production a great deal. The producer usually will plant sufficient acreage to effectively utilize this specialized equipment and will hesitate to buy extra equipment. This probably is a major reason for the relatively small variability in the number of acres planted since 1954.

The farm price of wheat in the previous period is also included in the acreage equation prior to 1954. The production of potatoes in the many different areas of the United States makes it difficult to determine a universal crop or crops which compete with potatoes for available acreage. Although wheat is not grown in all major producing regions, it is the only other major crop which competes with potatoes for acreage across the entire United States. Again it is assumed that producers expect farm prices to remain the same in the current year as they were in the previous year. Using these prices, producers made decisions about the allocation of acreage. The price of wheat was a significant variable prior to 1954 because

producers were less specialized and could more easily shift acreage from potato production to wheat production. After 1954, with the shift to mechanical potato harvesters, producers were no longer as flexible to change crops because of the high fixed capital investment and the resulting push toward specialization. Thus, the price of wheat was no longer a significant influence on the amount of potato acres planted. The value of the parameter $b_1$ is expected to be negative because a relatively high price of wheat would stimulate more wheat acreage and less potato acreage.

The two dummy variables, $D_1$ and $D_2$, are included to account for an unexplained shift in the potato producers supply behavior which apparently occurred in the mid-fifties. The primary cause for this shift was the introduction of mechanical potato harvesting. As mentioned above, the high fixed capital investment requirement, due to the introduction of the mechanical harvester and other capital intensive production techniques, combined with the increase specialization, probably reduced acreage variability. Thus, a possible shift in the functional relationship of the variables is allowed for by including both slope and intercept dummy variable shifters in the equation, selecting 1954 as the shifting point because after that year the variability in the actual amount of potato acreage was reduced.

The Yield Equation

The yield equation explains variations in the average yearly yield of potatoes in the United States for the current period. The yield equation is:

$$Y_t = a_1 + b_1 T + e$$

where:

$Y_t$ = Average yield of potatoes in the current period (lbs per acre).

$T$ = Time

$e$ = Statistical error term.

$a_1$ and $b_1$ = Regression coefficients to be estimated.

The average yield of potatoes ($Y_t$) is stated as a function of time (T). The independent variable time is used as a proxy for the amount of variable inputs used per acre which can not be readily quantified. The amount of the various inputs used in the production of potatoes will be a great influence on the yield obtained. As the prices of inputs change, the mix of inputs used will also change. The mix of inputs will directly affect yield. Lack of data over the time period specified (1949-1970) is the major obstacle to using this variable. The major producing states do not have time series data on this variable, although some is available for specific years. There would be a problem even if a time series of the amount of variable inputs used per acre were available for a major potato producing state. The amounts of inputs used vary from state

to state and season to season. So, data from one state for one season would not be sufficient to reflect the amount of inputs used in all other states and seasons.[2]

The Marketing Margin Equation

The marketing margin equation explains variations in the average yearly marketing margin for potatoes in the United States for the current period. The marketing margin equation is:

$$MM_t = a_1 + b_1 MC_t + e$$

This formulation of the marketing margin equation was found to have serial correlation in the statistical error term when it was estimated. The adjusted marketing margin equation is[3]:

$$(MM_t - \rho MM_{t-1}) = a_2 + b_2 (MC_t - \rho MC_{t-1}) + e$$

this equation can be transformed to:

$$MM_t = a_2 + b_2 MC_t - b_2 \rho MC_{t-1} + \rho MM_{t-1} + e$$

where:

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[2]The index of prices paid for were inputs by farmers and the expenditures of inputs in Idaho were tried in the yield equations as a proxy for the amount of inputs used. The coefficients for both variables were not significantly different from zero.

[3]The procedure used here was suggested by Dr. Lester V. Manderschied. The procedure is a variation of the Hildreth-Ln method of solving the serial correlation problem.

$MM_t$ = The average marketing margin for potatoes in the current period (cents per pound).

$MM_{t-1}$ = The average marketing margin for potatoes in the previous period (cents per pound).

$MC_t$ = The average marketing labor costs in the current period (dollars per hour).

$MC_{t-1}$ = The average marketing labor cost in the previous period (dollars per hour).

e = Statistical error term.

$\rho$ = A constant used to adjust the equation for serial correlation.

$a_1$, $a_2$, and $b_1$, $b_2$ = Regression coefficients to be estimated.

The average marketing margin for potatoes in the current period ($MM_t$) is a function of the average marketing labor cost in the current period ($MC_t$). Marketing labor cost is an average of wages paid for labor necessary to move the product through the market channel from the producer to the final consumer. If marketing labor costs could be eliminated, the differential between farm and retail price would be close to zero. Although this is unrealistic, it does lead to a prediction about the sign of $b_2$. A relatively high marketing labor cost will cause a higher marketing margin due to retailers desire to incorporate this increased cost into the retail price. So, it is expected that $b_2$ will be positive.

Marketing margin in the previous period ($MM_{t-1}$), marketing labor cost in the previous period ($MC_{t-1}$), and $\rho$

are included in the equation to adjust for serial correlation present in the first equation formulated. The value of $\rho$ is calculated using the Durbin-Watson statistic (d), which shows the presence of serial correlation in the first form of the equation. The formula used to calculate the value of $\rho$ is $d = 2(1-\rho)$. The use of the lagged variables and $\rho$ change the form of the independent and dependent variables which reduces the serial correlation problem.

The Retail Price Equation

The retail price equation explains variation in the average yearly retail price of fresh potatoes in the United States for the current period. The retail price equation is:

$$RP_t = a_1 Q_t^{b1} MM_t^{b2} PI_t^{b3} T^{b4} e$$

which can be transformed to the linear form for estimation by taking the logarithm of each side, thus:

$$\log RP_t = \log a_1 + b_1 \log Q_t + b_2 \log MM_t + b_3 \log PI_t + b_4 \log T + \log e$$

where:

$PR_t$ = The average retail price of fresh potatoes in the current period (dollars per cwt).

$Q_t$ = The total production of potatoes for all uses in the current period (1,000 cwt).

$MM_t$ = The average marketing margin for potatoes in the current period (cents per pound).

$PI_t$ = Per capita annual disposable income ($1,000).

T = Time

e = Statistical error term.

$a_1$ and $b_1$ to $b_4$ = Regression coefficients to be estimated.

The retail price of potatoes ($RP_t$) in the current period is a function of four variables, the total production of potatoes in the current period ($Q_t$), the marketing margin for potatoes in the current period ($MM_t$), per capita disposable income in the current period ($PI_t$) and time (T). The total production of potatoes reflects the influence of the supply of potatoes on the retail price of potatoes. Assuming a normal, downward sloping demand curve for potatoes, the relationship between retail price and the quantity supplied can be determined. A relatively small supply of potatoes will yield a higher retail price. A relatively large supply of potatoes will yield a lower retail price of potatoes. Although the degree of variability in the retail price change due to a change in the quantity of potatoes supplied depends on the price elasticity of demand, it can be assumed that retail price and quantity supplied vary inversely. This indicated that the value of the coefficient $b_1$ should be negative.

The marketing margin is an important variable in the retail price equation because retailers include the costs which determine this margin in the retail price. With collective bargaining being of little significance for potatoes, prices are determined by the interaction of demand and supply, and marketing margin can be assumed to be

independent of farm price. The desire of retailers to include all costs which determine marketing margin, not just marketing labor costs, make this a significant factor in determining the level of the retail price. As the marketing margin increases, retailers will increase the retail price. So it is expected that the regression coefficient for the marketing margin ($b_2$) should be positive.

The per capita disposable income will influence the demand for potatoes, which will be a direct influence on the retail price of potatoes. As disposable income increases, the demand for potatoes will shift. With a fixed supply of potatoes, changes in the demand for potatoes will also change the retail price of potatoes. The direction of the change in demand depends on whether consumers consider potatoes are an inferior commodity, that is, increases in disposable income cause a decrease in demand for the commodity, or if potatoes are a normal commodity, that is, increases in disposable income cause an increase in demand for the commodity. Population also influences the demand for potatoes, but because of the high correlation between disposable income and population (.98) it was not included in the equation as a separate variable. Instead, the per capita disposable income variable was used to incorporate the influence of both disposable income and population.

As in the yield equation, there are variables which affect the demand for potatoes which can not be readily quantified. Time is specified in the equation as a proxy for these variables which gradually change over the sample period. The most important of these variables is consumer tastes and preferences. The consumption tastes and preferences of the consumers will have a direct effect on the commodities demanded and the quantity of each commodity demanded. As these tastes and preferences change, so does the demand.

The Identity Equations

The identities are two definitional equations which are necessary when the projection procedure is used. The identity equations are:

$$Q_t = A_t \times Y_t$$

$$FP_t = RP_t - MM_t$$

where all variables are the same as defined above.

## Estimation Results

The Acreage Equation

An ordinary least square estimation procedure was used to estimate the regression coefficients for the acreage equation from the 1949-1970 time series data. The results are:[4]

[4]The figures in parentheses are the standard errors of the coefficients.

$$A_t = 420.32 + \underset{(53.93)}{299.96}\ D_1FP_{t-1} + \underset{(.15)}{.91}\ D_1A_{t-1} -$$

$$\underset{(109.12)}{307.98}\ D_2W_{t-1} + \underset{(28.12)}{56.41}\ D_2FP_{t-1} + \underset{(.22)}{.58}\ D_2A_{t-1}$$

$R^2 = .79$[5]

$d = 2.43$[6]

The results indicate that the variables included in the above equation explain approximately 79 percent of the potato acreage variation during the 1949-1970 time period. All signs of the regression coefficients are consistent with the expected sign and using the t-test, all regression coefficients are significantly different from zero at the 5 percent significance level. There is no serial correlation present in the residuals.

The regression coefficients for the farm price of potatoes prior to 1954 indicates that if the farm price in the previous period increased by ten cents per hundredweight, the potato acreage in the present period would increase by approximately 30,000 acres. After 1954, the same ten cent increase in farm price in the previous period would induce producers to increase potato acreage only 8640 acres.

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[5] $R^2$ is the coefficient of determination which indicates the percentage of variation in the dependent variable explained by the independent variables in the equation.

[6] d is the calculated Durbin-Watson statistic which is used to test for serial correlation.

These results indicate that the number of acres put into production of potatoes has become much more inflexible to price changes probably due to the shift to mechanized potato production, especially mechanized harvesting.

The regression coefficients for potato acreage in the previous period indicate that potato acreage in the present period increased as potato acreage in the previous period increased. Prior to 1954, an increase in potato acreage in the previous period of 1000 acres increased potato acreage in the present period by 910 acres. But, after 1954, the same 1000 acre increase in the previous period increased potato acreage in the present period by 580 acres. This decrease in the variability of potato acreage in the present period reflects structural changes in the three major variables for which acreage in the previous period is a proxy. The amount of fixed assets used in potato production increased as producers shifted to mechanization. Producers had a greater incentive to maintain sufficient acreage to effectively utilize these highly specialized fixed assets. This led to increased specialization which had repercussions on rotation practices. The producers were forced to abandon the rotation practices used before the introduction of the specialized equipment and adopt new ones which allowed them to obtain maximum utilization of this equipment. The increased amount of fixed assets also changed producer crop management habits. The grower was

forced to become a specialized potato producer. Diversification became a thing of the past.

The farm price of wheat in the previous period also influenced potato acreage prior to 1954. The regression coefficient for the farm price of wheat indicates that a ten cent increase in the price of wheat in the previous period decreased potato acreage in the present period by 30,798 acres. The negative regression coefficient for this variable indicates that wheat was a competing crop prior to 1954. In early formulations of the acreage equation, the farm price of wheat was included in the equation after 1954, but was found not to be significantly different from zero. Again, the influence of the shift to more mechanized potato production had a great deal to do with the reduction of the significance of wheat prices. The increase in mechanization has forced producers to be more specialized and to increase the size of potato farms to obtain economics of scale. Thus, wheat prices in the previous period after 1954 were not significant in determining potato acreage in the present period.

## The Yield Equation

The results of the yield equation are:

$$Y_t = 137.48 + \underset{(.20)}{4.06}\ T$$

$$R^2 = .95$$

$$d = 1.79$$

The results obtained indicate that the independent variable time explains approximately 95 percent of the yield variations during the 1949-1970 time period. This high coefficient of determination value indicates that the actual yield of potatoes during the time period closely resembles this linear approximation. The shifting of potato production from areas of the country with lower annual yields to areas of the United States which are better suited to produce potatoes and thus obtain larger yields, as discussed in Chapter II, is one important factor which has caused yields to rise over the sample time period. Also, yields in each of the potato production areas have increased for a number of other reasons. Some of these reasons are production of higher yielding varieties, use of better seed, wider use of irrigation, more use of fertilizers, better crop management, use of advanced production technology and use of pesticides and herbicides. The regression coefficient is judged to be significantly different from zero at the 5 percent significance level and there is no serial correlation in the residuals.

The Marketing Margin Equation

The results for the marketing margin equation are:

$$(MM_t - .51\ MM_{t-1}) = .03 + \underset{(.24)}{2.13}(MC_t - .51\ MC_{t-1})$$

or using the transformed version of this equation:

$$MM_t = .03 + \underset{(.24)}{2.13}\ MC_t - \underset{(.24)}{2.13}(.51\ MC_{t-1}) + .51\ MM_{t-1}$$

$$R^2 = .80$$

$$d = 1.79$$

$$\delta = .51^7$$

The independent variable, the adjusted first difference of the marketing labor cost, explains approximately 80 percent of the variation in the adjusted first difference of the marketing margin. Before the equation was adjusted for serial correlation, market labor costs explained approximately 93 percent of the variation in the marketing margin. The coefficient $b_1$ is positive, as predicted above, and significantly different from zero at the 5 percent significance level. The original equation yielded a value of .98 for the Durbin-Watson statistic which indicated that serial correlation was present. After adjusting the equation for the serial correlation, a Durbin-Watson statistic of 1.79 was obtained which shows that the serial correlation problem was reduced by the adjustment procedure described above.

It can be shown that the negative value of the marketing labor cost in the previous period will almost be completely offset by the positive value of the marketing

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[7] With a value of the Durbin-Watson statistic in the original equation of .98, $\rho$ is formulated from the equation $.98 = 2(1-\rho)$.

margin in the previous period. Thus, for explanation purposes, changes in the marketing margin the present period are dependent on changes in the marketing labor cost in the present period. For example, in period t, assuming no change in the previous period, a ten cent increase in marketing labor cost will increase the marketing margin by 21 cents. In period t + 1, assuming marketing labor cost stabilizes at this new, higher level, marketing labor cost in the previous period has increased by ten cents while marketing margin has increased by 21 cents and after inserting these values into the marketing margin equation and doing the arithmetic, the marketing margin in period t + 1 is unchanged from that for period t. The increase in marketing margin due to an increase in marketing labor cost reflects the desire of retailers to cover most costs associated with getting the product to market in the retail price.

The Retail Price Equation

The results for the retail price equation are:

$$RP_t = 3.35Q_t^{-.45}\, MM_t^{1.41}\, PI_t^{.27}\, T^{-.29}$$

or in the linear logarithmic form:

$$\log RP_t = \log 3.35 - \underset{(.24)}{.45 \log Q_t} + \underset{(.31)}{1.41 \log MM_t} + \underset{(.21)}{.27 \log PI_t} - \underset{(.08)}{.29 \log T}$$

$$R^2 = .85$$

$$d = 2.04$$

The value of the coefficient of determination indicates that the four independent variables explain approximately 85 percent of the variation in the logarithm of retail price. An $R^2$ value of 85 for the retail price equation is quite good, especially when it is realized that the data used is the average of retail price data collected in selected cities across the United States on a non-standardized product. All regression coefficients are consistent with expected results. Three out of four independent variables, total production, marketing margin, and time, are significantly different from zero at the 5 percent significance level. The fourth independent variable, per capita disposable income is not significantly different from zero at the 5 percent significance level. There are two reasons why the variable is retained even though it isn't significant at the 5 percent level. The presence of multicollinearity may have biased the standard error of the coefficient upward.[8] If the standard error of the coefficient is biased, the regression coefficient for per capita disposable income may be actually significant at the 5 percent significance level. Also, per capita disposable

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[8] The use of exponential form of the retail price equation reduced the correlation between the time variable and the per capita disposable income variable from .96 for the arithmetic equation to .89. This reduction in correlation reduces the severity of the multicollinearity problem, although it is still present.

income is an important economic variable. Thus, it should be retained in the equation. There is no serial correlation in the residuals.

The estimated regression coefficient for the total production of potatoes for all uses indicates that as potato production increases, retail price decreases. But, the magnitude of the regression coefficient seems smaller than would be normally expected for a staple food product. The price flexibility coefficient, which can be taken directly from the estimation results, is -.45.[9] If all cross flexibilities and cross elasticities are assumed to be zero, the price elasticity equals one over the price flexibility. So, the corresponding price elasticity is -2.22. This result implies that the demand for potatoes is very elastic. An elastic demand indicates that a large change in the quantity supplied has a very small effect on retail prices. Most prior studies indicate that the price elasticity is approximately -.3, where farm price is a function of total production. Although the calculated elasticity may be too high because of a slight simultaneous equation bias, there is a plausible explanation for this apparent inconsistency. It should be noted that this study uses retail prices for fresh potatoes instead of farm prices for potatoes. At the farm level, changes in production of potatoes will cause

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[9] Price flexibility = $\frac{\partial P}{\partial P} \times \frac{Q}{P} = b_1$

large fluctuations in the price of potatoes. But these variations in farm price need not carry over to the retail price. The shift toward increased processing of potatoes has been a major factor which has pushed the price elasticities upward and reduced the large variability of retail price. Processors can buy potatoes when farm prices are low and absorb much of this production increase because of the ability to store the processed product for relatively long lengths of time. Also, if farm prices are depressed, potato farmers may find it economically feasible to feed potatoes to livestock or keep them as seed for next year's crop. So, instead of a large increase in the amount of potatoes supplied to the fresh market, which would have occurred before the processing revolution, processors can absorb a majority of this increased production and reduce the size of the increase in the amount of potatoes supplied to the fresh market.

The regression coefficient for the marketing margin variable indicates that the retail price of potatoes increased as the marketing margin increased. This is consistent with the result predicted above and is based on the assumption that retailers incorporate any increase in the costs which determine the marketing margin into the retail price.

Increases in per capita disposable income increased the retail price of potatoes during the sample period as

indicated by the positive regression coefficient. This indicates that as per capita disposable income rises, the demand for potatoes rises to induce the increase in the retail price of potatoes. It cannot be determined whether potatoes are a normal or inferior good because the per capita disposable income variable measures the effects of disposable income and population. The estimated regression coefficient for the time variable indicates that the retail price of potatoes decreased every succeeding year during the sample period due to gradually changing unquantified variables such as tastes and preferences. It should be pointed out that the multicollinearity problem does not affect the estimated regression coefficients for these two variables. Multicollinearity will not bias the estimated regression coefficients either upward or downward, but it may bias the standard errors of the coefficients.[10]

## The Projection Procedure

There are three variables which are not determined within the model and must be predicted before any calculations can occur. Of the three predetermined variables, time, per capita disposable income, and marketing labor cost, only two need to be estimated by use of a statistical technique.

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[10]Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics. (John Wiley and Sons, Inc., 1970) p. 59.

The extrapolation of linear trends is used to estimate the per capita disposable income and marketing labor cost variables. The linear trend equation is of the form $Y = a + bT + e$ where Y is the estimated predetermined variable and T is time. The coefficient of determination was quite good for both variables, being 96 percent for per capita disposable income and 93 percent for marketing labor cost. These linear trends are extrapolated into future to obtain values of per capita disposable income and marketing labor cost.

Before the actual projection procedure is discussed, two important assumptions should be made explicit. It is known that linear increases or decreases will not continue at a constant rate to infinity. At some point in time, the rate of increase or decrease will begin to slow. This occurs because the value of the variable is approaching the asymptote, the upper limit of increase or lower limit of decrease for that variable. It is assumed in this model that during the prediction period the rate of increase or decrease will not slow or that the asymptote will not have been reached. An example of this would be the slowing of the increase in the yield of potatoes due to environmental factors. One of these factors could be a shortage of water for irrigation which would definitely reduce yields. It is also assumed that the structure of the estimated equations of the model remains constant over the projection

period. It is a distinct possibility, especially in the rapidly changing potato industry, that sometime during the next ten years the structural relationship within an equation will change. A good example of this was the shift to mechanical harvesters which occurred in the mid-fifties. This changed the structural relationship within the acreage equation. If a change does occur during the seventies, it is not known what this change will be or when it will occur. So, for projection purposes, it is assumed that the estimated structure will continue to 1980.

For projection purposes, the specification of the marketing margin equation is changed slightly. The equation is modified by adding $\rho\ e_t$, where $e_t$ is the residual value in the last period (1970 in this case). This last modification is necessary to assure the proper unbiased projections.[11] This allows the serial correlation present between the last error term and all succeeding error terms to be built into the projection. If this term was not added to the equation, the resultant projection of the marketing margin would be biased. The $\rho$ value must be squared for the second time period, cubed for the third time period, and so on to account for the decreasing correlation between the error term in the last observed time period and all succeeding periods. With $\rho = .51$ and $e_t = .04$ in 1970, the

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[11] J. Johnston, Econometric Methods. (McGraw-Hill, 1963) p. 187.

adjustment term becomes very close to zero after only two projections.

To explain the projection procedure, the year 1971 will be used as an example. To estimate the total potato acreage, the value for total potato acreage in 1970 and the farm price in 1970 are inserted into the acreage equation (the first three variables are not used because $D_1 = 0$). These values times their respective regression coefficients plus the constant term determines the total potato acreage in 1971. The projected yield for 1971 is the value of the predetermined variable time in 1971 multiplied by its regression coefficient plus the constant term. The marketing margin in 1971 can also be easily projected. The market margin in 1970 is known, the marketing labor cost in 1970 is known, and the marketing labor cost in 1971 is a projected predetermined variable. All other constants and regression coefficients needed to project marketing margin are known. Simple arithmatic calculations determine the marketing margin in 1971. At this point, the first identity is introduced. Total production in 1971 is the product of the projected total acreage in 1971 and the projected yield in 1971. The logarithm of the calculated total production for 1971 plus the logarithm of the projected marketing margin for 1971 are inserted into the retail price equation with the logarithms of the projected predetermined variables, per capita disposable income and time. From this equation, the

logarithm of the estimated retail price in 1971 is determined. Taking the anti-logarithm of this value yields the projected retail price in 1972. To determine estimated farm price in 1971, the second identity is introduced. The projected marketing margin in 1971 is subtracted from the projected retail price in 1971 to determine the projected farm price in 1971. The projected farm price in 1971 is inserted into the acreage equation and the system is started again. This system is repeated until 1980. Use of this procedure produces projections of potato acreage, average yields, marketing margins, total potato production, retail prices and farm prices.

## Results and Interpretation

Using the projection procedure described above, results are obtained for the projection period, 1971 to 1980, as shown in Table 9. Examining these projections leads to the conclusion that the predictions obtained from the recursive model are extremely stable.

As expected, the total acreage projection during the projection period is very stable, varying only 12,000 acres throughout the entire period. The structure of the acreage equation leads to the resulting stable acreage projection. With acreage being dependent on farm price in the previous period and with the projected slow, steady increase of farm prices, potato acreage also increases at a slow and

| Year | Acreage (1000 Acres) | Yield (lbs.per Acre) | Total Production (1000 cwt.) | Marketing Margin (cents per lb.) | Retail Price (dollars per cwt.) | Farm Price (dollars per cwt.) |
|---|---|---|---|---|---|---|
| 1971 | 1452 | 230.8 | 335,504 | 6.1 | 8.21 | 2.12 |
| 1972 | 1447 | 234.9 | 339,860 | 6.3 | 8.43 | 2.17 |
| 1973 | 1447 | 238.9 | 345,790 | 6.4 | 8.61 | 2.19 |
| 1974 | 1449 | 243.0 | 352,109 | 6.6 | 8.77 | 2.20 |
| 1975 | 1451 | 247.0 | 358,483 | 6.7 | 8.93 | 2.20 |
| 1976 | 1453 | 251.1 | 364,829 | 6.9 | 9.09 | 2.21 |
| 1977 | 1455 | 255.1 | 371,136 | 7.0 | 9.24 | 2.22 |
| 1978 | 1456 | 259.2 | 377,411 | 7.2 | 9.40 | 2.22 |
| 1979 | 1457 | 263.3 | 383,660 | 7.3 | 9.55 | 2.23 |
| 1980 | 1459 | 267.3 | 389,888 | 7.5 | 9.71 | 2.23 |

Source: Computed by the author.

steady rate. The one decrease in acreage in 1972 is due to the decline in farm price for potatoes between 1970 and 1971. Although potato acreage will probably vary much more than projected here, the average acreage will probably continue to be around the 1,450,000 level, as it has been for the last fifteen years. So, the projected potato acreage values are not out of line with past experience and expectations of the future.

The yield of potatoes is projected to continue to increase at a constant rate of approximately 4.1 pounds per acre per year throughout the projection period. By 1980, the yield is projected to be 267.3 pounds per acre, as compared to 228.0 pounds per acre in 1970. This is an increase of 39.3 pounds per acre during the ten year period. Continued shifts to areas of the United States which are better suited for potato production, are more specialized in potato production, use more irrigation, use better seed and make greater use of fertilizers will be the primary contributors to these increases in yields.

Total production of potatoes is also projected to increase during the seventies. With total production being formulated in the model as the product of the projected total potato acreage, which is increasing in all but one year throughout the projection period, and the projected yield, which is increasing throughout the projection period, total production must increase in at least nine out of the

ten years. The only possible decrease in projected total production could occur in 1972, but the increase in yield more than offsets the decrease in acreage, so projected production increased. In reality, it could be expected that total production of potatoes would vary upward and downward, depending on the variation of total potato acreage and the existence of random shocks. If potato acreage does vary around this 1,450,000 acre figure, total potato production will also vary. These increases and decreases in production will probably continue to trend upward over the projection period, as they have over the last fifteen years. The projection of total production does reflect this upward trend of actual production, even though the large increases and large decreases are not reflected.

The predicted marketing margin increases throughout the prediction period because marketing labor cost increases linearly throughout the prediction period. This is the same result which would be expected of the actual marketing margin.

The predicted value of the retail price is a function of the predicted marketing margin, the predicted total production, time and per capita disposable income. All four of these independent variables are increasing throughout the projection period. The results indicate

that the influence of the positive variables outweigh the influence of the negative variables. Retail price is predicted to increase from $8.21 per cwt. in 1971 to $9.71 per cwt. in 1980. Actual retail prices are also expected to increase during the seventies, but the increases are not expected to be a constant rate as predicted by the model. Actual retail price will probably fluctuate more during the projection period due to variations in total production and random factors.

The final variable, farm price, like total potato production, is calculated by use of an identity. Variations in the farm price are dependent on variations in the retail price and the marketing margin. The projected values of the farm price indicate that retail price is increasing slightly faster than marketing margin. The slow, steady increase in farm price seems to be unrealistic. With an inelastic demand curve at the farm level, prices should fluctuate by greater amounts than projected by the recursive model. If total production does vary during the projection period, as is expected because of random factors, farm price will also fluctuate substantially. Although it is almost certain that these fluctuations in the farm price will occur, the projection of the farm price should be a good indicator of the trend in actual farm prices if the industry behavioral structure does not change significantly over the next decade.

The projections of the model can be compared to actual data for the first two years of the projection period, 1971 and 1972. In both 1971 and 1972, total acreage decreased by much larger amounts than projected by the model. The reduction in total acreage in 1971 was due to a slight drop in the farm price in 1970. The increase in actual yield in 1971, which is very close to the yield projection, did not increase enough to offset the decrease in acreage, thus a decrease in actual total production. This decrease is contrary to the increase projected for total production. The actual marketing margin and actual retail price are slightly higher than the projections due to higher rise in marketing labor costs in 1971 than projected and the reduction in total production. The actual farm price is at a lower level in 1971 than predicted farm price because of the large carryover of stocks from the large potato production in 1970 which had a depressing effect on 1971 farm prices.

In 1972, the difference between projections and actual values is larger than in 1971 due to the influence of a random shock. The weather in 1972 was extremely bad during the harvesting season for the fall potato crop. This weather greatly reduced the total number of harvested acres (especially in the Midwest and the East). Although yield again increased, total production decreased. This differs from the projected increase in total production

because of this random shock. Although both actual marketing margin and actual retail price are slightly higher than the projected values for these variables, actual farm price increased to a much higher level than projected by the model. This large increase in the actual farm price is due to the random shock of bad weather, which reduced total production in 1972 and the inelastic farm demand.

## Potato Consumption and Utilization

Over the past two decades there has been a shift in potato utilization. In 1970, approximately half the potatoes produced for human consumption were shipped to potato processors, which can be contrasted with the five percent shipped to processors in 1950. This indicates the magnitude of the rapid evolution of the potato processing industry which occurred during the late fifties and through the sixties. The shifts in potato utilization can be examined by looking at shifts in per capita consumption or by looking at the usage of the potatoes produced. Tables 10 and 11 will facilitate this examination. Table 10 shows the shift in per capita consumption from 1950 to 1970, while Table 11 shows the shift in potato utilization from 1950 to 1970.

Total per capita consumption of potatoes has been on the rise since 1950. This rise in consumption is the

TABLE 10.--Per Capita Consumption of Fresh and Processed Potato Products in the United States, 1950, 1960 and 1970.

| | 1950 (pounds) | 1960 (pounds) | 1970 (pounds) |
|---|---|---|---|
| Total Potato Consumption | 106.3 | 108.4 | 118.6 |
| Fresh | 100.0 | 84.7 | 59.6 |
| Processed | 6.3 | 23.7 | 59.0 |
| Frozen French Fries | .3 | 5.7 | 24.5 |
| Other Frozen Products | 0.0 | .8 | 3.3 |
| Chips | 4.5 | 11.7 | 17.7 |
| Dehydrated | 1.2 | 5.0 | 12.8 |
| Canned and Flour | .3 | .5 | .7 |

Source: American Potato Yearbook, 1951, 1961 and 1971.

TABLE 11.--Potato Utilization, 1950, 1960 and 1970.

| | 1950 (1000 cwt.) | 1960 (1000 cwt.) | 1970 (1000 cwt.) |
|---|---|---|---|
| Total Production | 259,112 | 257,104 | 324,801 |
| Table Stock | 151,863 | 149,376 | 129,242 |
| Total Processed | 31,318 | 59,442 | 136,137 |
| Chips | 13,720 | 21,310 | 35,861 |
| Dehydrated | 1,849 | 10,104 | 26,053 |
| Frozen French Fries | 720 | 13,373 | 54,478 |
| Other Frozen Products | 0 | 1,669 | 7,381 |
| Starch, Flour and Canned | 15,529 | 12,986 | 12,364 |
| Seed, Feed, Shrinkage and Loss | 45,588 | 48,885 | 60,209 |

Source: American Potato Yearbook, 1951, 1961, and 1971.

result of interaction of the rapid evolution of the processing industry and the rapid change in consumer tastes. Prior to 1950, with primarily fresh potatoes being consumed, per capita potato consumption had decreased for forty years. Without the rapid evolution of the processing industry, per capita potato consumption would probably still be declining. This is shown by the fact that per capita fresh consumption has continued to decline throughout the fifties and sixties. Clearly the decline would not have been as rapid were processed potato products not available to substitute for fresh potatoes. Fresh potato per capita consumption decreased by 15.3 pounds per person between 1950 and 1960, when the great influx of processed potato products began to reach the market. During the sixties, the decade of very rapid increases in consumption of processed potato products, fresh potato consumption dropped to 59.6 pounds per person, a decrease of 25.1 pounds per person. This is a decline of 30 percent during the ten year period between 1960 and 1970. During the twenty year period between 1950 and 1970, per capita consumption of processed products grew rapidly. Consumption of processed products increased by 17.4 pounds per person in the fifties and by 35.3 pounds per person in the sixties. The decreases in per capita consumption of fresh potatoes was more than offset by the large increases in per capita

consumption of processed potato products, so total potato consumption increased during these two decades.

The per capita consumption of each of the various types of the processed potato products can be examined to determine which of the processed products were most responsible for the increase in consumption of potatoes. Per capita consumption of frozen potato products was the largest of all processed potato products in 1970, although it was the smallest in 1950. Frozen potato products experienced the largest increase in per capita consumption during the sixties, when per capita consumption increased from 6.5 pounds per person in 1960 to 27.8 pounds per person in 1970. Frozen french fries account for approximately 90 percent of this consumption. Per capita consumption of frozen french fries increased by 18.8 pounds per person during the sixties. Per capita consumption of other frozen potato products, (hash browns, tater tots, etc.) has also been on the rise. Per capita consumption of these frozen potato products rose from .8 pounds per person in 1960 to 3.3 pounds per person in 1970. The increases in the percapita consumption of frozen potato products, primarily frozen french fries, has been the major factor in the rapid increase in the per capita consumption of processed potato products.

Increases in the per capita consumption of dehydrated potatoes in 1950 was 1.2 pounds per person. By 1960,

per capita consumption had risen to 5.0 pounds per person, an increase of 3.6 pounds per person, and by 1970 per capita consumption had risen to 12.8 pounds per person. This is an increase of one and one-half times the level of consumption in 1960.

Per capita consumption of potato chips has also increased during the past two decades. During the fifties per capita consumption of potato chips increased by 7.2 pounds. It was during this decade that technological advancements were made in the chipping industry which allowed chippers to meet the increasing demand for processed products.[12] An increase in per capita consumption of 6 pounds per person was experienced during the sixties. Although per capita consumption of frozen potato products is the largest, per capita consumption of potato chips is still the second largest of all processed products. Per capita consumption of canned potatoes and potato flour has also been increasing, but a per capita consumption of only .7 pounds per person in 1970 indicates that these are not important processed products for human consumption.

The shifts in potato utilization also can be examined by looking at the use of the potatoes produced. The amount of potatoes going to the fresh market has decreased over the past two decades. The decrease between

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[12]Sullivan, loc. cit.

1950 and 1960 was approximately 2.5 million cwt., which parallels the decrease in total production of 2 million cwt. The largest decrease in the amount of potatoes going to the fresh market occurred during the sixties. During this ten year period the quantity decreased by 20 million cwt. This large decrease reflects the shifting of supplies of raw potatoes from the fresh market to processors.

Supplies of potatoes to processors have increased greatly during the fifties and the sixties to meet the increasing consumer demand. Supplies of potatoes to chippers has increased by two and one-half times during these two decades. Chippers increased the amount of potatoes processed during the fifties by 7.6 million cwt. The increase during the following decade was almost twice that at 14.5 million cwt. There appears to be an inconsistency between the consumption data and usage data. The consumption of potato chips during the fifties and sixties increased by equal amounts, while increases in supplies of potatoes to potato chippers in the sixties nearly doubled the increases in supplies during the fifties. This apparent inconsistency is explained by the technological advancement which occurred during the fifties. The new technology allowed potato chippers to produce the same amount of potato chips with a smaller amount of raw potatoes. So, supplies to potato chippers during the fifties did

not have to increase by 14 million cwt. as they did in the sixties to meet the increased demand.

The quantity of potatoes supplied to potato dehydrators has also increased rapidly during the fifties and the sixties. The quantity supplied increased from 1.8 million cwt. in 1950 to 10.1 million cwt. in 1960, an increase of 8.3 million cwt. Dehydrators were supplied with 26.1 million cwt. of potatoes in 1970, an increase of 16 million cwt. over the 1960 level. The increase in supply to dehydrators during the sixties was twice as large as the increase in supply to dehydrators during the fifties.

The largest increases experienced during the fifties and the sixties occurred in supplies of potatoes to potato freezers. During the fifties supplies to processors of all frozen potato products increased from 720 thousand cwt. to 15 million cwt. During the sixties, the increase in supplies was even more dramatic. Supplies of potatoes to potato freezers in 1970 were four times larger than in 1960. This is an increase of 46.8 million cwt. Approximately 90 percent of all supplies of potatoes shipped to processors of frozen potato products were processed into frozen french fries, just as 90 percent of all frozen potato products consumed were frozen french fries. Supplies of potatoes to potato freezers which were processed into frozen french fries increased by 12.7 million

cwt.during the fifties and 41.0 million cwt. during the sixties. Supplies of potatoes processed into other frozen potato products have also increased during these two decades. The increase between 1950 and 1970 was 5.8 million cwt.

Supplies of potatoes to flour and starch processors have varied greatly during the fifties and sixties because most cull and excess supply potatoes are shipped to these processors. The general trend of supplies to flour and starch processors has been downward. Supplies of potatoes to potato canners, also primarily cull potatoes, increased during the fifties and sixties. In total, supplies to these processors decreased by 2.5 million cwt. during the fifties and decreased by 600 thousand cwt. during the sixties. The amount of cull potatoes increases as total production increases which accounts for the smaller decrease in supplies to these processors during the sixties.

The total amount of potatoes used for feed and seed and not marketed because of shrinkage and loss increased over the past two decades. The amount of potatoes used as seed decreased during the fifties by 3 million cwt., primarily because of improvements in potato seed during the fifties. With the increase in total production during the sixties, the amount of potatoes used for seed increased by 1.7 million cwt. The quantity of potatoes used as feed

increased by 5 million cwt. during the fifties and 2 million cwt. during the sixties. The quantity of potatoes not marketed due to shrinkage and loss also increased during the fifties, by 1.3 million cwt. and the sixties by 7.8 million cwt. Potatoes used for feed and seed, which are primarily cull potatoes, and potatoes not marketed because of shrinkage and loss will tend to increase as production increases. This accounts for the increases in the amount of potatoes going to these uses in the sixties.

## Procedure for Projecting Potato Consumption and Utilization

To project the per capita consumption of fresh and processed potatoes, linear trends were extrapolated to 1980. The equation to determine the trend is of the familiar form, $Y = a + bT + e$, where Y is the per capita consumption of fresh or processed potatoes and T is time. A twenty year sample period, 1950 - 1970, was used to determine the trends. The coefficient of determination for the fresh equation is 78 percent, which is acceptable, while the coefficient of determination for the processed equation is 95 percent, which is quite good. The per capita consumption of each of the various types of processed potato products in 1980 is also determined by the extrapolation of the linear trends. All coefficients of determination are close to 85 percent. This same procedure can be used

to determine the supply of potatoes to the fresh market and to each of the various types of processors. The projected quantity of potatoes used as feed and seed and not marketed because of shrinkage and loss is the difference between the projected total production and projected fresh and processed potato usage. The projected total production is determined by the demand-supply model discussed above.

## Results and Interpretation

Before the results of the projections are discussed, a basic assumption of this type of projection procedure and implications of that assumption should be pointed out. It is assumed that during the projection period there will be no basic reversal of current consumer tastes and preferences. Use of linear trends for projection purposes assumes that if consumer tastes and preferences changed during the sample period, they will change in the same direction during the projection period. In reality, there may be forces in the market which could increase or decrease the tendency toward consumption of processed potatoes. One of these forces may be the consumerism movement. People may become disenchanted with potato processors and return to the consumption of fresh potatoes. Living patterns could drastically change during the projection period which may change the consumption patterns of consumers. Cooking innovations may be which

would reduce the preparation time of fresh potatoes may be marketed. The microwave oven may be just such an innovation. This oven would allow the consumer to prepare a baked potato in a very short amount of time, which may have a substantial affect on sales of fresh potatoes. Potato processing costs could change substantially during the projection period which would change the price of the processed potato products at the retail level. This change in prices could cause consumers to adjust consumption patterns. Changes in retailing practices could also affect consumer behavior. For example, the move toward standardization could have a tremendous impact on the consumption of potato chips. Retail food stores may stop stocking bagged potato chips which would drastically reduce the consumption of this processed potato product. The move of retail food stores to stocking only high volume items could also change consumption patterns. Unit pricing and changes in merchandising practices could affect the consumers decision of which potato product to purchase.

Using the procedure described above yields the results given in Tables 12 and 13. As expected, per capita consumption of fresh potatoes is projected to decrease during the seventies and per capita consumption of processed potatoes is projected to increase, with a net result of an increase in total potato per capita consumption of potatoes of 8.3 pounds per person.

TABLE 12.--Per Capita Consumption of Fresh and Processed Potato Products in 1970 and Projected Per Capita Consumption of Fresh and Processed Potato Products in 1980.

| | 1970 (pounds) | 1980 (pounds) |
|---|---|---|
| Total Potato Consumption | 118.6 | 126.9 |
| Fresh | 59.6 | 47.9 |
| Processed | 59.0 | 79.0 |
| Frozen French Fries | 24.5 | 34.6 |
| Other Frozen Products | 3.3 | 4.0 |
| Chips | 17.7 | 23.0 |
| Dehydrated | 12.8 | 16.6 |
| Canned and Flour | .7 | 1.0 |

Source: American Potato Yearbook, 1971. Projections Calculated by the Author.

TABLE 13.--Potato Utilization in 1970 and Projected Potato Utilization in 1980.

| | 1970 (1000 cwt.) | 1980 (1000 cwt.) |
|---|---|---|
| Total Production | 324,801 | 389,780 |
| Table Stock | 129,242 | 112,697 |
| Total Processed | 136,137 | 191,363 |
| Chips | 35,861 | 53,655 |
| Dehydrated | 26,053 | 38,443 |
| Frozen French Fries | 54,478 | 77,289 |
| Other Frozen Products | 7,381 | 8,588 |
| Starch, Flour and Canned | 12,364 | 13,388 |
| Seed, Feed, Shrinkage, and Loss | 60,209 | 85,720 |

Source: American Potato Yearbook, 1971. Projections Calculated by the Author.

The per capita consumption of fresh potatoes is projected to decrease by 11.7 pounds per person. Per capita consumption of processed potato products during the seventies is projected to increase by 20 pounds per person, as compared to an increase of 35.3 pounds per person during the sixties. The projected increase in the per capita consumption of processed potato products during the seventies is determined by the projected increases in per capita consumption of the different types of processed potato products. The per capita consumption of potato chips is projected to increase from 17.7 pounds per person in 1970 to 23 pounds per person in 1980, and increase of 5.3 pounds per person. Per capita dehydrated potato consumption is projected to increase by 3.8 pounds per person during the seventies. Per capita consumption of frozen potato products is projected to increase by the largest amount of any processed potato product. It is projected that per capita consumption of all frozen potato products will be 38.4 pounds per person in 1980, an increase of 10.6 pounds per person. Again frozen french fries will be approximately 90 percent of the per capita consumption of frozen potato products at 35.6 pounds per person. Consumption of canned potatoes and potato flour is projected to increase by .3 pounds per person during the seventies.

These projections can also be examined from the utilization side. Supplies to the fresh market are pro-

jected to continue to decrease during the seventies. Total supplies to the fresh markets in 1970 were 129.2 million cwt. and are projected to decrease to 112.7 million cwt. by 1980. All supplies to processors of potato processors of potato products are projected to increase during the seventies. Supplies to potato chippers are projected to increase by 12.3 million cwt. in 1980 from 35.9 million cwt. in 1970. This is an increase of 17.8 million cwt. Supplies to dehydrators are projected to increase by 12.3 million cwt. during the seventies. Supplies to potato freezers are projected to be 45 percent of all potatoes supplied to processors in 1980. This is a projected increase of 24 million cwt. during the seventies. Supplies of potatoes to processors of potato flour and starch and potato canners are also projected to increase, reversing a downward trend of the fifties and sixties. Potatoes used for feed and seed and potatoes not marketed because of shrinkage and loss are also expected to increase during the seventies. These increases are due to the increased amount of cull potatoes produced as total production increases.

# CHAPTER IV

## U. S. PRODUCTION PROJECTIONS BY STATE AND SEASON IN 1980

### Introduction

There has been a gradual shifting of potato production over the past two decades. These shifts were identified and possible factors leading to these shifts were discussed in Chapter II. Potato production by state and season is projected in this chapter to indicate possible future increases and decreases in potato production. The projections are determined by extrapolation of trends of time series data from 1955-1970. Also, factors which may lead to these projected shifts are discussed.

### Procedure

The extrapolation of the trend of production in the nineteen major potato producing states to 1980 is the procedure used to project the production of potatoes in 1980. The extrapolation of trends was used above to project the value of various variables to 1980. Besides the linear trend, the logarithmic type of nonlinear trend is used to predict potato production in the nineteen major producing states. The equation for the linear trend,

$Y = a + bT$, is transformed into its exponential form, $Y = aT^b$, where Y is the quantity of potatoes produced in a particular state and T is time. To calculate estimated production values by ordinary least squares, the equation is transformed into a linear form by taking the logarithm of both sides, $\log Y = \log a + b \log T$. The trend line obtained from this equation is a straight line if graphed on logarithmic scaled paper and curvilinear if graphed on arithmetic scaled paper. The logarithmic trend line has either a positive or negative slope throughout the 1955 to 1980 time range like the linear trend line, but unlike the linear trend line, the amount of increase or decrease is not constant.

The procedure used to project the value of the dependent variable is the same procedure used in Chapter III when dealing with trends. There is only a slight adjustment necessary when the logarithmic equation is used. To project the logarithm of the value of the dependent variable, the logarithm of the independent variable time must be taken. After calculating the projection, the anti-logarithm must be taken to transform this projected value from logarithms to natural numbers. Except for these two small adjustments, the projection procedure is the same as used above.

The criteria for the selection of the type of trend to be used was a combination of the comparisons of

the relative sizes of the coefficients of determination for the various trend equations for a particular state and a visual and graphic extrapolation of the trend of the observed data. The coefficient of determination, which measures the goodness of fit of the estimated values to the observed or actual values, is the first of the two criteria for selection. The trend equation which yields the highest coefficient of determination or the trend equation which best fits the observed data is selected. The second criterion for selection compares the projected trend with a visual and graphic extrapolation of the trend of the observed data. This criterion is used to make sure that the estimated trend yields reasonable projection results. Even though an equation has a high coefficient of determination, it could be rejected if the projected values are not reasonable.[13]

## Results

Before the results are examined, a major assumption of this method of projection should be discussed. Trends are based on historical data. Projections based on historical data assume that what has happened in the past

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[13]Various polynomial trend equations were compared with the linear and logarithmic trend equations used. In some cases the coefficient of determination was larger with polynomial trend equations. But, in all cases, the predicted values were not within reasonable expectations.

will continue to happen in the future. This is not always the case. The assumption disregards any environmental factors which may slow yield increases and any shortages which may occur in land availability. The push of environmentalists to outlaw certain types of agricultural chemicals may affect yields during the seventies. If replacements for these fertilizers are not readily available, increases in yields could be slowed. The lack of adequate amounts of irrigation water is also a very important environmental factor. Most major potato producing states use irrigation. If the amount of water used for irrigation is reduced, yields could be drastically effected. The problem of adequate amounts of irrigation water unless new sources are discovered, will be most important during the late seventies and early eighties in most major potato producing states. Land availability could also become a problem during the seventies. If land is not available to be converted into potato production, projected increases in potato production in some states may not be feasible.

The results of the trends of total potato production by major producing states are shown in Table 14. The 1980 projected production in each state is compared to the actual production of potatoes in each state in 1970. Of the nineteen major potato producing states, eleven are predicted to increase total potato production. The largest projected increase in potato production will occur in

TABLE 14.--Total Potato Production in 1970 and Projected Total Potato Production in 1980 by Major Producing States.

| State | 1970 (1000 cwt.) | Rank | 1980 (1000 cwt.) | Rank |
|---|---|---|---|---|
| Alabama | 2,127 | 18 | 2,742 | 17 |
| Arizona | 2,712 | 17 | 3,568 | 16 |
| California | 29,760 | 4 | 28,000 | 4 |
| Colorado | 12,916 | 10 | 11,620 | 11 |
| Florida | 5,836 | 13 | 5,180 | 14 |
| Idaho | 74,550 | 1 | 99,155 | 1 |
| Maine | 35,700 | 2 | 35,759 | 3 |
| Michigan | 10,550 | 11 | 11,854 | 10 |
| Minnesota | 13,390 | 8 | 18,550 | 7 |
| New Jersey | 3,380 | 16 | 2,742 | 18 |
| New York | 16,977 | 6 | 14,076 | 9 |
| North Carolina | 2,093 | 19 | 1,341 | 19 |
| North Dakota | 17,550 | 5 | 21,143 | 5 |
| Oregon | 14,660 | 7 | 16,641 | 8 |
| Pennsylvania | 8,280 | 12 | 6,732 | 13 |
| Texas | 4,593 | 14 | 6,956 | 12 |
| Washington | 33,590 | 3 | 62,431 | 2 |
| Wisconsin | 13,028 | 9 | 19,770 | 6 |
| Virginia | 3,990 | 15 | 4,173 | 15 |
| Total | 306,461 | | 372,449 | |

Source: U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board. Crop Production (1972). Projections calculated by the author.

Washington, where projected 1980 production will double that of 1970. The projections also indicate that Idaho production will continue to increase rapidly. Potato production in Idaho is projected to increase by 25 million cwt. or 33 percent by 1980. The three most important potato producing states in the Midwest, Wisconsin, North Dakota and Minnesota, are also projected to increase total potato production substantially. Wisconsin is projected to increase production by approximately 6.5 million cwt., while Minnesota production is projected to expand by 5.2 million cwt. North Dakota production is projected to increase from 17.5 million cwt. to 21.1 million cwt., an increase of 3.6 million cwt. Increases in total potato production of over a million cwt. are projected to occur in Texas, Michigan, and Oregon. Potato production is projected to increase by 2.4 million cwt. or 52 percent in Texas, 1.4 million cwt. in Oregon and 1.3 million cwt. or 11 percent in Michigan.

The remaining eight major potato producing states are projected to decrease production by 1980, with the exception of one state, Maine. Maine is the only state where total production in 1980 is projected to remain at its 1970 level of 35.7 million cwt. The largest projected decrease in production will occur in New York, a decrease of almost 3 million cwt. This is a reduction from 17 million cwt. in 1970 to 14 million cwt. in 1980.

California, Colorado, and Pennsylvania are also projected to experience reductions in potato production of over one million cwt. Potato production is projected to decrease by 800 thousand cwt. in Florida and 700 thousand cwt. in North Carolina.

Extrapolation of seasonal potato production trends by major producing states for each season are shown in Tables 15 through 20. Most states producing winter and spring potatoes are projected to reduce production between 1970 and 1980. Both major producing states of winter potatoes, California and Florida, are projected to decrease production by 1980. Florida production is projected to decline by 500 thousand cwt., while California production is projected to decline by 650 thousand cwt. This is a total decrease in production of winter potatoes of 1.2 million cwt. or 33 percent. Production of early spring potatoes is also projected to decrease over the ten year time span. Florida, the only state which produces a large amount of early spring potatoes, is projected to decrease production by 230 thousand cwt. or 50 percent. Three of the four states producing late spring potatoes, California, North Carolina, and Alabama, are projected to decrease production of late spring potatoes, with California experiencing the largest decline. The production of early spring potatoes in California is projected to decline by 4.1 million cwt. In percentage terms this is a

TABLE 15.--Winter Potato Production in 1970 and Projected Winter Potato Production in 1980 in Florida and California.

| State | 1970 (1000 cwt.) | 1980 (1000 cwt.) |
|---|---|---|
| California | 1955 | 1290 |
| Florida | 1627 | 1106 |
| Total | 3582 | 2396 |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production (1972). Projections calculated by the author.

TABLE 16.--Early Spring Potato Production in 1970 and Projected Early Spring Potato Production in 1980 in Florida.

| State | 1970 (1000 cwt.) | 1980 (1000 cwt.) |
|---|---|---|
| Florida | 4309 | 4074 |
| Total | 4309 | 4074 |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production (1972). Projections calculated by the author.

TABLE 17.-- Late Spring Potato Production in 1970 and Projected Late Spring Potato Production in 1980 by Major Producing State.

| State | 1970 (1000 cwt.) | Rank | 1980 (1000 cwt.) | Rank |
|---|---|---|---|---|
| Alabama | 1,027 | 4 | 864 | 4 |
| Arizona | 2,712 | 2 | 3,568 | 2 |
| California | 14,516 | 1 | 10,457 | 1 |
| North Carolina | 1,747 | 3 | 1,052 | 3 |
| Total | 20,005 | | 15,941 | |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production n (1972). Projections calculated by the author.

TABLE 18.--Early Summer Potato Production in 1970 and Projected Early Summer Potato Production in 1980 in Texas, Virginia, and California.

| State | 1970 (1000 cwt.) | Rank | 1980 (1000 cwt.) | Rank |
|---|---|---|---|---|
| California | 1,650 | 3 | 507 | 3 |
| Texas | 3,569 | 2 | 5,634 | 1 |
| Virginia | 3,918 | 1 | 4,173 | 2 |
| Total | 9,137 | | 10,314 | |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production, (1972). Projections calculated by the author.

TABLE 19.--Late Summer Potato Production in 1970 and Projected Late Summer Potato Production in 1980 by Major Producing States.

| State | 1970 (1000 cwt.) | Rank | 1980 (1000 cwt.) | Rank |
|---|---|---|---|---|
| California | 2,135 | 6 | 1,914 | 7 |
| Colorado | 3,512 | 3 | 3,252 | 5 |
| Michigan | 2,268 | 5 | 3,321 | 4 |
| Minnesota | 1,950 | 8 | 3,365 | 3 |
| New Jersey | 3,207 | 4 | 2,742 | 6 |
| New York | 2,002 | 7 | 1,193 | 8 |
| Washington | 8,580 | 1 | 9,031 | 1 |
| Wisconsin | 3,643 | 2 | 4,509 | 2 |
| Total | 27,297 | | 29,327 | |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production, (1972). Projections calculated by the author.

TABLE 20.-- Fall Potato Production in 1970 and Fall Potato Production in 1980 by Major Producing State.

| State | 1970 (1000 cwt.) | Rank | 1980 (1000 cwt.) | Rank |
|---|---|---|---|---|
| California | 9,504 | 8 | 13,832 | 7 |
| Colorado | 9,100 | 10 | 8,368 | 10 |
| Idaho | 74,660 | 1 | 99,155 | 1 |
| Maine | 35,700 | 2 | 35,759 | 3 |
| Michigan | 7,566 | 12 | 8,346 | 11 |
| Minnesota | 11,440 | 7 | 15,185 | 6 |
| New York | 14,859 | 6 | 12,905 | 9 |
| North Dakota | 17,550 | 4 | 21,143 | 4 |
| Oregon | 15,229 | 5 | 16,641 | 5 |
| Pennsylvania | 8,280 | 11 | 6,732 | 12 |
| Washington | 25,010 | 3 | 53,400 | 2 |
| Wisconsin | 9,125 | 9 | 12,975 | 8 |
| Total | 238,023 | | 304,441 | |

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production,(1972). Projections Calculated by the author.

projected reduction of 28 percent. The projected total decline in production of late spring potatoes in both North Carolina and Alabama is 860 thousand cwt. Arizona is the only state producing late spring potatoes which is projected to increase production during the seventies. Arizona is projected to increase production by 800 thousand cwt. or 29 percent. The projected increase in production of late spring potatoes by Arizona is offset by the projected decrease in production in North Carolina and Alabama, so total late spring potato production is projected to decline by 4 million cwt. or 20 percent.

Both summer and fall potato production are projected to increase during the seventies. Thus, the projected increase in total potato production will occur because of projected increases in the production of summer and fall potato crops. Total production in early summer is projected to increase because of the rapid projected rise in early summer potato production in Texas. Production in Texas is projected to increase by 2.1 million cwt. or 60 percent by 1980. The projected small increase in the production of early summer potatoes in Virginia will also contribute to the increase in total early summer potato production. Production is projected to increase in Virginia by 200 thousand cwt. Production of early summer potatoes in California is projected to decline by 1.1 million cwt. The projected production

increase in Texas and Virginia outweighs the projected decrease in California production leading to a projected increase in total early summer production of 1.2 million cwt., or 13 percent.

The total production of late summer potatoes is also projected to increase during the seventies. Of the eight states producing late summer potatoes, four states are projected to increase production and four states are projected to decrease production. The four states increasing production are Minnesota, Michigan, Wisconsin, and Washington. The largest increase in projected production will occur in Minnesota, where production of late summer potatoes is projected to increase by 1.4 million cwt. Late summer Michigan potato production is projected to increase from 2.2 million cwt. in 1970 to 3.3 million cwt. in 1980, an increase of 1.1 million cwt. or 33 percent. Wisconsin is projected to increase production by 900 thousand cwt. while Washington is projected to increase production 500 thousand cwt. Late summer potato production is projected to decline in New York, New Jersey, Colorado, and California. None of these projected decreases exceed one million cwt. New York is projected to experience the greatest reduction in late summer production, a decline of about 40 percent. The second largest reduction in potato production, 450 thousand cwt., is projected to occur in New Jersey. Late summer

production in Colorado and California is projected to decline slightly. Total late summer production is projected to increase by 1 million cwt., primarily due to the 2.5 million cwt. increases in production in Minnesota and Michigan.

The majority of the projected increase in total U. S. potato production comes from the projected increase in fall potato production. Of the twelve states which produce fall potatoes only three are projected to decrease production during the seventies and one is projected to remain stable, that being Maine. The three states which are projected to decrease production of fall potatoes are New York, Pennsylvania, and Colorado. Production of fall potatoes is projected to decline by 2 million cwt.,or 13.5 percent in New York. Pennsylvania and Colorado fall potato production is projected to decline by 1.5 million cwt. and 750 thousand cwt. respectively during the seventies. The remaining eight states which produce fall potatoes are projected to increase production by an amount which far exceeds the projected decreases in production. The largest increase in production is projected to occur in Washington where production will increase by 100 percent. Idaho produces primarily fall potatoes, so all of the projected increase in production will be absorbed in the fall crop. Major increases in production of fall potatoes are

projected to occur in the major Midwestern potato producers, Minnesota, North Dakota and Wisconsin. Fall potato production in California is projected to increase by 4.3 million cwt., while Oregon fall potato production is projected to increase by 1.5 million cwt. Fall potato production in Michigan is projected to increase from 7.5 million cwt. to 8.3 million cwt. or 800 thousand cwt. Total fall potato production is projected to increase by 66.7 million cwt. or 28 percent during the seventies with 5 million cwt. of this projected increase in fall crop production occurring in Washington and Idaho.

## Interpretation of Results

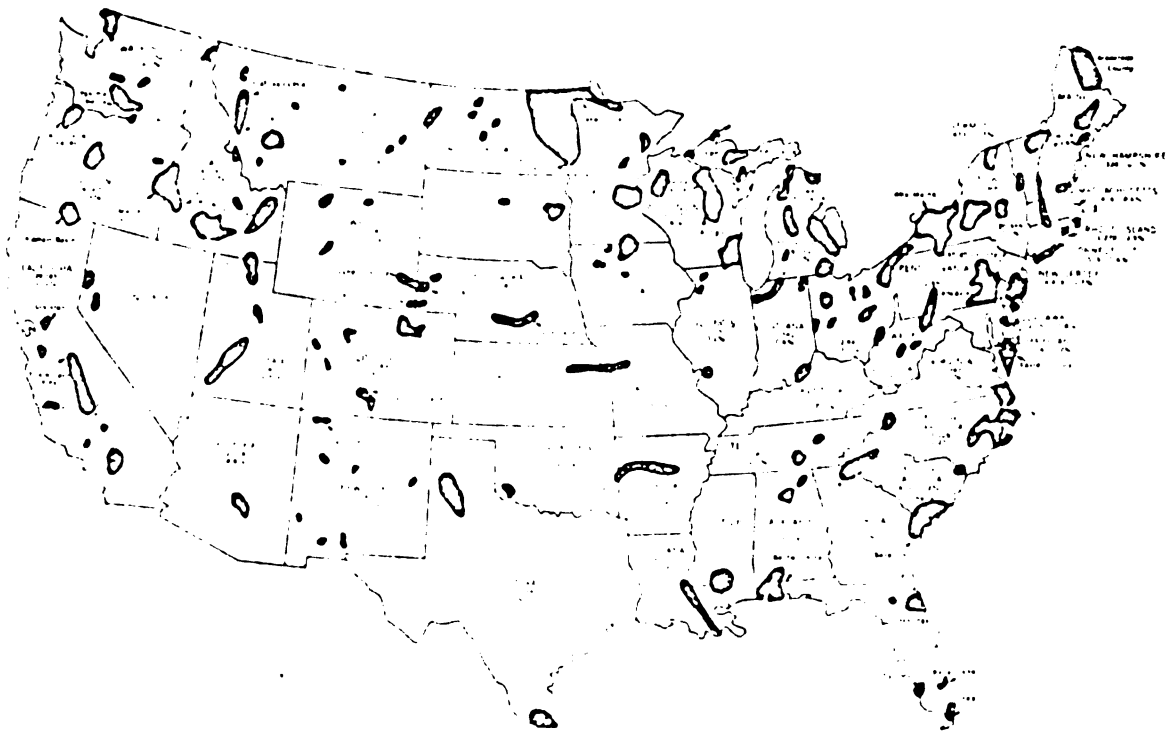
The results of the projections show some definite shifts in the amount of potatoes that will be produced in a particular region of the country. Shifts are also projected to occur in the amount of potatoes produced in each of the six potato producing seasons. The reasons for these shifts will be discussed in this section.

There has been and will continue to be a shift away from potato production in the Northeastern portion of the United States. Of the four major potato producing states in this area, Maine, New York, Pennsylvania and New Jersey, three are projected to experience a decline in production during the seventies. The only state not projected to decrease production, Maine, will produce

approximately the same amount of potatoes in 1980 as were produced in 1970. There is a possibility that production in Maine may decline.

Several of the factors which account for the projected decline in potato production in New York, New Jersey and Pennsylvania are common to all three states. One of the most important factors in all three states, as well as many other major potato producing states, is the increasing spread of urbanization. The Northeastern section of the United States has the highest concentration of population. Major cities in this area will continue to grow through the seventies. As the cities grow, more land will be taken out of agricultural production to be used for residential, commercial and industrial construction. Couple this with the fact that major potato producing areas in these states are located directly in the path of this increasing urbanization, as shown on Map 1, and the stage is set for the acreage reductions.

Increasing urbanization leads to another factor which will reduce potato acreage in these three states, that of increasing land values. As the urban areas spread, land that was once considered only for agricultural purposes becomes a possible area for further urbanization. With speculation that the land will soon be part of an urban area, land values increase rapidly. The value of



Source: American Potato Yearbook, 1972.

Map 1.--The Location of the Major Potato Producing Regions in the United States in 1972.

the land becomes so high that it is no longer economically feasible to grow potatoes in the area.

A major reason for the large population in New York, New Jersey, and Pennsylvania is the high degree of industrialization in those states. People are needed to work in the industrial plants, and large concentrations of people leads to cities and urbanization. As the industries in these states expand and multiply, more people will be needed. The pressure to expand urban areas will be increased by the needs of these industries. Industrialization leads to urbanization which leads to higher land values and the reduction of agricultural land.

Urbanization is a major problem in New York, along with other factors. In New York, all late summer potatoes are produced on Long Island. It is obvious that this area will be hit hard by the spread of urbanization from New York City and the increasing land value brought by this urbanization. But, even Northern New York and Western New York, where the state's fall potato crop is produced, will feel the pressures of urbanization. Cities such as Buffalo, Rochester, Syracuse, Utica, and Albany will be expanding during the seventies right into potato producing areas. Potato production in New York is also in competition with many other crops. As the acreage in high valued, competing crops increases, the land available for potato production will probably decline.

Pennsylvania faces the same type urbanization expansion and high land values that New York faces, but the urbanization and high land values will have more effect on Pennsylvania production for two reasons. Pennsylvania is more industrialized than Western and Northern New York thus, the push toward urbanization will be greater in Pennsylvania. Secondly, Pennsylvania is almost completely mountainous. There are only selected areas in which any crops can be grown. When land is lost to expanding urban areas there is no new land to put into production and few competing crops for which potatoes would be suitable as a substitute crop. So, urbanization around Pennsylvania cities such as Harrisburg, Lancaster, Philadelphia, Allentown and Scranton, located in the major potato producing areas, ahs a major impact on potato production. Because of the vast amount of minerals in Pennsylvania there will always be the possibility that land now used to produce potatoes may also be lost to the mining industry.

New Jersey is also faced with increasing land values and urbanization. New Jersey, producing primarily late summer potatoes, faces urbanization along the western border from cities of Trenton and Camden, a suburb of Philadelphia. New Jersey is also a highly industrialized state, which will speed up the spread of urbanization. High land values along the Atlantic Coast will make it

economically unfeasible to produce potatoes in that area. The area is used by people from metropolitan New York City and metropolitan Philadelphia for recreational purposes. New Jersey is also a large producer of vegetable crops which compete with potatoes for available acreage. Competition from higher valued vegetable crops will also be a factor in reduced acreage available for potatoes. The projected decline in production will be moderated somewhat by the proximity to Philadelphia and New York City markets. New Jersey late summer potatoes can enter these markets before the large fall crop is marketed. Late summer potatoes from New Jersey fill the gap between earlier season potatoes and fall potatoes. The availability of markets will probably slow the rate of decline in potato production.

Maine is the lone state in the Northeastern region of the United States in which it is not projected to decrease production. Potato production in Maine has remained relatively stable at 35 million cwt. since 1955. Several reasons account for this stable production. Maine does not have to face the loss of potato acreage to urbanization and the highly increased land values which accompany urbanization. All land in Maine that is suitable for production of potatoes has been in production for many years. But, there are very few crops which compete for this acreage, which tends to offset the land availability

restriction. The location of seven potato freezers in Maine has helped to maintain this stable production level. The close proximity to major Eastern markets has also been a factor which helped maintain production at the 35 million cwt. level. The Maine potato has been able to compete with the Idaho potato on the fresh market because of lower transportation costs. If the transportation cost differential declines, this competitive advantage will be reduced.

There are several factors which tend to reduce potato production in all of the Northeastern potato producing states. The first of these is the transportation cost differential, mentioned above. If this differential becomes smaller, the competitive advantage held by the Eastern states will decrease. This, combined with the willingness of consumers to pay a higher price for Idaho potatoes, because of the high quality image, will lead to a decrease in demand for Northeastern fresh potatoes. Another factor tending to decrease potato production is lower yields in Northeastern states. Both the soil and the climate are not as conducive to potato production in the Eastern states as they are in Western potato producing states. These smaller yield increases probably will not compensate for the acreage decreases in these potato producing states. Thus, the projected total production will decrease.

All major potato producing states in the Midwestern region of the United States, North Dakota, Minnesota, Wisconsin, and Michigan, are projected to increase production during the seventies. The three fastest increasing potato producing states, North Dakota, Minnesota and Wisconsin, have several factors in common which may cause this increase in production. A major factor which will allow for the increase in production is the lack of major competition from other crops. A majority of the major producing areas are located in the central to northern portion of these states. There are very few crops which can be grown in these areas dur to the weather. In North Dakota and Minnesota potatoes and wheat are the primary crops which are grown in these areas. In Wisconsin, the competition for land comes primarily from dairy operations. This is not a particular problem in Wisconsin because there is land available for grazing which is not suitable for potato production. So, land now producing potatoes need not be taken out of production and used for grazing. Urbanization and higher land values probably will not be instrumental in reducing potato production in these states. There may be some small losses in potato producing acreage in Southeastern Wisconsin around Milwaukee and in Minnesota around Minneapolis-St. Paul. Another important factor which will push production upward in these states is the good potato producing climate. The potato

producing areas of North Dakota, Minnesota, and Wisconsin all experience warm days and cool nights during the potato growing season. This type climate yields a potato with a higher percentage of solids. A potato with these characteristics yields better when processed, so demand by processors is higher. With processing becoming more important, the demand for these higher yielding potatoes will increase. This should give potato production in these three states a boost. This increase in demand will be met by greater yields and increased acreage by shifting some land into potato production that is now not being used to produce potatoes. As demand for these good processing potatoes increases prices will increase. These increased prices will cause land to be shifted to potato production. This shifting of land will at least offset any loss of land due to urbanization and higher land values.

Although the potato production is projected to increase in Michigan, the increase is much smaller than the projected production expansion in North Dakota, Minnesota, and Wisconsin. There are a number of factors which will tend to reduce the magnitude of the increase in production of potatoes. Urbanization and increasing land values will have a greater effect in Michigan. Potato producing areas in the eastern portion of the state will be hurt by the increase in size of Metropolitan Detroit, Flint and the

Saginaw Bay area. The high level of industrialization in these cities will insure their continued growth and spread. This could limit the number of acres devoted to potato production in these eastern areas of the state. Michigan also has a large number of recreational facilities. As the large masses of population demand more recreational facilities, the value of potato land near lakes and other recreation areas will be bid up to a point where it will no longer be economically feasible to produce potatoes. Competition from other crops will also help slow the increase in production of potatoes. Michigan winters are not as severe as other Midwestern states because of the lakes surrounding the state. The Great Lakes tend to moderate temperatures. This more moderate climate allows for the production of many different competing crops such as dry beans, feed grains, and tree fruits. The potato producer in Michigan has viable alternatives in production which could influence the amount of potatoes produced. The introduction of new potato producing land in the Southwest corner of Michigan could counteract the acreage reductions in other parts of Michigan.[14] Average yields in Michigan are expected to continue to rise. The net result of a possible reduction in acreage in Southeastern

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[14]Paul Wilkes, Procurement Manager for Ore-Ida Foods, Inc. A personal interview at Greenfield, Michigan, in September, 1971.

Michigan, possible acreage expansion in the Southwestern part of the state and rising average yields should be a slight expansion of Michigan potato production.

By 1980 the three major potato producing states in the Northwest are projected to produce approximately half of the total amount of potatoes produced in the United States as compared to 40 percent in 1970. None of the major factors which will reduce potato producing acreage in the East will affect Idaho. There is no threat of acreage reductions due to urbanization and the rising land values which accompany urbanization. Also, there are very few other crops which compete for acreage in Idaho. A major factor which will cause the rapid rise in potato production is a continued increase in average yields. The combination of the volcanic ash type soil, improved varieties, improved production technology, and irrigation will cause these continued increases, at least until the late seventies. The lack of proper amounts of irrigation water may cause a slowing of these increases in yield in the late seventies. The climate during the growing season is also conducive to producing a potato which is high in total solids. The increasing demand for processed potatoes and the demand by the large number of processors for this type potato will put upward pressure on potato production in Idaho. The establishment of the Idaho potato as the top potato in the fresh market will also be a factor in

increased production. As transportation and storage improve the marketing season for Idaho will expand. The increased length of the marketing season will cause an increase in the demand for fresh Idaho potatoes. Also, there is a possibility that dehydrated potatoes could be shipped to Japan. Opening of the export market to Idaho would also exert upward pressure on potato production. All these factors combined will increase the demand for Idaho potatoes. Rising demand for Idaho potatoes will push prices of potatoes in Idaho upward. As prices increase, land which is now producing other crops will be switched to potato production and land on which it is not now economically feasible to produce potatoes will be brought into production.

The largest increase in production is projected to occur in Washington. The increase in production of late summer potatoes will be small because of the intense competition for land in the Yakima Valley where the entire late summer crop is grown. The majority of the tree crops grown in Washington are grown in this valley. Land that is taken out of potato production and put into the production of tree crops is lost for the entire decade. The relative prices between the competing crops in the valley will determine the allocation of acreage. Increasing yields and increasing demand for late summer potatoes will offset any decrease in potato producing acreage. Yields

will increase in Washington as fast as they do in Idaho because of similar soil conditions and irrigation practices. Demand for fresh late summer Washington potatoes will continue to be strong as a carryover between earlier season potatoes and fall potatoes in Western and Midwestern markets. Also, as the amount of potatoes processed increases, the demand for early processing stocks will increase. Processing in the major factor which will cause production of fall potatoes to rise. At the present time, 80 percent of the Washington potato crop is processed. As the demand for processed potato products increases and the demand for fresh potatoes from the fall crop decreases, processing will become even more important. The introduction of the export market will also divert more potatoes to processing. The high demand for the good processing potato production in Washington will exert upward pressure on potato production. The demand for increased potato supplies will be met by increase yields and increased amounts of land in potato production. As in Idaho, increased demand will cause increased prices which will lead to the shifting of land from production of less valuable competing crops to the production of potatoes and reclaimation of land on which it was not previously economically feasible to produce potatoes.

Although Oregon is projected to increase production, the increase is not nearly as large as increases in Idaho

and Washington. There are several factors which tend to slow increases in production in Oregon. The potato processing industry is not as well developed in Oregon as it is in Washington and Idaho. The well developed processing industries in Washington and Idaho have much to do with the projected large increases in production. But in Oregon, processing will not have such a strong upward influence on production. Urbanization will also take some potato producing land out of production. This urbanization will come from the city of Portland, a fast growing Western city. With urbanization comes increased land values, but in Oregon, increased land values may effect all potato producing areas, not just the area near Portland. The demand for land in Oregon for recreational purposes has increased and will continue to increase during the seventies.

Two of the major potato producing states in the West, California and Colorado, are projected to decrease production of potatoes during the seventies. California produces potatoes in every crop season except early spring. Potato production is projected to decrease in all seasons except fall. The majority of winter, lage spring and early summer production occurs in the San Joaquin Valley. The production of vegetable crops, citrus fruits and grapes also takes place in this valley. Although a large amount of land has recently been reclaimed along the

western edge of the valley, there will be little of this done in the near future because of two major reasons. One, the costs of reclaiming the land are greater than the revenues which could be received from that land. Two, there is a shortage of water for irrigation which is needed to reclaim this land. So there is a large amount of competition from competing crops for the existing acreage. Also, with better transportation and longer storage of fall potatoes the demand for fresh early season potatoes from California will probably decrease. A strong processing industry would help support the production of potatoes, but there are no dehydrators and no freezers in this part of the state. As the demand for these early season potatoes decreases, land will be converted into the production of other, higher valued competing crops. There are several other areas in Central and Southern California which produce early season potatoes. All the factors just discussed apply in these areas, plus acreage will be lost due to urbanization and increased land values. Again land values are rising because of rising demand for land for urbanization and recreational facilities. The increases in fall potato production will occur in Northern California, near the Oregon border. There will be continued expansion of potato production in this area because of a climate and soil which is similar to the major potato producing states in the Northwest. At the present time there is a potato

freezer in the area and prospects look good for more processors to locate in the area as the demand for processed potato products increases. The increasing number of processors will cause potato production to increase as the demand for supplies increases.

A decrease in potato production is also projected to occur in Colorado. The amount of land suitable for potato production is limited in Colorado due to the mountains. This limits any expansion of potato producing acreage into areas not now in production. This is even more important when it is realized that acreage now in potato production will be reduced by higher land values brought on by the increased demand for recreational facilities in the state. Another factor which will tend to cause this decline in production is the lack of a substantial processing industry in Colorado. With a small processing industry, most potatoes produced in Colorado must be sold in the fresh market. But, the demand for fresh potatoes is decreasing. The combination of these factors will probably lead to the reduced production of potatoes during the seventies.

The two potato producing states in the Southwest, Arizona and Texas, are both projected to increase production by 1980. Both states produce early season crops, with Arizona producing all late spring potatoes and Texas producing primarily early summer potatoes. The most

important factor which will allow for the predicted increases in production is the availability of new land not in production. With irrigation, this arid land is suitable for potato production. Rising yields plus increased acreage will cause increased potato production. Since both states have almost no processing industry, the speed of the increase in production depends on the demand for early season fresh potatoes. Arizona will experience a smaller increase in demand than Texas because better transportation and longer storage of fresh fall potatoes will reduce the need for fresh late spring potatoes more than the need for fresh early summer potatoes. But, both seasons will be hurt by the decrease in consumption of fresh potatoes. Also, Texas has a geographical advantage in the major Texas and Midwestern markets.

Although two of the four major potato producing states in the Southern region of the United States are projected to increase production of potatoes during the seventies, there is a net projected decrease in production in the region. Florida produces both winter and early spring potatoes for fresh sale. Florida, along with all the other major potato producing states in this region, will experience a decreasing demand for these early season crops with the decrease in the consumption of fresh potatoes and the longer storage and better transportation of all potatoes for fresh consumption. There will be losses of

potato producing areas because of urbanization, increasing land values and competition of other crops. Losses due to urbanization will occur in potato producing areas near Miami Beach and Fort Myers. Increasing land values will be a factor in all potato producing areas. There will be a continued high demand for land for recreational purposes. Florida has a highly developed citrus industry which competes actively for the limited amount of land available for agricultural production. Acreage which is transferred to the production of citrus fruits will be lost at least until 1980.

Although total potato production in Alabama will increase, the production of late spring potatoes is projected to decrease. The decrease in late spring potatoes is due to the decrease in demand for fresh early season potatoes and losses in acreage due to the spread of urbanization from Mobile. Decreases in production of late spring potatoes will be balanced by increases in production of other seasonal crops in the northern part of the state. Production of potatoes give producers an alternative to cotton production in this part of the state. Also, demand for fresh early summer and fresh late summer potatoes will not be affected as much as fresh late spring potatoes by the better transportation and longer storage of fresh fall potatoes.

North Carolina potato productionis projected to decrease by 750 thousand cwt., the largest amount of any potato producing state in the Southern region. The decrease in demand for fresh early spring potatoes will be an important factor which will depress production, but competition for land from other crops will be the major contributing factor in this production decrease. Tobacco and peanuts are the major competing crops which are well suited for production in North Carolina. As the production of these high valued crops increases, land available for potato production will decrease.

A very small increase in potato production is projected to occur in Virginia, a producer of early summer potatoes. Potato production in Virginia occurs in the extreme Southwest corner of the state. Although there are large amounts of tobacco and peanuts grown in Virginia, this corner of the state is best suited for potato production. The increase in production is small because reductions in acreage due to urbanization tend to offset any factors which would cause production to increase. Also, increased land values, due to urbanization and increased demand for recreational facilities along the Atlantic Ocean, will reduce the amount of land available for potato production. The close proximity to major Eastern markets will keep demand for fresh early summer potatoes at a high level. This will influence potato production upward,

and along with increased yields, tend to balance any reductions in acreage.

# CHAPTER V

## SUMMARY AND CONCLUSIONS

There has been a major shift in potato utilization due to shifts in potato consumption patterns during the past two decades. Since the introduction of processed potato products in the late fifties, there has been a rapid shifting of potato consumption from fresh potatoes to processed potato products. This shift in the consumption pattern of consumers has been a major factor which reversed the downward trend in per capita potato consumption.

The increased demand for processed potato products has affected potato utilization and opened up new marketing channels to producers. In 1950, almost all potatoes produced were shipped to the fresh market. In 1970, half of the potatoes produced were shipped to the fresh market and half to potato processors. This shows the shift in potato utilization which has occurred during the fifties and sixties.

As the demand for processed potato products continues to increase, the amount of potatoes supplied to processors will continue to rise through the seventies. The increasing supply of potatoes to processors has given

potato producers a viable alternative to the fresh market. Potato producers now have a choice of different marketing channels for their products, at least in states with a high concentration of processing facilities.

Along with the shifts in potato consumption and utilization, there has been a geographical and seasonal shift in potato production. Production of winter, early spring and late spring potatoes has decreased, production of early summer and late summer potatoes has increased slightly, and production of fall potatoes has increased greatly during the past two decades. Improved storage and transportation methods and rapidly rising processed potato consumption are apparently the most important factors stimulating seasonal shifts in production.

Potato production has shifted away from highly populated states, which lost potato producing acreage because of the spread of urbanization, and states which grow a number of competing crops. Production has shifted to states which were better suited for potato production, states which produce few competing crops and states which did not face acreage losses due to urbanization. In geographical terms, potato production has been shifting from the major potato producing states in the Northeast and South to the major potato producing states in the Midwest, Northwest, and, to a smaller degree, the Southwest.

The movements of raw potatoes indicates which major potato producing states are the major suppliers for each of the four major consumption regions in the United States. The Eastern region receives the majority of its supply of raw potatoes from four states, Maine, Idaho, New York, and California. The smallest number of unloads of raw potatoes occurs in the Southern region. The major suppliers of the Southern region are Colorado, Idaho, North Dakota, and Wisconsin. The Midwestern consumption region receives a majority of the supply of raw potatoes from Idaho, Michigan, Wisconsin, Minnesota, North Dakota, and California. This largest number of unloads occurs in this region. The final consumption region, the Western region, unloads raw potatoes primarily from five states, Colorado, California, Idaho, Oregon, and Washington.

The trends discussed above are projected to continue through the seventies, with certain effects on consumers and marketing channels. Consumers will be eating more fresh and processed potatoes which were produced in the Northwest and the Midwest. The projected decrease in the consumption of fresh potatoes will primarily affect the demand for local fresh potatoes, not the demand for Idaho potatoes. As consumer incomes continue to rise during the seventies more people will be able to afford the higher priced fresh potatoes (Idaho), which has a quality image and is preferred to most local potatoes. Thus,

the share of the fresh market sold by Idaho will increase. Consumers will be able to consume fresh fall potatoes for a longer period of time as storage and transportation improves during the seventies. The larger marketing season for fresh fall potatoes will decrease the need for fresh early season potatoes which fill in the gap between the beginning and ending of the marketing season for fresh fall potatoes. As consumption of processed potatoes products increases during the seventies, consumption of potatoes produced in the Northwest and Midwest will increase. A growing majority of potato dehydrators and freezers are located in the Northwest. Thus, as the consumption of dehydrated and frozen potato products increases, the consumption of potatoes produced in the Northwest will increase. Also, as these processors search for other sources of supply beyond the Northwestern region of the United States, they will tend to locate in the major potato producing states in the Midwest which have the ability to produce a good processing potato and have relatively cheap labor available. Thus, as more processors locate in the Midwest, the consumption of processed potatoes produced in the Midwest will increase.

A comparison of the projected total production in 1980 determined by the recursive model and the projected total production in 1980 determined by the sum of the projections of the production in the nineteen major

potato producing states to 1980 seems to indicate an inconsistency. The sum of the projected potato production in the nineteen major potato producing states is 372 million cwt. in 1980. The recursive model predicts production to be 389 million cwt. in 1980. This is a difference of 17 million cwt. between the two predictions. There are several possible explanations for this differential. The projected production of 372 million cwt. is the sum of the projected production in the nineteen major potato producing states only. This projection does not include potato production in the other thirty-one states. Although the nineteen states accounted for 94.5 percent of the total potato production in 1970 and this percentage is increasing as potato production declines in the other thirty-one states, these nineteen states will not account for all potato production in 1980. Thus, total production will be higher than 372 million cwt. If these nineteen states account for 97 percent of the total production in 1980, a reasonable figure given past increases in the percent of total production accounted for by these states, the production will be approximately 380 million cwt. Assuming that the 389 million cwt. of potatoes are demanded for all uses in 1980, an additional 9 million cwt. of potatoes must be produced. These potatoes can be produced by increasing production in one or more of the nineteen major producing states or increasing production in one or

more of the states which border the major producing regions. The most likely bordering states which would increase production are Utah, Wyoming, and Montana because these states have similar soil and climate which is conducive to producing good processing potatoes. Also, these states are reasonably close to a high concentration of processors.

Another possible explanation for this apparent inconsistency is the realization that the projection of the amount of potatoes used as feed and seed and not marketed because of shrinkage and loss may be too high. The amount of potatoes used as feed and seed and the amount not marketed because of shrinkage and loss during the seventies is projected to increase by approximately 25 million cwt., with an increase in production of approximately 65 million cwt. Although this amount will increase as production increases, this seems to be an unreasonable increase, especially when compared to the prior decade. Total production increased by approximately 65 million cwt. during the sixties, but the amount of potatoes used for feed and seed and not marketed because of shrinkage and loss increased by approximately 12.5 million cwt. Reducing this projected amount by 9 million cwt. would reduce projected total production to 380 million cwt., which is consistent with the sum of the projected total production from the total United States, assuming that

the nineteen major potato producing states produce 97 percent of the total production.

Finally, the projected amount of total production from the recursive model may be too large if the projected amount of potato acreage and/or the projected yield is too large. The recursive model projects that total potato acreage will be at approximately the same level in 1980 as it was in 1970. If potato acreage is reduced during the seventies because of urbanization, increasing land values, competing crops and recreation in specific major potato producing states, total potato production would be lower than projected. Also, environmental factors may show the actual yield increases during the seventies. Again potato production would be lower than projected by the recursive model.

In conclusion, the actual size of the differential between the two predictions is not as large as it seems. The nineteen major potato producing states will not produce all the potatoes in 1980. Assuming that the nineteen major potato producing states produce 97 percent of the total production in 1980, the total potato production would be 380 million cwt. There is still a differential of 9 million cwt. between the two predictions. Total potato acreage will probably decline during the seventies, so the prediction yielded by the recursive model is probably too high. Most of this reduction will be absorbed in

reduced amounts of potatoes used for feed and seed and not marketed because of shrinkages and loss. Thus, potato production in 1980 will probably be close to 380 million cwt.

The projections used above are based on the assumption that past shifts continue into the future. This may not actually be the case. There are several factors which could cause major structural shifts in potato production, consumption and utilization. Factors such as increased production losses due to environmental concerns, lack of proper amounts of irrigation water and reduced amounts of potato producing acreage could slow the increase in the quantity of potatoes produced during the seventies. Factors such as changes in living patterns, the consumerism movement, changes in retailing practices, changes in the retail price of processed potato products due to changes in processing costs, and the development of new food preparation products could change the trends in consumption and utilization of the prior two decades.

# BIBLIOGRAPHY

BIBLIOGRAPHY

1. American Potato Yearbook. Various Issues. Stock Plains, New Jersey: 1950-1972.

2. Croxton, Frederick E., and Crowden, Dudley J. Applied General Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1955.

3. Hayenga, Marvin L., and Hacklander, Duane. Monthly Supply-Demand Relationships for Cattle and Hogs. Michigan State University, Agriculture Experiment Station, Article No. 4884.

4. Hee, Olman. Demand and Price Analysis for Potatoes. U. S. Department of Agriculture, Technical Bulletin No. 1380. July, 1967.

5. Johnston, J. Econometric Methods. New York: McGraw-Hill, 1963.

6. Krebs, Edward H.; Hayenga, Marvin L.; and Lehker, John N. Various Price and Supply Control Programs for Navy Beans : A Simulation Analysis. Michigan State University, Agriculture Economics Report, No. 212. January, 1972.

7. Kristianslund, Ivar. Analysis of Intraseasonal Potato Price Movements. Unpublished Ph.D. Thesis, Michigan State University, 1971.

8. Mainker, Kenneth W. Factors That Affect Price and Distribution of New Jersey Potatoes. New Jersey Agriculture Experiment Station, Bulletin No. 786. June, 1957.

9. National Potato Council, Annual Statistical Report. Denver, Colorado: 1971.

10. Simmons, Will M. An Economic Study of the U.S. Potato Industry. U. S. Department of Agriculture, Agricultural Economics Report No. 6, March, 1962.

11. Sullivan, G. H. The Potato Industry. Purdue University, Agriculture Experiment Station, Research Bulletin No. 862. 1968.

12. U. S. Department of Agriculture. Agricultural Statistics. Washington: 1962, 1967, and 1972.

13. U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board. Crop Production. Washington: 1972.

14. U. S. Department of Agriculture. Homemakers Preferences and Buying Practices for Selected Potato, Rice and Wheat Products. Marketing Research Report, No. 939. October, 1971.

15. U. S. Department of Agriculture, Consumer Marketing Service, Fresh Fruit and Vegetable Division, Market News Branch. Fresh Fruit and Vegetable Unloads in Eastern Cities. Washington: 1971.

16. U. S. Department of Agriculture, Consumer Marketing Service, Fresh Fruit and Vegetable Division, Market News Branch. Fresh Fruit and Vegetable Unloads in Midwestern Cities. Washington: 1971.

17. U. S. Department of Agriculture, Consumer Marketing Service, Fresh Fruit and Vegetable Division, Market News Branch. Fresh Fruit and Vegetable Unloads in Southern Cities. Washington: 1971.

18. U. S. Department of Agriculture, Consumer Marketing Service, Fresh Fruit and Vegetable Division, Market News Branch. Fresh Fruit and Vegetable Unloads in Western Cities. Washington: 1971.

19. U. S. Department of Agriculture, Economics Research Service. Marketing and Transportation Situation, Various Issues. Washington: 1947-1971.

20. U. S. Department of Agriculture, Economic Research Service. National Food Situation. Washington: 1972.

21. U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board. Potatoes and Sweet Potatoes. Washington: 1966, 1971, 1972.

22. U. S. Department of Agriculture. Potato Marketing Report. September, 1972.

23. U. S. Department of Agriculture, Economics Research Service. Vegetable Situation, Various Issues. Washington: 1952-1971.

24. U. S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census. Statistical Abstract of the United States, Various Issues. Washington: 1952-1971.

25. U. S. Department of Labor, Bureau of Labor Statistics. Estimated Retail Food Prices by Cities, Various Issues. Washington: 1950-1965.

26. Wonnacott, Ronald J., and Wonnacott, Thomas H. Econometrics. New York: John Wiley and Sons, Inc., 1970.

27. Zusman, Pinhas. Econometric Analysis of the Market for California Early Potatoes. Hilgardia Val. 33, 1962.