The competitive position of the Arizona egg industry

THE COMPETITIVE POSITION OF THE ARIZONA EGG INDUSTRY

by

Paul Nicholas Wilson

A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 7 5

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Paul N. Wilson

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

R. C. ANGUS
Professor of Agricultural Economics

May 26, 1975
Date

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. Robert C. Angus for his assistance in the organization of this research and to Dr. Roger W. Fox and Dr. Robert S. Firch for their assistance in the final review of this paper.

Special recognition and thanks goes to Dr. Bobby L. Reid and Dr. Frank D. Rollins for their patience, guidance, and financial assistance which made the completion of this research possible. Their knowledge of the egg industry was immensely helpful in formulating and carrying out this study.

Thanks also to Dr. Reuben N. Weisz who worked with me in developing the programming techniques. His interest made it possible to complete this study on time.

The author gratefully acknowledges the cooperation of the poultrymen in Arizona who provided the basic cost information for this thesis. Conversations with them also provided me with direction and supportive materials.

Also appreciated is the effort of Dena Tays for typing the rough draft. Deepest appreciation goes to Mrs. Paula Tripp for typing the final draft.

A special word of thanks to my wife, Ellen, whose sacrifices and encouragement were essential for my perseverance throughout my studies.

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF TABLES--Continued

LIST OF TABLES--Continued

LIST OF ILLUSTRATIONS

ABSTRACT

Egg producers in Arizona have experienced a decline in market share and production capacity over the past five years. An increasing percentage of Arizona's demand for shell eggs is being supplied by California producers. This competitive advantage is attributed to cost advantages in California. A linear programming transportation model was formulated to determine how sensitive Arizona's competitive position was to changes in feed cost, transportation cost, and market demand. The objective was to project the volume and geographical location of egg production in Arizona in 1990 under the specified alternative conditions.

It was determined that feed cost was the primary factor affecting the competitive advantage or disadvantage of Arizona egg producers. Increasing demand had only a slight influence on Arizona's egg producing regions while higher transportation costs had no affect at all. Decreasing Arizona feed costs by 7.8% from their 1974 level (approximately $11.00/ton) eliminated California production from the Arizona market. Only a concerted effort by Arizona producers to lower feed costs will make it possible for them to profitably expand their production.

CHAPTER I

INTRODUCTION

The future of egg production in Arizona is a legitimate concern for those involved with the Arizona egg industry. Egg producers are unsure of the long-run viability of their operations. Price instability for eggs and a dynamic economic environment make it increasingly difficult to make confident and accurate long-run production and investment decisions.

This paper will attempt to shed some insight on the long-run competitiveness of the Arizona egg industry versus the California egg industry under various economic conditions. Through the use of a linear programming transportation model, projections will be made through the year 1990 to clarify the long-run locational production shifts of the egg industry in Arizona. The model is based on the assumption that producers will move in the direction of increased profitability. The analysis is limited to California and Arizona, with California exporting eggs into Arizona.

Historically, Arizona has been a deficit egg producing state. The quantity demanded locally has been greater than local production. To meet Arizona demand, eggs produced in lower cost regions, primarily California, had been imported. In 1973, Arizona produced only 24% of its commercial egg needs (Table 1).

The decreasing number of layers in the state exemplifies the declining position of Arizona producers in the local market. In 1969 there

Table 1. Arizona's Degree of Self-Sufficiency in Egg Production (cases).[a]

Year	Population[b]	Demand[c]	Production[d]	Deficit	Production as Percent of Demand
1974	2,150,000	1,707,100	413,889	1,293,211	24%
1973	2,058,000	1,681,386	427,778	1,253,608	25%
1972	1,963,000	1,674,439	455,556	1,218,883	27%
1971	1,869,000	1,629,768	541,667	1,088,101	33%
1970	1,773,428	1,532,242	627,778	904,464	41%
1969	1,737,000	1,495,557	630,556	865,001	42%

a. A case of eggs throughout this study is assumed to be 30 dozen eggs.

b. Valley National Bank (1974).

c. Demand = Population x National Per Capita Consumption of Eggs for the year in question (see Appendix A).

d. Arizona Crop and Livestock Reporting Service (1975).

there 1,036,200 layers in the state as compared to only 700,000 in 1974 (Table 2). This was a 32.4% decrease in the number of layers. While during the same time period, the population of Arizona increased by 23.8%.

Concentration and integration also have characterized the Ariozna egg industry in the late 1960's and early 1970's. The total number of commercial poultry ranches[1] has declined considerably. In 1969, there were 55 commercial egg ranches but in 1974 that number had declined to 15 (Table 3). The number of ranches with 50,000 or more layers increased in the 1969-1974 period from five to seven and accounted for 84% of the layers in the state (Table 2).

Egg production is concentrated in three counties in Arizona. Maricopa, Pinal, and Pima Counties are the dominant producing areas in the state. They account for 91.5% of the total layers (Tables 4 and 5). In moving to reduce production and marketing costs, firms are establishing their own feed mills and processing plants adjacent to their ranches through acquisition or construction of facilities.

The Arizona egg industry finds itself in a transitional stage. The business of supplying the eggs for Arizona's consumers can come increasingly from California, or Arizona's industry can expand and take an increasing share of the market.

The factors that could lead to an expansion of the Arizona egg industry will be evaluated. Decreasing processed feed costs, increasing energy costs, an increasing population in the market areas and urban encroachment, and outdated facilities in California could all create

---

1. A commercial poultry ranch is defined as having 1,000 layers or more.

Table 2. Number and Percent of Total of Layers on Commercial Poultry Ranches by Size of Flock, Arizona, 1969 to 1974.

Year	1,000-4,999	%	5,000-9,999	%	10,000-19,999	%	20,000-49,999	%	50,000 and Over	%	Total	%
1974	5,000	.7	8,000	1.1	35,000	5.0	30,000	4.3	622,000	88.8	700,000	100.0
1973	8,100	1.2	14,500	2.1	66,500	9.7	--	--	601,000	87.0	690,100	100.0
1972	19,600	2.8	41,000	5.8	58,000	8.2	70,000	9.9	518,000	73.3	518,000	100.0
1971	22,300	2.3	70,000	8.8	41,500	5.2	116,800	14.7	543,000	68.4	543,000	100.0
1970	33,200	3.4	70,300	7.1	72,000	7.3	214,000	21.6	599,850	60.6	599,850	100.0
1969	55,700	5.4	95,300	9.2	93,000	8.9	250,000	24.2	542,000	52.3	542,000	100.0

Source: Rollins (1974) and Biehler (1975).

Table 3. Number and Percent of Total Commercial Poultry Ranches by Size of Flock, Arizona, 1969 to 1974.

Year	1,000-4,999	%	5,000-9,999	%	10,000-19,999	%	20,000-49,999	%	50,000 and over	%	Total	%
1974	3	20.0	1	6.7	3	20.0	1	6.7	7	46.7	15	100.0
1973	4	22.2	2	11.1	5	27.7	-	-	7	38.9	18	100.0
1972	9	34.6	5	19.2	4	15.4	2	7.7	6	23.1	26	100.0
1971	11	33.3	9	27.3	3	9.1	4	12.1	6	18.2	33	100.0
1970	15	34.1	11	25.0	5	11.3	7	15.9	6	13.6	44	100.0
1969	22	40.0	14	25.5	6	10.9	8	14.5	5	9.1	55	100.0

Sources: Rollins (1974) and Biehler (1975).

Table 4. Number and Percent of Total of Layers on Commercial Poultry Ranches, Arizona, by Counties, 1971 to 1974.

County	1974		1973		1972		1971	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Pima	222,000	31.7	242,100	35.1	263,600	37.3	319,500	40.3
Maricopa	305,000	43.6	374,000	54.2	361,000	51.1	369,300	46.5
Pinal	113,000	16.1	13,000	1.9	15,000	2.1	14,000	1.8
Yavapai	50,000	7.1	39,500	5.7	45,500	6.4	67,900	8.5
Cochise	--	--	--	--	--	--	--	--
Navajo	--	--	--	--	--	--	--	--
Santa Cruz	--	--	7,500	1.1	7,500	1.1	7,500	0.9
Apache	--	--	--	--	--	--	--	0.2
Graham	--	--	--	--	--	--	--	--
Gila	--	--	--	--	--	--	--	--
Greenlee	--	--	--	--	--	--	--	--
Yuma	--	--	--	--	--	--	--	--
Coconino	--	--	--	--	--	--	--	--
Mohave	10,000	1.4	14,000	2.0	14,000	2.0	14,000	1.8
TOTAL	700,000	100.0	690,100	100.0	706,600	100.0	793,600	100.0

Sources: Rollins (1974) and Biehler (1975).

Table 5. Number and Percent of Total of Commercial Poultry Ranches, Arizona, by Counties, 1971 to 1974.

County	1974		1973		1972		1971	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Pima	2	13.3	4	22.2	9	34.6	12	36.4
Maricopa	7	46.7	8	44.4	10	38.5	11	33.3
Pinal	2	13.3	1	5.6	1	3.8	2	6.1
Yavapai	3	20.0	3	16.6	4	15.4	5	15.2
Cochise	--	--	--	--	--	--	--	--
Navajo	--	--	--	--	--	--	--	--
Santa Cruz	--	--	1	5.6	1	3.8	1	3.0
Apache	--	--	--	--	--	--	1	3.0
Graham	--	--	--	--	--	--	--	--
Gila	--	--	--	--	--	--	--	--
Greenlee	--	--	--	--	--	--	--	--
Yuma	--	--	--	--	--	--	--	--
Coconino	--	--	--	--	--	--	--	--
Mohave	1	6.7	1	5.6	1	3.8	1	3.0
TOTAL	15	100.0	18	100.0	26	100.0	33	100.0

Sources: Rollins (1974) and Biehler (1975).

economic conditions where a shift in egg production from California to Arizona would be financially desirable. The possibility of such a transfer, its geographic distribution, and its magnitude will be analyzed in this project.

Objective and General Procedure

The purpose of this research is to project the volume and the geographic location of production of the Arizona egg industry as it adjusts towards 1990 under existing conditions, and under possible alternative economic conditions. The results of the analysis will also guide poultry work at The University of Arizona as to what areas they should concentrate on in their future extension and research programs. In projecting the size and location of the egg industry in Arizona towards 1990, the study will also be of service to large corporations involved in egg production and marketing, individual producers, supporting businesses and governmental agencies as they plan their activities into the future.

In order to realistically simulate interregional competition, the appropriate production and transportation costs of the regions in question were needed. Arizona data were gathered by interviewing the operators of six egg ranches which account for 75.1% of the layers in Arizona (Table 6). Comparable cost data for California were obtained through both primary and secondary sources (see Appendix C for interview guide).

Five adjustments or conditions will be simulated in the analysis so that their influence on the competitive position of Arizona's egg industry can be judged. These will be:

Table 6. Average Number of Layers in Arizona, Surveyed and Nonsurveyed Firms, 1975.

Area	Number of Layers	Percent of Total
Firms Surveyed		
Maricopa County		
Firm A	70,000	9.8
Firm C	90,000	12.7
Firm F	70,000	9.8
Pinal County		
Firm B	93,000	13.1
Pima County		
Firm D	100,000	14.3
Firm E	110,000	15.5
Nonsurveyed Firms	177,000	24.9
TOTAL	710,000[a]	100.0

a. Total taken from Arizona Crop and Livestock Reporting Service (1975).

(1) A static approach where present (1974) cost relationships remain relative through 1990. This will give a base upon which to compare the following adjustments as to their absolute and relative effects on the Arizona industry. This condition will answer the question, "Where will the Arizona egg industry be in 1990 if 1974 cost relationships remain relative?".

(2) Market demand for eggs will be expanded proportional to the expected increase in the population in all markets. Income elasticity of demand for eggs is assumed to be zero. This is supported by a Pennsylvania State University study that found the income elasticity for eggs to be .06 (Brandow, 1961).

(3) Arizona feed costs (i.e., cost of processed poultry feed to the producer) will be equated with those of California. This cost differential has been attributed to the larger operations and market in California versus the smaller operations and market demand in Arizona. Industry spokesmen have also mentioned railroad rates that favor California as a possible cause of this phenomena. The feed formula and the amount of feed used will be assumed to be the same in all production regions as a result of consultation with members of the Poultry Science Department, The University of Arizona.

(4) Transportation rates will be increased to reflect the predicted increase in the cost of energy. As transportation costs increase due to higher gasoline and diesel prices, Arizona production may be a better alternative than shipping eggs in from California. A projection of energy costs will be made and applied to the projected transportation cost which will be derived through budgeting techniques.

(5) The factors discussed above do not change singly but together. Therefore, in order to better reflect reality, all three factors, feed, energy, and market demand will be adjusted simultaneously to simulate the position of the Arizona egg industry in 1990.

Review of Literature

Various methods have been used in previous studies to analyze interregional competition of eggs. Most studies were limited to the analysis of regional cost and demand relationships from which predictions of future trends were made. Other studies have used transportation models to anticipate changes in the egg industry.

Christensen and Mighell (1951) reviewed the factors affecting egg production and consumption in the United States on a regional basis from 1925-1949. The demand for eggs, a description of the institutional structure, costs, and production volume were gathered for each region and compared on a national basis. Their analysis concluded that there would be little change in the regional pattern of production of eggs.

Judge, Seaver, and Henry (1954) looked primarily at the nature and degree of regional specialization along with geographic flow of factors and goods and services within and among regions. They ascertained that the degree and nature of specialization and the geographic flows of eggs within and among regions were a result of three factors: (1) the inequalities in the geographic distribution of resources and the corresponding production possibility relationships; (2) the behavior of households and their geographic demands for the products produced; and (3) the market where the interaction between the firms and the households

determine prices for factors, goods, and services. Finally, they presented the dynamic forces which they felt conditioned interregional competition. These forces or innovations were classified as: (1) biological, (2) mechanical, and (3) organizational. Each and/or a combination of these can alter the absolute and relative advantages of one region over anoter. Judge et al. (1954) provides a good deal of the theoretical framework for this study.

Judge (1956) researched the application of linear programming in handling problems in location and space economy. A spatial equilibrium model was used to derive the geographical equilibrium prices and flows as predetermined variables were adjusted to fit alternative sets of conditions. The United States was divided into twelve regions and an optimum solution (profit maximization) for egg flows was determined for 1950. Judge then changed variables such as population, income, and transportation costs, and analyzed the effect each change had on the optimum geographical flows of eggs. The model was also adjusted to estimate equilibrium price and trade flows for a future time period. Judge's work was primarily aimed at developing a decisional framework whereby policy decisions could be made. He concluded that information gained from the regional equilibrium prices and flows of the market egg sector under alternative conditions has practical importance, as it can be used to predict the implications of policy decisions made by both the private and public sectors of the economy.

Stemberger and Jasper (1960) investigated the competitive position of North Carolina in regard to out-of-state egg markets. After gathering the required cost data, the authors solved a number of

transportation problems. The results showed that North Carolina producers could produce and market table eggs as cheaply as their midwestern competitors. Cost advantages could be further realized provided the industry could organize and obtain a more efficient method of assembling eggs. In conclusion, the research showed that egg production in North Carolina was profitable and that the best markets for North Carolina would be Baltimore, Washington, D. C., and the coastal cities of Virginia.

Rogers and Bluestone (1967) studied the competitive position of the Midwest by drawing upon the findings of earlier studies. Regional costs, institutional structure, and market demand were all evaluated to determine their influence on the position of the Midwest. Their conclusions were that the Midwestern egg industry must undergo substantial changes if it is to remain competitive. Innovations in the areas of improved marketing practices and channels, consolidation of production units, and a more efficient input-supplying industry are all needed.

Forker, Chayat and Ben-David (1970) investigated the future of the egg industry in New York and the factors or conditions that will influence the competitive position of New York producers towards 1985. They used a transportation model to determine the advantages of the various regions. Recursive linear programming was used to determine the geographical distribution of egg production which would yield the lowest total costs under different sets of conditions. The various conditions were: (1) a static situation where relative costs and absolute market demands remained constant; (2) an improvement in feed procurement; (3) an equalization in the costs of labor among all regions producing for the Northeast markets; (4) an improvement in the organization and method of

distribution; (5) an expansion in demand; and (6) a simultaneous change in the preceding factors, except for labor, to simulate 1985. The authors concluded that egg production in New York would decline if the industry did not innovate and improve its efficiency in the areas of feed procurement and egg distribution. The method used in this study will be modified and adapted to the analysis of interregional competition between Arizona and California.

Theoretical Basis for Analysis of Interregional Competition

The competitive position of a region is primarily determined by (1) the number of firms in the industry, the potential market, and the preferences of that market for the final product; (2) the degree of efficiency in performing the production and marketing functions; and (3) the distances involved in the distribution of inputs, assembling the unprocessed product and distributing the final product. Samuelson (1952) presented a theoretical model for spatial economic problems which was used by Judge (1956) in his work with interregional competition of eggs in the United States.

An alternative manner of presentation is a continuation of the model of derived demand and supply as presented by Friedman (1962) and Tomek and Robinson (1972). This multiple-dimension model dealing with space and form is more specific and detailed than the Samuelson model. Changes in cost or demand relationships can be more readily observed and analyzed. In presenting the production and consumption patterns of two competitive regions together, the model can provide a clear simulation of interregional competition.

Figure 1 illustrates a theoretical derived demand and supply relationship between two regions without trade. Market demand is reflected in the demand for eggs at the retail level in each region: Dr represents this relationship. The supply function at the farm level, Sf, reflects the production costs, production efficiency, and the alternative uses of resources in a particular region. Marketing costs are shown in the separate supply of marketing services function, Ss, which includes the costs of assembling and processing eggs. For ease and clarity of analysis, this function is drawn to represent constant marketing costs per case of eggs.

Demand for eggs at the farm level, Df, and the supply of eggs at the retail level, Sr, are derived functions. Their derivations rest on the following relationships between the retail demand (Dr), farm supply (Sf) and marketing services supply (Ss).

$$D_f = D_r - S_s$$

$$S_r = S_f + S_s$$

The equilibrium points of the model will determine the farm and retail price of eggs in each region and the quantity of eggs that will be traded within and between regions.

Region A has an advantage over Region B because it can produce eggs at a lower cost (P1) than can B (P3). Given identical assembling and processing costs for both regions, the retail price in Region A (P2) is lower than that of B (P4). A price differential at the farm level (e.g., P1, P3) will encourage producers in Region A to ship a part of

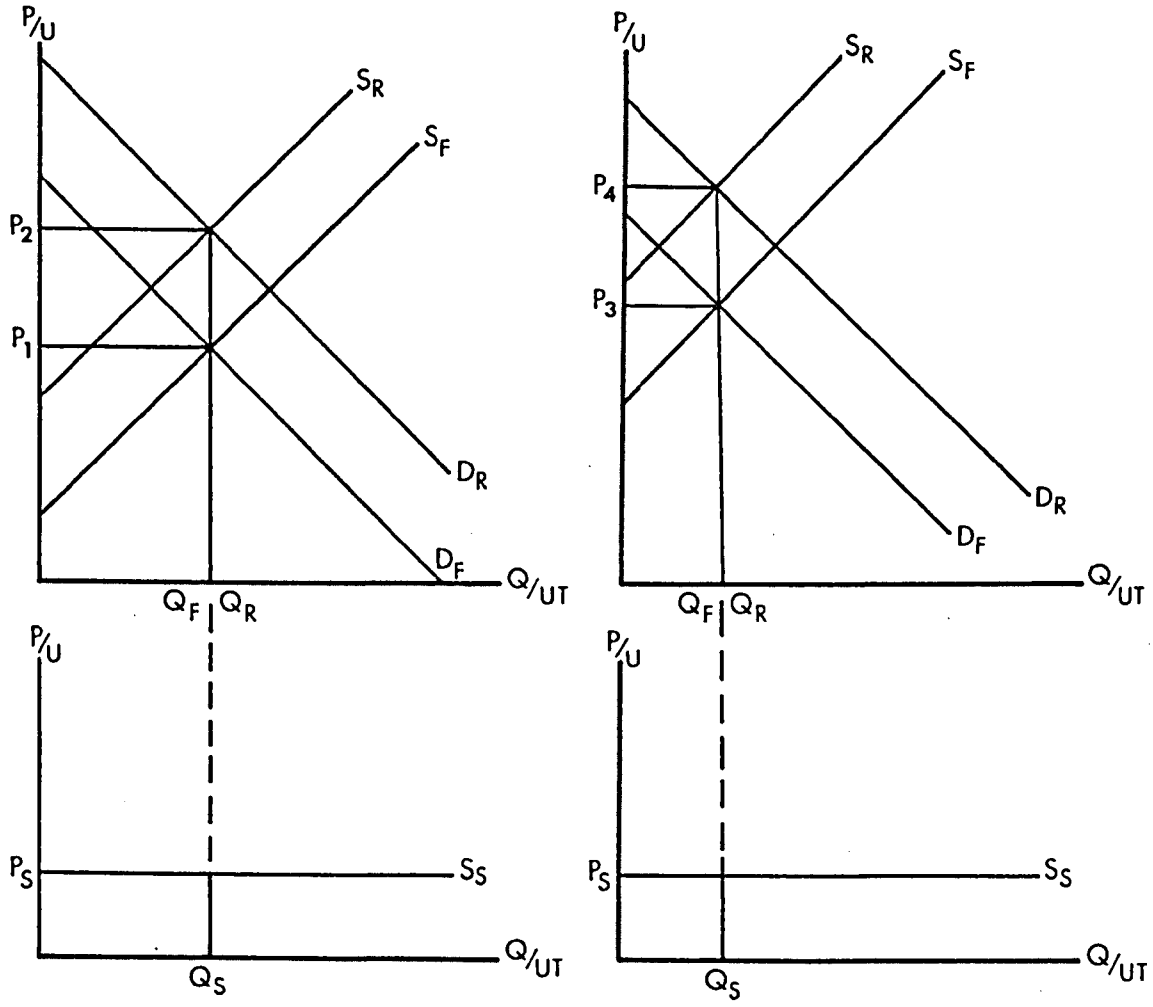


Figure 1. Model of Interregional Competition.

their production to Region B. The price differential must be greater than transportation costs for such a shipment to be profitable.

Adjustments of interregional trade are shown in Figure 2. Region A will ship eggs to Region B up to the point where the difference in price at the farm level between the two regions is equal to the transportation cost (A). A similar effect on the retail price of eggs occurs, because the supply of marketing services is the same for both regions. Increased supply decreases the retail price of eggs in Region B until the retail price differential between the two regions equals the transportation cost of shipping the eggs. The quantity "exported" by A is $Q_1\ Q_2$ and the quantity "imported" by B is $Q_3\ Q_4$. Exports equal imports ($Q_1\ Q_2 = Q_3\ Q_4$) and the model is in equilibrium.

Technical change will alter the relationships that are presented in Figures 1 and 2. Biological innovations can increase the total output per bird or per unit of feed. Improved rations, advances in breeding, and better control of diseases have the effect of shifting the supply curve at the farm level to the right. Mechanical innovations such as better designed houses, mechanical feeders, ranch-located feed mills, and more efficient trucking operations can reduce the costs to the industry both at the farm supply level and in the supply of marketing services. Finally, the organizational structure of firm and industry can affect the cost picture. Consolidation or vertical integration and the management by more sophisticated parent companies can increase efficiencies and lower per unit total costs. An increased market demand is also an organizational change which can result in definite cost savings.

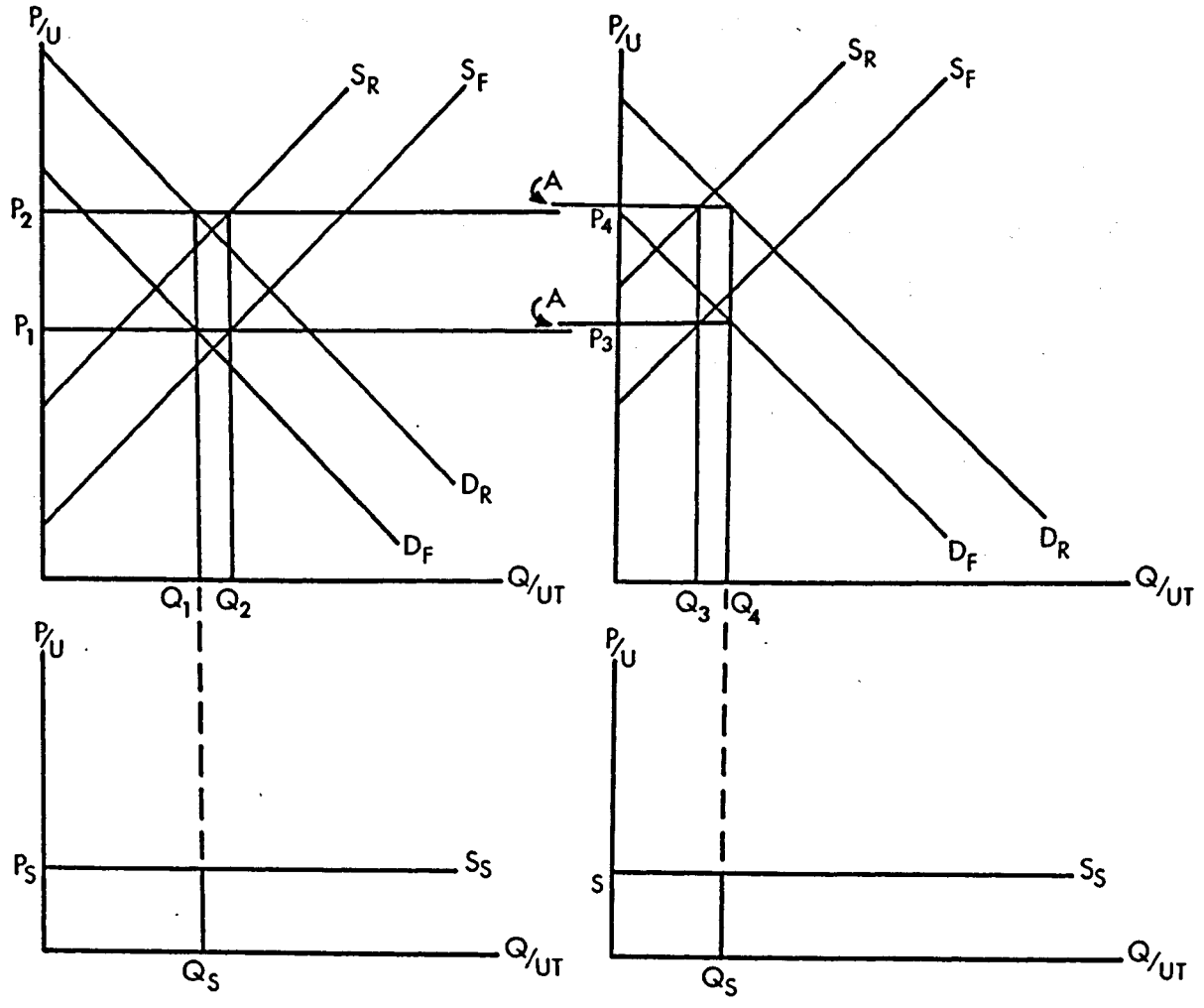


Figure 2. Model of Interregional Competition with Trade.

Change may also create adversity for the egg industry. The outbreak of disease can shift the supply curve at the farm level to the left and reduce the competitiveness of a firm or region. Increased costs for energy such as gasoline, diesel, and electricity can increase costs at the farm level as well as increase the costs of marketing services in the form of higher processing and transportation costs. The organizational structure of the parent company may not adequately reflect the costs to the individual firm. Costs may be transferred to an operating unit not because they were incurred there but because with such a transaction, the parent company can maximize its profits over all its operations. Finally, the market demand for eggs could continue to diminish and shift demand at the retail level to the left (Appendix A).

CHAPTER II

FORMULATION OF THE MODEL

Transportation Model

Linear programming is a mathematical decision aid that is helpful in making decisions requiring a choice among a large number of alternative actions. Linear programming is referred to by Daellenback and Bell (1970, p. 1) as a mathematical model which, " . . . is a representation of all or part of the properties of some subject of reality, such as an object, an event, a process, an operation, or a system, and its primary purpose is to explain, predict, or control the behavior of the entity modeled." For linear programming to be applicable to a problem, three common characteristics must exist:

(1) An objective that is to be optimized such as the maximization of profits or the minimization of costs.

(2) Alternative courses of action to reach the desired objective.

(3) Constraints or restrictions on the courses of action in attaining the objective.

A transportation model is a computerized technique with the objective of minimizing the transportation costs of moving goods from producing and/or storage points to market areas. Minimum costs (maximum profit) are achieved within a specified set of constraints such as production capacity and market demand.

In this study, the transportation model will minimize total costs. Production and transportation costs will equal total costs. Processing costs were not included in the model due to the lack of up-to-date California data. Therefore, processing costs are assumed to be equal in all producing regions.

Assumptions

In order to reduce the model to a simplified version of reality, certain assumptions regarding the economic environment are made. The assumption of perfect competition dictates that there will be flows of the commodity between the different regions given unequal production efficiencies. Each region will attempt to maximize profits by shipping eggs to the region which yields the greatest net return. The supply source and market for each geographical region is assumed to be represented by a fixed point. Regional demand is predetermined. Regional supplies are dependent on the initial capacities in year 0 (1974) and the resulting competitiveness of the region as the model progresses. It is assumed that consumers are indifferent to the source of supply and that the product is homogeneous. Finally, there can be no negative shipments of eggs between regions and all variables in the model that are not varied are assumed to remain constant relative to their 1974 levels.

The transportation model will be specified as follows:

1. The objective function is:

$$\text{minimize} \sum_{i}^{6} \sum_{j}^{14} X_{ij} (C_i + T_{ij})$$

where: X_{ij} = the volume of eggs shipped from production region i to market j

C_i = the cost of production in region i

T_{ij} = the cost of transportation from region i to market j

2. The constraints are:

$$X_{ij} \geq 0 \quad \text{and} \quad \Sigma X_{ij} = D_j$$

where: D_j = the quantity of eggs demanded in market j. The quantity shipped to any market must completely meet the demands in that market

3. There will be six production regions: i = 1, 2, 3, 4, 5, 6.

4. There will be fourteen market areas: j = 1, 2, 3 . . . 14.

Figure 3 presents a simplified picture of how supply will react to demand in the model. Where there are few producers in the industry, a step-cost supply function is an adequate representation of the supply curve. With a large number of producers in each region, a smoother positive sloping function would better reflect reality. With a step-cost function, volume will be allocated to each market (in this example Market 1) from the production region with the lowest combined cost, i.e., production and delivery cost. Production region 1 delivers its production capacity X_{11} at price C_{11}. Production region 4 delivers the volume $X_{41} - X_{11}$ at price C_{41}. And production region 3 will deliver volume $D_1 - X_{41}$ at price C_{31}. Production region 3 could deliver the volume $X_{31} - X_{41}$ but any volume in excess of D_1 D_1 will not be demanded in market 1. The implied price in the market is the combined production and transportation costs of the highest cost region necessary to satisfy the demands of the market. In this case, the implied price would be C_{31}.

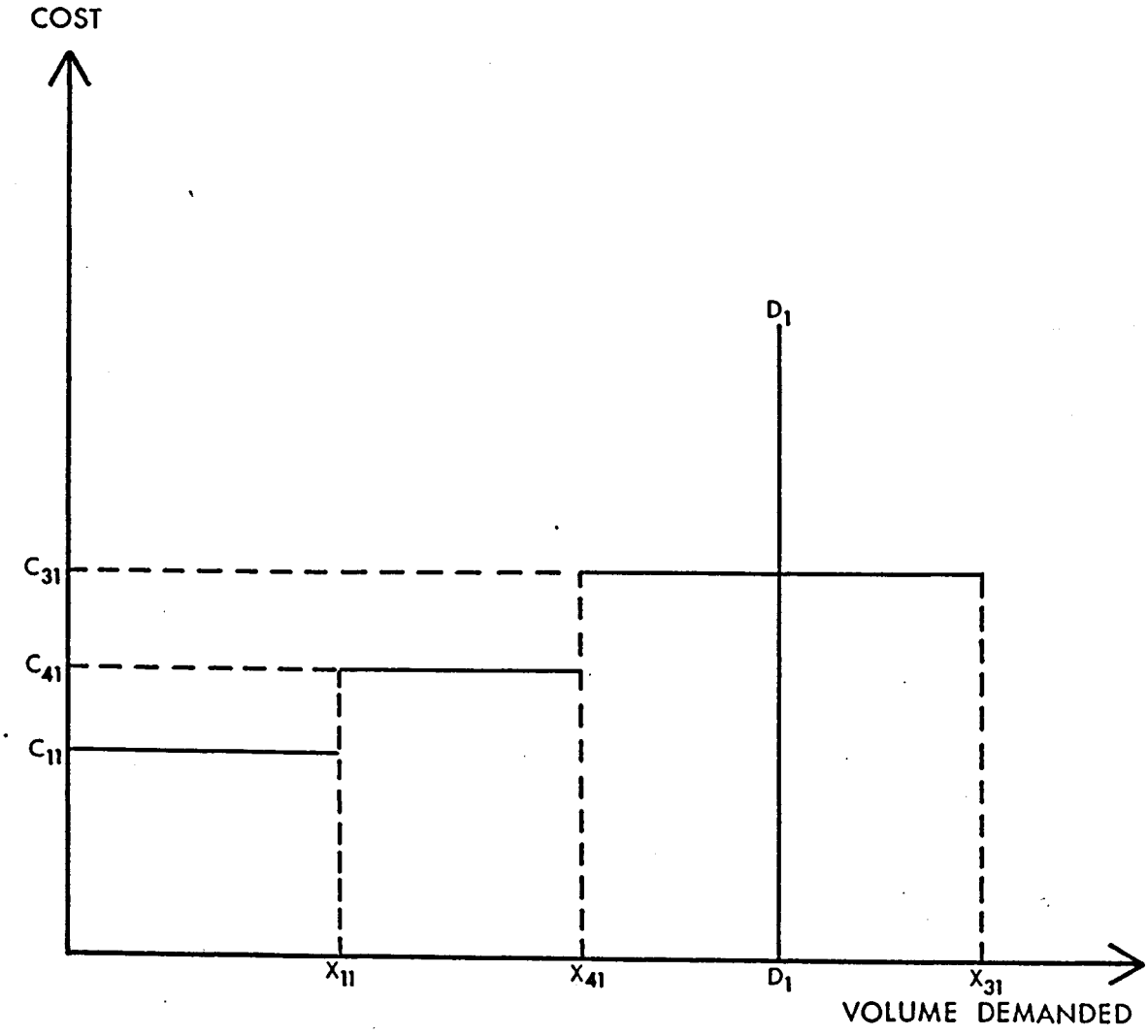


Figure 3. Demand and Supply Functions Used in the Model.

Limitations of the Model

The analytical technique used in this study provides information on the probable output of eggs over a time period if fifteen years for six competing production areas. Nevertheless, the model has certain limitations which must be recognized so that the results can be analyzed in the right perspective.

First, the model is a normative model. It assumes that the egg producer is a cost minimizer (profit maximizer) and the optimum solution is built on that assumption. The model will predict the structure of the Arizona egg industry in 1990 given the economic assumptions made. It will not provide the answer to what will be.

Secondly, some arbitrary assumptions have been made. Per capita consumption of shell eggs is considered to be constant throughout the analysis. Demand is presented as being perfectly price inelastic. Also the cost level at which expansion will take has been chosen quite arbitrarily without detailed empirical evidence.

Thirdly, the analysis is conditional. For example, the technique used states that assuming all other things equal, an equalization of Arizona feed costs to those of California will result in a redistribution of production and market allocations.

Procedure

Egg Production Regions

Arizona is divided into five production regions:

Region 1: Maricopa County (Phoenix)

Region 2: Pima County (Tucson)

Region 3: Pinal County (Casa Grande)

Region 4: Yavapai County (Prescott)

Region 5: Mohave County (Kingman)

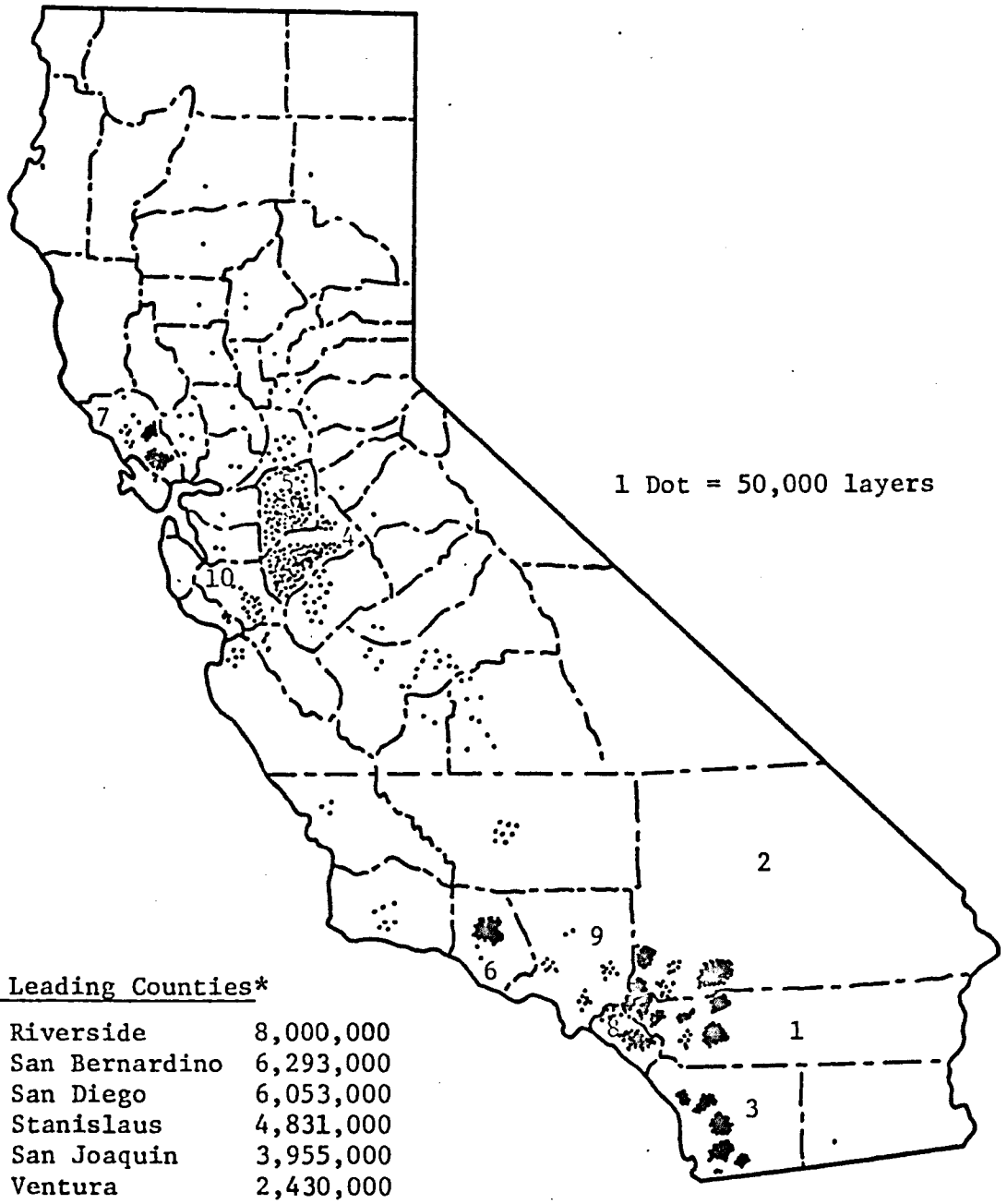
These regions represent the areas with egg production as of 1974. County boundaries were chosen for convenience in isolating the regions geographically. The city in parentheses represents a production point from which transportation costs to the individual market areas are determined.

California will represent Region 6 with San Diego representing the central production point. The distribution of laying hens in California is represented in Figure 4. San Diego was chosen because the majority of the eggs shipped to Arizona originate in San Deigo County. Also the California egg production costs used in this study are taken from this area.

Egg production and initial capacity for each region is shown in Table 7. Initial capacity for California is the amount of shell eggs shipped to Arizona from California in 1974 as reported by the Arizona State Egg Inspector (Table 8).

Market Areas and Market Demand

Arizona's market areas are the fourteen counties in the state (Figure 5). The specific market location is the county seat except for Pinal County where Casa Grande is used instead of Florence to better represent the location of the majority of the county's population. Demand in each market will be specified and fixed (perfectly inelastic) for the analysis. The volume of shell eggs demanded is estimated by assuming a per capita consumption rate of 264 shell eggs and multiplying



Ten Leading Counties*

1.	Riverside	8,000,000
2.	San Bernardino	6,293,000
3.	San Diego	6,053,000
4.	Stanislaus	4,831,000
5.	San Joaquin	3,955,000
6.	Ventura	2,430,000
7.	Sonoma	1,900,000
8.	Orange	1,831,000
9.	Los Angeles	1,155,000
10.	Santa Clara	849,000

*Based on 1970 County Agricultural Commissioners Reports

Figure 4. Distribution of Laying Hens in California -- January 1971.

Source: Swanson (1971).

Table 7. Egg Production Volume and Initial Levels of Capacity, 1974.

Production Region	Actual Production[a]	Initial Capacity[b]	Arizona Initial Distribution of Capacity
	----- cases -----		
1. Maricopa County	192,150	192,150	.44
2. Pima County	139,860	139,860	.32
3. Pinal County	71,190	71,190	.16
4. Yavapai County	31,500	31,500	.07
5. Mohave County	6,300	6,300	.01
			100.00
6. California	23,569,444[c]	1,186,854	

a. For Arizona, actual production = average number of layers x 225. It is assumed that the average production per year is 250 eggs with 90% of the egg production being sold as shell eggs at the retail, wholesale, and institutional levels.

b. The initial capacity is actual production for Arizona. Initial capacity for California is the amount of shell eggs shipped to Arizona from all areas in 1974 as reported by the Arizona State Egg Inspector less 10% for breakage, checks, and breaking.

c. California production data was taken from California Crop and Livestock Reporting Service (1975).

Table 8. Imports of Eggs to Arizona, 1974.

Month	Origin						
	California			Non-California			
	Shell Eggs	Frozen	Dried	Shell Eggs	Frozen	Liquid	Dried
		- - - lbs.- -			- - - - lbs. - - - -		
January	100,117	40,876		3,918			
February	95,293	24,280		4,001			
March	105,525	71,127	3,800	6,482		284	1,800
April	110,836	63,108		6,977			
May	102,067	24,750	2,520	9,124	5,250		
June	101,668	4,300		7,603			
July	104,118	15,280		5,138			
August	105,436	6,470	5,475	3,395			
September	94,810	14,763		4,991			
October	109,993	84,628	59,885	3,290			27,610
November	111,888	13,394		3,210			
December	115,673	20,046	5,250	3,174			
TOTAL	1,257,424	388,022	76,930	61,303	5,250	284	29,410

Source: Biehler (1975).

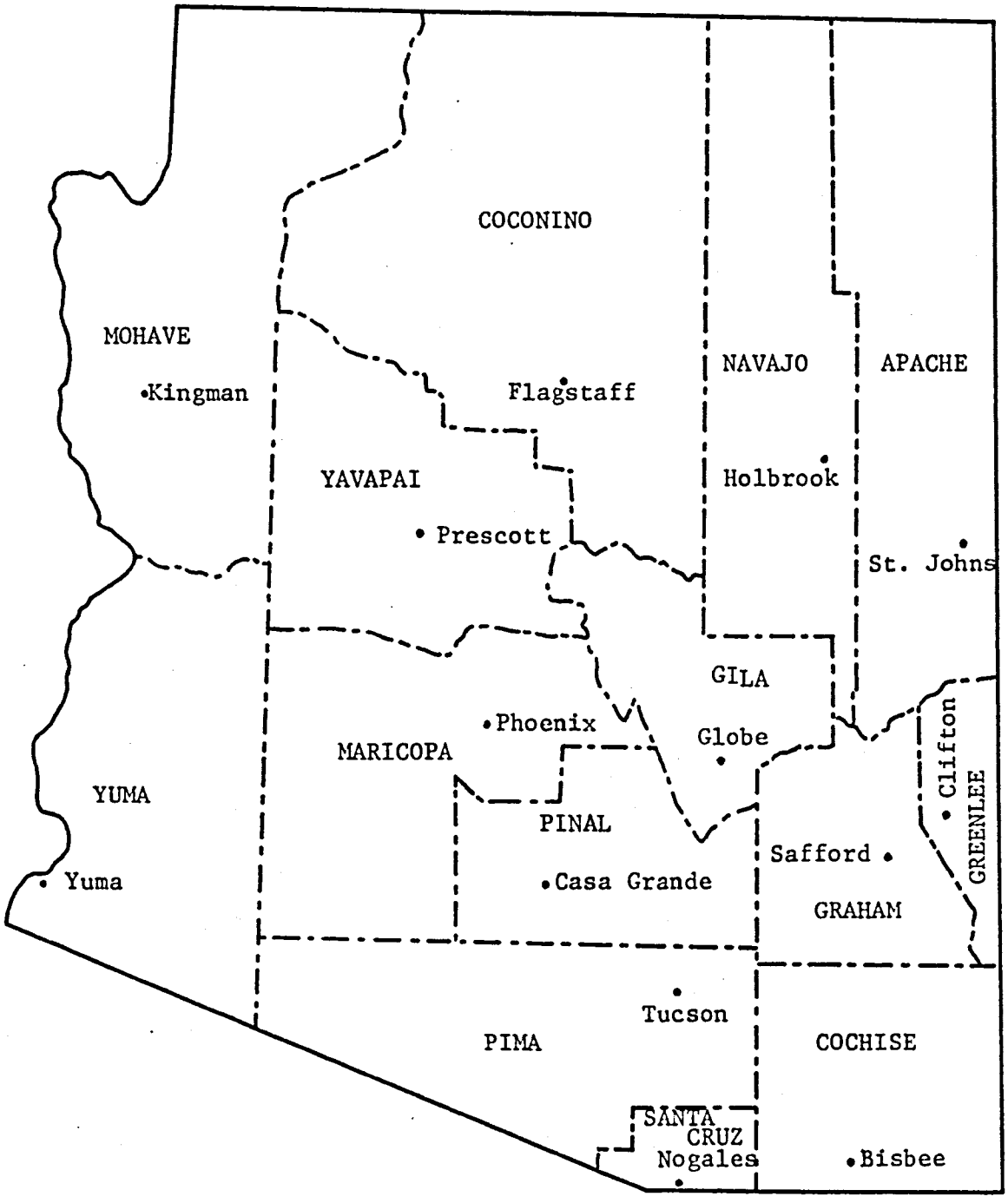


Figure 5. Arizona Production Regions and Market Areas.

by the projected population in the market area for each year (Appendix B). Per capita consumption was determined by dividing the number of shell eggs sold in Arizona in 1974 by the state's population for that year. Table 9 shows the quantity of shell eggs and egg products sold for 1973 and 1974. The differences between the two years can be attributed for the most part to high egg prices in 1973 and high beef prices in 1974. Per capita consumption will be assumed to be constant throughout the analysis.

Production Costs

The production costs for Arizona used in this study are based on a survey of six poultry ranches. Three were form Maricopa County, one from Pinal County, and two from Pima County. They represent 75.1% of the layers in the state. The cost information gathered was accounting data from general ledgers, profit and loss statements, and intra-company reports. A weighted average of the costs was computed to arrive at a representative production cost budget as presented in Table 10. Detailed cost information will not be presented on a firm-by-firm basis because of the confidentiality of that information.

Comparable California production costs as presented in Table 10 are taken from an annual publication of the Agricultural Extension Service, The University of California. This report deals with the production costs in San Diego County (Bell, 1975).

Production costs will be the same for all five production regions in Arizona. Confidentiality makes this assumption necessary. The lack

Table 9. Shell Eggs and Egg Products Sold in Arizona, 1973 to 1974.

Quarter Ending	Cases of Shell Eggs	Cans
March 31, 1973	360,382	15,176
June 30, 1973	360,678	12,572
September 30, 1973	330,460	11,344
December 31, 1973	372,535	9,741
TOTAL	1,424,055	48,833
March 31, 1974	393,901	10,162
June 30, 1974	387,966	9,596
September 30, 1974	385,531	4,989
December 31, 1974	406,412	12,477
TOTAL	1,573,811	37,224

1973 Population	2,058,000	Per Capita Consumption = 249
1974 Population	2,150,000	Per Capita Consumption = 264

Source: Biehler (1975).

Table 10. Average Production Costs, 1974.

Costs	Arizona		California	
	Per Dozen	Per Case	Per Dozen	Per Case
Variable Costs				
Feed	$.3223	$ 9.67	$.2960	$ 8.88
Layer Amortization	.0814	2.44	.0860	2.58
Labor	.0236	.71	.0200	.60
Other Expenses	.0245	.74	.0230	.69
Subtotal	$.4518	$13.56	$.4250	$12.75
Fixed Costs				
Building and Equipment Depreciation	$.0162	$ .49	$.0130	$ .39
Interest on Investment	.0136	.41	.0150	.45
Subtotal	$.0298	$ .90	$.0280	$ .84
TOTAL COST	$.4816	$14.46	$.4530	$13.59

of any real difference in factor input prices and production efficiencies make this equal cost assumption reasonable.

Transportation Costs

Delivery costs as represented on the accounting books of the Arizona egg ranches do not adequately reflect the costs of shipping to different geographical or market regions. All costs of transportation and delivery are aggregated and any possibility to differentiate costs of shipments to particular areas is lost.

A computerized budgeting technique developed by the Cooperative Extension Service at The University of Arizona was used to determine transportation costs for 1974 (Hathorn and Wright, 1975). Distances between the fourteen market areas and the six production regions were taken from the appropriate highway road maps.

The average retail prices for equipment actually used in Arizona and California to transport eggs were acquired through converstions with truck dealers in Phoenix and Tucson. For interstate shipments between California and Arizona a Peterbuilt tractor is used in this study. It comes equipped with a 350 h.p. Cummins engine, twin screw and a 13 speed transmission. Average retail price is $36,000. The trailer is a 40 foot Utility refrigerated trailer that has an average retail price of $20,500.

For intra-state shipments within Arizona, the average retail price of a Ford bobtail refrigerated truck, Model LN 750 was determined. The truck has an 18 foot bed, a 5 speed transmission and two axles with an average retail price of $10,700. The gas mileage to be expected from

both vehicles was determined by discussion with the operators of similar vehicles that are presently being used on the road.

In Table 11, the average annual cost for operating the tandem tractor-refer trailer is computed. Each cost is determined in the following manner:

1. Depreciation = Purchase Price - Remaining Farm Value (RFV)/years of useful life

   RFV = Purchase price x 10 percent

2. THII refers collectively to the costs charged to taxes, housing, interest, and insurance. In this study, 22.0% was charged for THII annually.

   THII = Rate x (Purchase Price + RFV/2)

   Rate = Percentage of average investment charged to THII.

3. Repairs = TAR x Purchase Price/years to trade

   TAR = .00096 (Percent use)$^{1.4}$

   Percent use = (hours of annual use x years to trade x 100)/ hours to wear out.

4. Fuel Cost = Gallons/hour x price x years of use

   Oil Cost = Fuel cost x 1.15

The average cost of shipping a case of eggs from California (San Diego) to Maricopa, Pinal, and Pima Counties was determined in Tables 12 through 14. The annual cost of the vehicle was determined by calculating the cost based on hours of use per year. Linear extrapolation was used in estimating the total cost of using the machinery given the hours of annual use.

Table 11. Tandem Tractor-Refer Trailer Operating Costs, Projected Annual Costs and Cost Per Hour of Use for 1974.

Hours of Use	Years to Trade	Depreciation	THII	Repairs	Fuel & Oil	TOTAL	Cost Per Hour
525	5.0	10170.	6837.	770.	3472.	21248.	40.47
600	5.0	10170.	6837.	928.	3968.	21902.	36.50
675	5.0	10170.	6837.	1095.	4463.	22565.	33.43
750	5.0	10170.	6837.	1269.	4959.	23234.	30.98
825	5.0	10170.	6837.	1450.	5455.	23911.	28.98
900	5.0	10170.	6837.	1637.	5951.	24595.	27.33
975	5.0	10170.	6837.	1832.	6447.	25285.	25.93
1,050	5.0	10170.	6837.	2032.	6943.	25982.	24.74
1,125	5.0	10170.	6837.	2238.	7439.	26683.	23.72
1,200	5.0	10170.	6837.	2450.	7935.	27391.	22.83
1,275	5.0	10170.	6837.	2667.	8431.	28104.	22.04
1,350	5.0	10170.	6837.	2889.	3927.	28822.	21.35
1,425	5.0	10170.	6837.	3116.	9423.	29545.	20.73
1,500	5.0	10170.	6837.	3348.	9919.	30273.	20.18
1,575	5.0	10170.	6837.	3584.	10415.	31006.	19.69
1,650	5.0	10170.	6837.	3826.	10911.	31743.	19.24
1,725	5.0	10170.	6837.	4071.	11407.	32484.	18.83
1,800	5.0	10170.	6837.	4321.	11903.	33230.	18.46
1,875	5.0	10170.	6837.	4575.	12398.	33980.	18.12
1,950	5.0	10170.	6837.	4834.	12894.	34735.	17.81
2,025	5.0	10170.	6837.	5096.	13390.	35493.	17.53
2,100	5.0	10170.	6837.	5362.	13886.	36255.	17.26
2,175	5.0	10170.	6837.	5632.	14382.	37021.	17.02
2,250	5.0	10170.	6837.	5906.	14878.	37791.	16.80
2,323	5.0	10170.	6837.	6183.	15374.	38564.	16.59
2,400	5.0	10170.	6837.	6464.	15870.	39341.	16.39
2,475	5.0	10170.	6837.	6749.	16366.	40121.	16.21
2,550	4.9	10373.	6837.	6982.	16862.	41053.	16.10
2,625	4.8	10679.	6837.	7187.	17358.	42060.	16.02

Table 11. (continued)

Hours of Use	Years to Trade	Depreciation	THII	Repairs	Fuel & Oil	TOTAL	Cost Per Hour
2,700	4.6	10984.	6837.	7392.	17854.	43066.	15.95
2,775	4.5	11289.	6837.	7598.	18350.	44072.	15.88
2,850	4.4	11594.	6837.	7803.	18846.	45079.	15.82
2,925	4.3	11899.	6837.	8008.	19342.	46085.	15.76
3,000	4.2	12204.	6837.	8214.	19838.	47092.	15.70

56500.	Purchase price -- quoted 5/20/75
5	RFV group number
3	Tar equation number
12500	Hours to wearout or 5 years to trade
.460	Fuel price per gallon for diesel
12.5	Gallons of fuel consumed per hour
22.0	Percent of average investment charged for THII annually

Table 12. San Diego to Phoenix Transportation Cost.

Assumptions:

1. 3 trips per week
2. Average load: 811 cases
3. Driver Wage = $85 per trip ($.1184 per mile)
4. Profit = 10% return on initial investment
5. Distance = 718 miles round trip
6. Total Cases Shipped per year = 126,516
7. No backhaul

Annual miles traveled = 112,008

Average speed = 50 m.p.h.

Hours of use/year = 2,240

Annual Cost of truck and trailer	$37,688
Driver Wage $5.92/hr x 40 hrs/wk x 52 wk/yr	12,314
Prifit 10% x $56,500	5,650
TOTAL COST	$55,652

Average cost per case of eggs shipped = $.44[a]

Average cost per mile traveled = $.50

a. Industry spokesmen quoted an average cost of $.45 to ship one case of eggs from San Diego to Phoenix in 1974.

Table 13. San Diego to Casa Grande Transportation Cost.

Assumptions:

1. 3 trips per week
2. Average load: 811 cases
3. Driver Wage = $84.00 (based on pay of $.1184 per mile)
4. Profit = 10% return on initial investment
5. Distance = 710 miles round trip
6. Total Cases Shipped per year = 126,516
7. No backhaul

Annual miles traveled = 110,760

Average speed = 50 m.p.h.

Hours of use/year = 2,215

Annual Cost of truck and trailer	$37,432
Driver Wage $5.92/hr x 40 hrs/wk x 52 wks/yr	12,314
Profit 10% x $56,500	5,650
TOTAL COST	$55,396

Average cost per case of eggs shipped = $.44

Average cost per mile traveled = $.50

Table 14. San Diego to Tucson Transportation Cost.

Assumptions:

1. 3 trips per week
2. Average load: 811 cases
3. Driver Wage = $110 per trip (based on pay of $.1089 per mile)
4. Profit = 10% return on initial investment
5. Distance = 844 miles round trip
6. Total Cases Shipped per year = 126,516
7. No backhaul

Annual miles traveled = 131,664

Average speed = 50 m.p.h.

Hours of use/year = 2,633

Annual Cost of truck and trailer	$42,167
Driver Wage $5.92/hr x 40 hrs/wk x 52 wks/yr	12,314
Profit 10% x $56,500	5,650
TOTAL COST	$60,131

Average cost per case of eggs shipped = $.48

Average cost per mile traveled = $.46

The driver's wage for shipments from California to Arizona was assumed to be $85.00 for a round trip. This figure was determined through conversation with a representative of an Arizona egg firm that receives eggs from California. It was assumed that an average return on initial investment would be 10%.

Table 15 represents the determination of average annual total cost of operating the Ford Bobtail refrigerated truck for intrastate shipments of eggs. The same method was used in computing intrastate costs as was used in computing interstate costs. Table 16 presents the costs of shipping a case of eggs for trips of various distances within Arizona. Appendix D provides a detailed picture of how these costs were computed.

It is assumed that there are no costs of transportation if a producing region sells its eggs locally, i.e., within the same region. This is done because this analysis will end with the final product in the cooler ready for delivery to the wholesaler, retailer, or institutional buyer. The actual marketing of eggs at the local level is a separate and complex activity which is not a necessary part of this analysis.

Tables 17 through 21 show how the total cost of producing and shipping eggs from each of the six production regions to the fourteen market areas were determined. Take for example the case of producing eggs in Maricopa County and shipping them to Pima County. The production cost is $14.46 per case. The distance between the two areas is 116 miles or a round trip distance of 232 miles. From Table 16 transportation cost is taken for that distance and added to production cost. Total cost is

Table 15. Bobtail Refer Operating Costs, Projected Annual Costs and Cost Per Hour of Use for 1974.

Hours of Use	Years to Trade	Depreciation	THII	Repairs	Fuel & Oil	TOTAL	Cost Per Hour
200	10.0	963.	1295.	42.	1058.	3358.	16.79
300	10.0	963.	1295.	75.	1587.	3919.	13.06
400	10.0	963.	1295.	112.	2116.	4485.	11.21
500	10.0	963.	1295.	153.	2645.	5055.	10.11
600	10.0	963.	1295.	197.	3174.	5629.	9.38
700	10.0	963.	1295.	244.	3703.	6205.	8.86
800	10.0	963.	1295.	295.	4232.	6784.	8.48
900	10.0	963.	1295.	347.	4761.	7366.	8.18
1000	10.0	963.	1295.	403.	5290.	7950.	7.95
1100	10.0	963.	1295.	460.	5819.	8537.	7.76
1200	10.0	963.	1295.	520.	6348.	9125.	7.60
1300	10.0	963.	1295.	581.	6877.	9716.	7.47
1400	10.0	963.	1295.	645.	7406.	10309.	7.36
1500	9.4	1028.	1295.	692.	7935.	10950.	7.30
1600	8.8	1097.	1295.	738.	8464.	11593.	7.25
1700	8.3	1165.	1295.	784.	8993.	12237.	7.20
1800	7.8	1234.	1295.	830.	9522.	12881.	7.16
1900	7.4	1302.	1295.	876.	10051.	13524.	7.12
2000	7.0	1371.	1295.	923.	10580.	14168.	7.08
2100	6.7	1439.	1295.	969.	11109.	14812.	7.05
2200	6.4	1508.	1295.	1015.	11638.	15455.	7.03
2300	6.1	1576.	1295.	1061.	12167.	16099.	7.00
2400	5.9	1645.	1295.	1107.	12696.	16743.	6.98
2500	5.6	1714.	1295.	1153.	13225.	17386.	6.95
2600	5.4	1782.	1295.	1199.	13754.	18030.	6.93
2700	5.2	1851.	1295.	1245.	14283.	18674.	6.92
2800	5.0	1919.	1295.	1292.	14812.	19317.	6.90
2900	4.8	1988.	1295.	1338.	15341.	19961.	6.88
3000	4.7	2056.	1295.	1384.	15870.	20605.	6.87

Table 15. (continued)

Hours of Use	Years to Trade	Depreciation	THII	Repairs	Fuel & Oil	TOTAL	Cost Per Hour
3100	4.5	2125.	1295.	1430.	16399.	21248.	6.85
3200	4.4	2193.	1295.	1476.	16928.	21892.	6.84
3300	4.3	2262.	1295.	1522.	17457.	22536.	6.83
3400	4.1	2330.	1295.	1568.	17986.	23179.	6.82
3500	4.0	2399.	1295.	1615.	18515.	23823.	6.81

10700.	Purchase price -- quoted 5/20/75
5	RFV group number
3	TAR equation number
14050	Hours to wearout or 10 years to trade
.460	Fuel price per gallon for gasoline
10.0	Gallons of fuel consumed per hour
22.0	Percent of average investment charged for THII annually

Table 16. Intrastate Transportation Costs.[a]

Miles Traveled Per Trip	Cost Per Case Shipped
50 - 100	.18
101 - 150	.20
151 - 200	.22
201 - 250	.24
251 - 300	.26
301 - 350	.28
351 - 400	.30
401 - 450	.32
451 - 500	.34
501 - 550	.45
551 - 600	.48
601 and over	.51

a. See Appendix C for detailed computation of intrastate transportation costs.

Table 17. Total Costs for Maricopa County Shipments.

Miles to	Market	Production Cost	Transportation Cost	Total Cost
0	1. Maricopa	$14.46	$ 0	$14.46
116	2. Pima	14.46	.24	14.70
49	3. Pinal	14.46	.18	14.64
210	4. Cochise	14.46	.32	14.78
181	5. Yuma	14.46	.30	14.76
142	6. Coconino	14.46	.26	14.72
206	7. Navajo	14.46	.32	14.78
96	8. Yavapai	14.46	.22	14.68
220	9. Apache	14.46	.32	14.78
181	10. Mohave	14.46	.30	14.76
88	11. Gila	14.46	.22	14.68
164	12. Graham	14.46	.28	14.47
180	13. Santa Cruz	14.46	.30	14.76
207	14. Greenlee	14.46	.32	14.78

Table 18. Total Costs for Pima County Shipments.

Miles to	Market	Production Cost	Transportation Cost	Total Cost
116	1. Maricopa	$14.46	$.24	$14.70
0	2. Pima	14.46	0	14.46
67	3. Pinal	14.46	.20	14.66
94	4. Cochise	14.46	.22	14.68
244	5. Yuma	14.46	.34	14.80
258	6. Coconino	14.46	.45	14.91
240	7. Navajo	14.46	.34	14.80
212	8. Yavapai	14.46	.32	14.78
238	9. Apache	14.46	.34	14.80
297	10. Mohave	14.46	.48	14.94
106	11. Gila	14.46	.24	14.70
126	12. Graham	14.46	.26	14.72
64	13. Santa Cruz	14.46	.20	14.66
169	14. Greenlee	14.46	.28	14.74

Table 19. Total Costs for Pinal County Shipments.

Miles to	Market	Production Cost	Transportation Cost	Total Cost
49	1. Maricopa	$14.46	$.18	$14.64
67	2. Pima	14.46	.20	14.66
0	3. Pinal	14.46	0	14.46
192	4. Cochise	14.46	.30	14.76
177	5. Yuma	14.46	.30	14.76
191	6. Coconino	14.46	.30	14.76
221	7. Navajo	14.46	.32	14.78
145	8. Yavapai	14.46	.26	14.72
220	9. Apache	14.46	.32	14.78
230	10. Mohave	14.46	.34	14.80
88	11. Gila	14.46	.22	14.68
164	12. Graham	14.46	.28	14.74
131	13. Santa Cruz	14.46	.26	14.72
207	14. Greenlee	14.46	.32	14.78

Table 20. Total Costs for Yavapai County Shipments.

Miles to	Market	Production Cost	Transportation Cost	Total Cost
96	1. Maricopa	$14.46	$.22	$14.68
212	2. Pima	14.46	.32	14.78
145	3. Pinal	14.46	.26	14.72
306	4. Cochise	14.46	.51	14.97
218	5. Yuma	14.46	.32	14.78
90	6. Coconino	14.46	.22	14.68
181	7. Navajo	14.46	.30	14.76
0	8. Yavapai	14.46	0	14.46
243	9. Apache	14.46	.34	14.80
163	10. Mohave	14.46	.28	14.74
184	11. Gila	14.46	.30	14.76
260	12. Graham	14.46	.45	14.91
276	13. Santa Cruz	14.46	.48	14.94
303	14. Greenlee	14.46	.51	14.97

Table 21. Total Costs for Mohave County Shipments.

Miles to		Market	Production Cost	Transportation Cost	Total Cost
181	1.	Maricopa	$14.46	$.30	$14.76
297	2.	Pima	14.46	.48	14.94
230	3.	Pinal	14.46	.34	14.80
391	4.	Cochise	14.46	.51	14.97
240	5.	Yuma	14.46	.34	14.80
161	6.	Coconino	14.46	.28	14.74
252	7.	Navajo	14.46	.45	14.91
163	8.	Yavapai	14.46	.28	14.74
314	9.	Apache	14.46	.51	14.97
0	10.	Mohave	14.46	0	14.46
269	11.	Gila	14.46	.45	14.91
345	12.	Graham	14.46	.51	14.97
361	13.	Santa Cruz	14.46	.51	14.97
388	14.	Greenlee	14.46	.51	14.97

the key to the model as it will be minimized (profits maximized) to determine long-run equilibrium supply positions.

Table 22 treats the cost of shipping eggs from California to Arizona markets. For shipments to Maricopa, Pima, and Pinal Counties the transportation cost is figured from Tables 12 through 14. The remainder of the counties are assumed to receive their eggs through Phoenix. Therefore, Maricopa County acts as a transshipment point. Transportation costs are determined in the following manner given that Gila County is the final destination for the eggs. It costs $.44 per case from California to Maricopa plus $.22 from Phoenix to Globe. Therefore, the transportation cost is $.66 per case and the total cost of producing eggs in California and shipping them to Globe (Gila County) is $14.25.

To relate the preceding figures to the structure of the transportation model, Table 23, the total cost matrix for 1974, is presented along with initial supply and demand figures. Supply is greater than demand in the model therefore necessitating the use of a surplus or excess supply variable. A more detailed explanation for this surplus factor is in the next section. The linear programming transportation model will solve the matrix so that the demand of all fourteen markets is met at the lowest possible cost. The percentages under the total production figure for each region represent the share of total overall production that region has. For example, Maricopa County produces 12% of the eggs in the model. References to the beginning figure will be made throughout the analysis.

Table 22. Total Cost of California Shipments.

Miles to	Market	Production Cost	Transportation Cost	Total Cost
359	1. Maricopa	$13.59	$.44	$14.03
422	2. Pima	13.59	.48	14.07
355	3. Pinal	13.59	.44	14.03
569	4. Cochise	13.59	.72	14.31
540	5. Yuma	13.59	.74	14.33
501	6. Coconino	13.59	.70	14.29
565	7. Navajo	13.59	.76	14.35
455	8. Yavapai	13.59	.66	14.25
579	9. Apache	13.59	.76	14.35
540	10. Mohave	13.59	.74	14.33
447	11. Gila	13.59	.66	14.25
523	12. Graham	13.59	.72	14.31
539	13. Santa Cruz	13.59	.74	14.33
566	14. Greenlee	13.59	.76	14.35

Table 23. Total Cost Matrix, 1974.

Origin — Production Region i \ Destination — Market Area j	Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yavapai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus	Total Production
	dollars															cases
Maricopa 1	14.46	14.70	14.64	14.78	14.76	14.72	14.78	14.68	14.78	14.76	14.68	14.74	14.76	14.78	0	192,150 (.12)
Pima 2	14.70	14.46	14.66	14.68	14.80	14.91	14.80	14.78	14.80	14.94	14.70	14.72	14.66	14.74	0	139,860 (.09)
Pinal 3	14.64	14.66	14.46	14.76	14.76	14.76	14.78	14.72	14.78	14.80	14.68	14.74	14.72	14.78	0	71,190 (.04)
Yavapai 4	14.68	14.78	14.72	14.97	14.78	14.68	14.76	14.46	14.80	14.74	14.76	14.91	14.94	14.97	0	31,500 (.02)
Mohave 5	14.76	14.94	14.80	14.97	14.80	14.74	14.91	14.74	14.97	14.46	14.91	14.97	14.97	14.97	0	6,300 (.00)[a]
California 6	14.03	14.07	14.03	14.31	14.33	14.29	14.35	14.25	14.35	14.33	14.25	14.31	14.33	14.35	0	1,186,854 (.73)
DEMAND (cases)	738,990	274,050	50,715	47,502	43,029	39,501	33,894	29,862	25,578	21,609	20,160	11,340	10,962	7,308	0	1,627,854 / 1,354,500

a. (.00) denotes a percentage less than .5%.

Depreciation Rate and Cost-Volume Relations

The assumption is made that production facilities in each region are of equal age in 1974. So that currently existing capacity will wear out or become obsolete by 1990, the capacity level of each region will be depreciated at a rate of 7% per year subsequent to the starting year, 1974.

Finding that the implied price of a market area is equal to or greater than the total cost of production of the supplying region, it shall be assumed that existing capacity can be maintained or expanded depending on the cost relationships.

If the production region has surplus production which is not distributed to any of the fourteen markets, that quantity of surplus capacity will be depreciated. A production region is not competitive if it shows a high percentage of surplus production relative to existing capacity. Hence, the surplus is an indicator of the relative strength or weakness of a production region.

Given that two or more regions are supplying the same market, the implied price of the market may be greater than the total cost of one of the production regions. If this is the case, it is assumed in this model that the region will expand its production. Expansion will take place only if the implied price of the market exceeds the total cost of production of the lower cost region by $.30 per case. The region will expand its production by the amount produced by the competing, higher cost region. It will be assumed that expansion will not add to or decrease the cost of producing a case of eggs.

CHAPTER III

RESULTS OF ANALYSIS

The cost, supply, and demand conditions as presented in Table 23 represent the base year, 1974. Year 1 is 1975 and is the least-cost solution of the 1974 data. The results expressed in this solution will provide the quantitative base that will be used to compare the results of the various conditions that will be simulated. The comparison provides a systematic appraisal of the consequences of assumed economic changes on the competitive position of the Arizona egg industry. The analysis provides a measurement of the relative importance of the various economic factors as the model adjusts toward a long-run equilibrium.

Static Conditions

The assumption of static conditions provides an estimate of a production region's competitive strength in the market area at the present time (1974). The cost and demand conditions will remain at their 1974 levels. Production capacity will be allowed to vary under the conditions specified in Chapter II. Therefore, this situation is a representation of a static market where demand remains at 1974 levels through 1990 and a static production and transportation cost picture where no relative cost reductions or increases are realized.

Table 24 demonstrates the format that will be used throughout the analysis. The year of comparison is represented by 1975 so the

Table 24. Static Analysis, 1975 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															178,700 (100.0) (0.0)	178,700 (.11) (0.0)
Pima 2		64,074 (.46) (.23)		47,502 (.34) (100.0)									10,962 (.08) (100.0)	7,308 (.05) (100.0)	9,313 (.07) (0.0)	139,159 (.08) (.10)
Pinal 3															66,207 (100.0) (0.0)	66,207 (.04) (0.0)
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	209,976 (.17) (.77)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)				1,252,566 (.75) (.88)

results will be described in some detail so that further results can be treated with more brevity.

The linear programming solution to the 1974 data points out that Maricopa County cannot adequately compete in any of the fourteen markets. Its total productive capacity is surplus and therefore is depreciated at .07 for the year giving a 1975 productive capacity of 178,700 cases.

The percentages under the production figure represent the important variables. In regard to the regional numbers, the first figure signifies the percent of the region's total production that is allocated to that market. The second refers to the market share that that region has in the particular market. The percentages under the total production figures represent the comparable figures for the entire model. For example, in 1975, Maricopa County has 11% of the overall production but has no market share.

Pima County is shipping eggs to Cochise, Santa Cruz, and Greenlee Counties as well as covering 23% of the local demand. Only 7% of its productive capacity is surplus, giving it a relatively strong position in the south and southeastern areas of Arizona.

Pinal County has a similar situation to that of Maricopa County. It is cheaper to ship eggs in from San Diego than to produce and market eggs from Casa Grande. The capacity of Pinal County has also been depreciated.

A region that has no surplus is Yavapai County. Ninety-five percent of its production is marketed locally. Five percent is shipped to Coconino County. Mohave County is also producing without any surplus capacity, marketing its production locally.

As of 1975, California controls 75% of total production directed towards Arizona markets and supplies 88% of the market demand. California is especially strong in Maricopa and Pinal Counties. A total figure for each market that California supplies will not yield the 1,252,566 cases as shown. This is because California will expand its production of 1,186,854 cases in 1974 to 1,252,566 cases in 1975 due to cost advantages over other production regions.

This is an illustration of the expansion factor that is built into the model to better represent real economic behavior. As discussed in Chapter II, a production region will expand its production if the implied price in any of the markets it serves is $.30/case greater than its costs of production and transportation to that market. Pima County is producing eggs for the local market for $14.46 per case whereas California can produce and ship eggs to Pima County for $14.07 per case. Given the assumptions of the model, California will increase its production capacity by 64,074 cases.

The same phenomena occurs in market area six, or Coconino County. California can service this market at $14.29 per case whereas Yavapai County is providing 4% of the market needs at $14.68 per case. California's production capacity will therefore be allowed to expand by 1,638 cases.

A year further into the analysis demonstrates two major changes in the distribution of production. By 1976 (Table 25), Pima County has fallen to the level of supplying only 2% of the local market. California has increased its market share from 77% to 98%. Because of the cost advantages in this market, California will continue to expand its production.

Table 25. Static Analysis, 1976 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															165,250 (100.0) (0.0)	165,250 (.10) (0.0)
Pima 2		5,670 (.04) (.02)		47,502 (.36) (100.0)									10,962 (.08) (100.0)		69,773 (.52) (0.0)	133,907 (.08) (.05)
Pinal 3															61,224 (100.0) (0.0)	61,224 (.04) (.00)[a]
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5											6,300 (100.0) (.29)					6,300 (.00)[a] (.01)
California 6	738,990 (.59) (100.0)	268,330 (.21) (.98)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.76) (.92)

a. (.00) denotes a percentage less than .5%.

Pima County no longer supplies Greenlee County in 1976. With the increased production, California can supply this market therefore driving 7,308 cases of Pima County eggs into surplus production. Except for these adjustments, the model appears stable.

By 1980, (Table 26) the model has stabilized further with California absorbing all of the market share for both Pima and Coconino Counties. However, Pima County continues producing eggs to meet demand in outlying nonproducing regions. Yavapai and Mohave produce entirely for the local market. California has expanded its production capacity to 86% of the entire model. California's market share has gone from 88% in 1975 to 93% in 1980.

Surplus capacity is depreciated each year as production regions fail to compete favorably in the fourteen market areas. Table 27 shows how the production positions of various regions has deteriorated. In 1985, Maricopa County is producing only 44,200 cases, down 147,950 cases from 1974. Pinal County is only producing 1% of total overall production, whereas it produced 4% in 1974.

The final year in the analysis is 1990. By then Maricopa and Pinal Counties are out of the egg business under the model's assumptions. Arizona is producing 7% of its needs and competing strongly in only four market areas (Table 28).

The conclusions drawn from this exercise are:

1. Arizona producers cannot compete with California in the larger metropolitan markets.

2. Maricopa and Pinal Counties do not retain any production capacity over the long-run.

Table 26. Static Analysis, 1980 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															111,450 (100.0) (0.0)	111,450 (.08) (0.0)
Pima 2				47,502 (.42) (100.0)									10,962 (.10) (100.0)		54,319 (.48) (0.0)	112,783 (.08) (.04)
Pinal 3															41,292 (100.0) (0.0)	41,292 (.03) (0.0)
Yavapai 4								29,862 (.96) (100.0)							1,178 (.04) (0.0)	31,040 (.02) (.02)
Mohave 5										6,300 (100.0) (.30)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.86) (.93)

Table 27. Static Analysis, 1985 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															44,200 (100.0) (0.0)	44,200 (.03) (0.0)
Pima 2				47,502 (.55) (100.0)									10,962 (.13) (100.0)		27,914 (.32) (0.0)	86,378 (.06) (.04)
Pinal 3															16,377 (100.0) (0.0)	16,377 (.01) (0.0)
Yavapai 4								29,862 (.98) (100.0)							603 (.02) (0.0)	30,465 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)	43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)			1,259,874 (.87) (.93)

Table 28. Static Analysis, 1990 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1																0 (0.0) (0.0)
Pima 2				47,502 (.79) (100.0)									10,962 (.18) (100.0)		1,509 (.02) (0.0)	59,973 (.04) (.04)
Pinal 3																0 (0.0) (0.0)
Yavapai 4								29,862 (100.0) (100.0)							28 (0.0) (0.0)	29,890 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.93) (.93)

3. Pima, Yavapai, and Mohave Counties can expect to control only 7% of the market in 1990.

4. Without any changes in economic factors between 1974 through 1990, Arizona egg production is virtually eliminated.

Expansion of Market Demand

Demand was adjusted to reflect the growth in population in the fourteen market areas from 1974 to 1990. Per capita consumption of eggs was held constant at 264 shell eggs. All cost variables were held constant at their 1974 levels. Tables 29 through 33 represent the results.

The important implications are:

1. The increase in demand does not offset the production cost disadvantages that Arizona producers face.

2. Maricopa and Pinal Counties fail to market any of their production over the time period.

3. Pima County retains six percent of the local market and ships eggs to Cochise, Santa Cruz, and Greenlee Counties. Yavapai and Mohave Counties produce at or near initial productive capacity throughout.

4. California increases its market share from 88% to 92% and produces 91% of the eggs in the model by 1990.

Reduction in Arizona Feed Costs

The primary cost difference between Arizona and California egg production is the lower feed cost per dozen that is reflected in the California data. This cost differential has been attributed to economies of size, favorable shipping rates, and other economic variables.

Table 29. Demand Adjustment, 1975 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															178,700 (100.0) (0.0)	178,700 (.11) (0.0)
Pima 2		64,074 (.46) (.23)		47,502 (.34) (100.0)									10,962 (.08) (100.0)	7,308 (.05) (100.0)	9,313 (.07) (0.0)	139,159 (.08) (.10)
Pinal 3															66,207 (100.0) (0.0)	66,207 (.04) (0.0)
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	209,976 (.17) (.77)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)				1,252,566 (.75) (.88)

Table 30. Demand Adjustment, 1976 (cases).

Production Region	Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
	Market Area															
Maricopa 1															165,250 (100.0) (0.0)	165,250 (.10) (0.0)
Pima 2		19,495 (.14) (.07)		48,287 (.36) (100.0)									11,135 (.08) (100.0)	7,387 (.06) (100.0)	49,155 (.36) (0.0)	135,459 (.08) (.06)
Pinal 3															61,224 (100.0) (0.0)	61,224 (.04) (0.0)
Yavapai 4						1,145 (.04) (.03)		30,355 (.96) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.00)[a] (.01)
California 6	751,473 (.59) (100.0)	258,771 (.20) (.93)	51,514 (.04) (100.0)		43,772 (.03) (100.0)	38,997 (.03) (.97)	34,457 (.03) (100.0)		26,917 (.02) (100.0)	15,674 (.01) (.71)	20,402 (.02) (100.0)	11,489 (.01) (100.0)				1,273,206 (.76) (.91)

a. (.00) denotes a percentage less than .5%.

Table 31. Demand Adjustment, 1980 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															111,450 (100.0) (0.0)	111,450 (.07) (0.0)
Pima 2		21,135 (.17) (.07)		51,427 (.42) (100.0)									11,825 (.10) (100.0)	7,705 (.06) (100.0)	31,969 (.26) (0.0)	124,061 (.07) (.06)
Pinal 3															41,292 (100.0) (0.0)	41,292 (.02) (0.0)
Yavapai 4								31,489 (100.0) (.97)								31,489 (.02) (.02)
Mohave 5										6,300 (100.0) (.27)						6,300 (.00)[a] (.00)[a]
California 6	801,404 (.59) (100.0)	273,995 (.20) (.93)	54,709 (.04) (100.0)		46,743 (.03) (100.0)	42,708 (.03) (100.0)	36,710 (.03) (100.0)	839 (0.0) (.03)	27,774 (.02) (100.0)	17,136 (.01) (.73)	21,370 (.02) (100.0)	12,086 (.01) (100.0)				1,356,609 (.81) (.91)

a. (.00) denotes a percentage less than .5%.

Table 32. Demand Adjustment, 1985 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															44,200 (100.0) (0.0)	44,200 (.03) (0.0)
Pima 2		21,133 (.18) (.07)		55,352 (.48) (100.0)									12,688 (.11) (100.0)	8,102 (.07) (100.0)	18,050 (.16) (0.0)	115,325 (.07) (.06)
Pinal 3															16,377 (100.0) (0.0)	16,377 (.01) (0.0)
Yavapai 4								31,489 (100.0) (.90)								31,489 (.02) (.02)
Mohave 5										6,300 (100.0) (.25)						6,300 (.00)[a] (.00)[a]
California 6	863,818 (.59) (100.0)	295,077 (.20) (.93)	58,703 (.04) (100.0)		50,457 (.04) (100.0)	45,914 (.03) (100.0)	39,526 (.03) (100.0)	3,306 (.00)[a] (.10)	29,969 (.02) (100.0)	18,963 (.01) (.75)	22,579 (.02) (100.0)	12,833 (.01) (100.0)				1,462,278 (.87) (.91)

a. (.00) denotes a percentage less than .5%.

Table 33. Demand Adjustment, 1990 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1																0 (0.0) (0.0)
Pima 2		21,133 (.19) (.06)		59,277 (.54) (100.0)									13,551 (.12) (100.0)	8,499 (.08) (100.0)	8,364 (.08) (0.0)	110,824 (.06) (.06)
Pinal 3																0 (0.0) (0.0)
Yavapai 4								31,489 (100.0) (.84)								31,489 (.02) (.02)
Mohave 5										6,300 (100.0) (.23)						6,300 (.00)[a] (.00)[a]
California 6	926,232 (.59) (100.0)	316,156 (.20) (.94)	62,698 (.04) (100.0)		54,170 (.04) (100.0)	49,121 (.03) (100.0)	42,342 (.03) (100.0)	5,772 (.00)[a] (.16)	32,165 (.02) (100.0)	20,790 (.01) (.77)	23,789 (.02) (100.0)	13,580 (.01) (100.0)				1,567,948 (.91) (.92)

a. (.00) denotes a percentage less than .5%.

Arizona feed costs were reduced in order to see what influence the relatively high feed cost has on the competitive position of Arizona. Local costs were adjusted to approximately the California level over a five year period of time. Table 34 presents the rate of reduction. Arizona feed costs were reduced 7.8% or to $8.92 per case which is still a higher cost than California.

The base year of 1975 is the same as was used in the previous situations (Table 35). A 1.6% reduction in feed costs does not halt the slippage in Arizona's market and production shares. California increases its market share from 88% to 92% while its production share increases from 75% to 76%. The reduction in total costs does prevent California from expanding its share of the Pima County market after 1975.

The tables for the years 1976 to 1980 are presented in this situa- so the yearly adjustments can be better analyzed (Tables 36 through 40). Table 36 shows that production shares continue to deteriorate for Arizona producers due to uncompetitive capacity. Market share is stabilized for each of the production regions.

With a 4.8% reduction in feed costs, the competitive position of Arizona egg producers changes dramatically. All surplus production that existed previously is allocated to market areas. Twenty-one percent of California's production is forced into surplus and a declining position in production share. Table 38 shows that each production region is absorbing all or a portion of local demand. Pinal County is the exception as its production is shipped to Yuma, Gila, and Graham Counties.

By 1979, Arizona is marketing all its production while California remains in surplus. However, reallocations of production in various

Table 34. Reduction Schedule of Arizona Feed Costs (Per Case).[a]

Year	Feed Costs	Percent Change	Total Cost
1974	$9.67	--	$14.46
1975	9.52	.016	14.31
1976	9.37	.031	14.16
1977	9.22	.047	14.01
1978	9.07	.062	13.86
1979	8.92	.078	13.71

a. California feed cost = $8.88/case.

Table 35. Cost of Feed Adjustment, 1975 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															178,700 (100.0) (0.0)	178,700 (.11) (0.0)
Pima 2		64,074 (.46) (.23)		47,502 (.34) (100.0)									10,962 (.08) (100.0)	7,308 (.05) (100.0)	9,313 (.07) (0.0)	139,159 (.08) (.10)
Pinal 3															66,207 (100.0) (0.0)	66,207 (.04) (0.0)
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	209,976 (.17) (.77)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)				1,252,566 (.75) (.88)

Table 36. Cost of Feed Adjustment, 1976 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															165,250 (100.0) (0.0)	165,250 (.10) (0.0)
Pima 2		7,308 (.05) (.03)		47,502 (.35) (100.0)									10,962 (.08) (100.0)		68,250 (.51) (0.0)	134,022 (.08) (.05)
Pinal 3															61,224 (100.0) (0.0)	61,224 (.04) (0.0)
Yavapai 4								29,862 (.95) (100.0)							1,523 (.05) (0.0)	31,385 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.00)[a] (.01)
California 6	738,990 (.59) (100.0)	266,742 (.21) (.97)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,252,566 (.76) (.92)

a. (.00) denotes a percentage less than .5%.

Table 37. Cost of Feed Adjustment, 1977 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															151,800 (100.0) (0.0)	151,800 (.09) (0.0)
Pima 2		7,308 (.06) (.03)		47,502 (.37) (100.0)									10,962 (.08) (100.0)		63,113 (.49) (0.0)	128,885 (.08) (.05)
Pinal 3															56,241 (100.0) (0.0)	56,241 (.04) (0.0)
Yavapai 4								29,862 (.96) (100.0)							1,408 (.04) (0.0)	31,270 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.00)[a] (.01)
California 6	738,990 (.59) (100.0)	266,742 (.21) (.97)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,252,566 (.77) (.93)

a. (.00) denotes a percentage less than .5%.

Table 38. Cost of Feed Adjustment, 1978 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1	118,203 (.78) (.16)				18,288 (.12) (.42)					15,309 (.10) (.71)						151,800 (.09) (.11)
Pima 2		63,113 (.49) (.23)		47,502 (.37) (100.0)									10,962 (.08) (100.0)	7,308 (.06) (100.0)		128,885 (.08) (.10)
Pinal 3					24,741 (.44) (.58)						20,160 (.36) (100.0)	11,340 (.20) (100.0)				56,241 (.04) (.04)
Yavapai 4						1,408 (.04) (.04)		29,862 (.96) (100.0)								31,270 (.02) (.02)
Mohave 5										6,300 (.29) (.29)						21,609 (.01) (.01)
California 6	620,787 (.50) (.84)	210,937 (.17) (.77)	50,715 (.04) (100.0)			38,093 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)						253,483 (.21) (0.0)	1,233,487 (.76) (.72)

Table 39. Cost of Feed Adjustment, 1979 (cases).

Production Region		Market Area															
		Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
	Maricopa 1	66,732 (.44) (.09)				43,029 (.28) (100.0)		33,894 (.22) (100.0)		837 (.01) (.03)					7,308 (.05) (100.0)		151,800 (.10) (.11)
	Pima 2		70,421 (.55) (.26)		47,502 (.37) (100.0)									10,962 (.08) (100.0)			128,885 (.08) (.10)
	Pinal 3									24,741 (.44) (.97)		20,160 (.36) (100.0)	11,340 (.20) (100.0)				56,241 (.04) (.04)
	Yavapai 4						1,408 (.04) (.04)		29,862 (.96) (100.0)								31,270 (.02) (.02)
	Mohave 5										21,609 (100.0) (100.0)						21,609 (.01) (.02)
	California 6	672,258 (.55) (.91)	203,629 (.17) (.74)	50,715 (.04) (100.0)			38,093 (.03) (.96)									249,977 (.21) (0.0)	1,214,672 (.76) (.71)

Table 40. Cost of Feed Adjustment, 1980 (cases).

Production Region		Market Area															
		Maricopa	Pima	Pinal	Cochise	Yuma	Coconino	Navajo	Yapavai	Apache	Mohave	Gila	Graham	Santa Cruz	Greenlee	Surplus	Total Production
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	Maricopa 1	56,229 (.07) (.08)				43,029 (.05) (100.0)		33,894 (.04) (100.0)					11,340 (.01) (100.0)		7,308 (.01) (100.0)		834,561 (.32) (.11)
	Pima 2		70,421 (.21) (.26)		47,502 (.14) (100.0)									10,962 (.03) (100.0)			332,514 (.13) (.10)
	Pinal 3			10,503 (.11) (.21)						25,578 (.26) (100.0)		20,160 (.21) (100.0)					96,453 (.04) (.04)
	Yavapai 4						1,408 (.02) (.04)		29,862 (.43) (100.0)								69,363 (.03) (.02)
	Mohave 5										21,609 (100.0) (100.0)						21,609 (.01) (.02)
	California 6	682,761 (.57) (.92)	203,629 (.17) (.74)	40,212 (.03) (.79)			38,093 (.03) (.96)									232,479 (.19) (0.0)	1,197,174 (.46) (.71)

markets have taken place. Maricopa County has shifted some of its local production to Navajo, Apache, and Greenlee Counties. Because of favorable cost relationships in 1978, Mohave County has expanded its production and eliminated Maricopa County from the local market.

The most significant finding in this cost adjustment is that with a 7.8% reduction in feed costs, Arizona moves into the favorable cost position of expanding its production and absorbing the total Arizona market. Table 40 illustrates this relationship. For example, in 1980, Maricopa County can expand its production to 834,561 cases from the 1979 level of 151,800 cases. This increased production will be allocated in the 1981 results. For Maricopa County, production share has increased from 11% in 1975 to 32% in 1980. California's production share has fallen from 75% to 46%.

Table 41 represents the market and production shares as of 1985. Arizona producers control all of Arizona's market. California's production capacity has fallen to 36% of total model capacity. By 1990 (Table 42), California is down to only 21% of the model's total productive capacity. Arizona's production and market shares stabilize after 1981.

The implications of this analysis are:

1. Feed costs are the major factor in determining the competitive strength of the Arizona egg industry.

2. With a 4.7% reduction in feed costs, Arizona can eliminate its noncompetitive (surplus) production. This equates to a $.015 per dozen decrease in feed costs.

Table 41. Cost of Feed Adjustment, 1985 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1	738,990 (.88) (100.0)				36,099 (.04) (.84)		33,894 (.04) (100.0)		25,578 (.03) (100.0)							834,561 (.39) (.62)
Pima 2		274,050 (.82) (100.0)		47,502 (.14) (100.0)									10,962 (.03) (100.0)			332,514 (.16) (.24)
Pinal 3			50,715 (.53) (100.0)		6,930 (.07) (.16)						20,160 (.21) (100.0)	11,340 (.12) (100.0)		7,308 (.08) (100.0)		96,453 (.04) (.07)
Yavapai 4						39,501 (.57) (100.0)		29,862 (.43) (100.0)								69,363 (.03) (.05)
Mohave 5										21,609 (100.0) (100.0)						21,609 (.01) (.02)
California 6															778,164 (100.0) (0.0)	778,164 (.36) (0.0)

Table 42. Cost of Feed Adjustment, 1990 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1	738,990 (.88) (100.0)				36,099 (.04) (.84)		33,894 (.04) (100.0)		25,578 (.03) (100.0)							834,561 (.49) (.62)
Pima 2		274,050 (.82) (100.0)		47,502 (.14) (100.0)									10,962 (.03) (100.0)			332,514 (.19) (.24)
Pinal 3			50,715 (.53) (100.0)		6,930 (.07) (.16)						20,160 (.21) (100.0)	11,340 (.12) (100.0)		7,308 (.08) (100.0)		96,453 (.06) (.07)
Yavapai 4						39,501 (.57) (100.0)		29,862 (.43) (100.0)								69,363 (.04) (.05)
Mohave 5										21,609 (100.0) (100.0)						21,609 (.01) (.02)
California 6															359,154 (100.0) (0.0)	359,154 (.21) (0.0)

3. With a 7.8% reduction in feed costs, Arizona can eliminate California production from the Arizona market. This works out to a $.025 per dozen reduction in feed costs.

4. In 1990, market share is allocated amongst the Arizona production regions primarily as a function of locational advantages.

Increase in Fuel Cost

With the rising cost of energy, businesses are becoming increasingly concerned with how these increased costs will affect their competitive positions. The egg industry in Arizona is no exception. Rising electrical rates increase the cost of cooling the laying houses and in processing (i.e., candling, sorting, packaging) the eggs. Higher fuel prices increase delivery costs.

This analysis deals strictly with the increase of real fuel prices and how this added expense will affect Arizona egg producers given the assumptions of the model. Comparable California data was not found that would have allowed the measurement of the effects of higher electrical rates. When such information becomes available it would be beneficial to analyze it in conjunction with the available Arizona data.

Projections of fuel prices into the future are a hazardous business. Due to the political, social, environmental, and economic forces that can influence the price of fuel, no single agency or business wants to take an authoritative stance on this issue. If projections are to be made they are made arbitrarily and must be analyzed in this "what if" framework.

Table 43 represents the fuel price projections made for this analysis. Various truck stop operators were contacted as to the average price of diesel and gasoline in 1974. The average price determined for both types of fuel was quoted at $.46 per gallon. While there is a price differential between gasoline and diesel throughout most time periods, it was felt that a common price as quoted by the operators would not adversely affect the outcome of the analysis.

It was arbitrarily assumed that the price of both fuels would rise to a price of $.76 per gallon by 1990. This is a 65% increase over the 1974 real price. These revised fuel costs were inserted into the LILMAC budgeting program, in order to determine the cost of shipping a case of eggs between the production regions and the market areas. The results of this process are shown in Table 44. These adjusted transportation costs were then added to the constant 1974 production costs and the model was simulated to find the cost minimizing (profit maximizing) solution.

The results of this analysis can be seen in Tables 45 through 49. The implications are:

1. Increased fuel costs as projected here have no favorable affect on the competitive position of Arizona egg producers provided all other variables are held constant.

2. The results of the fuel cost adjustment are equal to the findings with the static analysis.

3. Fuel prices (diesel, particularly) would have to rise approximately $1.50 per gallon before Arizona would be more competitive with California given that all other factors remain constant.

Table 43. Projected Increase in Fuel Prices, Gasoline and Diesel, 1974 to 1979.

Year	Price	Percent Increase
1974	$.46/gallon	--
1975	$.52/gallon	13%
1976	$.58/gallon	26%
1977	$.64/gallon	39%
1978	$.70/gallon	52%
1979	$.76/gallon	65%

Table 44. Round Trip Transportation Costs for 1974 to 1979.

Distance	1974	1975	1976	1977	1978	1979
miles	- - - - - dollars per case - - - - - - -					
50 - 100	.18	.18	.18	.19	.19	.19
101 - 150	.20	.20	.21	.21	.22	.23
151 - 200	.22	.22	.23	.24	.25	.26
201 - 250	.24	.24	.26	.27	.28	.29
251 - 300	.26	.27	.28	.29	.31	.32
301 - 350	.28	.29	.31	.32	.34	.35
351 - 400	.30	.32	.33	.35	.37	.38
401 - 450	.32	.34	.36	.38	.40	.42
451 - 500	.34	.36	.38	.41	.43	.45
501 - 550	.45	.48	.50	.53	.55	.57
551 - 600	.48	.50	.53	.55	.58	.61
601 and over	.51	.54	.57	.60	.63	.66
718 miles (San Diego to Phoenix)	.44	.46	.47	.49	.50	.52
844 miles (San Diego to Tucson)	.48	.49	.51	.53	.55	.56
710 miles (San Diego to Casa Grande)	.44	.45	.47	.48	.50	.51

Table 45. Fuel Cost Adjustment, 1975 (cases).

Production Region		Market Area															
		Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
	Maricopa 1															178,700 (100.0) (0.0)	178,700 (.11) (0.0)
	Pima 2		64,074 (.46) (.23)		47,502 (.34) (100.0)									10,962 (.08) (100.0)	7,308 (.05) (100.0)	9,313 (.07) (0.0)	139,159 (.08) (.10)
	Pinal 3															66,207 (100.0) (0.0)	66,207 (.04) (0.0)
	Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
	Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
	California 6	738,990 (.59) (100.0)	209,976 (.17) (.77)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)				1,252,566 (.75) (.88)

Table 46. Fuel Cost Adjustment, 1976 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															165,250 (100.0) (0.0)	165,250 (.10) (0.0)
Pima 2				47,502 (.36) (100.0)									10,962 (.08) (100.0)	5,670 (.04) (.78)	69,773 (.52) (0.0)	133,907 (.08) (.05)
Pinal 3															61,224 (100.0) (0.0)	61,224 (.04) (0.0)
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.00)[a] (0.1)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		1,638 (.00)[a] (.22)		1,259,874 (.76) (.92)

a. (.00) denotes a percentage less than .5%.

Table 47. Fuel Cost Adjustment, 1980 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															111,450 (100.0) (0.0)	111,450 (.08) (0.0)
Pima 2				47,502 (.42) (100.0)									10,962 (.10) (100.0)		54,319 (.48) (0.0)	112,783 (.08) (.04)
Pinal 3															41,292 (100.0) (0.0)	41,292 (.03) (0.0)
Yavapai 4								29,862 (.96) (100.0)							1,178 (.04) (0.0)	31,040 (.02) (.02)
Mohave 5										6,300 (100.0) (.30)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.86) (.93)

Table 48. Fuel Cost Adjustment, 1985 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															44,200 (100.0) (0.0)	44,200 (.03) (0.0)
Pima 2				47,502 (.55) (100.0)									10,962 (.13) (100.0)		27,914 (.32) (0.0)	86,378 (.06) (.04)
Pinal 3															16,377 (100.0) (0.0)	16,377 (.01) (0.0)
Yavapai 4								29,862 (.98) (100.0)							603 (.02) (0.0)	30,465 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.87) (.93)

Table 49. Fuel Cost Adjustment, 1990 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															0 (0.0) (0.0)	0 (0.0) (0.0)
Pima 2				47,502 (.79) (100.0)									10,962 (.18) (100.0)		1,509 (.02) (0.0)	59,973 (.04) (.04)
Pinal 3															0 (0.0) (0.0)	0 (0.0) (0.0)
Yavapai 4								29,862 (100.0) (100.0)							28 (0.0) (0.0)	29,890 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	274,050 (.22) (100.0)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	39,501 (.03) (100.0)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)		7,308 (.01) (100.0)		1,259,874 (.93) (.93)

Simultaneous Adjustment

The factors discussed so far in the analysis do not change singly but simultaneously. To better simulate a more realistic environment in 1990, demand, feed costs, and fuel costs were varied together. The level of adjustment in these factors was identical to the changes in the previous situations: (1) demand is changed proportionately to the growth in population; (2) feed costs for Arizona producers are reduced by 7.8% between 1975 to 1980; and (3) fuel prices are increased by 65% between 1975 to 1980.

Tables 50 through 54 represent the geographical shifts in production as the appropriate economic factors are simultaneously adjusted. The implications for Arizona producers are as follows:

1. By 1978, efficiencies of production have been realized by Arizona producers so that all productive capacity is allocated and depreciating facilities are replaced.

2. Arizona producers attain a favorable cost advantage over California in 1980. The price differentials between the two regions allow expansion in the Arizona regions thereby eliminating a large percentage of California production from the Arizona market.

3. By 1985, California's market share in Arizona stabilizes to 5%. Only marginal market shares are controlled in Maricopa and Pima Counties. California supplies all of the Pinal County demand because Pinal County production is more economically allocated to other counties given the cost minimizing objective of the model.

Table 50. Simultaneous Adjustment, 1975 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															178,700 (100.0) (0.0)	178,700 (.11) (0.0)
Pima 2		64,074 (.46) (.23)		47,502 (.34) (100.0)									10,962 (.08) (100.0)	7,308 (.05) (100.0)	9,313 (.07) (0.0)	139,159 (.08) (.10)
Pinal 3															66,207 (100.0) (0.0)	66,207 (.04) (0.0)
Yavapai 4						1,638 (.05) (.04)		29,862 (.95) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.01) (.01)
California 6	738,990 (.59) (100.0)	209,976 (.17) (.77)	50,715 (.04) (100.0)		43,029 (.03) (100.0)	37,863 (.03) (.96)	33,894 (.03) (100.0)		25,578 (.02) (100.0)	15,309 (.01) (.71)	20,160 (.02) (100.0)	11,340 (.01) (100.0)				1,252,566 (.75) (.68)

Table 51. Simultaneous Adjustment, 1976 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1															165,250 (100.0) (0.0)	165,250 (.10) (0.0)
Pima 2		19,495 (.14) (.07)		48,287 (.36) (100.0)									11,135 (.08) (100.0)	7,387 (.06) (100.0)	49,155 (.36) (0.0)	135,459 (.08) (.06)
Pinal 3															61,224 (100.0) (0.0)	61,224 (.04) (0.0)
Yavapai 4						1,145 (.04) (.03)		30,355 (.96) (100.0)								31,500 (.02) (.02)
Mohave 5										6,300 (100.0) (.29)						6,300 (.00)[a] (0.1)
California 6	751,473 (.60) (100.0)	258,771 (.21) (.93)	51,514 (.04) (100.0)		43,772 (.04) (100.0)	38,997 (.03) (.97)	34,457 (.03) (100.0)		26,017 (.02) (100.0)	15,674 (.01) (.71)	20,402 (.02) (100.0)	11,489 (.01) (100.0)				1,252,566 (.76) (.91)

a. (.00) denotes a percentage less than .5%.

Table 52. Simultaneous Adjustment, 1980 (cases).

Production Region		Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
	Maricopa 1	67,689 (.08) (.08)					42,708 (.05) (100.0)		828 (.00)[a] (.03)	6,754 (.01) (.24)	365 (.00)[a] (.02)	21,370 (.02) (100.0)	12,086 (.01) (100.0)				885,515 (.34) (.10)
	Pima 2		61,822 (.17) (.21)		51,427 (.14) (100.0)									11,825 (.03) (100.0)	7,705 (.02) (100.0)		366,087 (.14) (.09)
	Pinal 3							36,710 (.64) (100.0)		21,020 (.36) (.76)							57,730 (.02) (.04)
	Yavapai 4								31,500 (100.0) (.97)								31,500 (.01) (.02)
	Mohave 5										23,071 (.98) (.98)						23,436 (.01) (.02)
	California 6	733,715 (.60) (.92)	233,308 (.19) (.79)	54,709 (.04) (100.0)		46,743 (.04) (100.0)										155,899 (.13) (0.0)	1,213,461 (.46) (.73)

a. (.00) denotes a percentage less than .5%.

Table 53. Simultaneous Adjustment, 1985 (cases).

Production Region	Market Area: Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
Maricopa 1	848,066 (.83) (.98)				32,253 (.03) (.64)	45,914 (.04) (100.0)		3,295 (.00)[a] (.09)	29,969 (.03) (100.0)	365 (.00)[a] (.01)	22,579 (.02) (100.0)	12,833 (.01) (100.0)				1,011,026 (.42) (.63)
Pima 2		310,957 (.79) (.98)		55,352 (.14) (100.0)									12,688 (.03) (100.0)	8,102 (.02) (100.0)		392,352 (.16) (.24)
Pinal 3					18,204 (.31) (.36)		39,526 (.68) (100.0)									57,730 (.02) (.04)
Yavapai 4								31,500 (100.0) (.91)								31,500 (.01) (.02)
Mohave 5										24,898 (.98) (.98)						25,263 (.01) (.02)
California 6	15,752 (.02) (.02)	5,253 (.01) (.02)	58,703 (.07) (100.0)												791,488 (.90) (0.0)	871,196 (.36) (.05)

a. (.00) denotes a percentage less than .5%.

Table 54. Simultaneous Adjustment, 1990 (cases).

Production Region		Market Area															
		Maricopa 1	Pima 2	Pinal 3	Cochise 4	Yuma 5	Coconino 6	Navajo 7	Yapavai 8	Apache 9	Mohave 10	Gila 11	Graham 12	Santa Cruz 13	Greenlee 14	Surplus 15	Total Production
	Maricopa 1	910,480 (.83) (.98)				38,782 (.04) (.72)	49,121 (.04) (100.0)		5,761 (.01) (.15)	32,165 (.03) (100.0)	365 (.00)[a] (.01)	23,789 (.02) (100.0)	13,580 (.01) (100.0)				1,089,795 (.48) (.64)
	Pima 2		332,036 (.79) (.98)		59,277 (.14) (100.0)									13,551 (.03) (100.0)	8,499 (.02) (100.0)		418,616 (.18) (.24)
	Pinal 3					15,388 (.27) (.28)		42,342 (.73) (100.0)									57,730 (.02) (.03)
	Yavapai 4								31,500 (100.0) (.84)								31,500 (.01) (.02)
	Mohave 5										26,725 (.99) (.99)						27,090 (.01) (.02)
	California 6	15,752 (.02) (.02)	5,253 (.01) (.02)	62,698 (.10) (100.0)												547,399 (.87) (0.0)	631,102 (.28) (.05)

a. (.00) denotes a percentage less than .5%.

4. Arizona's production regions control 95% of the market as of 1983. This relationship continues through 1990 and can be seen graphically in Figure 6.

Number of Layers and Derived Demand for Feed

The figures presented in terms of cases of shell eggs can be adjusted to reflect the average number of layers necessary to produce that quantity of eggs. It was assumed throughout the analysis that the average annual production per layer was 250 eggs per year. With a 10% allowance for breaking, loss, breakage, etc., the average production of shell eggs per layer is 225 eggs per year. This number was divided into the 1990 production capacity of each region under the various economic alternatives to determine the average number of layers. The results are presented in Table 55.

An estimate of the quantity of feed demanded by Arizona producers under each economic alternative can also be calculated from the production totals expressed in cases. Poultrymen estimate that it takes four pounds of feed to produce one dozen eggs. An estimate of the demand for poultry feed can be calculated by multiplying this figure times the number of 30-dozen cases. This has been done in Table 56.

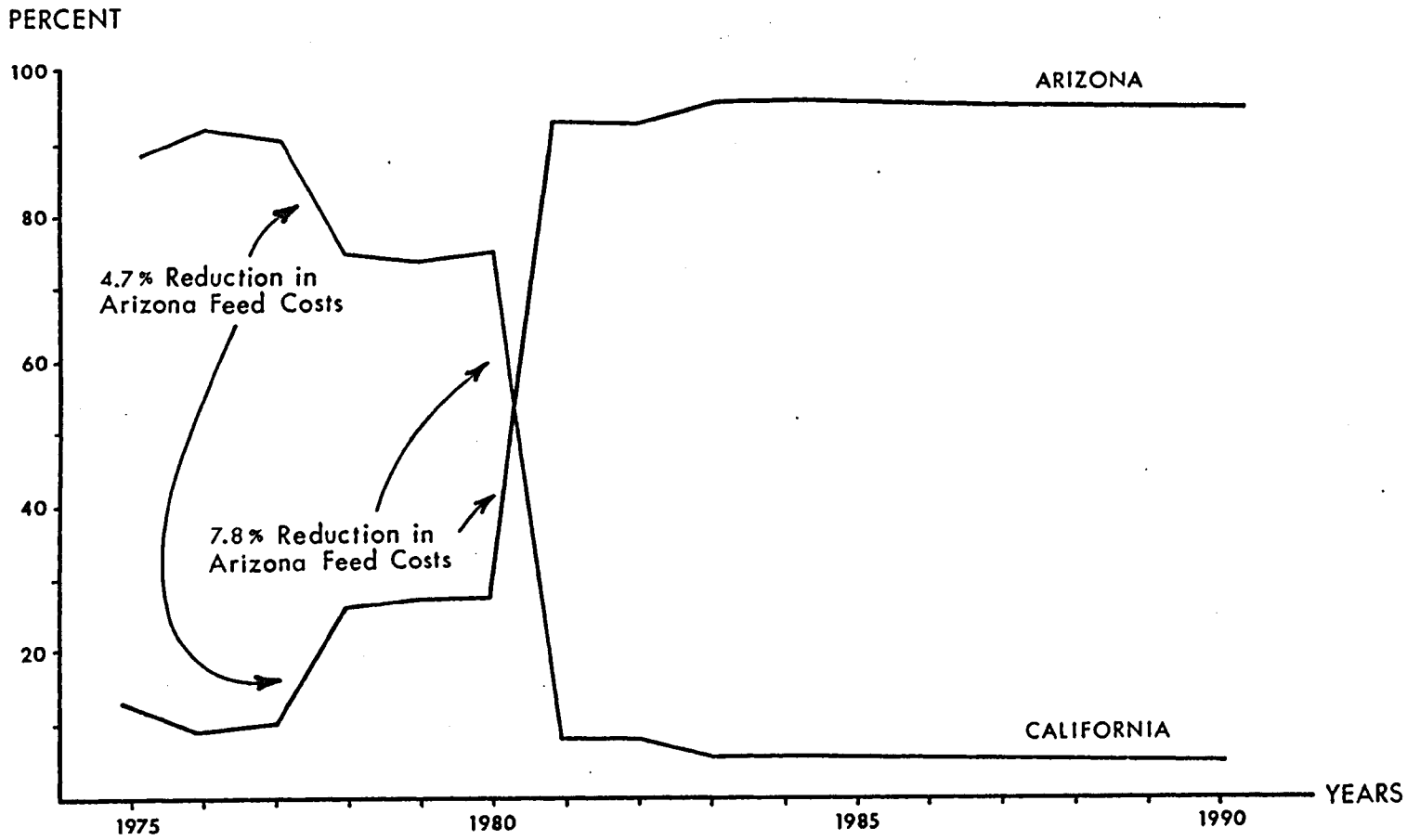


Figure 6. Market Shares for Simultaneous Adjustment

Table 55. Number of Layers in 1990 Under Alternative Economic Conditions for Arizona.

Production Region	Average Number of Layers					
	1974 Initial Capacity	Static Conditions	Increased Demand	Lower Arizona Feed Costs	Increase in Fuel Cost	Simultaneous Adjustment
1. Maricopa	305,000	0	0	1,335,298	0	1,743,672
2. Pima	222,000	95,957	177,318	532,022	95,957	669,786
3. Pinal	113,000	0	0	154,325	0	92,368
4. Yavapai	50,000	47,824	50,382	110,081	47,824	50,400
5. Mohave	10,000	10,080	10,080	34,574	10,080	43,344
TOTAL	700,000	153,861	237,780	2,167,200	153,861	2,599,570
Percent Increase or Decrease		-78%	-66%	+210%	-78%	+271%

Table 56. Derived Demand for Poultry Feed in 1990 Under Alternative Economic Conditions for Arizona.

Production Region	Tons of Poultry Feed Demanded					
	1974 Initial Capacity	Static Conditions	Increased Demand	Lower Arizona Feed Costs	Increase in Fuel Cost	Simultaneous Adjustment
1. Maricopa	11,529	0	0	50,074	0	65,388
2. Pima	8,362	3,598	6,649	19,951	3,598	25,117
3. Pinal	4,271	0	0	5,787	0	3,464
4. Yavapai	1,890	1,793	1,889	4,162	1,793	1,890
5. Mohave	378	378	378	1,296	378	1,625
TOTAL	26,430	5,769	8,916	81,270	5,769	97,484
Percent Increase or Decrease		-78%	-66%	+210%	-78%	+271%

CHAPTER IV

SUMMARY AND CONCLUSIONS

The purpose of this study was to project the volume and geographic location of production of the Arizona egg industry as it adjusts towards 1990 under various economic conditions. A linear programming transportation model was constructed to simulate the economic environment. Assuming the model reflects reality, the results may be helpful in managerial decision-making in the Arizona egg industry.

Forecast changes in egg production and market share are summarized in Table 57 and Table 58, respectively. Maricopa Cuunty is the largest market in the model and initially has the greatest production among the Arizona regions. Continued production from this region will only be possible provided the feed cost in producing egg is lowered by at least 4.7%. Expanded demand and higher fuel costs have no favorable influence on Maricopa County's competitive position. With a 7.8% reduction in feed costs, Maricopa County controls 64% of the Arizona market in 1990. This substantiates the trend of locating egg production near large metropolitan areas.

Pima County is more fortunate than Maricopa as it retains at least a portion of its initial production in all of the various economic conditions. Expanded demand has a positive competitive impact on Pima County relative to the results from the statis analysis. But none of the economic changes, except a reduction in Arizona feed costs, cause an

Table 57. Index of Expected Changes in Egg Production for 1990 Under Alternative Economic Conditions.

Production Region	Index of Change Under Specific Assumptions (100 = no change)					
	1974 Initial Capacity (cases)	Static Conditions	Increased Demand	Lower Arizona Feed Costs	Increase in Fuel Cost	Simultaneous Adjustment
1. Maricopa	192,150	0	0	434	0	567
2. Pima	139,860	43	79	237	43	299
3. Pinal	71,190	0	0	136	0	81
4. Yavapai	31,500	95	100	220	95	100
5. Mohave	6,300	100	100	343	100	430
6. California	1,186,854	106	132	30	106	53

Table 58. Total Market Shares for 1990 Under Alternative Economic Conditions.

Production Region	Percentage Distribution of Total Market Demand				
	Static Conditions	Increased Demand	Lower Arizona Feed Costs	Increase in Fuel Cost	Simultaneous Adjustment
1. Maricopa	0.00	0.00	0.62	0.00	0.64
2. Pima	0.04	0.06	0.24	0.04	0.24
3. Pinal	0.00	0.00	0.07	0.00	0.03
4. Yavapai	0.02	0.02	0.05	0.02	0.02
5. Mohave	0.01	0.00[a]	0.02	0.01	0.02
6. California	0.93	0.92	0.00	0.93	0.05

a. Less than .005.

increase in production greather than initial capacity. Lower feed costs have a substnatial positive effect on production and allow Pima County to achieve control over 24% of the market as of 1990.

Pinal County does not considerably increase its production or market share in any of the proposed economic conditions. The reasons for this are due to various factors. First, the Pinal County market is small relative to Maricopa and Pima Counties, thereby limiting its capacity to expand appreciably in the local area. Given the assumption of the model that transportation costs are not incurred locally, Pinal County will not be able to compete with the lower total costs of production and transportation of Maricopa and Pima Counties. Secondly, the expansion factor of $.30 per case restricts Pinal County from producing for the local market. The Pinal County market is supplied entirely by California in 1990, given the simultaneous adjustment in economic factors. A reduction in the value of the expansion factor to $.27 per case would eliminate California production from the local market and increase the competitive position of Pinal County production.

Yavapai and Mohave Counties are outlying production and market areas which demonstrate a definite competitive strength in their local markets. Yavapai County is at a locational disadvantage because of its nearness to Maricopa County. Its production capacity is not increased above initial (1974) capacity in the simultaneous adjustment because it does not have the cost differential necessary for expansion. As of 1990, Maricopa County is supplying 5,761 cases of eggs to Yavapai County which accounts for 15% of the market demand.

The production region that exhibits the strongest competitive position is Mohave County. In none of the alternative conditions does productive capacity decline below initial (1974) capacity. Mohave County enjoys definite locational advantages in relation to the other production regions thereby allowing it to control 100% of the local market. Mohave County supplies only the local market with its production expanding with the increase in the local market demand.

This research was primarily concerned with how various economic factors affected Arizona egg production and market share. Nevertheless, the presence of California as an exporter of eggs to Arizona is also an important consideration. Lower Arizona feed costs is the only economic variable in the model that reduces the export capacity of California to Arizona below initial (1974) capacity. Productive export capacity for California increases in the other economic conditions. In the simultaneous adjustment California experiences a decline in its Arizona market share from a maximum of 92% in 1976 to 5% in 1990.

Assuming the model reflects reality, various conclusions can be made from the analysis. First, Arizona producers must reduce their feed costs if they intend to achieve greater market shares in the future. With a static feed cost situation (i.e., feed cost at 1974 level), it is cheaper to ship eggs from California than to produce them in Arizona. If this situation continues, Arizona producers will discontinue production and only provide local marketing services for California produced eggs.

Several courses of action could be taken by Arizona egg producers to remedy their high feed cost situation. The establishment of a cooperative feed mill to blend and transport poultry feed to the respective

members could achieve the economies of size necessary to lower feed costs. The desire and willingness to cooperate on the part of the producer appears to be a major obstacle to this solution.

Individual producers can establish their own feed mills. Small-volume, efficiently operated mills have proven to be profitable in Arizona. The determination of the ideal number of layers to support such a feed mill can be obtained through further research and economic analysis.

If the cooperative feed mill or the small private feed mill prove to be unattainable as an objective, the egg producers could encourage more competition in the area of poultry feed. A more competitive feed supplying environment would lower processed feed costs and create a healthier atmosphere for expanding Arizona's egg production. Arizona feed suppliers should look at the advantages realized if they lowered their feed costs by 7.8% relative to California feed costs. The quantity of layers in Arizona would increase by 256% with a more favorable feed situation. Also, the quantity of feed demanded would also increase by 256%. By reducing feed prices, Arizona feed suppliers could expand their market to more than make up for the reduced price. Total revenue for their operations would definitely increase. A more favorable feed cost relative to California would also force California producers to reevaluate their long-run plans and possibly encourage them to shift some of their production capacity to Arizona.

A second conclusion is that the growth in population does have an influence on the strengths of the various productive regions. Per capita consumption of eggs was held constant throughout this study, but from the

sensitivity demonstrated by the model, an increase in per capita consumption could favorably affect Arizona's competitive position. The egg industry must continue its efforts to find alternative uses for eggs and improve upon the public image of the egg as a healthy food.

Thirdly, small production regions such as Yavapai and Mohave Counties are not threatened by other production regions given the assumptions in the model. Production capacity remains constant for Yavapai and increases for Mohave County in the simultaneous adjustment. Each region's entire production is sold locally.

Finally, the results of the analysis support the hypothesis that egg production locates near the large market areas. Maricopa and Pima Counties control 88% of the Arizona market in 1990 under the simultaneous adjustment model. The reader should be cautioned, however, in assuming that Pinal County has no future as a production area. The assumptions of the model virtually eliminate the possibility of Pinal County producing for either Maricopa and Pima Counties. A favorable adjustment in production costs or transportation costs could alter this situation, and the conclusions of the model could be quite different for Pinal County.

This research is a first step in analyzing the competitive position of Arizona's egg industry. The linear programming transportation model used in this analysis is basic and relatively unsophisticated theoretically. A more econometric approach (i.e., regression analysis on demand and supply functions) would add realism to the analysis and could conceivably change some of the results.

It is also suggested that an effort be made to incorporate egg processing into the model. This would help in determining the advantage,

if any, of various production and processing locations given different geographical combinations for each economic activity. That is, producing eggs in California, shipping them to Arizona, and processing in Arizona versus producing in Arizona and processing in Arizona. The data needed to make this analysis possible are California processing costs which at the time of this writing were not available.

In conclusion, Arizona egg producers will have no influence over their economic environment as long as their production costs are $.03 per dozen greater than those of the California industry due to higher feed costs. Only a firm commitment to lower processed feed costs by the Arizona egg producers will have any positive long-run effect on their competitive position.

APPENDIX A

PER CAPITA CONSUMPTION OF EGGS

Year	Shell	Processed[a]	Total
1969	279	31	310
1970	277	34	311
1971	277	37	314
1972	272	35	307
1973[b]	262	32	294
1974[c]	252	34	286

a. Shell equivalent of processed eggs.

b. Preliminary

c. Forecast

Source: U. S. Department of Agriculture (1974).

APPENDIX B

DETERMINATION OF MARKET DEMAND

Table B-1. Market Demand in Arizona Counties.[a]

Year	Market 1 Maricopa County (Phoenix)		Market 2 Pima County (Tucson)	
	Population	Demand	Population	Demand
		cases		cases
1974[b]	1,173,000	738,990	435,000	274,050
1975	1,192,814	751,473	441,692	278,266
1976	1,212,628	763,956	448,384	282,482
1977	1,232,442	776,438	455,076	286,698
1978	1,252,256	788,921	461,768	290,914
1979	1,272,070	801,404	468,460	295,130
1980	1,291,884	813,887	475,152	299,346
1981	1,311,698	826,370	481,844	303,562
1982	1,331,512	838,852	488,536	307,778
1983	1,351,326	851,335	495,228	311,994
1984	1,371,140	863,818	501,920	316,210
1985	1,390,954	876,301	508,612	320,426
1986	1,410,768	888,784	515,304	324,642
1987	1,430,582	901,267	521,996	328,857
1988	1,450,396	913,749	528,688	333,073
1989	1,470,210	926,232	535,380	337,289
1990[c]	1,490,028	938,718	542,076	341,508

Table B-1. (continued)

Year	Market 3 Pinal County (Casa Grande)		Market 4 Cochise County (Bisbee)	
	Population	Demand	Population	Demand
1974[b]	80,500	50,715	75,400	47,502
1975	81,768	51,514	76,646	48,287
1976	83,036	52,313	77,892	49,072
1977	84,304	53,112	79,138	49,857
1978	85,572	53,910	80,384	50,642
1979	86,840	54,709	81,630	51,427
1980	88,108	55,508	82,876	52,212
1981	89,376	56,307	84,122	52,997
1982	90,644	57,106	85,368	53,782
1983	91,912	57,904	86,614	54,567
1984	93,180	58,703	87,860	55,352
1985	94,448	59,502	89,106	56,137
1986	95,716	60,301	90,352	56,922
1987	96,984	61,100	91,598	57.707
1988	98,252	61,899	92,844	58,492
1989	99,520	62,698	94,090	59,277
1990[c]	100,788	63,496	95,340	60,064

	Market 5 Yuma County (Yuma)		Market 6 Coconino County (Flagstaff)	
1974[b]	68,300	43,029	62,700	39,501
1975	69,479	43,772	63,718	40,142
1976	70,658	44,514	64,736	40,784
1977	71,837	45,257	65,754	41,425
1978	73,016	46,000	66,772	42,066
1979	74,195	46,743	67,790	42,708
1980	75,374	47,486	68,808	43,349
1981	76,553	48,228	69,826	43,990
1982	77,732	48,971	70,844	44,632
1983	78,911	49,714	71,862	45,273
1984	80,090	50,457	72,880	45,914
1985	81,269	51,199	73,898	46,556
1986	82,448	51,942	74,916	47,197
1987	83,627	52,685	75,934	47,838
1988	84,806	53,428	76,952	48,480
1989	85,985	54,170	77,970	49,121
1990[c]	87,168	54,916	78,996	49,767

Table B-1. (continued)

Year	Market 7 Navajo County (Holbrook)		Market 8 Yavapai County (Prescott)	
	Population	Demand	Population	Demand
1974[b]	53,800	33,894	47,400	29,862
1975	54,694	34,457	48,183	30,355
1976	55,558	35,020	48,966	30,848
1977	56,482	35,584	49,749	31,342
1978	57,376	36,147	50,532	31,835
1979	58,270	36,710	51,315	32,328
1980	59,164	37,273	52,098	32,822
1981	60,058	37,836	52,881	33,315
1982	60,952	38,400	53,664	33,808
1983	61,846	38,963	54,447	34,302
1984	62,740	39,526	55,230	34,795
1985	63,634	40,089	56,013	35,288
1986	64,528	40,653	56,796	35,781
1987	65,422	41,216	57,579	36,275
1988	66,316	41,779	58,362	36,768
1989	67,210	42,342	59,145	37,261
1990[c]	68,100	42,903	59,928	37,755

	Market 9 Apache County (St. Johns)		Market 10 Mohave County (Kingman)	
1974[b]	40,600	25,578	34,300	21,609
1975	41,297	26,017	34,880	21,974
1976	41,994	26,456	35,460	22,340
1977	42,691	26,895	36,040	22,705
1978	4,3388	27,334	36,620	23,071
1979	44,085	27,774	37,200	23,436
1980	44,782	28,213	37,780	23,801
1981	45,479	28,652	38,360	24,167
1982	46,176	29,091	38,940	24,532
1983	46,873	29,530	39,520	24,898
1984	47,570	29,969	40,100	25,263
1985	48,267	30,408	40,680	25,628
1986	48,964	30,847	41,260	25,994
1987	49,661	31,286	41,840	26,359
1988	50,358	31,726	42,420	26,725
1989	51,055	32,165	43,000	27,090
1990[c]	51,756	32,606	43,584	27,458

Table B-1. (continued)

Year	Market 11 Gila County (Globe)		Market 12 Graham County (Safford)	
	Population	Demand	Population	Demand
1974[b]	32,000	20,160	18,000	11,340
1975	32,384	20,402	18,237	11,489
1976	32,768	20,644	18,474	11,639
1977	33,152	20,886	18,711	11,788
1978	33,536	21,128	18,948	11,937
1979	33,920	21,370	19,185	12,086
1980	34,304	21,612	19,422	12,236
1981	34,688	21,853	19,659	12,385
1982	35,072	22,095	19,896	12,534
1983	35,456	22,337	20,133	12,684
1984	35,840	22,579	20,370	12,833
1985	36,224	22,821	20,607	12,982
1986	36,608	23,063	20,844	13,132
1987	36,992	23,305	21,081	13,281
1988	37,376	23,547	21,318	13,430
1989	37,760	23,789	21,555	13,580
1990[c]	38,136	24,026	21,792	13,729

	Market 13 Santa Cruz County (Nogales)		Market 14 Greenlee County (Clifton)	
1974[b]	17,400	10,962	11,600	7,308
1975	17,674	11,135	11,726	7,387
1976	17,948	11,307	11,852	7,467
1977	18,222	11,480	11,978	7,546
1978	18,496	11,652	12,104	7,626
1979	18,770	11,825	12,230	7,705
1980	19,044	11,998	12,356	7,784
1981	19,318	12,170	12,482	7,864
1982	19,592	12,343	12,608	7,943
1983	19,866	12,516	12,734	8,022
1984	20,140	12,688	12,860	8,102
1985	20,414	12,861	12,986	8,181
1986	20,688	13,033	13,112	8,260
1987	20,962	13,206	13,238	8,340
1988	21,236	13,379	13,364	8,419
1989	21,510	13,551	13,490	8,499
1990[c]	21,792	13,729	13,620	8,581

Table B-1. (continued)

a. Assuming the percentage of total state population in each county remains constant through 1990.

b. 1974 data taken from Valley National Bank, 1974.

c. Projections for 1990 taken from U. S. Department of Commerce, 1972.

APPENDIX C

INTERVIEW GUIDE FOR PRODUCTION AND MARKETING COSTS OF THE ARIZONA EGG INDUSTRY IN 1974

Department of Poultry Science
University of Arizona
Tucson, Arizona 85721

Feed Ration

Winter:

Summer:

Cost of replacement pullets

- Cull sales

Net Replacement Cost

Feed Conversion Ratio

Feed Cost Per CWT

Marketing Channels % of Business

Retail

Wholesale

Supermarkets

Restaurants

Institutional

Breaking

Production Costs 1974

Average Number of Layers _____

Eggs produced for commercial use _____

	Total Cost	Cost per Dozen
Salaries and Wages		
Layer Amortization		
Feed Expense		
Depreciation -- Buildings		
-- Equipment		
-- Vehicles		
Repairs and Maintenance -- Vehicles		
-- Equipment		
-- Buildings		
Insurance -- Vehicles		
-- Equipment		
-- Buildings		
-- Inventories		
-- Employee Benefits		
Taxes -- Property		
-- Vehicles		
-- Payroll		
Rentals and Leases		
Supplies		
Tires and Tubes		
Gas and Oil		
Utilities		
Fertilizer Removal		
Fly and Pest Control		
Bird Mortality		
Retirement and Stock Plan		
Interest on Investment		
TOTAL PRODUCTION COSTS		

Processing Costs 1974

Quantity of eggs processed for commercial use _____.

	Total Cost	Cost per Dozen
Packaging Supplies		
Fixed Costs		
Depreciation -- Buildings		
-- Equipment		
-- Vehicles		
Insurance -- Building		
-- Equipment		
USDA Fees		
Rental -- Facilities		
-- Equipment		
-- Vehicles		
Taxes -- Property		
Interest on Investment		
TOTAL FIXED COSTS		
Variable Costs		
Insurance -- Employee Benefits		
-- Inventories		
Temporary Labor		
License and Registration		
Repairs -- Vehicles		
-- Equipment		
-- Buildings		
Salaries and Wages		
Supplies		
Payroll Taxes		
Travel and Entertainment		
Laundry		
Utilities		
Storage		
Fly and Pest Control		
Inspection		
Compensation Taxes		
Janitor		
Retirement and Stock Plan		
Miscellaneous		
TOTAL VARIABLE COSTS		
TOTAL PROCESSING COSTS		

Administrative, Marketing (Sales) and Accounting Costs 1974

	Total Cost	Cost per Dozen
Advertising		
Depreciation -- Vehicles		
Insurance -- Employee Benefits		
-- Vehicles		
Retirement and Stock Plan		
Professional Fees and Services		
Repair and Maintenance -- Vehicles		
Salaries and Wages		
Office Supplies		
Payroll Taxes		
Telephone		
Temporary Labor		
Travel and Entertainment		
Miscellaneous		
TOTAL		

Trucking or Delivery Costs 1974

	Total Cost	Cost per Dozen
Depreciation -- Vehicles		
Insurance -- Employee Benefits		
-- Vehicles		
Gas, Oil, and Lubrication		
License and Registration		
Repairs and Maintenance -- Vehicles		
Rentals and Leases -- Vehicles		
Salaries and Wages		
Supplies		
Taxes -- Payroll		
-- Personal Property		
Tires and Tubes		
Temporary Labor		
Retirement and Stock Plan		
Laundry		
Contract Freight		
Miscellaneous		
Freight Income		
TOTAL TRUCKING COSTS		

APPENDIX D

INTRASTATE TRANSPORTATION COSTS

Miles Traveled Per Round Trip -- 50-100

Assumptions:
1. Five trips per week
2. Average load per trip: 300 cases
3. Driver wage: $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 75 miles

Average annual miles traveled = 19,500
Average speed = 50 m.p.h.
Average hours of use per year = 390

Annual cost of bobtail refer	$ 4,428.40
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$13,818.40

Average cost per mile traveled = $.71
Average cost per case shipped = $.18

- -

Miles Traveled Per Round Trip -- 101-150

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 125 miles

Average annual miles traveled = 32,500
Average speed = 50 m.p.h.
Average hours of use per year = 650

Annual cost of bobtail refer	$ 5,916.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$15,306.00

Average cost per mile traveled = $.47
Average cost per case shipped = $.20

- -

Miles Traveled Per Round Trip -- 151-200

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 175 miles

Average annual miles traveled = 45,500
Average speed = 50 m.p.h.
Average hours of use per year = 910

Annual cost of bobtail refer	$ 7,424.40
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$16,814.40

Average cost per mile traveled = $.37
Average cost per case shipped = $.22

- -

Miles Traveled Per Round Trip -- 201-250

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 225 miles

Average annual miles traveled = 58,500
Average speed = 50 m.p.h.
Average hours of use per year = 1,170

Annual cost of bobtail refer	$ 8,948.60
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$18,338.60

Average cost per mile traveled = $.31
Average cost per case shipped = $.24

- -

Miles Traveled Per Round Trip -- 251-300

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 275 miles

Average annual miles traveled = 71,500
Average speed = 50 m.p.h.
Average hours of use per year = 1,430

Annual cost of bobtail refer	$10,500.40
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$19,890.40

Average cost per mile traveled = $.28
Average cost per case shipped = $.26

- -

Miles Traveled Per Round Trip -- 301-350

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 325 miles

Average annual miles traveled = 84,500
Average speed = 50 m.p.h.
Average hours of use per year = 1,690

Annual cost of bobtail refer	$12,172.60
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$21,562.60

Average cost per mile traveled = $.26
Average cost per case shipped = $.28

- -

Miles Traveled Per Round Trip -- 351-400

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 375 miles

Average annual miles traveled = 97,500
Average speed = 50 m.p.h.
Average hours of use per year = 1,950

Annual cost of bobtail refer	$13,846.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$23,236.00

Average cost per mile traveled = $.24
Average cost per case shipped = $.30

- -

Miles Traveled Per Round Trip -- 401-450

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 425 miles

Average annual miles traveled = 110,500
Average speed = 50 m.p.h.
Average hours of use per year = 2,210

Annual cost of bobtail refer	$15,519.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$24,909.00

Average cost per mile traveled = $.22
Average cost per case shipped = $.32

- -

Miles Traveled Per Round Trip -- 451-500

Assumptions:
1. Five trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 78,000
6. No backhaul
7. Average length of one trip = 475 miles

Average annual miles traveled = 123,500
Average speed = 50 m.p.h.
Average hours of use per year = 2,470

Annual cost of bobtail refer	$17,193.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$26,583.00

Average cost per mile traveled = $.22
Average cost per case shipped = $.34

- -

Miles Traveled Per Round Trip -- 501-550

Assumptions:
1. Three trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 46,800
6. No backhaul
7. Average length of one trip = 525

Average annual miles traveled = 81,900
Average speed = 50 m.p.h.
Average hours of use per year = 1,638

Annual cost of bobtail refer	$11,837.72
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$21,227.72

Average cost per mile traveled = $.26
Average cost per case shipped = $.45

- -

Miles Traveled Per Round Trip -- 551-600

Assumptions:
1. Three trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 46,800
6. No backhaul
7. Average length of one trip = 575

Average annual miles traveled = 89,700
Average speed = 50 m.p.h.
Average hours of use per year = 1,794

Annual cost of bobtail refer	$12,842.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$22,232.00

Average cost per mile traveled = $.25
Average cost per case shipped = $.48

- -

Miles Traveled Per Round Trip -- 601 and over

Assumptions:
1. Three trips per week
2. Average load per trip = 300 cases
3. Driver wage = $4.00 per hour
4. Profit = 10% return on initial investment
5. Total cases shipped per year = 46,800
6. No backhaul
7. Average length of one trip = 650

Average annual miles traveled = 101,400
Average speed = 50 m.p.h.
Average hours of use per year = 2,028

Annual cost of bobtail refer	$14,348.00
Driver wage ($4.00/hr x 40 hrs/wk x 52)	8,320.00
Profit (10% x $10,700)	1,070.00
TOTAL COST	$23,738.00

Average cost per mile traveled = $.23
Average cost per case shipped = $.51

- -

LIST OF REFERENCES

Arizona Crop and Livestock Reporting Service, Arizona Agricultural Statistics, Bulletin S-10, Phoenix: U. S. Department of Agriculture, March 1975.

Bell, Donald, "Cost of Production Trends," Poultry Scratch, Riverside: The University of California Agricultural Extension Service, April 23, 1975.

Biehler, Carl R., Arizona State Egg Inspector, Personal Interview, June 1975.

Brandow, G. E., Interrelations Among Demands for Farm Products and Implications for Control of Market Supply, Bulletin 680, University Park: Pennsylvania Agricultural Experiment Station, August 1961.

California Crop and Livestock Reporting Service, Production and Marketing California Eggs, Chickens and Turkeys 1974, Sacramento: U. S. Department of Agriculture, May 1975.

Christensen, Raymond P. and Ronald L. Mighell, Interregional Competition in the Production of Chickens and Eggs, Technical Bulletin 1039, U. S. Department of Agriculture, Washington: Government Printing Office, 1951.

Daellenback, Hans G. and Earl J. Bell, User's Guide to Linear Programming, Englewood Cliffs: Prentice-Hall, Inc., 226 p., 1970.

Forker, Olan D., Meir Chayat and Shaul Ben-David, Toward the Year 1985: Egg and Poultry Production, Special Cornell Series Number 11, Ithaca: Cornell University Press, 1970.

Friedman, Milton, Price Theory, A Provisional Text, Chicago: Aldine Publishing Company, 1962, pp. 148-161.

Hathorn, Scott, Jr. and N. Gene Wright, Arizona Agribusiness Planning Data: Farm Machinery Costs, 1975, Cooperative Extension Service, Tucson: The University of Arizona, 1975.

Judge, George G., Competitive Position of the Connecticut Poultry Industry. A Spatial Equilibrium Model for Eggs, Bulletin 318, The University of Connecticut, Storrs: Storrs Agricultural Experiment Station, 1956.

Judge, George G., S. K. Seaver, and W. F. Henry, Competitive Position of the Connecticut Poultry Industry. Economic Interpretations of Interregional Competition, Bulletin 309, The University of Connecticut, Storrs: Storrs Agricultural Experiment Station, February 1954.

Rollins, Franklin D., Arizona Poultry Statistics, Poultry Science Department, The University of Arizona, Tucson, mimeograph, January, 1974.

Rogers, George B. and Herman Bluestone, Competitive Position of the Midwestern Egg Industry, Marketing Research Report No. 784, Economic Research Service, U. S. Department of Agriculture, Washington: Government Printing Office, February 1967.

Samuelson, Paul A., "Spatial Price Equilibrium and Linear Programming," American Economic Review, Vol. XLII, No. 3, June 1952, pp. 283-303.

Stemberger, A. P. and W. J. Jasper, North Carolina Eggs in Interregional Competition, A. E. Information Series No. 73, Raleigh: North Carolina State College, February 1960.

Swanson, Milo H., The California Egg Industry: Its Scope and Relationship to the National Situation, University of California, Riverside County: Agricultural Extension Service, 1971.

Tomek, William G. and Kenneth L. Robinson, Agricultural Product Prices, Ithaca: Cornell University Press, 1972, pp. 110-113.

U. S. Department of Agriculture, 1974 Handbook of Agricultural Charts, Agricultural Handbook 477, Washington: Government Printing Office, October 1974.

U. S. Department of Commerce, Population Estimates and Projections, Series P-25, No. 477, Bureau of the Census, Washington: Government Printing Office, March 1972.

Valley National Bank, Arizona Statistical Review, Economic Research Department, Phoenix, 1974.