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To the Graduate Council:

I am submitting a thesis written by Harry B. Strawn entitled "The Estimated Economic Impact of the Interstate Highway System on the Marketing of Tennessee Eggs." I recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Stanley P. Parvin
Major Professor

We have read this thesis and recommend its acceptance:

Irving Dickson

Cecil E. Fuller

Howard A. Dye

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

# THE ESTIMATED ECONOMIC IMPACT OF THE INTERSTATE HIGHWAY SYSTEM ON THE MARKETING OF TENNESSEE EGGS

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A Thesis

Presented to

the Graduate Council of

The University of Tennessee

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Harry B. Strawn

December 1964

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# CHAPTER I

## THE INTERSTATE HIGHWAY SYSTEM

The Interstate Highway System bears the official designation of the National System of Interstate and Defense Highways. The system consists of 41,000 miles of planned, integrated, high-capacity, high-speed routes connecting the nation's centers of commerce and population, vital defense installations and providing connecting links with important continental routes in Canada and Mexico. These routes comprise only about one per cent of the total highway mileage in the continental United States, but they are expected to carry over 20 per cent of the nation's highway traffic when they are completed. It has been estimated that the Interstate Highway System will yield an annual return of approximately nine billion dollars from reduced vehicle operating costs and savings in travel time in 1973, and increasing amounts thereafter.[1]

### I. DEVELOPMENT OF THE INTERSTATE HIGHWAY SYSTEM

The National System of Interstate and Defense Highways was originally created by the Federal Aid Highway Act of 1944 and carried a 40,000 mile limitation. General location of 37,700 miles of intercity routes were officially designated in 1947 and 2,300 miles of beltline and expressway routes through cities were designated in 1955. The

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[1]United States Department of Commerce, Highway Progress 1963 (Annual Report of the Bureau of Public Roads, Fiscal Year 1963, Washington: Government Printing Office, 1963), pp. 12-13.

selection of route locations was made jointly by the various states and the Federal Bureau of Public Roads on the basis of the following factors: (1) population, (2) services, (3) transportation requirements of industry, commerce and agriculture, (4) system integration, and (5)National Defense requirements.[2]

The Federal Aid Highway Act of 1956 provided a 1,000 mile increase in the total mileage limitation of the highway system. This increased mileage brought the system up to its present 41,000 mile limit. The Federal Aid Highway Act of 1956 also authorized approximately twenty-five billion dollars in federal aid funds for interstate highway construction over a thirteen-year-period from 1957 through 1969 on a matching basis of 90 per cent federal and 10 per cent state funds.[3]

The Federal Aid Highway Act of 1961 provided increased appropriations for the National System of Interstate and Defense Highways totaling twelve billion dollars. The tentative completion date for the Interstate Highway System has been set at January 1, 1975.[4]

Table I indicates the present status of the Interstate Highway System and the mode of financing used in construction; Figure 1 approximates the locations of the completed and the proposed Interstate Highway routes as of June 30, 1963.

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[2]United States Department of Commerce, Highway Progess 1962 (Annual Report of the Bureau of Public Roads, Fiscal Year 1962, Washington: Government Printing Office, 1962), p. 10.

[3]Ibid.

[4]United States Department of Commerce, Highway Progress 1963, op. cit., p. 14.

TABLE I

STATUS OF IMPROVEMENT OF THE INTERSTATE SYSTEM AS OF JUNE 30, 1963

| Improvements | Financed by Interstate Funds[a] | Financed by Other Public Funds[b] | Total[c] |
|---|---|---|---|
| | Miles | Miles | Miles |
| Improved and open to traffic: | | | |
| Completed to full or acceptable standards | 8,924 | 602 | 9,526 |
| Improved to standards adequate for present traffic but additional improvement needed to meet full standards | 1,386 | 1,623 | 3,009 |
| Toll facilities | -- | -- | 2,294 |
| Total improved and open to traffic | 10,310 | 2,225 | 14,829 |
| Improvements underway with interstate funds: | | | |
| Under construction | 5,292 | -- | 5,292 |
| Preliminary engineering or right-of-way acquisition underway | 11,308 | -- | 11,308 |
| Total improvements underway | 16,600 | -- | 16,600 |
| Total completed, improved, or underway | -- | -- | 31,429[d] |

Source: United States Department of Commerce, Highway Progress 1963 (Annual Report of the Bureau of Public Roads, Fiscal Year 1963, Washington: Government Printing Office, 1963), p. 13.

[a]Including state matching funds.

[b]Including some federal aid.

[c]Including toll facilities.

[d]For a state-by-state breakdown of the presently completed and potential mileage of the Interstate Highway System, see Appendix B, Table XVI.

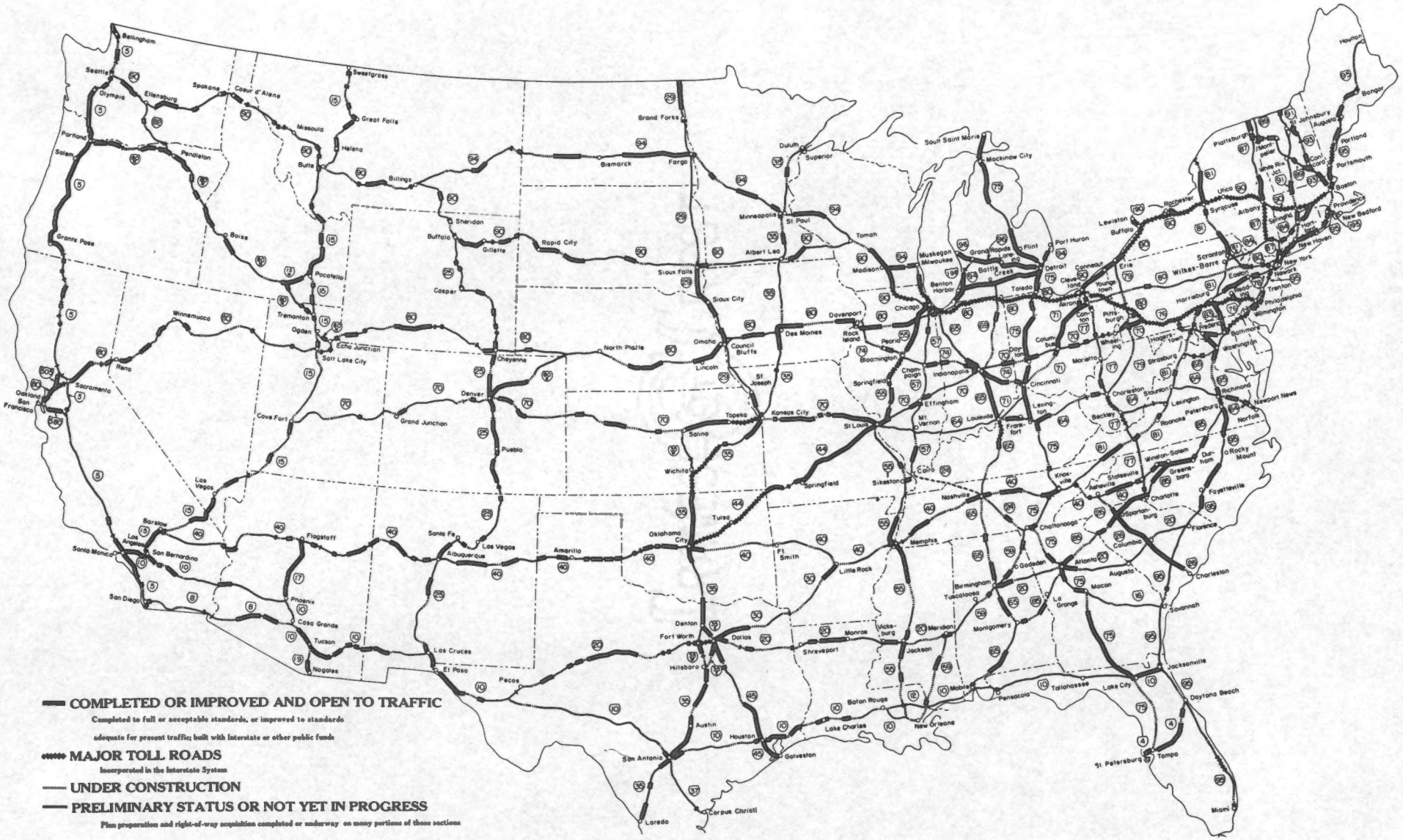



Figure 1. The National System of Interstate and Defense Highways as of March 31, 1964.

Source: Public Roads, April 1964.

## II. POSSIBLE IMPACT OF THE INTERSTATE HIGHWAY SYSTEM ON TENNESSEE AGRICULTURE

Transfer costs provide the link between initial production of both consumer and capital goods and later stages of processing or final demand.[5] Motor trucks are the most common mode of transportation for many agricultural commodities. Their greater versatility in picking up and delivering relatively small quantities of payload and the lower proportion of fixed costs in the cost structures of trucking firms make them the most economical method for moving many goods short and intermediate distances.[6] Another important factor is that many customers do not have the processing and storage capacity to handle a railroad carload of goods at one time.

Since the Interstate Highway System is expected to decrease the time and cost required to move agricultural commodities from producing areas to consuming areas by truck, the locational advantage of those areas situated near the consuming centers will be reduced. A reduced transfer cost will yield proportionately greater benefits to those producers located more distantly from deficit areas because transportation accounts for a larger share of their total cost of production. The net effects of the reduced time and cost of moving agricultural

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[5]Edgar M. Hoover, The Location of Economic Activity (New York: McGraw-Hill Book Company, 1948), p. 167.

[6]D. Philip Locklin, Economics of Transportation (Fifth edition; Homewood, Illinois: Richard D. Irwin Incorporated, 1960), p. 636.

commodities will decrease the price differentials between geographically separated markets. This will place greater relative importance on the effects of regional differences in processing costs, economies of scale in processing, and real or psychological regional differences in product quality.

Transfer cost reductions will enable producers of surplus agricultural commodities, such as snap beans in Tennessee, to compete more effectively with other producing regions for a share of the demand in the northern and northeastern markets. The Interstate Highway System will also lower the distance barriers to entry of those commodities in which the State of Tennessee is deficit.

Knowledge of factors which tend to produce geographical shifts in production and consumption will be useful to the managers of agricultural marketing firms for rational production and capital budgeting decisions. Such knowledge should also be of interest to legislators and other people interested in policy formulation for maximum social welfare.

## III. REASONS FOR SELECTING THE COMMERCIAL EGG INDUSTRY IN TENNESSEE FOR STUDY

Commercial eggs are of considerable importance to Tennessee producers.[7] In the year 1962, nine hundred twenty-seven million eggs were produced and consumed on farms or sold in Tennessee. These eggs yielded

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[7]The term commercial eggs in this study indicates shell eggs for human consumption as opposed to liquid eggs, dried eggs or hatching eggs.

a return to farmers and egg handlers of the State in terms of sales plus home consumption of $27,887,250.[8]

Commercial eggs undergo relatively few processing operations after they leave the farm. Normally, eggs are washed, candled, graded, and cartoned or cased in the marketing process.[9] Most of these operations are performed near the location where the eggs are produced. Under properly controlled conditions eggs may be stored for moderate periods of time with little deterioration in quality. In many cases the cost of transporting eggs from their production areas to the final markets is second only to the farmer's cost of producing the eggs. This is especially true if the eggs are marketed in a different geographical region from where they were produced. The commercial egg industry has, therefore, been chosen as one part of a study analyzing the effects of the Interstate Highway System on the marketing of Tennessee agricultural products.

## IV. THE EXPECTED IMPACT OF IMPROVED TRANSPORTATION ON EGG PRODUCERS, MARKETING FIRMS AND CONSUMERS

The Interstate Highway System is a limited system of high-speed, high-capacity roads comprising about one per cent of the nation's total

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[8]United States Department of Agriculture, Poultry and Egg Situation (Washington: Government Printing Office, May 1963), p. 47.

[9]The term cartoning eggs refers to the operation of placing the eggs in cartons holding one or two dozens for sale in retail stores. The term casing refers to placing the eggs in special protective cases holding 30 dozen each for shipment or sale to large volume buyers.

highway network. The effects of the highways on individual egg producers and egg marketing firms will depend to a large extent on the proximity of the various firms to the interstate routes.

The direct effects of the Interstate Highway System on Tennessee producers will be limited. The majority of farmers sell their eggs to local haulers who distribute them to other nearby egg marketing firms. Other farmers establish private egg routes and retail or wholesale their eggs directly. In either case the length of haul is short, and no special trucks or other equipment are needed.

The impact of the Interstate Highway System might be felt indirectly by Tennessee egg producers by price decreases of one or two cents per dozen eggs, depending on the size of the local market and its proximity to interstate routes. The price effect is expected to be greater in the large city markets of Nashville, Knoxville, Chattanooga, and Memphis because of the large aggregate demand for eggs in these cities which justifies the shipment of truckload lots from distant surplus areas.

Tennessee egg marketing firms are generally relatively small in terms of the investment in plant and equipment and the number of workers employed. Many of these firms maintain small fleets of van type trucks for local egg delivery. These egg delivery routes usually include local urban areas and rarely encompass more than one county.

The Interstate Highway System will give large egg marketing firms the alternative of importing eggs to supplement local supply at a some-

what lower cost than was feasible previously. The price of imported eggs will in effect place a ceiling on local farm-level prices because modern, temperature-controlled trucks can deliver eggs to Tennessee with little deterioration in egg quality.

Chain stores are important handlers of commercial eggs, and their regional warehouses often include egg-handling facilities. Some also purchase eggs from separate marketing firms, packaged under the trade name of the chain. These chains are large volume handlers that demand a constant supply of high quality eggs. The Interstate Highway System will influence chain store purchase patterns because it will decrease the price effects of seasonal variations in local egg supply and should place a lower ceiling on egg prices.

The impact of decreased transfer costs for eggs on consumers is difficult to estimate because egg prices reflect a complex interaction of supply, demand, marketing margins, transfer costs and competitive environment. The price elasticity of demand for eggs at the retail level has been estimated at approximately -0.3 which would indicate a small consumer response to changes in egg prices.[10] Any cost economies achieved by the Interstate Highway System might be taken up entirely or partly by increased marketing margins. This will depend on the intensity of present and future competition in the industry.

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[10]G. E. Brandow, Interrelationships Among Demands for Farm Products and Implications for Control of Market Supply, Agricultural Experiment Station Bulletin 680 (University Park, Pennsylvania: The Pennsylvania State University, 1961), p. 17.

## V. OBJECTIVES OF THE STUDY

The specific objectives of this study may be listed as follows:

1. To describe existing production patterns for commercial eggs before the Interstate Highway System.
2. To estimate transfer time and cost functions for moving commercial eggs from surplus areas to deficit areas.
   (a) Pre-Interstate Highway System.
   (b) Post-Interstate Highway System.
3. To describe expected shifts in egg production after the Interstate Highway System is completed.
4. To estimate the impact of the Interstate Highway System on production and distribution patterns for Tennessee commercial eggs.

## VI. REVIEW OF LITERATURE

There has been no previous work on the specific effects of transportation on the marketing of Tennessee eggs. However, there have been similar projects undertaken in egg marketing by other states.

Stemberger found that midwestern egg producers enjoyed a moderate advantage over North Carolina egg producers in feed cost.[11] He also

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[11] A. P. Stemberger, North Carolina Eggs in Interregional Competition, Agricultural Economics Information Series No. 73 (Raleigh: North Carolina State College, 1960).

showed that North Carolina had a slight labor advantage and a negligible advantage in building and equipment cost over the midwestern poultry farmers. Stemberger also investigated the locational advantage of North Carolina eggs by solving several transportation models for the national egg market. He emphasized that the locational advantage of North Carolina producers relative to midwestern poultrymen is not great and may easily be dissipated by marketing inefficiencies.

Judge investigated the effects of several different conditions of supply, demand and transport cost on geographic equilibrium prices and flows of eggs.[12] He found that approximately one-half of the variation in egg prices in the Northern markets was due to factors other than changes in transportation costs. His investigation also showed that demand for egg transport services was inelastic both for transportation cost increases and decreases.

Roy and others investigated the production and marketing practices of commercial egg producers in the states of Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and the territory of Puerto Rico, in cooperation with the Agricultural Marketing Service of the United States Department of Agricul-

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[12]George G. Judge, Competitive Position of the Connecticut Poultry Industry: No. 7 A Spatial Equilibrium Model for Eggs, Agricultural Experiment Station Bulletin 318 (Storrs, Connecticut: University of Connecticut, 1956).

ture.[13] They found all ten states were deficit in table egg production relative to the consumption levels existing in 1954. They also found that the majority of the local eggs were marketed through local haulers to retail outlets or consumers or hauled by the farmers themselves to assembly points for local distribution.

Seaver analyzed the California egg industry in 1960. He found that California had been a deficit production area since World War II, but the deficit was rapidly declining due to increased domestic egg production and decreased per capita consumption of eggs.[14] Even though California egg production was increasing rapidly, Seaver emphasized that the probability was remote that California would surpass self-sufficiency and become an exporting area due to the locational disadvantage of the California producers relative to midwestern surplus states and eastern markets. If California became self-sufficient in egg production, however, most of the eggs that were being imported into California from the midwestern states would be diverted to the eastern markets and would affect prices in these markets.

Hertsgaard used a transportation model to investigate the interregional egg marketing structure among eighteen arbitrarily chosen

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[13] Ewell P. Roy, Eggs Marketed by Commercial Producers in the South, Southern Cooperative Series Bulletin No. 50 (Knoxville: The University of Tennessee, 1957).

[14] S. K. Seaver, Economic Analysis of the Market Organization and Operation of the California Egg Industry, Giannini Foundation of Agricultural Economics, Mimeographed Report No. 229 (Berkeley: The University of California, 1960).

regions in the United States for the years 1950-1958 and made estimates for the year 1975.[15] His investigation indicated that freight cost savings may be of less importance in determining locational advantage than other considerations, such as relative costs of egg production. He estimated the economic loss from shipping to the wrong market to be less than one cent per dozen.

In an investigation of the competitive position of the New Jersey egg industry in 1963, Meredith found that the majority of the eggs consumed in New York City were produced in three geographical regions:[16] (1) nearby states, (2) the South, (3) the Midwest. He found that the emergence of the South as a major egg-producing region was the most important development in the New York market in several years. Meredith found that commercial egg dealers in New York City did not discount the price of eggs produced in distant geographical areas for quality deterioration if they were properly handled in transit. Refrigerated trucks were the most significant factors enhancing the competitive position of distant producers. He also found that egg producers absorbed most of the cost of transporting eggs from distant producing areas to the New York markets. It was further determined in this study that tariffs charged by truckers were less consistent with length-of-haul as distance

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[15]Thor A. Hertsgaard, Egg Distribution Patterns: An Economic Analysis of Past and Projected Change, Agricultural Experiment Station Bulletin No. 429 (Fargo: North Dakota State University, 1960).

[16]Alan A. Meredith, The Competitive Position of New Jersey's Egg Industry: Part III Transportation Costs and Problems, Agricultural Economics Series No. 289 (New Brunswick, New Jersey: Rutgers University, 1963).

from New York increased and that economies of using improved highways and vehicles were largely offset by increases in other operating costs.

## VII. SUMMARY OF ANALYTICAL PROCEDURE

The analytical model used in this study to determine the optimum pattern of shipments in the national egg-trading system was the transportation model. The transportation model was a partial equilibrium model that was very effective under its required conditions. It stated that under conditions of pure competition, prices for an homogeneous commodity would differ in various geographically separated markets by an amount not greater than the transfer costs among the markets.[17]

Estimates of egg production and consumption were obtained by counties for the forty-eight states making up the continental United Sates. These counties were then grouped according to trade areas delineated by Rand McNally Commercial Atlas and Marketing Guide. In some cases trade areas were combined to facilitate computation.

The egg-trading system was assumed to be a national system because eggs were found to flow freely among the various states and municipal divisions. The only regulations that possibly applied to egg movements

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[17]For detailed explanations of the methods of estimating egg production and consumption, delineation of trading areas, derivation of estimating equations and the transportation model, see Appendix A.

were safety and hours regulations and individual state laws on weight limitations.[18]

Since eggs are an agricultural commodity, they are exempt from the regulation of the Interstate Commerce Commission, and their transportation rates are not a matter of public record. Virtually all movements occurred by motor truck, and the trucks were generally owned by individual shippers or were contract vehicles (Table II). The lack of public records of egg-transportation costs necessitated the use of estimating equations relating the transfer costs to distance traveled in miles before and after the Interstate Highway System was initiated.

Solving the transportation model using pre-interstate highway transfer costs yielded the optimum flow pattern of eggs over the existing network of roads. Intermarket price comparisons were made by constructing an equilibrium-cost matrix. Both intermarket price comparisons and equilibrium returns to producers were estimated from this matrix.

The cost of using non-optimum routes was estimated by constructing an opportunity-cost matrix which was obtained by subtracting the equilibrium cost matrix from the cost-flow matrix.. Cell values of zero in this matrix indicated alternative routes which could be used without increasing total transfer costs.

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[18]Letter from Fred L. Faber, Agricultural Economist, Marketing Economics Division, Economic Research Service, United States Department of Agriculture, Washington, D. C., to author dated May 7, 1964.

The transportation problem was solved again, using post-Interstate Highway System cost estimates for moving eggs. This solution yielded the optimum pattern of egg shipments when the same quantity of eggs was moved over the Interstate Highway System. Equilibrium-cost and opportunity-cost matrices were again constructed to determine the effects of the new highway system on the national egg-trading economy.

TABLE II

REPORTED RECEIPTS OF SHELL EGGS AT SELECTED CITIES, BY ORIGIN AND MODE OF TRANSPORTATION, 1960[a]

| Source | Balti-more | Boston | Chicago | Detroit | Los Angeles | New York | Phila-delphia | Pitts-burgh | Port-land | San Francisco |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1000 cases | | | | | |
| Alabama | 1.3 | -- | 4.8 | -- | -- | 40.4 | 3.8 | 1.0 | -- | -- |
| Arizona | -- | -- | -- | -- | .1 | .5 | -- | -- | -- | -- |
| Arkansas | 5.5 | -- | -- | -- | .6 | 3.3 | -- | -- | -- | -- |
| California | -- | -- | 1.9 | -- | 3,762.1 | 23.5 | .2 | -- | -- | 2,146.4 |
| Colorado | -- | -- | .6 | -- | .7 | -- | -- | -- | -- | -- |
| Connecticut | -- | 75.8 | -- | -- | -- | 23.1 | -- | -- | -- | -- |
| Delaware | -- | -- | -- | -- | -- | 2.8 | 1.5 | -- | -- | -- |
| Georgia | 11.5 | -- | -- | -- | -- | 138.2 | 12.1 | -- | -- | -- |
| Illinois | -- | 5.2 | 511.1 | 47.1 | .6 | 58.0 | 83.2 | 16.0 | -- | -- |
| Indiana | .6 | -- | 179.5 | 105.1 | -- | 123.9 | -- | 103.5 | -- | -- |
| Iowa | 207.4 | 100.2 | 1,099.4 | 280.6 | 9.9 | 1,752.5 | 174.0 | 79.5 | -- | 2.7 |
| Kansas | 1.9 | 1.8 | -- | 1.1 | -- | 1.2 | .3 | -- | -- | 1.3 |
| Kentucky | -- | -- | 3.0 | -- | -- | 19.9 | 1.9 | -- | -- | -- |
| Maine | -- | 730.5 | -- | -- | -- | 2.8 | -- | -- | -- | -- |
| Maryland | 122.4 | -- | -- | -- | -- | 3.7 | .6 | 14.5 | -- | -- |
| Massachusetts | .6 | 345.4 | -- | -- | -- | 23.7 | -- | -- | -- | -- |
| Michigan | -- | -- | 33.5 | 557.1 | -- | 1.0 | -- | -- | -- | -- |
| Minnesota | 346.2 | 48.4 | 979.3 | 238.1 | 24.2 | 1,019.1 | 53.7 | 219.1 | -- | -- 1.3 |
| Mississippi | 4.6 | -- | -- | -- | -- | 95.0 | -- | 3.0 | -- | -- |
| Missouri | -- | -- | 1.4 | 2.4 | -- | .6 | -- | -- | -- | -- |
| Nebraska | .6 | .6 | 14.6 | 2.4 | -- | 17.5 | 2.5 | 1.3 | -- | -- |
| New Hampshire | -- | 272.0 | -- | -- | -- | 3.1 | -- | -- | -- | -- |
| New Jersey | 7.1 | -- | -- | -- | -- | 699.3 | 123.8 | -- | -- | -- |
| New York | .7 | 10.3 | -- | -- | -- | 318.4 | .5 | -- | -- | -- |

TABLE II (CONTINUED)

| Source | Balti-more | Boston | Chicago | Detroit | Los Angeles | New York | Phila-delphia | Pitts-burgh | Port-land | San Francisco |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1000 cases | | | | | |
| North Carolina | 141.7 | 16.7 | -- | -- | -- | 134.7 | -- | 1.9 | -- | -- |
| North Dakota | -- | -- | 5.2 | -- | -- | .5 | .3 | -- | -- | -- |
| Ohio | 25.6 | -- | 19.8 | 610.9 | -- | 6.4 | 6.1 | 410.0 | -- | -- |
| Oregon | -- | -- | -- | -- | -- | -- | -- | -- | 485.2 | -- |
| Pennsylvania | 312.5 | .1 | -- | -- | -- | 517.7 | 836.6 | 48.4 | -- | -- |
| Rhode Island | -- | 12.6 | -- | -- | -- | 2.3 | -- | -- | -- | -- |
| South Carolina | 34.5 | -- | -- | -- | -- | 32.8 | -- | -- | -- | -- |
| South Dakota | 4.3 | -- | 41.1 | .2 | .8 | 45.0 | 2.5 | 8.0 | -- | -- |
| Tennessee | 1.2 | -- | 2.2 | -- | -- | .1 | .6 | -- | -- | -- |
| Vermont | -- | 22.3 | -- | -- | -- | -- | -- | -- | -- | -- |
| Virginia | 33.5 | -- | .1 | -- | -- | 54.6 | 1.6 | -- | -- | -- |
| West Virginia | -- | -- | -- | -- | -- | -- | -- | 1.5 | -- | -- |
| Wisconsin | .6 | -- | 1,133.9 | 57.8 | -- | 6.3 | 2.9 | -- | -- | -- |
| Canada | -- | .6 | 3.4 | 2.1 | 1.3 | 6.9 | -- | -- | -- | -- |
| Total[b] | 1,264.3 | 1,642.5 | 4,034.8 | 1,904.9 | 3,800.3 | 5,178.8 | 1,308.7 | 907.7 | 485.2 | 2,151.7 |
| Mode of transport | | | | | | | | | | |
| Truck | 1,264.3 | 1,642.5 | 4,033.6 | 1,886.8 | 3,800.3 | | 1,308.7 | 907.7 | 485.2 | 2,151.7 |
| Rail | 0 | 0 | 1.2 | 18.1 | 0 | | 0 | 0 | 0 | 0 |

[a]Reported receipts at all cities were discontinued in 1961.

[b]Columns may not add due to rounding.

Source: Economic Research Service, Statistical Reporting Service, Agricultural Marketing Service, United States Department of Agriculture, Egg and Poultry Statistics Through Mid-1961, Statistical Bulletin No. 305 (Washington: Government Printing Office, 1962), p. 137.

# CHAPTER II

## TRANSFER TIME AND COST ESTIMATES FOR EGGS

Transfer costs are typically expressed in terms of an appropriate commodity unit and distance traveled. The particular units in which the transfer costs are expressed depend on the characteristics of the commodity under consideration. In this study transfer costs for eggs are expressed in terms of cents per case. Transfer cost functions normally contain components that remain constant regardless of the length-of-haul and components that vary with distance.

### I. FIXED COSTS

Fixed costs remain constant with changes in lengths-of-haul, and in the trucking industry include terminal costs, docking charges, time depreciation of equipment, insurance, taxes and licenses, and specialized labor may also be included in some cases. Certain fixed costs may become variable under vehicle leasing arrangements.

Terminal costs include terminal buildings and equipment, management expenses, clerical help and various other office expenses. Docking charges include all costs incurred in the process of loading and unloading trucks, including any special packing material or containers purchased by the firm. Innovations in equipment design which render existing equipment less desirable occur intermittently. Such obsolescence is

independent of the intensity of equipment use. Property taxes and truck license fees vary in the several states and are not directly influenced by the miles traveled by the vehicle. Various types of liability and equipment insurance are also largely independent of miles traveled.

## II. VARIABLE COSTS

Variable costs or line haul costs include all trucking costs that vary with the length-of-haul. Costs falling into this category include fuel, the driver's wages, lubricants, vehicle maintenance, tires and tubes, certain taxes[1] and wear depreciation. The proportion of variable costs to fixed costs varies considerably within the trucking industry, but probably it is higher than in many other modes of transportation. The prime effect of the Interstate Highway System on total trucking costs will be made through decreases in certain of these variable cost components. It should be noted, however, that while these costs vary with the length-of-haul they are inelastic with respect to the size of the payload.

## III. OTHER FACTORS INFLUENCING TRANSPORTATION COSTS FOR EGGS

Several other factors influenced the cost of transporting eggs from surplus to deficit regions, two of the most important of which are whether eggs comprise the forward or back-haul for the vehicle and the

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[1]Ton-mile taxes and gasoline taxes.

number of unladen miles traveled by the vehicle. Rates for back-hauls are normally less than forward haul rates because most of the vehicular costs will be incurred whether the truck returns loaded or empty. A rational operator would, therefore, carry a back-haul as long as its revenue covered the out-of-pocket costs incurred in moving it and contributed something to the other costs of returning the vehicle.

Table III shows tonnage and direction of haul for poultry and eggs in 1960. There is a significant variation in the percentages of poultry and egg movements when classified according to direction of haul. The South Central states have the largest volume of outbound traffic, comprising 95.9 per cent; and the Western states have the smallest proportion of outbound traffic at 44.5 per cent.

Since the proportion of unladen miles also contributes to the total cost of moving eggs by truck, all of the costs of operating the vehicle must be charged against the payload it carries. Any time a vehicle operates empty for considerable distances, there must be a corresponding adjustment in tariffs for the commodity handled. Table IV indicates the loaded and unladen miles traveled by trucks by regions of the continental United States in 1960.

It has recently been found that truckers in the South who ship eggs on regular weekly or semi-weekly schedules tend to specialize in moving eggs and generally return to the South unloaded or hauling empty

TABLE III

TONNAGE AND PERCENTAGE OF POULTRY AND EGGS HAULED BY TRUCKERS IN THE CONTINENTAL UNITED STATES BY REGION OF HOME OFFICE AND DIRECTION OF HAUL, 1960

| Regions of Home Office and Direction of Haul | Tons | Per Cent |
|---|---|---|
| North Atlantic | | |
| Outbound | 18,373 | 48.3 |
| Homebound | 20,185 | 51.7 |
| Total | 39,058 | 100.0 |
| East North Central | | |
| Outbound | 45,087 | 91.1 |
| Homebound | 4,420 | 8.9 |
| Total | 49,507 | 100.0 |
| West North Central | | |
| Outbound | 142,019 | 79.5 |
| Homebound | 36,599 | 20.5 |
| Total | 178,618 | 100.0 |
| South Atlantic | | |
| Outbound | 115,466 | 90.0 |
| Homebound | 12,766 | 10.0 |
| Total | 128,232 | 100.0 |
| South Central | | |
| Outbound | 58,136 | 95.9 |
| Homebound | 2,493 | 4.1 |
| Total | 60,629 | 100.0 |
| Western | | |
| Outbound | 1,722 | 44.5 |
| Homebound | 2,146 | 55.5 |
| Total | 3,868 | 100.0 |
| Total | | |
| Outbound | 381,303 | 82.9 |
| Homebound | 78,609 | 17.1 |
| Total | 459,912 | 100.0 |

Source: Economic Research Service, Marketing Economics Division, United States Department of Agriculture, For Hire Motor Carriers Hauling Exempt Agricultural Commodities, Nature and Extent of Operations, Marketing Research Report No. 585 (Washington: Government Printing Office, 1963), p. 33.

TABLE IV

NUMBER OF TRUCKS, MILES TRAVELED LADEN AND EMPTY, AVERAGE MILES PER VEHICLE, AND PERCENTAGE OF MILES LADEN PER VEHICLE BY REGION OF TRUCKER'S HOME OFFICE, 1960

| Region of Home Office | Total Tractors and Straight Trucks[a] | Laden | | Unladen | | Total | | Per Cent Laden |
|---|---|---|---|---|---|---|---|---|
| | | Miles | Average per Vehicle | Miles | Average per Vehicle | Miles | Average per Vehicle | |
| North Atlantic | 502 | 14,133,901 | 28,155 | 7,348,280 | 14,638 | 21,482,181 | 42,793 | 65.7 |
| East North Central | 775 | 21,141,767 | 27,280 | 11,918,054 | 15,378 | 33,059,821 | 42,658 | 63.9 |
| West North Central | 1,414 | 47,965,830 | 33,922 | 22,312,009 | 15,779 | 70,277,839 | 49,701 | 68.2 |
| South Atlantic | 1,070 | 43,869,257 | 40,999 | 17,571,441 | 16,422 | 61,440,698 | 57,421 | 71.4 |
| South Central | 718 | 36,881,519 | 51,367 | 14,323,553 | 19,949 | 51,205,072 | 71,316 | 72.0 |
| Western | 651 | 30,371,713 | 46,654 | 9,937,429 | 15,265 | 40,309,142 | 61,919 | 75.3 |
| Total | 5,130 | 194,363,987 | 37,888 | 83,410,766 | 16,529 | 227,774,753 | 54,147 | 69.9 |

Source: Economic Research Service, Marketing Economics Division, United States Department of Agriculture, For Hire Motor Carriers Hauling Exempt Agricultural Commodities - Nature and Extent of Operation, Marketing Research Report No. 585 (Washington: Government Printing Office, 1963), p. 39.

[a]From a survey taken in 1960.

cartons or cases.[2] This could be explained by the time factor. Southern truckers are often specialized egg marketing firms and operate on a very tight schedule; therefore, they do not have time to lay over to wait for a profitable back-haul or to trip-lease their vehicles. This may be an indication of a future trend in moving eggs as transfer schedules become tighter and egg-handling equipment becomes more specialized.

## IV. PRE-INTERSTATE HIGHWAY SYSTEM COST ESTIMATES

The lack of uniform data on the costs of moving eggs over the various routes in the egg-trading system made estimation of these costs on a comparable basis necessary. Therefore, an equation was used to relate transfer costs to distance traveled for the several routes. The use of this technique required several simplifying assumptions about the egg economy: (1) Equivalent charges were made for similar distances traveled regardless of the points of origin, destination or direction of haul. (2) The charges included a fixed docking charge plus a variable or line-haul component. (3) The particular equation chosen also assumed that per mile charges decreased with increases in the length-of-haul.

The basic transfer-cost equation chosen for use in this study was obtained from a North Carolina study. The equation took the following form:[3]

$$Y = 70.2242 + .0214202679X - .0000030829X^2$$

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[2]Letter from Alan A. Meredith, Associate Research Specialist in Marketing, Department of Agricultural Economics, Rutgers University, New Brunswick, New Jersey, to author dated June 25, 1964.

[3]A. P. Stemberger, North Carolina Eggs in Interregional Competition, Agricultural Economics Information Series No. 73 (Raleigh: North Carolina State College, 1960), p. 34.

where

Y = the transportation rate in cents per case and

X = the estimated highway distances between origins and destinations.[4]

This second degree transfer cost function yielded a correlation coefficient of 90.3 per cent when first used in 1959.[5]

The possibility of adjusting the cost function to take account of price increases in the economy since 1959 was examined and rejected because the wholesale price index remained relatively constant over this time period.[6]

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[4]Highway distance estimates between origins and destinations were obtained from the Rand McNally Commercial and Marketing Atlas in the following manner. Estimates of air distance between shipping and receiving points were obtained by application of the scale of miles in the map legend. The resulting air mileages were converted to highway mileages by the following relationship:

$$D_r = 1.19\ D_a{}^*$$

where $D_r$ = highway miles

$D_a$ = air miles

*Source: Gene A. Mathia and R. A. King, Planning Data for the Sweet Potato Industry, Part 3, Selection of the Optimum Number, Size and Location of Processing Plants in Eastern North Carolina. Agricultural Economics Information Series No. 97 (Raleigh: North Carolina State College, 1962), p. 18.

[5]Stemberger, op. cit.

[6]The wholesale price index is a continuous statistical series published by the Bureau of Labor Statistics and is designed to measure average changes in prices of commodities sold in primary markets in the United States. The index had a value of 100.6 in both 1959 and 1962 (1957-59 = 100).*

*Source: United States Department of Commerce, Statistical Abstract of the United States, 1963 (84th Annual Edition) (Washington: Government Printing Office, 1963), pp. 349-351.

## V. TRANSIT TIME REQUIREMENTS FOR EGGS

The time required to transport eggs from a specified point of origin to a given destination is a function of the distance traveled and the rate of vehicular speed. An investigation was made to determine the effects of the Interstate Highway System on the transfer time requirements for eggs. This study consisted of two integral parts: the effects of the new highways on the alignment of principal routes among important cities in the continental United States, and the effects of the new highways on the average rates of speed of various types of private and commercial vehicles.

## VI. EFFECTS OF THE INTERSTATE SYSTEM ON ROUTE ALIGNMENT

No appreciable change in route alignment could be attributed to the Interstate Highway System. Straight line air distances in statute miles were used as indices of optimum alignment. Conventional and interstate routes were compared with these direct airline routes to estimate the alignment of the two systems. The relation between conventional highways and corresponding direct air distances may be shown as follows:[7]

$$D_r = 1.19\ D_a$$

where

$D_a$ = direct airline distance in miles and

$D_r$ = conventional highway distance in miles.

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[7]See footnote 4, page 25.

Comparison of direct airline distances and similar routes using the Interstate Highway System yielded the following relationship:[8]

$$D_i = 1.196\ D_a$$

where

$D_a$ = direct airline miles and

$D_i$ = interstate highway miles.

On the basis of these relationships, it can be assumed that any decreases in transit time requirements due to the new highway network will be due to increased vehicle speed rather than decreased distance.[9]

## VII. EFFECTS OF THE INTERSTATE SYSTEM ON VEHICLE SPEEDS

The Interstate Highway System will increase vehicular speeds through reductions in traffic congestion, signal stops, traffic slowdowns, maximum grade specifications, and rise and fall of routes. Eliminating intersections at grade,[10] limiting access points, and improving roadway surface will also affect vehicular movements. Table V summarizes the average speeds of various common motor vehicles over several types of highways in the United States.

In order to arrive at a plausible estimate of the time savings due to the existence of the new system, weighted averages of the speeds

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[8]From a sample of 250 observations. The equation was statistically adjusted to force it through the origin. The resulting correlation coefficient was .990.

[9]There was no significant difference in the coefficients at the .99 significance level.

[10]Except in extremely sparsely populated areas.

TABLE V

AVERAGE SPEEDS OF COMMON MOTOR VEHICLES BY TYPE OF HIGHWAY, 1963

| Type of Highway | Average Vehicular Speed in Miles Per Hour | | | |
|---|---|---|---|---|
| | All Vehicles | Passenger Cars | Trucks | Buses |
| Rural interstate completed | 59.5 | 60.8 | 53.9 | 60.7 |
| Rural interstate not completed | 54.2 | 55.5 | 49.6 | 54.7 |
| Urban interstate completed | 51.6 | 52.6 | 48.0 | 52.9 |
| Urban interstate not completed | 43.6 | 44.4 | 41.1 | 42.8 |
| Suburban interstate completed | 50.2 | 50.4 | 49.7 | 56.7 |
| Main rural | 55.6 | 56.9 | 51.1 | 57.7 |
| Rural secondary | 48.2 | 49.0 | 45.4 | 44.6 |
| Urban primary | 47.9 | 48.6 | 45.0 | 47.9 |
| Urban secondary | 35.1 | 35.7 | 35.8 | 31.2 |
| Suburban primary | 46.3 | 47.0 | 45.0 | 56.7 |
| Suburban secondary | 43.2 | 43.5 | 42.5 | 38.2 |

Source: United States Department of Commerce, Traffic Speed Trends (Washington: Government Printing Office, March 1964), p. 4.

of trucks over conventional and interstate system routes listed in Table V were constructed.[11] The weighted averages yielded mean speeds of 47.2 and 53.1 miles per hour for trucks moving over conventional and Interstate Highway System routes, respectively. A speed differential of 5.9 miles per hour was obtained and used in the estimating equation relating time consumption over the interstate system to the time consumption for similar trips over the conventional road network. This change in vehicular speeds resulted in a proportionate decrease in the transit time required to travel identical distances over the Interstate Highway System when compared with the conventional road net. The basic relationship is expressed in simple functional form below:[12]

$$T_i = .875\ T_r$$

where

$T_i$ = the mean time requirement for a truck moving over an Interstate Highway System route, and

$T_r$ = the mean time requirement for a truck moving over a corresponding conventional route.

The most important factors determining the impact of the new highway system on the distribution of shipments in the national egg-trading system are the decrease in required transit time and the accompanying

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[11]The weights consisted of the proportions of the total national highway network falling into each category listed in Table V.

[12]Time functions for other vehicles may obviously be constructed in the same manner.

reduction in transfer costs for eggs. Table VI shows the value of a one-minute reduction in the required travel time for common motor vehicles in the year 1961.

The value data can be combined with the equations for estimating the magnitude of the transit time reduction due to the interstate system to yield functions for estimating the value of the respective time decreases. For a tractor-semi-trailer combination the value of time saved function would assume the form shown below:

$$V_{ti} = 6.08\ (.125\ T_r)$$

which reduces to

$$V_{ti} = .760\ T_r$$

This estimate is derived by multiplying the value of a minute saved in transit time by the proportionate time saving that can be attributed to the Interstate Highway System.

## VIII. EFFECTS OF THE INTERSTATE SYSTEM ON TRANSFER COSTS

The next phase in deriving the transfer cost function for moving commercial eggs from surplus to deficit areas over the Interstate Highway System consisted of combining the estimated value of the proportionate decrease in transit time with the original transfer cost function. It was necessary, however, to convert these functions to a similar base before combining them. The simplest method of conversion consisted of multiplying the original cost function by the average number of cases

TABLE VI

ESTIMATES OF THE VALUE OF A REDUCTION IN TIME CONSUMPTION TO USERS OF HIGHWAY VEHICLES, 1961

| Type of Vehicle | Value of a Reduction in Time Consumption per Vehicle in Cents per Minute |
|---|---|
| Passenger cars | 2.37 |
| Buses: | |
| Local and suburban | 5.77 |
| Intercity | 7.52 |
| Single unit trucks: | |
| 2-axle, 4 tire | 4.75 |
| 2-axle, 6 tire | 5.02 |
| 3-axle | 5.78 |
| Tractor-semi-trailer combinations:[a] | |
| 2-S1 | 5.53 |
| 2-S2 | 6.08 |
| 3-S2 | 6.50 |
| Truck, full-trailer combinations: | |
| 2-1 | 5.52 |
| 2-2 | 6.52 |
| 2-3 | 6.67 |
| 3-2 | 6.75 |
| 6 axles or more | 6.87 |
| Tractor-semi-trailer and full trailer combinations, all units | 7.13 |

Source: United States Department of Commerce, Final Report of the Highway Cost Allocation Study (Washington: Government Printing Office, 1961), p. 209.

[a]The combined numerical and letter designation refers to the number of axles the vehicle possesses. For example 2-S1 refers to a tractor with two axles and a semi-trailer with one axle. Likewise the designation 2-1 refers to a tractor with two axles and a full trailer with one axle.

per truckload.[13] The resulting equation is shown below.

$$Y = 47191. + 14.39442003X - .00207171X^2$$

where

Y = transfer cost in cents per truckload and

X = highway distance in miles.

Since the Interstate Highway System is expected to make its greatest contribution to transfer cost reduction by lowering line haul costs, the original cost function was partitioned into a constant element and two terms that varied with distance.[14]

It was established in the previous section that the estimated monetary value of the proportionate decrease in transit time associated with the use of the Interstate Highway System was .760 cents per truck-mile. The effects of this cost reduction on over-the-road costs can be estimated by multiplying the variable components[15] of the original transfer-cost function by the cost-savings factor. This yields the following relationship:

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[13]This average was determined from firms in the Knoxville, Tennessee area. They hauled an average of 672 cases of eggs per load. The range extended from 600 cases to 756 cases.

[14]Since the original transfer cost function was derived by regression techniques from a mail questionnaire (Stemberger, op. cit., p. 34) on actual rates changed by firms, rather than budgeting the various costs of hauling eggs by truck, it was not feasible to quantitatively estimate the effects of the interstate system on the fixed costs of hauling eggs by truck. It is known, however, that the interstate system contributes to longer useful lives of vehicles; therefore the fixed costs would also be influenced.

[15]Those components which vary with length of haul.

$$Y_1 = 47191. + .760\ (14.39442003X - .00207171X^2)$$

which may be simplified to:

$$Y_1 = 47191. + 10.93975922X - .0015744996X^2$$

The remaining step in simplifying the revised expression of the cost function consists of converting from cents per truckload to cents per case[16] to obtain continuity of expression. The revised transfer cost function becomes:

$$Y_1 = 70.2242 + .0162794036X - .0000023430X^2$$

where

$Y_1$ = the transfer costs in cents per case utilizing the Interstate Highway System and

$X$ = highway distance in miles.

This cost function was used to estimate projected changes in optimum flows of commercial eggs and in the associated equilibrium price differentials.[17]

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[16]This was accomplished by dividing the entire function by the mean number of cases hauled.

[17]An alternative technique for deriving a cost function in this case would have been to assume that a proportionate change in transit time was equivalent to a proportionate change in distance traveled for all routes. The constant of proportionality in this case would have been .875, (1 - .125). Therefore .875X would have been substituted everywhere X appeared in the original transfer cost function. Use of this technique would have yielded the following relationships:

$Y = 47191 + 12.59511753X - .001586153X^2$ for trucks

and $Y = 70.2242 + .01874273444X - .0000023604X^2$ for cases of eggs.

The revision technique using the value-of-time saved factor was chosen because it did not require the use of the additional assumption of equal proportions.

# CHAPTER III

## SUPPLY AND DEMAND FOR EGGS

### I. TOTAL EGG SUPPLY

The supply of commercial eggs available for consumption during a given period consists of commercial egg production during that period plus net changes in inventories of stored eggs plus net imports. During the period from 1950-1962 United States imports of eggs never rose above four-tenths of one per cent, and exports were never over 3.5 per cent of total domestic egg production. Commercial stocks of cold storage eggs never accounted for more than 1.5 per cent of domestic production during the period. Table VII shows the magnitudes of egg imports, exports, commercial storage holdings of eggs and the percentages of total domestic production accounted for by each category for the years 1950-1962.

Since neither foreign trade nor changes in storage inventory accounted for more than 4.5 per cent of total domestic egg production in any one year, yearly egg production was assumed to equal yearly egg consumption; and the continental United States was considered to be a closed egg trading system for analytical purposes.

### II. DOMESTIC PRODUCTION OF COMMERCIAL EGGS

Total egg production is a function of the number of hens on farms, hen mortality, and rate-of-lay. Commercial egg production is widespread,

TABLE VII

COMMERCIAL STORAGE STOCKS OF EGGS: EXPORTS AND IMPORTS OF EGGS IN THE UNITED STATES, 1950-62

| Year | Total Production[a] | Average Cold Storage Holdings[b] | Imports[b] | Exports[c] | Percentage of Production | | |
|---|---|---|---|---|---|---|---|
| | | | | | Imports | Exports | Cold Storage |
| | (million dozen) | | | | % | % | % |
| 1950 | 5,404 | 52.5 | 20 | 169 | .370 | 3.127 | .972 |
| 1951 | 5,322 | 57.5 | 8 | 182 | .150 | 3.420 | 1.080 |
| 1952 | 5,323 | 58.5 | 8 | 72 | .150 | 1.353 | 1.099 |
| 1953 | 5,307 | 46.0 | 7 | 58 | .132 | 1.093 | .867 |
| 1954 | 5,402 | 53.5 | 4 | 64 | .074 | 1.185 | .990 |
| 1955 | 5,407 | 71.0 | 2 | 65 | .037 | 1.202 | 1.313 |
| 1956 | 5,500 | 80.5 | 2 | 64 | .036 | 1.164 | 1.464 |
| 1957 | 5,441 | 78.0 | 1 | 50 | .018 | .919 | 1.434 |
| 1958 | 5,441 | 58.5 | 2 | 44 | .037 | .809 | 1.075 |
| 1959 | 5,542 | 55.0 | 1 | 53 | .018 | .956 | .992 |
| 1960 | 5,329 | 58.0 | 3 | 48 | .056 | .901 | 1.088 |
| 1961 | 5,315 | 49.5 | 3 | 45 | .056 | .847 | .931 |
| 1962 | 5,354[d] | 49.0 | 2 | 37 | .037 | .691 | .915 |

Source: Agricultural Statistics, 1962 and 1963, United States Department of Agriculture (Washington: Government Printing Office, 1962), p. 506 and p. 430, respectively.

[a]Including allowance for backyard (nonfarm) production.

[b]Shell egg equivalent of eggs and egg products.

[c]Shell eggs and shell equivalent of egg products, including exports made from government owned stocks acquired for price support and other purposes.

[d]Preliminary.

occurring in every state of the continental United States. It has been shown that regional differences in hen mortality are insignificant.[1] Regional differences in rate-of-lay exist, but the magnitude is not as great as conventional rate-of-lay estimates indicate since they include hatching egg production for broilers. These heavy breed hens lay fewer eggs than the commercial egg types and cause the rate-of-lay estimates to be biased against those states having heavy broiler production.[2] It is also generally true that all regions have access to similar bloodlines of laying hens. This indicates that while the rate-of-lay is significant, the major factor in determining the quantity of commercial eggs produced in an area is the density of laying hens. Table VIII shows the density of hens and pullets and density of egg production by states for the continental United States for the year 1962.

While some commercial eggs are produced in every state of the continental United States, there is much variation in the numbers of eggs produced in the various states and geographic areas. California produces the largest quantity of eggs, followed by Iowa, Minnesota, and Pennsylvania. For an indication of the magnitude and location of domestic egg production in 1962, see Figure 2.

Historically, significant shifts in the patterns of commercial egg production have occurred. The South Atlantic states have made the

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[1]A. P. Stemberger, North Carolina Eggs in Interregional Competition, Agricultural Economics Information Series No. 73 (Raleigh: North Carolina State College, 1960), p. 15.

[2]Ibid., p. 14.

TABLE VIII

HEN AND EGG PRODUCTION DENSITY BY STATES FOR THE CONTINENTAL UNITED STATES, 1962

| State | Land Area in Square Miles[a] | Average Number Hens and Pullets During Year[b] (000) | Birds per Square Mile | Total Egg Production[c] (000,000) | Egg Production per Square Mile |
|---|---|---|---|---|---|
| Maine | 31,012 | 3,594 | 115.9 | 805 | 25,957.7 |
| New Hampshire | 9,014 | 1,507 | 167.2 | 330 | 36,609.8 |
| Vermont | 9,276 | 725 | 78.2 | 163 | 17,572.3 |
| Massachusetts | 7,867 | 2,677 | 340.3 | 592 | 75,251.1 |
| Rhode Island | 1,058 | 364 | 344.0 | 78 | 73,724.0 |
| Connecticut | 4,899 | 3,251 | 663.6 | 714 | 145,744.0 |
| New York | 47,939 | 8,272 | 172.6 | 1,780 | 37,130.5 |
| New Jersey | 7,521 | 9,720 | 1,292.4 | 1,864 | 247,839.4 |
| Pennsylvania | 45,007 | 14,994 | 333.1 | 3,202 | 71,144.5 |
| North Atlantic | 163,593 | 45,104 | 275.7 | 9,528 | 58,242.1 |
| Ohio | 40,972 | 11,367 | 277.4 | 2,465 | 60,163.0 |
| Indiana | 36,185 | 10,509 | 290.4 | 2,284 | 63,120.1 |
| Illinois | 95,930 | 10,666 | 190.7 | 2,283 | 40,818.9 |
| Michigan | 57,019 | 6,144 | 107.8 | 1,326 | 23,255.4 |
| Wisconsin | 54,705 | 8,849 | 161.8 | 1,933 | 35,335 |
| East North Central | 244,811 | 47,535 | 194.2 | 10,291 | 42,036.5 |
| Minnesota | 80,009 | 14,701 | 183.7 | 3,282 | 41,020.4 |
| Iowa | 56,032 | 20,003 | 357.0 | 4,434 | 79,133.4 |
| Missouri | 69,138 | 8,549 | 123.7 | 1,741 | 25,181.5 |
| North Dakota | 69,457 | 2,186 | 31.5 | 424 | 6,104.5 |
| South Dakota | 76,378 | 7,309 | 95.7 | 1,587 | 20,778.2 |
| Nebraska | 76,612 | 7,572 | 98.8 | 1,623 | 21,184.7 |
| Kansas | 82,048 | 5,349 | 65.2 | 1,106 | 13,479.9 |
| West North Central | 509,674 | 65,669 | 128.8 | 14,195 | 27,851.1 |
| Delaware | 1,978 | 655 | 331.1 | 128 | 64,711.8 |
| Maryland | 9,874 | 1,324 | 134.1 | 270 | 27,344.1 |
| Virginia | 39,838 | 5,386 | 135.2 | 1,108 | 27,812.6 |
| West Virginia | 24,079 | 1,661 | 69.0 | 342 | 14,203.2 |
| North Carolina | 49,067 | 10,838 | 220.9 | 2,304 | 46,956.2 |
| South Carolina | 30,272 | 4,545 | 150.1 | 948 | 31,316.1 |
| Georgia | 58,274 | 12,429 | 213.3 | 2,583 | 44,325.1 |
| Florida | 54,252 | 5,617 | 103.5 | 1,225 | 22,579.8 |
| South Atlantic | 267,634 | 42,455 | 158.6 | 8,908 | 33,284.3 |

TABLE VIII (CONTINUED)

| State | Land Area in Square Miles | Average Number Hens and Pullets During Year[b] (000) | Birds per Square Mile | Total Egg Production[c] (000,000) | Egg Production Per Square Mile |
|---|---|---|---|---|---|
| Kentucky | 39,863 | 4,599 | 115.4 | 853 | 21,398.3 |
| Tennessee | 41,762 | 4,916 | 117.7 | 927 | 22,197.2 |
| Alabama | 51,060 | 8,075 | 158.1 | 1,666 | 32,628.3 |
| Mississippi | 47,223 | 7,814 | 165.5 | 1,506 | 31,891.2 |
| Arkansas | 42,499 | 7,409 | 141.1 | 1,522 | 28,991.0 |
| Louisiana | 45,106 | 2,760 | 61.2 | 511 | 11,329.1 |
| Oklahoma | 68,887 | 2,838 | 41.2 | 560 | 8,129.3 |
| Texas | 262,840 | 13,065 | 49.7 | 2,562 | 9,747.4 |
| South Central | 609,240 | 51,476 | 84.5 | 10,107 | 16,589.5 |
| Montana | 145,736 | 973 | 6.7 | 198 | 1,358.6 |
| Idaho | 82,708 | 1,169 | 14.1 | 258 | 3,119.4 |
| Wyoming | 97,411 | 276 | 2.8 | 57 | 585.1 |
| Colorado | 103,884 | 1,410 | 13.6 | 284 | 2,733.8 |
| New Mexico | 121,510 | 771 | 6.3 | 157 | 1,292.1 |
| Arizona | 113,575 | 762 | 6.7 | 160 | 1,408.8 |
| Utah | 82,339 | 1,349 | 16.4 | 299 | 3,631.3 |
| Nevada | 109,788 | 58 | .5 | 12 | 109.3 |
| Washington | 66,709 | 4,651 | 69.7 | 1,054 | 15,800.0 |
| Oregon | 96,248 | 2,524 | 26.2 | 571 | 5,932.6 |
| California | 156,573 | 30,838 | 197.0 | 6,907 | 44,113.6 |
| Western | 1,176,481 | 44,781 | 38.1 | 9,957 | 8,463.4 |
| 48 states | 2,971,433 | 297,020 | 100.0 | 62,986 | 21,197.6 |

[a]Harry Hansen (ed.), The World Almanac, 1964 (New York: The New York World Telegram and The Sun, 1964), p. 174.

[b]United States Department of Agriculture, Agricultural Statistics, 1963 (Washington: United States Government Printing Office, 1964), p. 426.

[c]United States Department of Agriculture, Poultry and Egg Situation (Washington: Government Printing Office, May 1963), p. 47.

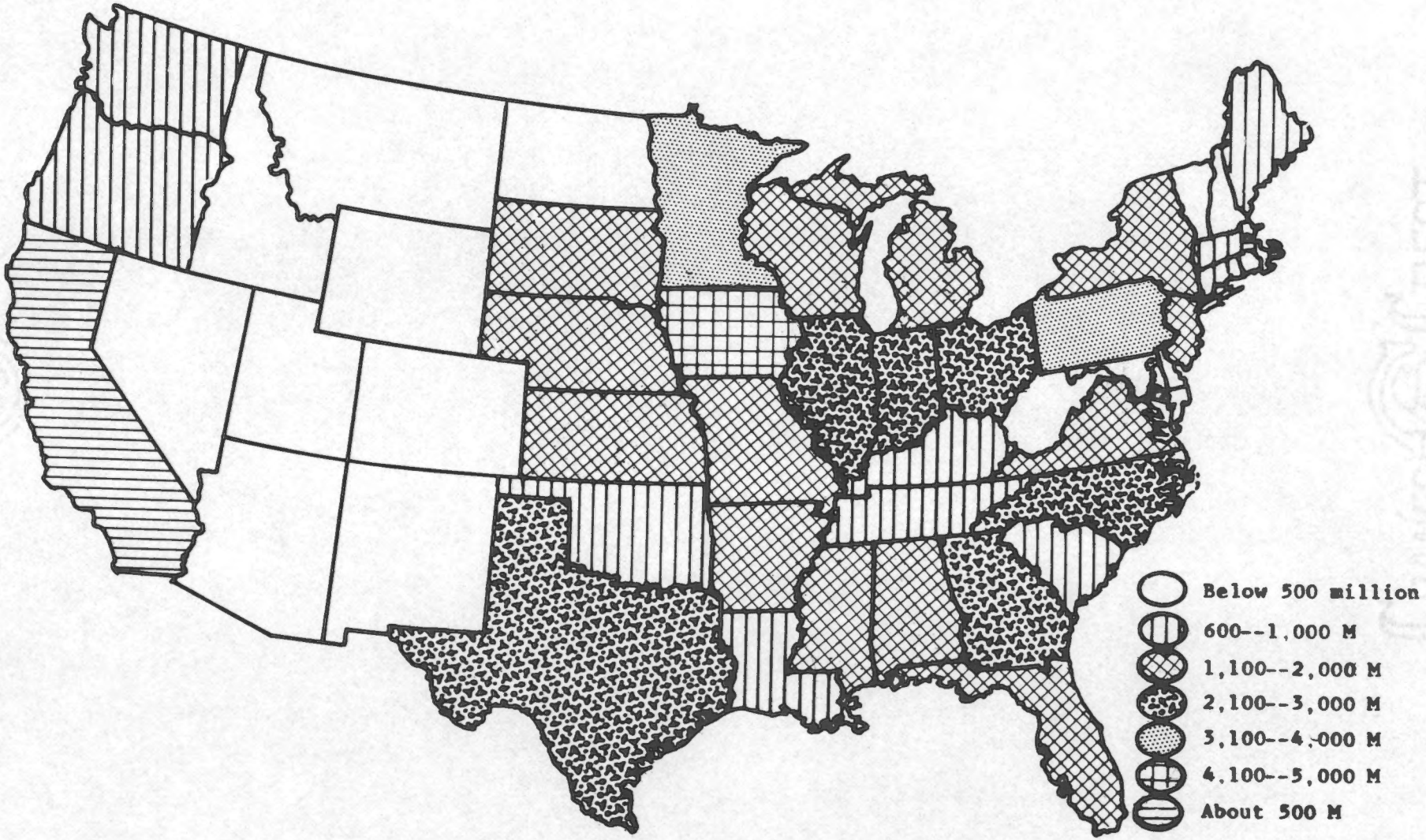



Figure 2. Commercial egg production by states, United States, 1962.

largest proportionate increases since 1947. The 1947-49 breakdown of domestic egg production indicates that they produced only 8.6 per cent of the total eggs compared to 14.2 per cent in 1962. During the same period the West increased its production by nearly one-half. The West North Central region showed the largest proportionate decrease in egg production. It decreased from 29.0 per cent of the national production in 1947-49 to 22.5 per cent in 1962.[3] Table IX shows the proportion of total egg production accounted for by the various geographical regions in the continental United States by years for the period 1947-1962.

These figures are particularly significant when it is realized that aggregate egg production increased from 55,384[4] million eggs to 63,151[5] million eggs during the same period. The South Atlantic states are increasing commercial egg production much faster than the nation as a whole. If this trend continues, it could affect the prices and origins of eggs supplied to the northeastern markets.

## III. EGG PRODUCTION IN TENNESSEE

Poultry production[6] in Tennessee is generally a secondary source of income for farmers. In 1959 three-fourths of the counties in the state

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[3]United States Department of Agriculture, Poultry and Egg Situation, No. 244 (Washington: Government Printing Office, March 1963), p. 23.

[4]United States Department of Agriculture, Agricultural Statistics 1962 (Washington: Government Printing Office, 1963), p. 504.

[5]Agricultural Statistics 1963, p. 429.

[6]Includes chickens, chicken eggs, turkeys, and other poultry products. From available data it was impossible to separate egg producers from the other categories.

TABLE IX

RELATIVE EGG PRODUCTION BY REGIONS OF THE CONTINENTAL UNITED STATES, 1962

| Year | North Atlantic | East North Central | West North Central | South Atlantic | South Central | West | 48 States |
|---|---|---|---|---|---|---|---|
| | Per Cent | | | | | | |
| 1947-49 average | 16.3 | 20.7 | 29.0 | 8.6 | 15.4 | 10.0 | 100.0 |
| 1950 | 17.2 | 19.9 | 28.3 | 8.8 | 14.9 | 10.9 | 100.0 |
| 1951 | 17.5 | 19.9 | 28.6 | 8.7 | 14.2 | 11.1 | 100.0 |
| 1952 | 18.3 | 19.7 | 27.6 | 9.0 | 13.4 | 12.3 | 100.0 |
| 1953 | 18.5 | 19.4 | 27.4 | 9.0 | 13.4 | 12.3 | 100.0 |
| 1954 | 18.4 | 19.6 | 27.8 | 9.0 | 12.6 | 12.6 | 100.0 |
| 1955 | 18.5 | 19.6 | 27.9 | 9.3 | 12.3 | 12.4 | 100.0 |
| 1956 | 18.5 | 19.6 | 27.0 | 9.8 | 12.8 | 12.3 | 100.0 |
| 1957 | 18.2 | 18.8 | 27.1 | 10.4 | 13.1 | 12.4 | 100.0 |
| 1958 | 17.7 | 18.8 | 26.6 | 10.8 | 13.3 | 12.8 | 100.0 |
| 1959 | 17.0 | 18.0 | 25.6 | 12.0 | 14.2 | 13.2 | 100.0 |
| 1960 | 16.3 | 17.5 | 24.6 | 13.1 | 14.3 | 14.2 | 100.0 |
| 1961 | 15.7 | 16.6 | 23.9 | 13.6 | 15.1 | 15.1 | 100.0 |
| 1962 | 15.1 | 16.3 | 22.5 | 14.2 | 16.1 | 15.8 | 100.0 |

Source: United States Department of Agriculture, Poultry and Egg Situation, No. 224 (Washington: Government Printing Office, March 1963), p. 24.

reported some commercial poultry farms.[7] However, only three counties in the State reported one hundred or more commercial poultry farms in that year. (See Figure 3.)

Figure 4 shows that egg production is somewhat more concentrated in the eastern half of the State. This can be explained partly by the fact that the terrain in the eastern part of the State is more mountainous and makes large scale field-cropping operations difficult.

It is also true that with the exception of Shelby County, the western half of the State is less populous, offering a smaller market for local eggs. Shelby County is located adjacent to the states of Mississippi and Arkansas which are both surplus egg producing states. The city of Memphis, therefore, has ready access to commercial eggs from nearby sources outside Tennessee.

Most of the cities in the eastern half of the State are located at greater distances from the surplus egg producing states to the south of Tennessee. This gives local commercial egg producers and haulers more opportunities for developing profitable egg-selling routes in the eastern cities.

## IV. CONSUMPTION OF EGGS

Population is the most important factor in determining regional egg consumption. Consumption of commercial eggs is relatively

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[7]United States Bureau of the Census, United States Census of Agriculture: 1959, Vol. I, Counties, Part 31, Tennessee (Washington: Government Printing Office, 1961), p. 176.

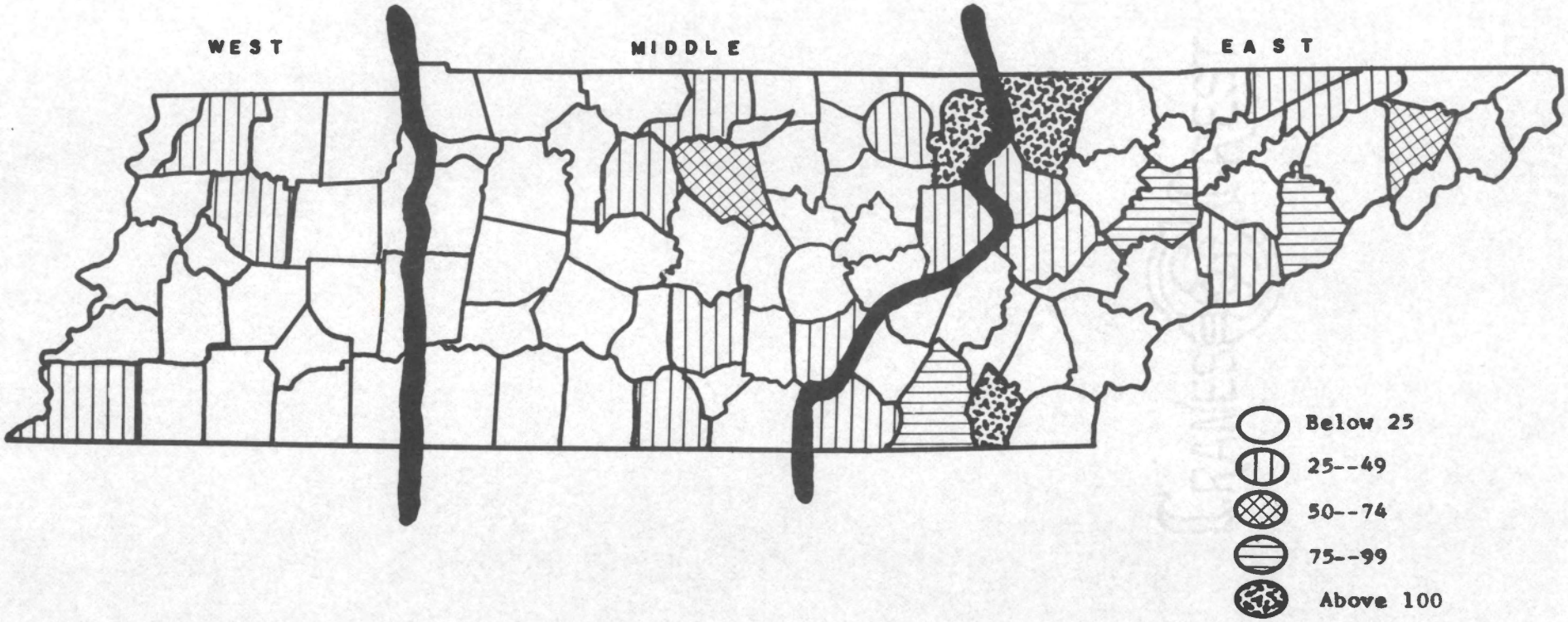



Figure 3. Number of commercial farms obtaining fifty per cent or more of their income from the sale of poultry products, Tennessee, by counties, 1959.

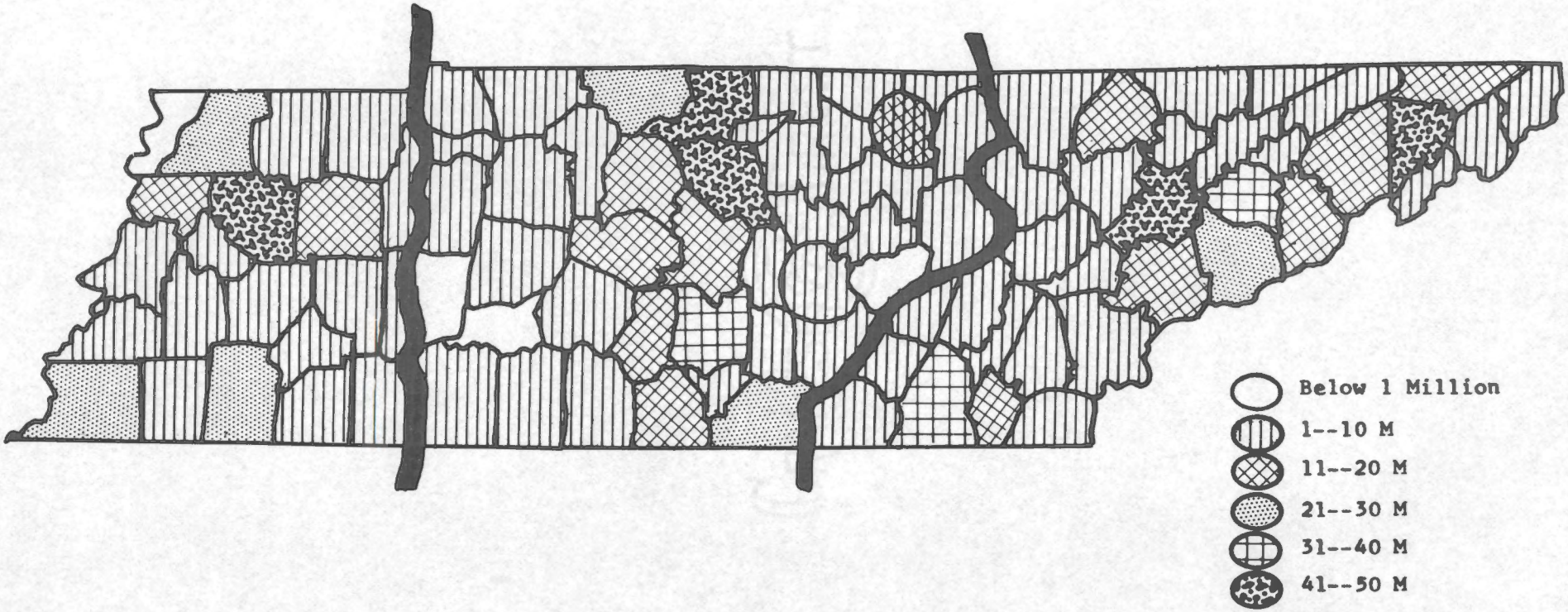



Figure 4. Number of eggs produced by county, Tennessee, 1959.

unresponsive to changes in egg prices or consumers' incomes.[8] The effects of other factors such as national origin, race, and age composition of consumers are difficult to measure quantitatively. The increased urbanization of the population will tend to cause egg production and consumption to become more geographically separated.

Another very important factor in the national egg-trading system is per capita egg consumption. Per capita consumption of eggs has been declining since 1952. (See Figure 5.) Total egg consumption did not decrease during this period because the decline in per capita egg consumption was more than offset by the increase in population.

## V. SURPLUS AND DEFICITS OF EGGS BY STATES

Regional shifts in production and consumption of commercial eggs have combined to alter the movement patterns within the national egg-trading system. The southern states of North Carolina, South Carolina, Georgia, Alabama and Mississippi have obtained large proportionate increases in egg production and have become net exporters of eggs in the

---

[8]Price and income elasticities for eggs at the retail level have recently been estimated to be approximately -.30000 and .16000, respectively. This indicates that the quantity of eggs taken by consumers would move .3 per cent in the opposite direction from a change in egg prices and .16 per cent in the same direction or a change in consumer incomes if other variables remain constant.

*Source: G. E. Brandow, Interrelationships Among Demands for Farm Products and Implications for Control of Market Supply, Agricultural Experiment Station Bulletin 680 (University Park: Pennsylvania State University, 1961), p. 17.

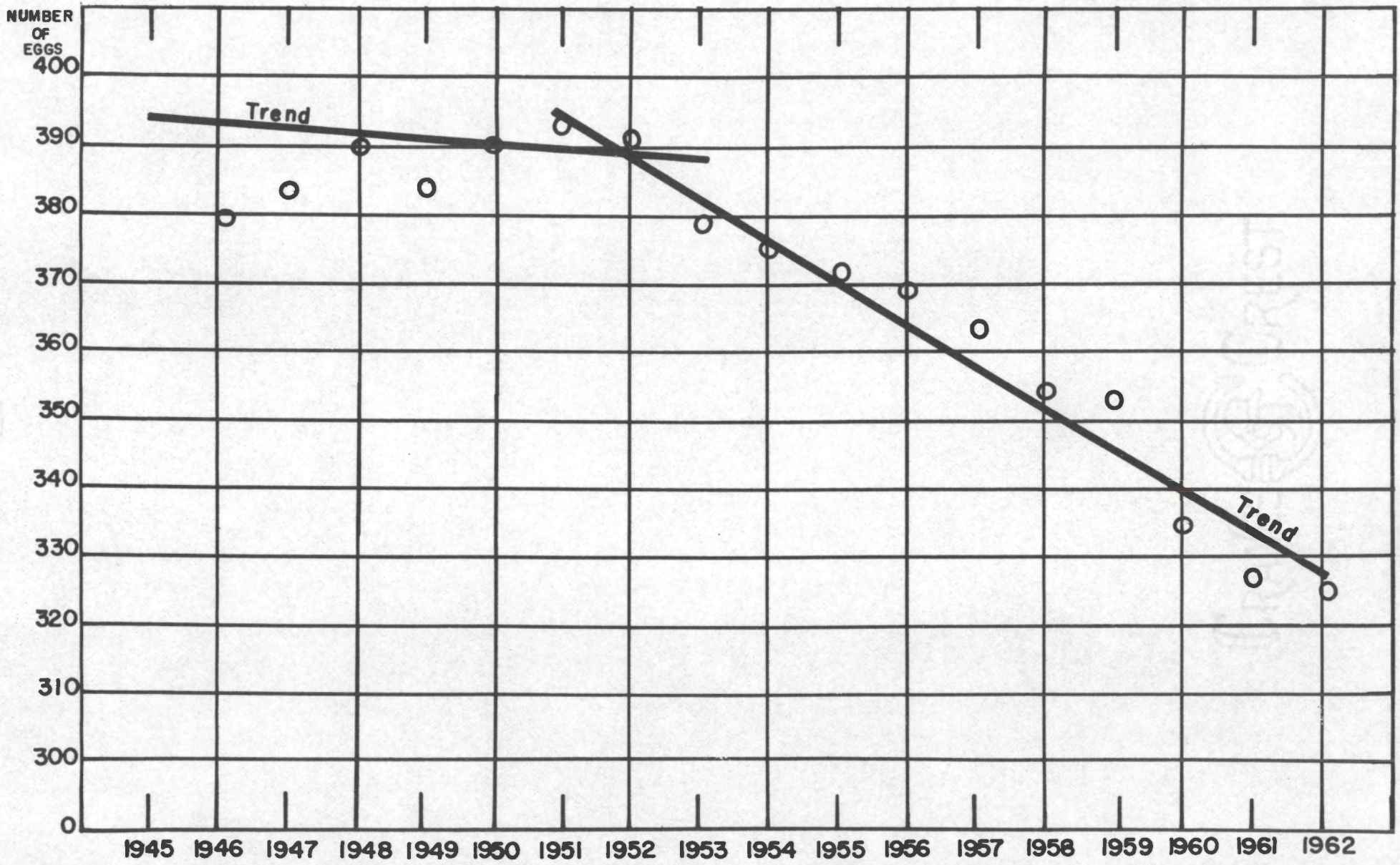



Figure 5. Trends in per capita egg consumption, United States, 1945-1962.

last ten years. Figure 6 shows the relative changes in egg production by states since 1953. The magnitude of increase in egg production in California has been sufficiently large to enable that state to move from a deficit area in 1958 to a surplus area in 1962. Figure 7 indicates the estimated surplus and deficit states in the national egg-trading system for the year 1962.

Tennessee has historically been a deficit state in the production of commercial eggs. There is no evidence that this condition will change in the near future. Figure 8 provides an estimate of the egg deficit in Tennessee for the period extending from 1953 to 1962. Interaction between egg production, per capita consumption, and changes in state population have caused aggregate production and consumption of eggs to remain relatively constant during this ten-year period.

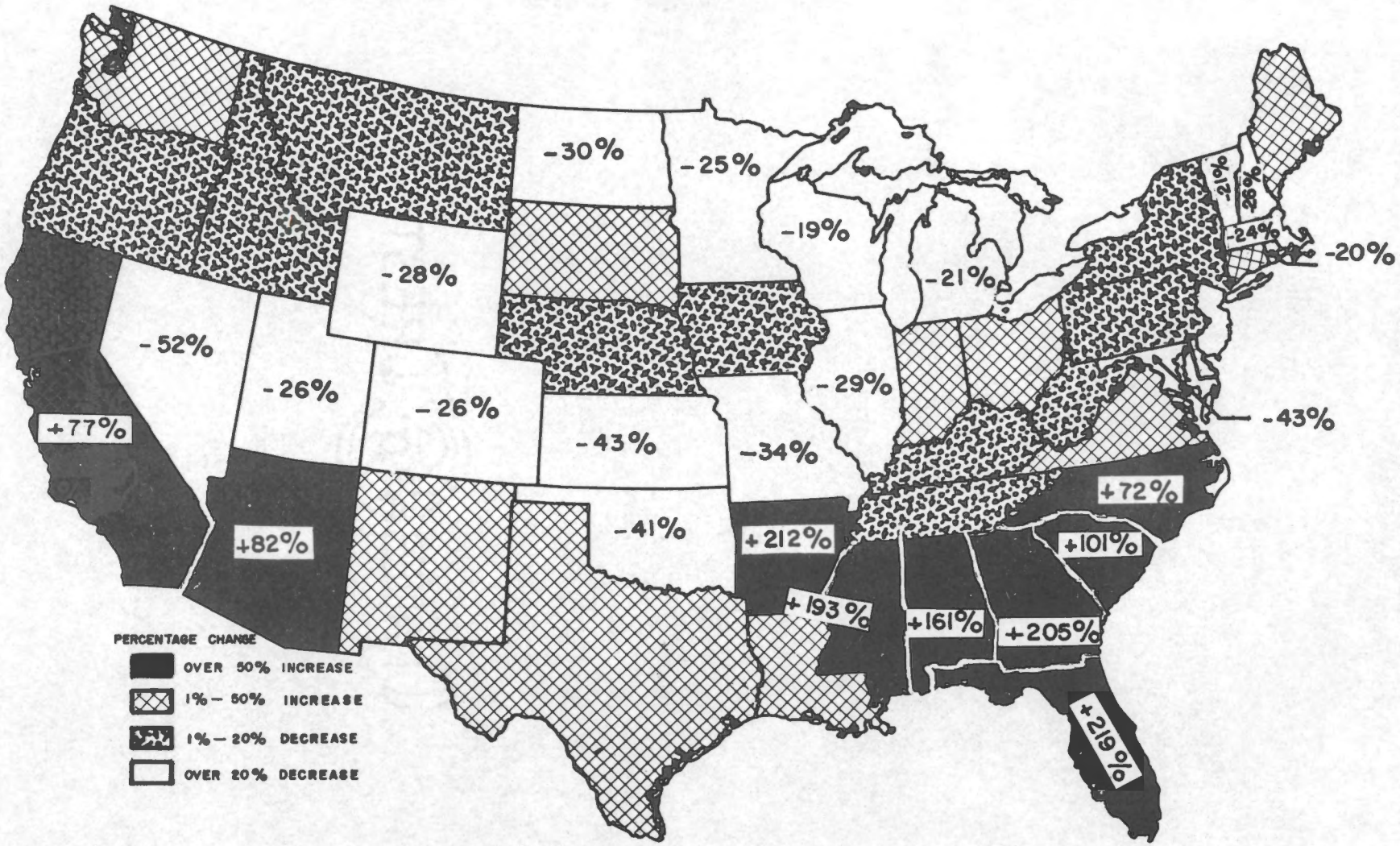



Figure 6. Percentage change in egg production by states, United States, 1953-1963.

Source: Poultry and Egg Situation, May 1964.

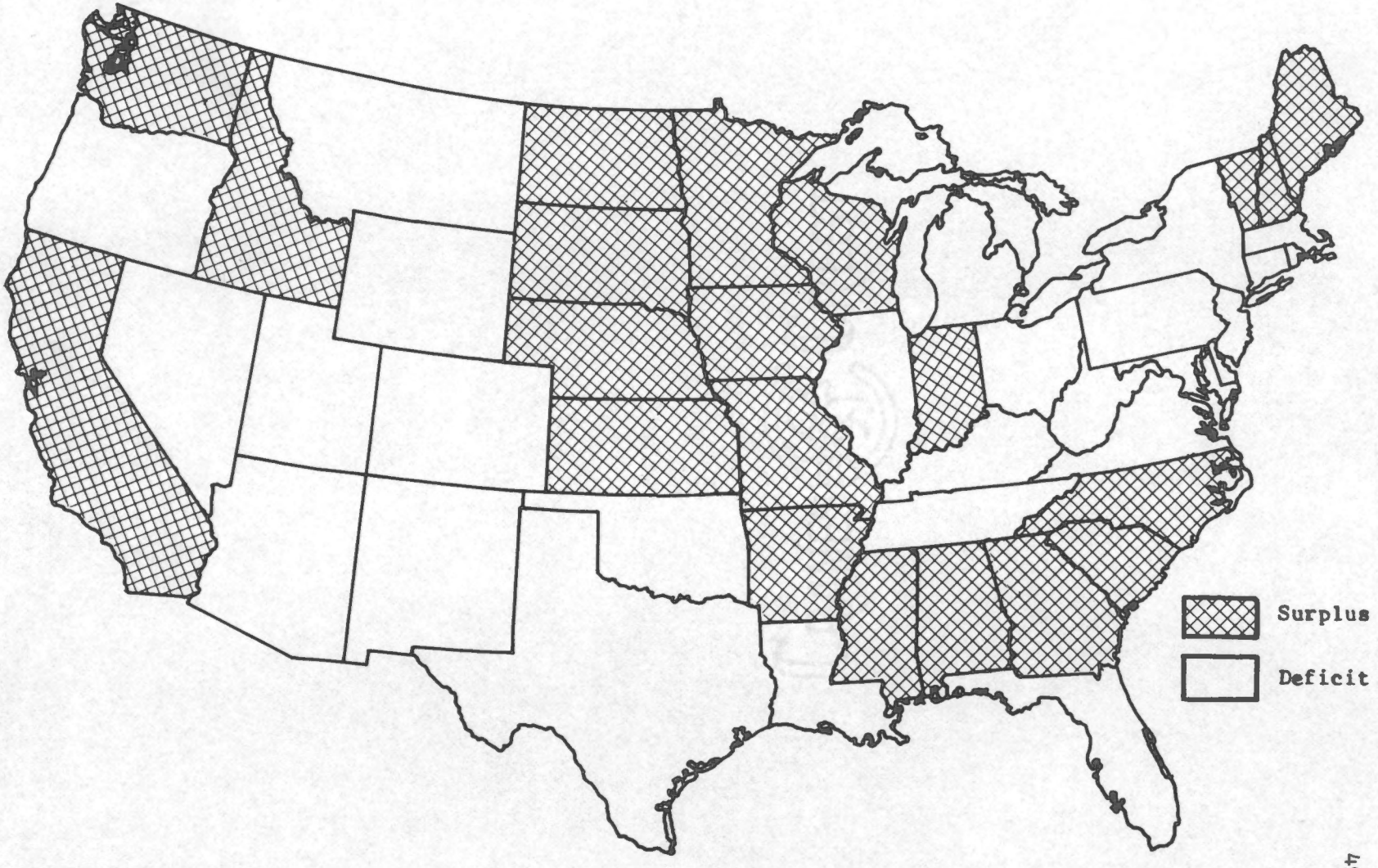



Figure 7. Surplus and deficit egg producing states, United States, 1962.

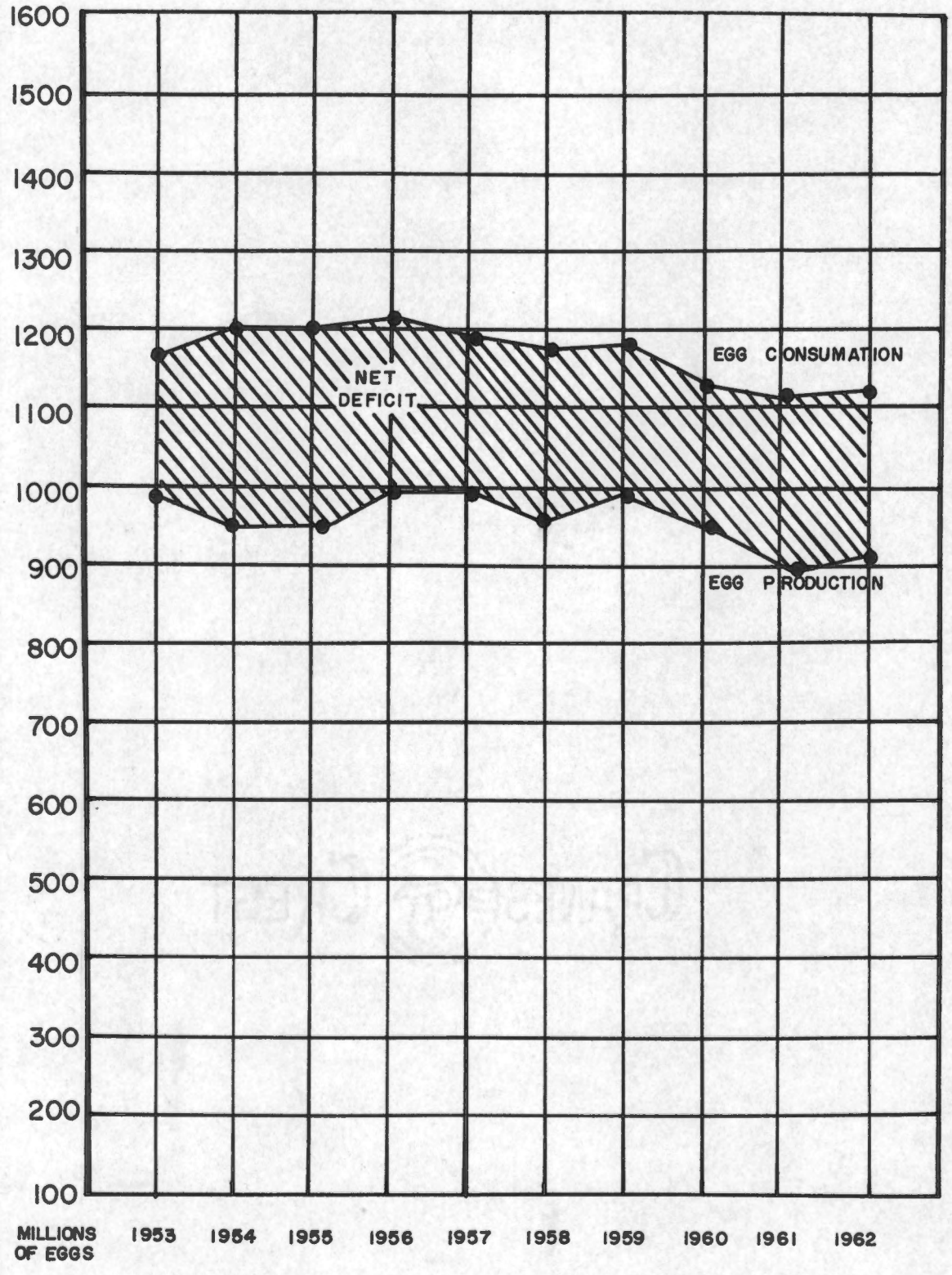



Figure 8. Production, consumption and estimated net deficit in commercial eggs, Tennessee, 1953-1962.

# CHAPTER IV

## OPTIMUM ROUTING OF COMMERCIAL EGG SHIPMENTS

In this study only the role of transportation and its associated costs were considered.[1] The perfect market concept was used as a standard by which to evaluate the pricing efficiency of the commercial egg industry. In a perfect market, location and distance affect prices in both consuming centers and producing areas through transfer costs.

A system of shipments was considered optimum when no alternative shipping pattern would yield a reduction in the total transportation charges under existing conditions. Accompanying the optimum shipping pattern was a set of equilibrium price differentials which the several markets tended to approximate because of profit motive of entrepreneurs, and competition between them. The strength of the forces affecting changes in the system can be approximated by the opportunity costs of non-optimum actions. This section attempts to investigate the optimal shipping patterns and the magnitudes of the adjustment forces stemming from the use of non-optimal routes.

### I. OPTIMUM COMMERCIAL EGG SHIPPING PATTERNS PRIOR TO THE INTERSTATE HIGHWAY PATTERN

The least-cost shipping pattern for commercial eggs over the conventional highway net yielded the flows represented in Figure 9.

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[1] Commercial egg marketing spreads were considered to be similar throughout the national egg trading system.

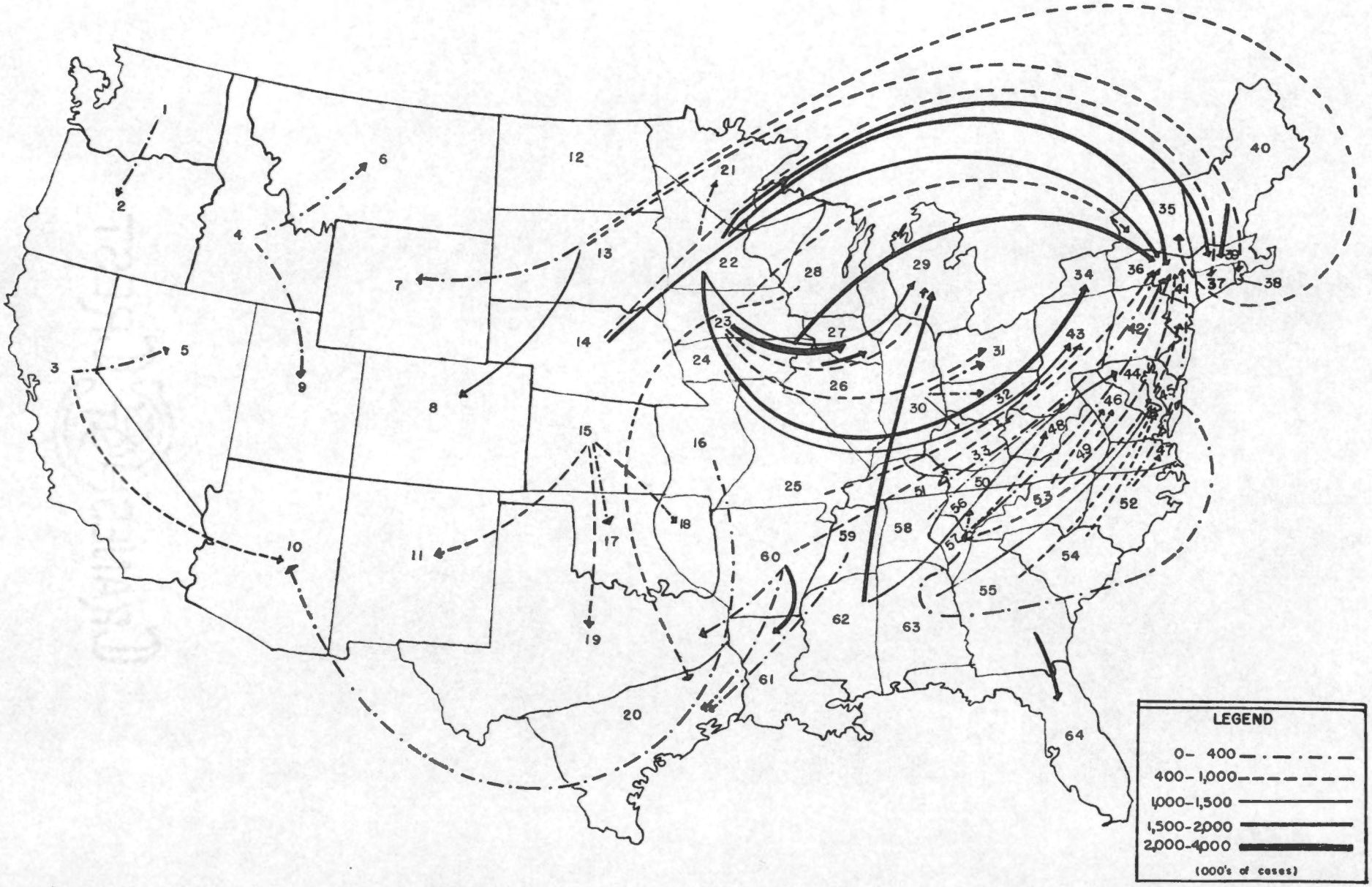



Figure 9. Optimum flows of commercial eggs in the United States prior to the Interstate Highway System.

The two largest suppliers of the northern and northeastern deficit areas were the South and Midwest. The associated optimum price differentials are shown in an abbreviated manner in Table X. The costs associated with shipping eggs over non-optimum routes were approximated by subtracting the equilibrium transfer costs obtained in Table X from the estimated actual transfer charges for moving eggs over the same routes. All costs were either zero or positive because no trading pairs could improve their best alternative.[2] The producers' price differentials that can be attributed to location were generally found to be around three cents per dozen eggs (Table X).

Table XI is an abbreviated representation of the cost of shipping eggs over non-optimum routes in the National Egg Trading System. The highest cost of using a non-optimum route was 47.2 cents per case or 1.57 cents per dozen eggs, and in most cases these costs were less than one-half cent per dozen. On the basis of these findings, only moderate pressure appears to exist for egg traders to utilize the optimum routes.

## II. OPTIMUM COMMERCIAL EGG SHIPPING PATTERNS UTILIZING THE INTERSTATE HIGHWAY SYSTEM

The least-cost shipping pattern for commercial eggs utilizing the interstate highway network is presented by the diagram in Figure 10.

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[2]There may be alternate least-cost routes which are denoted by all zeros in their respective cells of the table cost showing the utilizing non-optimum routes but such values are not underlined.

TABLE X

ESTIMATED EQUILIBRIUM PRICE DIFFERENTIALS AMONG REPRESENTATIVE COMMERCIAL EGG MARKETS IN THE UNITED STATES BASED ON TRANSPORTATION COSTS FOR EGGS USING CONVENTIONAL HIGHWAY[a]

| Exporting Region | Importing Region | | | | | | | | | | Producers Price Differentials[c] ($U_i$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York[b] N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. | |
| | (dollars per case) | | | | | | | | | | |
| Pierre, S. D. | .887 | .804 | .817 | .826 | .893 | .969 | .986 | .934 | .925 | .825 | .969 |
| Lincoln, Neb. | .865 | .782 | .795 | .804 | .871 | .947 | .964 | .912 | .903 | .803 | .947 |
| Wichita, Kan. | .856 | .773 | .786 | .795 | .862 | .938 | .955 | .903 | .894 | .794 | .938 |
| Minneapolis-St. Paul, Minn. | .835 | .752 | .765 | .774 | .841 | .917 | .934 | .882 | .873 | .773 | .917 |
| Mason City, Iowa | .833 | .750 | .763 | .772 | .839 | .915 | .932 | .880 | .871 | .771 | .915 |
| Des Moines, Iowa | .836 | .753 | .766 | .775 | .842 | .918 | .935 | .883 | .874 | .774 | .918 |
| St. Louis, Mo. | .805 | .722 | .735 | .744 | .811 | .887 | .904 | .852 | .843 | .743 | .887 |
| Peoria, Ill. | .797 | .714 | .727 | .736 | .803 | .879 | .896 | .844 | .835 | .735 | .879 |
| Milwaukee, Wis. | .659 | .576 | .589 | .598 | .665 | .741 | .758 | .706 | .697 | .597 | .741 |
| Indianapolis, Ind. | .759 | .676 | .689 | .698 | .765 | .841 | .858 | .806 | .797 | .697 | .841 |
| Lewiston, Maine | .636 | .553 | .566 | .575 | .642 | .718 | .735 | .683 | .674 | .574 | .718 |
| Philadelphia, Pa. | .642 | .559 | .572 | .581 | .648 | .724 | .741 | .689 | .680 | .580 | .724 |
| Roanoke, Va. | .711 | .628 | .641 | .650 | .717 | .793 | .810 | .758 | .749 | .649 | .793 |
| Paducah, Ky. | .798 | .715 | .728 | .737 | .804 | .880 | .897 | .845 | .836 | .736 | .880 |
| Raleigh, N. C. | .721 | .638 | .651 | .660 | .727 | .803 | .820 | .768 | .759 | .659 | .803 |
| Charlotte, N. C. | .744 | .661 | .674 | .683 | .750 | .826 | .843 | .791 | .782 | .682 | .826 |
| Columbia, S. C. | .761 | .678 | .691 | .700 | .767 | .843 | .860 | .808 | .799 | .699 | .843 |
| Macon, Ga. | .795 | .712 | .725 | .734 | .801 | .877 | .894 | .842 | .833 | .733 | .877 |
| Chattanooga, Tenn. | .789 | .706 | .719 | .728 | .795 | .871 | .888 | .836 | .827 | .727 | .871 |
| Nashville, Tenn. | .786 | .703 | .716 | .725 | .792 | .868 | .885 | .833 | .824 | .724 | .868 |
| Memphis, Tenn. | .767 | .684 | .697 | .706 | .773 | .849 | .866 | .814 | .805 | .705 | .849 |
| Little Rock, Ark. | .845 | .762 | .775 | .784 | .851 | .927 | .944 | .892 | .883 | .783 | .927 |

TABLE X (CONTINUED)

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York,[b] N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. | Producers Price Differentials[c] ($U_i$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | | |
| Jackson, Miss. | .789 | .706 | .719 | .728 | .795 | .871 | .888 | .836 | .827 | .727 | .871 |
| Montgomery, Ala. | .740 | .657 | .670 | .679 | .746 | .882 | .839 | .<u>787</u> | .778 | .678 | .822 |
| Market price differentials $D_j$ | -.082 | -.165 | -.152 | -.143 | -.076 | .000 | .017 | -.035 | -.044 | -.144 | |

[a]Obtained from data derived by solving the transportation problem. The figures in the body of the table are equilibrium transfer costs among the several surplus and deficit areas. The underlined values denote active routes in the system.

[b]New York City was chosen as the base area for comparison purposes.

[c]Producers net returns may be compared by changing the signs in the $U_i$ column.

TABLE XI

ESTIMATED COST OF HAULING OVER NON-OPTIMUM ROUTES AMONG REPRESENTATIVE COMMERCIAL EGG MARKETS IN THE UNITED STATES UTILIZING THE CONVENTIONAL HIGHWAY NET[a]

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. |
|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | |
| Pierre, S. D. | .106 | .000 | .070 | .025 | .017 | .005 | .004 | .002 | .032 | .098 |
| Lincoln, Neb. | .086 | .025 | .040 | .013 | .007 | .000 | .003 | .017 | .024 | .078 |
| Wichita, Kan. | .079 | .033 | .000 | .045 | .034 | .022 | .029 | .035 | .041 | .077 |
| Minneapolis-St. Paul, Minn. | .134 | .109 | .124 | .013 | .005 | .000 | .000 | .026 | .029 | .104 |
| Mason City, Iowa | .120 | .098 | .108 | .000 | .000 | .004 | .021 | .022 | .034 | .092 |
| Des Moines, Iowa | .105 | .086 | .080 | .002 | .002 | .000 | .004 | .018 | .021 | .076 |
| St. Louis, Mo. | .088 | .156 | .094 | .021 | .006 | .005 | .016 | .017 | .018 | .052 |
| Peoria, Ill. | .118 | .169 | .132 | .000 | .029 | .003 | .017 | .017 | .022 | .075 |
| Milwaukee, Wis. | .277 | .325 | .307 | .127 | .121 | .130 | .152 | .146 | .155 | .234 |
| Indianapolis, Ind. | .137 | .243 | .189 | .046 | .000 | .014 | .028 | .021 | .026 | .078 |
| Lewiston, Maine | .329 | .472 | .442 | .325 | .203 | .054 | .000 | .132 | .151 | .329 |
| Philadelphia, Pa. | .265 | .449 | .388 | .270 | .140 | .000 | .027 | .038 | .053 | .249 |
| Roanoke, Va. | .137 | .346 | .281 | .175 | .058 | .009 | .029 | .001 | .000 | .112 |
| Paducah, Ky. | .073 | .185 | .107 | .035 | .015 | .000 | .023 | .012 | .014 | .034 |
| Raleigh, N. C. | .121 | .347 | .271 | .188 | .076 | .000 | .022 | .000 | .001 | .115 |
| Charlotte, N. C. | .083 | .310 | .228 | .154 | .055 | .000 | .020 | .000 | .000 | .065 |
| Columbia, S. C. | .047 | .298 | .216 | .153 | .059 | .005 | .018 | .000 | .003 | .058 |
| Macon, Ga. | .000 | .250 | .153 | .119 | .043 | .081 | .017 | .000 | .002 | .026 |
| Chattanooga, Tenn. | .038 | .232 | .140 | .093 | .024 | .000 | .017 | .000 | .001 | .000 |
| Nashville, Tenn. | .062 | .216 | .128 | .074 | .018 | .003 | .019 | .010 | .009 | .018 |
| Memphis, Tenn. | .092 | .214 | .115 | .115 | .078 | .066 | .075 | .068 | .073 | .086 |
| Little Rock, Ark. | .028 | .112 | .000 | .045 | .016 | .000 | .010 | .011 | .012 | .032 |

TABLE XI (CONTINUED)

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. |
|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | |
| Jackson, Miss. | .046 | .206 | .083 | .129 | .085 | .092 | .070 | .072 | .067 | .083 |
| Montgomery, Ala. | .057 | .285 | .178 | .176 | .111 | .080 | .092 | .000 | .083 | .094 |

[a]Obtained by subtracting the various elements in Table X from the actual transfer costs between the various surplus and deficit areas.

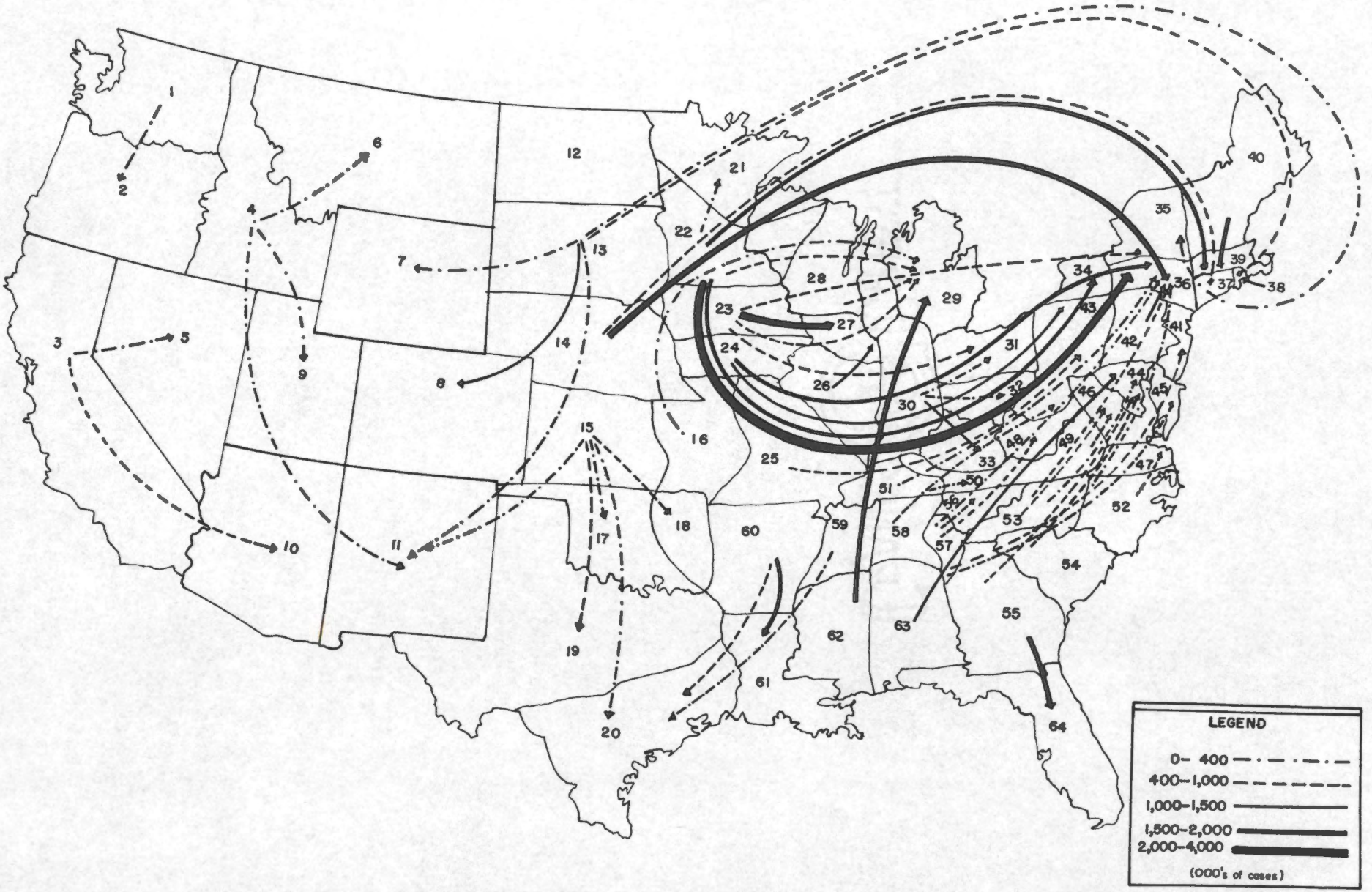



Figure 10. Optimum flows of commercial eggs in the United States with the Interstate Highway System completed.

The new equilibrium flows represented only a slight departure from the pre-interstate equilibrium situation. The two largest suppliers of the northern and northeastern markets remained the South and the Midwest. The proportion of shipments from the respective origins to the several destinations remained relatively constant.

An example of the moderate changes in routing of shipments which did occur is illustrated by the fact that the Little Rock, Arkansas, area diverted commercial egg shipments which had previously gone to the New York City area and the Dallas-Fort Worth, Texas, area into San Antonio, Texas. This was the only significant shift in egg flows that affected the southeastern egg-producing region. The shipping patterns for Chattanooga, Memphis, and Nashville, Tennessee, were unchanged by the new road net. The least-cost source of commercial eggs for the Knoxville area remained Chattanooga.

The equilibrium price differentials which accompanied the second pattern of egg shipments are shown in Table XII. In most cases the equilibrium market price differentials, which indicate what the market is willing to pay for shipments over specific routes, are less under the new system of highways. The average producer price differential which could be attributed to location was 82.8 cents per case or 3.1 cents less than was true under the previous solution of the transportation model.[4]

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[3]See Appendix, Table XX, for a complete representation of the commercial egg flows obtained in the second solution of the transportation model.

[4]Computed from Table XV.

TABLE XII

ESTIMATED EQUILIBRIUM PRICE DIFFERENTIALS AMONG REPRESENTATIVE COMMERCIAL EGG MARKETS IN THE UNITED STATES BASED ON TRANSPORTATION COSTS FOR EGGS UTILIZING THE INTERSTATE HIGHWAY SYSTEM

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. | Producers Price Differentials ($U_i$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | | |
| Pierre, S. D. | .843 | .780 | .793 | .798 | .848 | .905 | .918 | .878 | .872 | .796 | .905 |
| Lincoln, Neb. | .826 | .763 | .776 | .781 | .831 | .888 | .901 | .861 | .855 | .779 | .888 |
| Wichita, Kan. | .816 | .753 | .766 | .771 | .821 | .878 | .891 | .851 | .845 | .769 | .878 |
| Minneapolis-St. Paul, Minn. | .803 | .740 | .753 | .758 | .808 | .865 | .878 | .838 | .832 | .756 | .865 |
| Mason City, Iowa | .802 | .739 | .752 | .757 | .807 | .864 | .877 | .837 | .831 | .755 | .864 |
| Des Moines, Iowa | .804 | .741 | .754 | .759 | .809 | .866 | .879 | .839 | .833 | .757 | .866 |
| St. Louis, Mo. | .780 | .717 | .730 | .735 | .785 | .842 | .855 | .815 | .809 | .733 | .842 |
| Peoria, Ill. | .773 | .710 | .723 | .728 | .778 | .835 | .848 | .808 | .802 | .726 | .835 |
| Milwaukee, Wisc. | .756 | .693 | .706 | .711 | .761 | .818 | .831 | .791 | .785 | .709 | .818 |
| Indianapolis, Ind. | .745 | .682 | .695 | .700 | .750 | .807 | .820 | .780 | .744 | .698 | .807 |
| Lewiston, Maine | .652 | .589 | .602 | .607 | .657 | .714 | .727 | .687 | .681 | .605 | .714 |
| Philadelphia, Pa. | .656 | .593 | .606 | .611 | .661 | .718 | .731 | .691 | .685 | .609 | .718 |
| Roanoke, Va. | .709 | .646 | .659 | .664 | .714 | .771 | .784 | .744 | .738 | .662 | .771 |
| Paducah, Ky. | .775 | .712 | .725 | .730 | .764 | .837 | .850 | .810 | .804 | .728 | .837 |
| Raleigh, N. C. | .717 | .654 | .667 | .672 | .706 | .779 | .792 | .752 | .746 | .670 | .779 |
| Charlotte, N. C. | .734 | .671 | .684 | .689 | .739 | .796 | .809 | .769 | .763 | .687 | .796 |
| Columbia, S. C. | .748 | .685 | .698 | .703 | .753 | .810 | .823 | .783 | .777 | .701 | .810 |
| Macon, Ga. | .773 | .710 | .723 | .728 | .778 | .835 | .848 | .808 | .802 | .726 | .835 |
| Chattanooga, Tenn. | .768 | .705 | .718 | .723 | .773 | .830 | .843 | .803 | .797 | .721 | .830 |
| Nashville, Tenn. | .766 | .703 | .716 | .721 | .771 | .828 | .841 | .801 | .795 | .719 | .828 |
| Memphis, Tenn. | .745 | .682 | .695 | .700 | .750 | .807 | .820 | .780 | .774 | .698 | .807 |
| Little Rock, Ark. | .804 | .741 | .754 | .759 | .809 | .866 | .879 | .839 | .833 | .757 | .866 |

TABLE XII (CONTINUED)

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. | Producers Price Differentials ($U_i$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | | |
| Jackson, Miss. | .768 | .705 | .718 | .723 | .773 | .830 | .843 | .803 | .797 | .721 | .830 |
| Montgomery, Ala. | .732 | .669 | .682 | .687 | .737 | .794 | .807 | .767 | .761 | .685 | .794 |
| Market price differentials ($D_j$) | -.662 | -.125 | -.112 | -.107 | -.057 | .000 | +.013 | -.027 | -.033 | -.109 | |

The cost of shipping eggs over non-optimum routes among the same origins and destinations is shown in Table XIII. In most cases these costs were reduced by the Interstate Highway System. Under the new system the highest cost of utilizing a non-optimum route was estimated to be 39.6 cents per case or 1.32 cents per dozen eggs.

## III. COMPARISON OF THE EQUILIBRIUM PRICE DIFFERENTIALS BEFORE AND AFTER INITIATION OF THE INTERSTATE HIGHWAY SYSTEM

This section analyzes the effects of the new system of highways on the equilibrium price differentials for the national egg-trading system in equilibrium. These price differentials are based on projected transfer costs under the alternative networks of possible routes.

It is possible under certain circumstances for price effects to be present when the effects on shipping patterns are absent. The equilibrium market price differentials relative to New York City were computed from the solutions of the least-cost transportation model. They are shown in Table XIV and producer price differentials are shown in Table XV.

The relevant problem is one of determining if a significant difference in the two groups of relative prices exists. The data allow little grounds for assuming a normal distribution of observations; therefore, to be consistent with statistical theory, a nonparametric technique

TABLE XIII

ESTIMATED COST OF HAULING OVER NON-OPTIMUM ROUTES AMONG REPRESENTATIVE COMMERCIAL EGG MARKETS IN THE UNITED STATES UTILIZING THE INTERSTATE HIGHWAY SYSTEM

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. |
|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | |
| Pierre, S. D. | .080 | .000 | .050 | .018 | .012 | .003 | .003 | .017 | .024 | .080 |
| Lincoln, Neb. | .066 | .019 | .027 | .008 | .005 | .000 | .022 | .014 | .018 | .059 |
| Wichita, Kan. | .063 | .028 | .000 | .036 | .029 | .020 | .025 | .030 | .034 | .040 |
| Minneapolis-St. Paul, Minn. | .102 | .083 | .091 | .009 | .003 | .000 | .000 | .021 | .022 | .079 |
| Mason City, Iowa | .091 | .074 | .078 | .000 | .000 | .003 | .016 | .017 | .025 | .069 |
| Des Moines, Iowa | .080 | .066 | .057 | .000 | .001 | .000 | .003 | .014 | .016 | .057 |
| St. Louis, Mo. | .067 | .119 | .069 | .015 | .004 | .004 | .013 | .014 | .014 | .040 |
| Peoria, Ill. | .091 | .130 | .099 | .000 | .023 | .004 | .015 | .015 | .018 | .058 |
| Milwaukee, Wisc. | .124 | .160 | .144 | .008 | .005 | .012 | .029 | .025 | .031 | .091 |
| Indianapolis, Ind. | .105 | .185 | .141 | .034 | .000 | .012 | .022 | .017 | .020 | .059 |
| Lewiston, Maine | .250 | .359 | .333 | .245 | .153 | .042 | .000 | .101 | .115 | .250 |
| Philadelphia, Pa. | .202 | .342 | .292 | .205 | .107 | .000 | .021 | .030 | .041 | .190 |
| Roanoke, Va. | .104 | .262 | .210 | .132 | .043 | .007 | .023 | .001 | .000 | .085 |
| Paducah, Ky. | .055 | .140 | .078 | .025 | .011 | .000 | .018 | .010 | .010 | .026 |
| Raleigh, N. C. | .091 | .263 | .202 | .141 | .057 | .000 | .016 | .000 | .000 | .087 |
| Charlotte, N. C. | .063 | .235 | .170 | .116 | .041 | .000 | .016 | .000 | .000 | .049 |
| Columbia, S. C. | .035 | .225 | .160 | .114 | .043 | .003 | .013 | .000 | .001 | .043 |
| Macon, Ga. | .000 | .190 | .113 | .089 | .032 | .062 | .013 | .000 | .001 | .019 |
| Chattanooga, Tenn. | .029 | .176 | .104 | .069 | .018 | .000 | .013 | .000 | .001 | .000 |
| Nashville, Tenn. | .047 | .164 | .094 | .053 | .013 | .002 | .015 | .008 | .007 | .013 |

TABLE XIII (CONTINUED)

| Exporting Region | Importing Region: Tampa, Fla. | Denver, Col. | Ft. Worth-Dallas, Texas | Chicago, Ill. | Cleveland, Ohio | New York, N. Y. | Boston, Mass. | Baltimore, Md. | Washington, D. C. | Knoxville, Tenn. |
|---|---|---|---|---|---|---|---|---|---|---|
| | (dollars per case) | | | | | | | | | |
| Memphis, Tenn. | .007 | .169 | .091 | .092 | .066 | .057 | .064 | .059 | .062 | .071 |
| Little Rock, Ark. | .028 | .092 | .003 | .040 | .019 | .007 | .015 | .016 | .015 | .031 |
| Jackson, Miss. | .035 | .157 | .060 | .097 | .064 | .070 | .054 | .056 | .051 | .063 |
| Montgomery, Ala. | .042 | .216 | .131 | .132 | .083 | .060 | .069 | .000 | .062 | .071 |

TABLE XIV

COMPARISON OF ESTIMATED PRICE DIFFERENTIALS AMONG COMMERCIAL EGG MARKETS WITH OPTIMUM ROUTING OF SHIPMENTS AND NEW YORK CITY AS A BASE

| Market | Conventional Highways Alone | Interstate Highway System | Signed Difference | |
|---|---|---|---|---|
| | | | Positive | Negative |
| | (Dollars per case) | | | |
| Portland, Ore. | a | a | | |
| Carson City, Nev. | a | a | | |
| Helena, Mont. | a | -.146 | | |
| Cheyenne, Wyo. | -.186 | -.141 | | -.045 |
| Denver, Colo. | -.165 | -.125 | | -.040 |
| Salt Lake City, Utah | a | -.144 | | |
| Phoenix, Ariz. | a | a | | |
| Santa Fe, New Mexico | -.117 | -.086 | | -.031 |
| Oklahoma City, Okla. | -.198 | -.147 | | -.051 |
| Tulsa, Okla. | -.202 | -.150 | | -.052 |
| Dallas, Tex. | -.152 | -.112 | | -.040 |
| San Antonio, Tex. | -.105 | -.073 | | -.032 |
| Duluth, Minn. | -.181 | -.137 | | -.044 |
| Chicago, Ill. | -.143 | -.107 | | -.036 |
| Detroit, Mich. | -.090 | -.068 | | -.022 |
| Cleveland, Ohio | -.076 | -.057 | | -.019 |
| Columbus, Ohio | -.097 | -.073 | | -.024 |
| Cincinnati, Ohio | -.111 | -.084 | | -.027 |
| Rochester, New York | -.039 | -.029 | | -.010 |
| Utica, New York | -.014 | -.011 | | -.003 |
| New York, New York | .000 | .000 | | .000 |
| Hartford, Conn. | +.009 | +.007 | +.002 | |
| Providence, R. I. | +.017 | +.013 | +.004 | |
| Boston, Mass. | +.017 | +.013 | +.004 | |
| Newark, N. J. | -.005 | -.003 | | -.002 |
| Pittsburgh, Pa. | -.056 | -.042 | | -.014 |
| Baltimore, Md. | -.035 | -.027 | | -.008 |
| Wilmington, Del. | -.023 | -.017 | | -.006 |
| Washington, D. C. | -.044 | -.033 | | -.011 |
| Richmond, Va. | -.066 | -.050 | | -.016 |
| Charleston, W. Va. | -.096 | -.073 | | -.023 |
| Louisville, Ky. | -.133 | -.101 | | -.032 |
| Knoxville, Tenn. | -.144 | -.109 | | -.035 |
| Baton Rouge, La. | -.150 | -.107 | | -.043 |
| Tampa, Fla. | -.082 | -.062 | | -.020 |

[a]The missing values could not be computed.

Note: For verification a T statistic was computed even though some of its assumptions were violated. The calculated statistic had a value of -7.198. The critical value was $T < -2.462$.

TABLE XV

COMPARISON OF ESTIMATED PRICE DIFFERENTIALS AMONG DESIGNATED COMMERCIAL EGG SHIPPING POINTS WITH OPTIMUM ROUTING OF SHIPMENTS AND NEW YORK CITY AS A BASE

| Shipping Point | Observations: Before Interstate System | Observations: After Interstate System | Signed Difference: Positive | Signed Difference: Negative |
|---|---|---|---|---|
| 1. Seattle, Wash. | a | a | | |
| 3. Sacramento, Calif. | a | a | | |
| 4. Boise, Idaho | a | -.903 | | |
| 12. Bismark, N. D. | a | a | | |
| 13. Pierre, S. D. | -.969 | -.905 | | -.064 |
| 14. Lincoln, Neb. | -.947 | -.888 | | -.059 |
| 15. Wichita, Kan. | -.938 | -.878 | | -.060 |
| 16. Kansas City, Kan.-Mo. | | -.851 | | |
| 22. Minneapolis-St. Paul, Minn. | -.917 | -.865 | | -.052 |
| 23. Mason City, Iowa | -.915 | -.864 | | -.051 |
| 24. Des Moines, Iowa | -.918 | -.866 | | -.052 |
| 25. St. Louis, Mo. | -.887 | -.842 | | -.045 |
| 26. Peoria, Ill. | -.879 | -.835 | | -.044 |
| 28. Milwaukee, Wis. | -.741 | -.818 | +.077 | |
| 30. Indianapolis, Ind. | -.841 | -.807 | | -.034 |
| 40. Lewiston, Maine | -.718 | -.714 | | -.004 |
| 42. Philadelphia, Pa. | -.724 | -.718 | | -.006 |
| 49. Roanoke, Va. | -.793 | -.771 | | -.022 |
| 51. Paducah, Ky. | -.880 | -.837 | | -.043 |
| 52. Raleigh, N. C. | -.803 | -.779 | | -.024 |
| 53. Charlotte, N. C. | -.826 | -.796 | | -.030 |
| 54. Columbia, S. C. | -.843 | -.810 | | -.933 |
| 55. Macon, Ga. | -.877 | -.835 | | -.042 |
| 57. Chattanooga, Tenn. | -.871 | -.830 | | -.041 |
| 58. Nashville, Tenn. | -.868 | -.828 | | -.040 |
| 59. Memphis, Tenn. | -.849 | -.807 | | -.042 |
| 60. Little Rock, Ark. | -.927 | -.866 | | -.061 |
| 62. Jackson, Miss. | -.871 | -.830 | | -.041 |
| 63. Montgomery, Ala. | -.822 | -.794 | | -.028 |

[a]The missing values could not be computed.

is required.[5] For this purpose the sign test was chosen. Strict application of this test requires only that the observations be independent.[6] The technique was to pair the observed price differentials before and after the Interstate Highway System and note the positive or negative signs obtained. The sign occurring less frequently was designated by the letter r. The total value of r was determined and referred to an appropriate statistical table containing critical values of r for various significance levels and sample size.[7] No computations of sample means or variances were required.

Positive signs occurred in three instances out of a total of thirty observations, indicating a significant difference at the 99 per cent level. The sign test of the producer price differentials yielded only one positive sign out of twenty-four observations. This was also significant at the 99 per cent level.

The largest observed difference in receiving point prices relative to New York which can be attributed to the Interstate Highway System occurred in the Oklahoma City market. This amounted to 5.1 cents per case. Pierre, South Dakota showed the largest price difference of any of the shipping points for which data were available. There were

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[5]Obtained through consultation with Dr. Charles Thigpen, Statistician, Knoxville: University of Tennessee, November 1964.

[6]Winfrid J. Dixon and Frank J. Massey, Introduction to Statistical Analysis (New York: McGraw-Hill Book Company, 1951), pp. 247-254.

[7]Ibid., p. 324.

technical limitations to calculating the equilibrium price differentials for certain western cities which theoretically should have yielded greater differences. These price differences, however, are not expected to exceed ten cents per case under the present assumptions regarding transfer costs.

# CHAPTER V

## SUMMARY AND CONCLUSIONS

### I. SUMMARY

The Interstate Highway System will consist of 41,000 miles of planned, integrated, high-capacity, high-speed routes connecting the nation's centers of commerce and population, vital defense installations, and providing connecting links in important continental routes in Canada and Mexico.

Motor trucks have become a common mode of transportation for many agricultural commodities. Their versatility in picking up and delivering relatively small quantities of pay load, and the lower proportion of fixed costs typically in the cost structures of trucking firms make them an economical method of moving agricultural goods short and intermediate distances. Because of this, the Interstate Highway System is expected to have an impact on the movement of many agricultural commodities.

Commercial egg production has been increasing rapidly in the southeastern region of the United States during recent years. The South and the Midwest have become competitors in the large commercial egg markets in the North and Northeast. Because of the rapid growth of the commercial egg industry in the South and the necessity of marketing the net surplus of eggs outside the region, marketing of commercial eggs

was chosen as the representative commodity for study in relation to the impact of the interstate highways on Tennessee agriculture.

The objectives of this study were: (1) To describe existing production patterns for commercial eggs; (2) to estimate time and cost functions for moving commercial eggs from surplus areas to deficit areas before and after the Interstate Highway System is completed; (3) to describe expected shifts in egg production after the Interstate Highway System is completed; (4) to estimate the impact of the Interstate Highway System on the production and distribution patterns of Tennessee eggs.

For the purpose of this study the continental United States was divided into sixty-four marketing areas. Commercial egg production and consumption for each area were approximated through the use of the census and other secondary data. The surplus or deficit condition of each area was then determined. The United States was considered to be a closed egg-trading economy with egg consumption equal to egg production. Commercial egg storage stocks and net foreign trade in eggs accounted for an insignificant portion of total domestic production.

A transportation model was used to determine the optimum shipping patterns before and after the Interstate Highway System was completed. Lack of comparable cost data over the several routes necessitated the use of estimating equations to approximate the actual transfer costs. Equilibrium cost and alternative cost matrices were used to analyze the solutions of the transportation model and estimate pressures for adjustments.

# II. CONCLUSIONS

Historically Tennessee has been deficit in egg production, and this condition is expected to continue. The ready availability of eggs from the surplus states to the East, South and West of Tennessee will tend to prevent any significant increase in the farm prices of Tennessee eggs above the prices in surrounding areas. Any shifts in the concentration of egg production in the State will possibly be due to local changes in the profitability of egg production relative to alternative farm enterprises.

The primary effect of the Interstate Highway System on the transit time requirements of vehicles was found to be due to speed rather than distance. No significant change in route alignment could be attributed to the interstate highway net. A speed differential of 5.9 miles per hour was obtained for tractor-semi-trailer combinations moving over the interstate system as compared to the conventional road net.

The effects of the Interstate Highway System on the optimal routing of commercial egg shipments was found to be slight. The total interregional transportation bill for commercial eggs under the conventional road net was $38,046,656. Use of the Interstate Highway System for moving the same quantity of eggs resulted in a transportation bill of $36,811,755, or a saving of $1,234,900. There were no data on a nationwide scale with which to compare the optimal shipping patterns. This lack of actual data required the use of indirect methods for comparing shipments over non-optimum routes with the least cost shipping patterns.

Equilibrium price differentials were estimated under both situations with New York City as a base for the several markets and shipping points. The Interstate Highway System was found to have significantly reduced the price differentials in these geographically separated markets. It was also found that the highest cost of utilizing a non-optimum route was 49.1 cents per case under the conventional road net and 39.6 cents per case under the interstate system.

It was found that while significant differences in transfer cost did occur, these differences were not great and may be easily dissipated by inefficiencies in other areas of the egg-marketing process. Attention should also be called to the fact that any economies of transfer due to the Interstate Highway System will accrue gradually over time as more of the routes become operational. Marketing firms will, therefore, have several years in which to make any necessary adjustments in their shipping practices.

The author wishes to emphasize that the conclusions drawn from this study are conservative ones based on theoretical considerations and should be used only to indicate the direction of commodity and price movements, not the magnitudes of such movements. Additional research should be carried out in the area of trucking cost determination through engineering analysis and personal survey of truckers primarily engaged in the transportation of agricultural commodities before the quantitative effects of the Interstate Highway System on an area can be estimated with reasonable certainty.

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# BIBLIOGRAPHY

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# APPENDIX A

## ANALYTICAL PROCEDURES

Estimates of production and consumption of commercial eggs were obtained for each county in the continental United States for the year 1962, and these county estimates were aggregated into sixty-four geographic marketing areas[1] according to an adaptation of a similar delineation of marketing areas for all commodities which appeared in the Rand McNally Commercial Atlas and Marketing Guide, 1962.[2] Use of this technique assumed that marketing centers for other products were also marketing centers for commercial eggs. The Commercial Atlas and Marketing Guide divided the forty-eight states into 450 basic trading areas and fifty major trading areas on the basis of physiography, population, economic activities, highway facilities, railroad service, department of commerce studies, and field reports of experienced sales analysts.

To facilitate these inter-area comparisons, many of the Rand McNally major marketing areas in the Mountain States, the Far West and the Northwest were combined into larger trading regions; and many of the major marketing areas of the Midwest, Southeast, North, and Northeast were divided into smaller areas for a more detailed examination. See Figure 11 for a pictorial representation of the sixty-four trading regions and legend for Figure 11 for major commercial centers used in this study.

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[1]For the relevant theory behind this approach, see P. A. Samuelson, "Spatial Price Equilibrium and Linear Programming," American Economic Review XLII (American Economic Association, June 1952), pp. 283-303.

[2]Rand McNally Commercial Atlas and Marketing Guide, Ninety-third edition (New York: Rand McNally and Company, 1962), p. 29.

LEGEND FOR FIGURE 11

| Number | Commercial Centers Used in Study |
|---|---|
| 1 | Seattle, Washington |
| 2 | Portland, Oregon |
| 3 | Sacramento, California |
| 4 | Boise, Idaho |
| 5 | Carson City, Nevada |
| 6 | Helena, Montana |
| 7 | Cheyenne, Wyoming |
| 8 | Denver, Colorado |
| 9 | Salt Lake City, Utah |
| 10 | Phoenix, Arizona |
| 11 | Santa Fe, New Mexico |
| 12 | Bismark, North Dakota |
| 13 | Pierre, South Dakota |
| 14 | Lincoln, Nebraska |
| 15 | Wichita, Kansas |
| 16 | Kansas City, Kansas-Missouri |
| 17 | Oklahoma City, Oklahoma |
| 18 | Tulsa, Oklahoma |
| 19 | Fort Worth-Dallas, Texas |
| 20 | San Antonio, Texas |
| 21 | Duluth, Minnesota |
| 22 | Minneapolis - St. Paul, Minnesota |
| 23 | Mason City, Iowa |
| 24 | Des Moines, Iowa |
| 25 | St. Louis, Missouri |
| 26 | Peoria, Illinois |
| 27 | Chicago, Illinois |
| 28 | Milwaukee, Wisconsin |
| 29 | Detroit, Michigan |
| 30 | Indianapolis, Indiana |
| 31 | Cleveland, Ohio |
| 32 | Columbus, Ohio |
| 33 | Cincinnati, Ohio |
| 34 | Rochester, New York |
| 35 | Utica, New York |
| 36 | New York, New York |
| 37 | Hartford, Connecticut |
| 38 | Providence, Rhode Island |
| 39 | Boston, Massachusetts |
| 40 | Lewiston, Maine |
| 41 | Newark, New York |
| 42 | Philadelphia, Pennsylvania |
| 43 | Pittsburgh, Pennsylvania |
| 44 | Baltimore, Maryland |
| 45 | Wilmington, Delaware |

| | |
|---|---|
| 46 | Washington, D. C. |
| 47 | Richmond, Virginia |
| 48 | Charleston, West Virginia |
| 49 | Roanoke, Virginia |
| 50 | Louisville, Kentucky |
| 51 | Paducah, Kentucky |
| 52 | Raleigh, North Carolina |
| 53 | Charlotte, North Carolina |
| 54 | Columbia, South Carolina |
| 55 | Macon, Georgia |
| 56 | Knoxville, Tennessee |
| 57 | Chattanooga, Tennessee |
| 58 | Nashville, Tennessee |
| 59 | Memphis, Tennessee |
| 60 | Little Rock, Arkansas |
| 61 | Baton Rouge, Louisiana |
| 62 | Jackson, Mississippi |
| 63 | Montgomery, Alabama |
| 64 | Tampa, Florida |

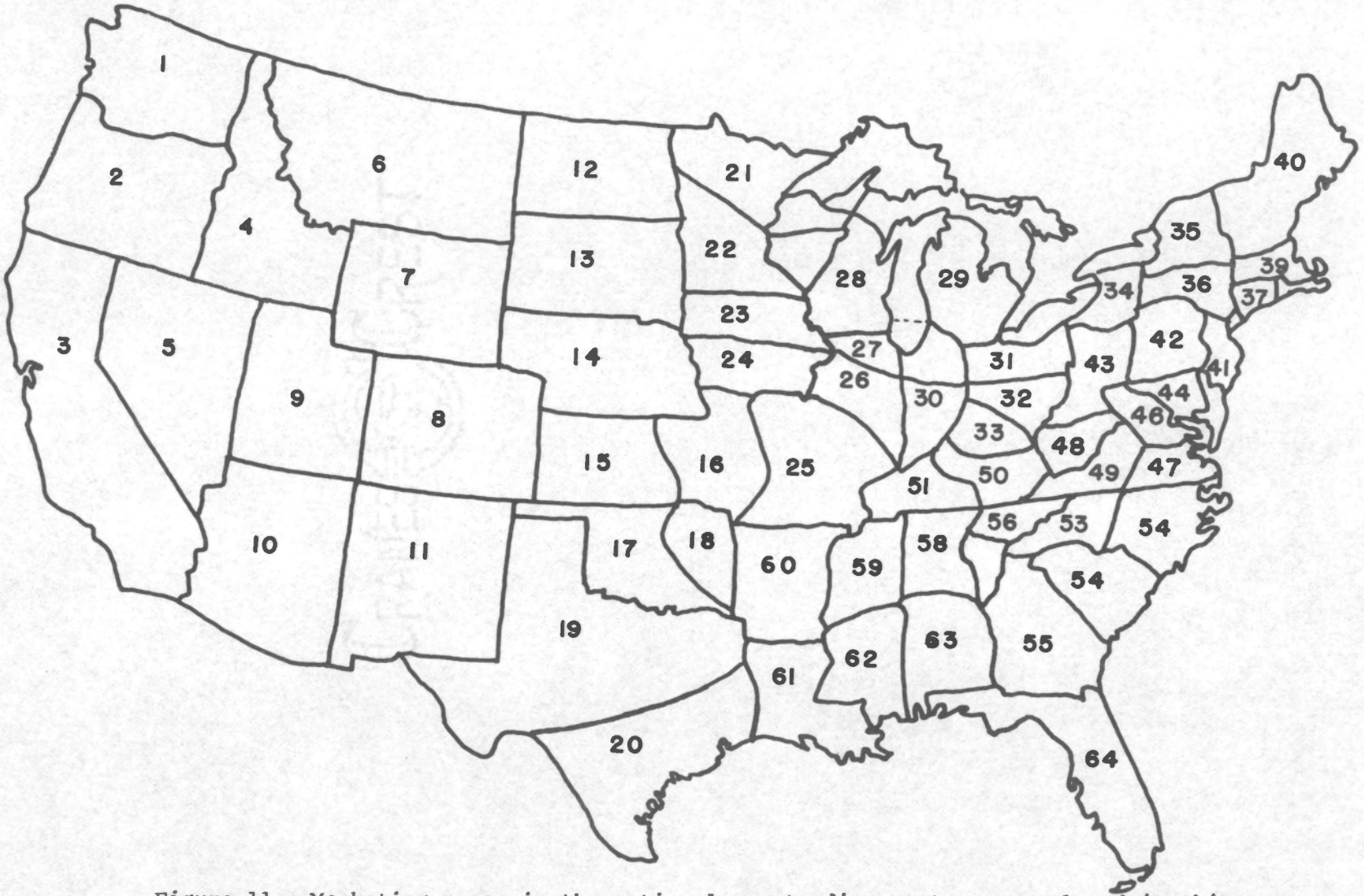



Figure 11. Marketing areas in the national egg trading system as analyzed in this study, United States, 1962.

## I. PARAMETER ESTIMATES

Two sources of data relating to total egg supply were examined. These sources were the United States Department of Commerce, Census of Agriculture[3] and the United States Department of Agriculture, Poultry and Egg Situation.[4] Large discrepancies in aggregate egg production were apparent in these two sources. The United States Department of Agriculture's estimates appeared best for commercial egg production by states; and the Census of Agriculture provided a more complete breakdown of commercial egg production by counties. On the basis of the preceding conclusion, estimates of commercial egg production for several states were obtained from the Poultry and Egg Production Situation and broken down by counties according to the Census of Agriculture estimates.

Since the primary function of this study was estimating the effects of the Interstate Highway System on egg movements rather than completely describing the supply and demand for commercial eggs, an incomplete model was used to approximate commercial egg consumption. The procedure used was to adjust the estimated national per capita consumption of eggs for 1962[5] by the estimated income elasticity of eggs[6] and

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[3]United States Department of Commerce, Bureau of the Census, United States Census of Agriculture, 1959, I Counties (Washington: United States Government Printing Office, 1961), County Table 10.

[4]United States Department of Agriculture, Poultry and Egg Situation, Number 226 (May 1963), p. 47.

[5]United States Department of Agriculture, Poultry and Egg Situation, Number 228 (November 1963), p. 24.

[6]G. E. Brandow, Interrelationships Among Demands for Farm Products and Implications for Control of Supply. Agricultural Experiment Station Bulletin 680. (University Park, Pennsylvania: The Pennsylvania State University, 1961), p. 17.

the relative income differentials of each of the several states. This technique resulted in the following relationship:

$$C_s = 324 + .15R$$

where

$C_s$ = state per capita egg consumption, 1962

324 = national per capita egg consumption, 1962

.15 = estimated income elasticity of eggs at the retail level.

R = the relative per capita income differential by states computed as follows:

$$R = \frac{\text{State per capita income, 1962 - National per capita income, 1962}}{\text{National per capita income, 1962}} \times 100$$

This procedure obviously overlooks the effects of other factors influencing the demand for eggs at the retail level, such as regional differences in tastes and preferences and relative prices of substitute goods.

County estimates of egg consumption were obtained by aggregating the state per capita egg consumption estimates to the estimated 1962 state population levels[7] and allocating this total among the counties according to the 1960 Census of Agriculture. This technique assumes no intrastate population shifts during the intervening period. State and regional commercial egg surpluses and deficits were then obtained by subtracting estimated egg consumption from estimated egg production.

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[7]United States Department of Commerce, Bureau of the Census, Current Population Reports, "Estimates of the Population by Age for States and Puerto Rico, July 1, 1962," Series p-25, Number 280 (Washington: United States Bureau of the Census, March 2, 1964), p. 4.

## II. THE TRANSPORTATION MODEL[8]

The transportation model is a partial equilibrium model which is effective under its stated conditions. It says essentially that under conditions of perfect competition the price of a given product will not differ in separate geographical markets by more than the transfer costs among the markets. Solving a transportation model will yield the least-cost flow of goods from M surplus areas to N deficit areas; hence, the solution of a transportation model yields an equilibrium situation until one of the necessary conditions is changed.

The formal assumptions of the transportation model may be listed as follows:[9]

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[8]For a technical description of the transportation model the reader is referred to the following sources:

C. B. Danteig, "Application of the Simplex Method to a Transportation Problem," Activity Analysis of Production and Allocation, Cowles Commission Monograph No. 13 (New York: John Wiley & Sons, 1951).

R. A. King and W. R. Henry, "Transportation Models in Studying of Interregional Competition," Journal of Farm Economics, XLI, 1959, pp. 997-1011.

T. C. Koopmans, "Optimum Utilization of the Transport System," Econometrica, XVII (Supplement), 1949, pp. 136-149.

E. O. Heady and W. Candler, Linear Programming Methods (Ames, Iowa: Iowa State University Press, 1958), pp. 332-377.

[9]E. O. Heady and W. Candler, Linear Programming Methods (Ames, Iowa: Iowa State University Press, 1958), p. 339.

1. Minimize $Z_0 = \sum_{i=1}^{M} \sum_{j=1}^{N} C_{ij} X_{ij}$

The objective is to minimize the sum of products formed by multiplying the costs of transporting each unit of product between regions by the amount of product transported between the same regions.

Restrictions

2. $\sum_{i=1}^{M} X_{ij} = Y_j$

The sum of product moving from the several surplus regions to the $j^{th}$ market must equal the total deficit.

3. $\sum_{i=1}^{N} X_{ij} = b_i$

The sum of quantities moved from the $i^{th}$ origin to the several destinations must equal the supply of products of the $i^{th}$ origin.

4. $\sum_{j=1}^{N} Y_j = \sum_{i=1}^{M} b_i$

The total quantity supplies in the system must equal the total quantity demanded.

5. $X_{ij} \geqslant 0$

All flows must be positive.

Efficiency of the pricing system and pressure for adjustment in the national egg-trading system were estimated through the use of equilibrium-cost and alternative-cost matrices before and after the new highway system was put into use.

# APPENDIX B

TABLE XVI

NATIONAL SYSTEM OF INTERSTATE AND DEFENSE HIGHWAYS: IMPROVEMENT
STATUS OF MILEAGE AS OF JUNE 30, 1963

| State | Work in Progress | | | | Open to Traffic | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Preliminary Status or Not Yet in Progress[a] | Engineering or Right-of-Way | Under Construction | Total Under Way | Toll Facilities | Improved to Standards Adequate for Present Traffic[b] | Completed to Full or Acceptable Standards[c] | Total Open to Traffic | Total Designated System Mileage |
| Alabama | 266.0 | 228.3 | 139.6 | 139.9 | --- | 51.5 | 189.2 | 240.7 | 874.6 |
| Alaska | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Arizona | 221.6 | 338.6 | 42.5 | 381.1 | --- | 251.2 | 307.1 | 558.3 | 1,161.0 |
| Arkansas | 13.8 | 277.9 | 152.2 | 430.1 | --- | 2.8 | 73.3 | 76.1 | 520.0 |
| California | 78.8 | 1,167.2 | 190.4 | 1,357.6 | 14.0 | 382.7 | 343.4 | 740.1 | 2,176.5 |
| Colorado | 326.5 | 245.7 | 64.0 | 309.7 | --- | 96.3 | 215.5 | 311.8 | 948.0 |
| Connecticut | 1.3 | 72.1 | 57.6 | 129.7 | 19.3 | 23.0 | 122.2 | 164.5 | 295.5 |
| Delaware | --- | 19.4 | 17.6 | 37.0 | 2.3 | --- | 1.2 | 3.5 | 40.5 |
| Florida | 495.3 | 198.0 | 203.0 | 401.0 | 42.4 | --- | 197.3 | 239.7 | 1,136.0 |
| Georgia | 247.7 | 354.9 | 232.0 | 586.9 | --- | 75.2 | 193.8 | 269.0 | 1,103.6 |
| Hawaii | 28.2 | 14.5 | --- | 14.5 | --- | 5.8 | --- | 5.8 | 48.5 |
| Idaho | 97.2 | 229.0 | 67.2 | 296.2 | --- | 53.5 | 165.2 | 218.7 | 612.1 |
| Illinois | 304.1 | 496.4 | 133.7 | 630.1 | 155.1 | 153.9 | 344.8 | 653.8 | 1,588.0 |
| Indiana | 146.2 | 491.2 | 130.2 | 621.4 | 156.9 | 10.2 | 186.2 | 353.3 | 1,120.9 |
| Iowa | 189.8 | 165.2 | 80.8 | 246.0 | 3.6 | 22.2 | 247.4 | 273.2 | 709.0 |
| Kansas | 165.3 | 121.5 | 69.2 | 190.7 | 187.1 | 35.8 | 222.2 | 445.1 | 801.1 |
| Kentucky | 90.1 | 338.9 | 97.6 | 436.5 | 39.6 | 16.4 | 121.4 | 177.4 | 704.0 |
| Louisiana | 120.9 | 295.7 | 179.2 | 474.9 | --- | 6.3 | 80.5 | 86.8 | 682.6 |
| Maine | 120.3 | 33.5 | 38.3 | 71.8 | 59.6 | 3.0 | 56.7 | 119.3 | 311.4 |
| Maryland | 22.1 | 94.9 | 80.7 | 175.6 | 10.5 | 69.7 | 75.9 | 156.1 | 353.8 |
| Massachusetts | 46.2 | 95.1 | 83.2 | 178.3 | 126.3 | 28.4 | 68.8 | 223.5 | 448.0 |

TABLE XVI (CONTINUED)

| State | Work in Progress | | | Open to Traffic | | | | Total Designated System Mileage |
|---|---|---|---|---|---|---|---|---|
| | Preliminary Status or Not Yet in Progress[a] | Engineering or Right-of-Way | Under Construction | Total Under Way | Toll Facilities | Improved to Standards Adequate for Present Traffic[b] | Completed to Full or Acceptable Standards[c] | Total Open to Traffic | |
| Michigan | 216.9 | 66.8 | 167.1 | 233.9 | 4.8 | 5.6 | 616.6 | 627.0 | 1,077.8 |
| Minnesota | 291.2 | 358.3 | 99.3 | 457.6 | --- | 62.7 | 86.6 | 149.3 | 898.1 |
| Mississippi | 171.6 | 170.5 | 178.5 | 349.0 | --- | 26.9 | 130.7 | 157.6 | 678.2 |
| Missouri | 1.3 | 480.1 | 136.0 | 616.1 | 3.2 | 199.9 | 284.2 | 487.3 | 1,104.7 |
| Montana | 573.4 | 263.1 | 138.9 | 402.0 | --- | --- | 205.0 | 205.0 | 1,180.4 |
| Nebraska | 104.0 | 193.7 | 103.1 | 296.8 | 0.3 | 12.9 | 75.9 | 89.1 | 489.9 |
| Nevada | 142.2 | 165.0 | 84.3 | 249.3 | --- | 17.5 | 125.3 | 142.8 | 534.3 |
| New Hampshire | 72.9 | 16.8 | 20.8 | 37.6 | 21.6 | 7.2 | 74.5 | 103.3 | 213.8 |
| New Jersey | 121.3 | 91.6 | 40.7 | 132.3 | 54.2 | 32.4 | 35.7 | 122.3 | 375.9 |
| New Mexico | 410.2 | 161.0 | 107.7 | 268.7 | --- | 95.5 | 232.5 | 328.0 | 1,006.9 |
| New York | 125.6 | 219.4 | 93.8 | 313.2 | 494.4 | 24.7 | 269.3 | 788.4 | 1,227.2 |
| North Carolina | 172.1 | 140.6 | 66.4 | 207.0 | --- | 78.7 | 310.3 | 389.0 | 768.1 |
| North Dakota | 215.0 | 78.2 | 56.5 | 124.7 | --- | 39.4 | 188.8 | 228.2 | 567.9 |
| Ohio | 84.5 | 503.7 | 252.1 | 755.8 | 206.5 | 62.6 | 412.2 | 681.3 | 1,521.6 |
| Oklahoma | 127.6 | 144.5 | 68.2 | 212.7 | 174.4 | 48.0 | 231.5 | 453.9 | 794.2 |
| Oregon | 73.9 | 60.1 | 72.5 | 132.6 | 0.8 | 194.4 | 330.3 | 525.5 | 732.0 |
| Pennsylvania | 279.0 | 408.7 | 168.8 | 577.5 | 362.1 | 1.7 | 355.2 | 719.0 | 1,575.5 |
| Rhode Island | 8.3 | 31.6 | 9.0 | 40.6 | --- | 0.3 | 22.0 | 22.3 | 71.2 |
| South Carolina | 241.9 | 78.1 | 73.0 | 151.1 | --- | 41.2 | 244.5 | 285.7 | 678.7 |
| South Dakota | 233.1 | 160.3 | 62.1 | 222.4 | --- | 54.6 | 168.7 | 223.3 | 678.8 |
| Tennessee | 330.2 | 304.1 | 244.1 | 548.2 | --- | 39.7 | 129.5 | 169.2 | 1,047.6 |
| Texas | 624.3 | 843.6 | 388.9 | 1,182.5 | 30.1 | 313.2 | 881.9 | 1,225.2 | 3,032.0 |
| Utah | 476.8 | 276.5 | 82.0 | 358.5 | --- | 26.7 | 72.9 | 99.6 | 934.9 |
| Vermont | 167.5 | 57.5 | 46.7 | 104.2 | --- | --- | 52.2 | 52.2 | 323.9 |
| Virginia | 344.4 | 233.3 | 231.8 | 465.1 | 39.0 | 43.2 | 61.4 | 243.6 | 1,053.1 |
| Washington | 129.2 | 199.5 | 96.3 | 295.8 | 0.3 | 192.9 | 107.4 | 300.6 | 725.6 |
| West Virginia | 278.0 | 84.3 | 32.1 | 116.4 | 85.9 | --- | 50.4 | 136.3 | 530.7 |

TABLE XVI (CONTINUED)

| State | Preliminary Status or Not Yet in Progress[a] | Work in Progress: Engineering or Right-of-Way | Work in Progress: Under Construction | Work in Progress: Total Under Way | Open to Traffic: Toll Facilities | Open to Traffic: Improved to Standards Adequate for Present Traffic[b] | Open to Traffic: Completed to Full or Acceptable Standards[c] | Open to Traffic: Total Open to Traffic | Total Designated System Mileage |
|---|---|---|---|---|---|---|---|---|---|
| Wisconsin | 278.0 | 145.7 | 69.6 | 215.3 | --- | 39.5 | 197.7 | 237.2 | 452.5 |
| Wyoming | 412.5 | 90.5 | 96.5 | 187.0 | --- | 58.0 | 258.6 | 316.6 | 916.1 |
| Dist. of Columbia | 15.8 | 3.1 | 6.2 | 9.3 | --- | 1.9 | 1.6 | 3.5 | 28.6 |
| Pending[d] | 144.7 | --- | --- | --- | --- | --- | --- | --- | 144.7 |
| Total | 9,570.8 | 11,308.2 | 5,292.0 | 16,600.2 | 2,294.3 | 3,009.2 | 9,525.5 | 14,829.0 | 14,000.0 |

[a]Location studies and public hearings have been undertaken on many portions of the mileage in this column.

[b]Includes 1,386.6 miles improved with Interstate and State matching funds and 1,622.6 miles improved with other public funds.

[c]Includes 8,923.8 miles improved with Interstate and State matching funds and 601.7 miles improved with other public funds.

[d]Includes routes for which the final locations have not yet been determined.

Source: United States Department of Commerce, Highway Progress, 1963 (Annual Report of the Bureau of Public Roads, Fiscal Year 1963, Washington: Government Printing Office, 1963), pp. 94-95.

TABLE XVII

ESTIMATES OF PER CAPITA EGG CONSUMPTION BY STATES FOR THE FORTY-EIGHT STATES IN THE NATIONAL EGG-TRADING SYSTEM, 1962[a]

| State | Per Capita Consumption |
|---|---|
| Alabama | 307 |
| Arizona | 318 |
| Arkansas | 305 |
| California | 336 |
| Colorado | 324 |
| Connecticut | 340 |
| Delaware | 340 |
| Florida | 317 |
| Georgia | 311 |
| Idaho | 315 |
| Illinois | 334 |
| Indiana | 324 |
| Iowa | 320 |
| Kansas | 320 |
| Kentucky | 310 |
| Louisiana | 310 |
| Maine | 314 |
| Maryland | 331 |
| Massachusetts | 333 |
| Michigan | 325 |
| Minnesota | 321 |
| Mississippi | 300 |
| Missouri | 324 |
| Montana | 321 |
| Nebraska | 322 |
| Nevada | 344 |
| New Hampshire | 321 |
| New Jersey | 335 |
| New Mexico | 312 |
| New York | 336 |
| North Carolina | 310 |
| North Dakota | 322 |
| Ohio | 325 |
| Oklahoma | 314 |
| Oregon | 323 |
| Pennsylvania | 324 |
| Rhode Island | 324 |

TABLE XVII (CONTINUED)

| State | Per Capita Consumption |
|---|---|
| South Carolina | 306 |
| South Dakota | 317 |
| Tennessee | 309 |
| Texas | 316 |
| Utah | 318 |
| Vermont | 316 |
| Virginia | 316 |
| Washington | 327 |
| West Virginia | 312 |
| Wisconsin | 322 |
| Wyoming | 320 |
| District of Columbia | 343 |
| Forty-eight states | 324 |

[a]Per capita consumption estimates by states were derived by adjusting the national per capita consumption estimate obtained from The Poultry and Egg Situation (U. S. D. A., May 1963) by a factor equal to the relative per capita income differential between each of the several states and the national per capita income and the estimated income elasticity of eggs at the retail level (Pennsylvania State Agricultural Experiment Station, Bulletin 680, August 1961).

TABLE XVIII

ESTIMATES OF REGIONAL SURPLUSES AND DEFICITS OF EGGS IN THE CONTINENTAL UNITED STATES, 1962[a]

| Area[b] | Surplus (000 cases) | Area | Deficit (000 cases) |
|---|---|---|---|
| 1 Seattle, Washington | 193.7 | 2 Portland, Oregon | 39.7 |
| 3 Sacramento, California | 3,014.6 | 5 Carson City, Nevada | 340.1 |
| 4 Boise, Idaho | 104.2 | 6 Helena, Montana | 80.8 |
| 12 Bismark, North Dakota | 750.5 | 7 Cheyenne, Wyoming | 154.5 |
| 13 Pierre, South Dakota | 3,773.5 | 8 Denver, Colorado | 1,033.2 |
| 14 Lincoln, Nebraska | 3,215.0 | 9 Salt Lake City, Utah | 17.7 |
| 15 Wichita, Kansas | 145.8 | 10 Phoenix, Arizona | 980.6 |
| 16 Kansas City, Missouri | 1,576.4 | 11 Santa Fe, New Mexico | 483.4 |
| 20 Minneapolis-St. Paul, Minn. | 6,860.8 | 17 Oklahoma City, Oklahoma | 243.0 |
| 23 Mason City, Iowa | 6,478.1 | 18 Tulsa, Oklahoma | 424.0 |
| 24 Des Moines, Iowa | 3,367.7 | 19 Ft. Worth-Dallas, Texas | 617.3 |
| 25 St. Louis, Missouri | 904.8 | 20 San Antonio, Texas | 1,379.9 |
| 26 Peoria, Illinois | 1,084.3 | 21 Duluth, Minnesota | 74.2 |
| 28 Milwaukee, Wisconsin | 885.4 | 27 Chicago, Illinois | 5,362.4 |
| 30 Indianapolis, Indiana | 1,467.0 | 29 Detroit, Michigan | 4,026.6 |
| 40 Lewiston, Maine | 1,731.4 | 31 Cleveland, Ohio | 1,013.3 |
| 42 Philadelphia, Pennsylvania | 1,318.5 | 32 Columbus, Ohio | 52.4 |
| 49 Roanoke, Virginia | 464.1 | 33 Cincinnati, Ohio | 1,287.2 |
| 51 Paducah, Kentucky | 286.7 | 34 Rochester, New York | 1,527.1 |
| 52 Raleigh, North Carolina | 641.2 | 35 Utica, New York | 890.4 |
| 53 Charlotte, North Carolina | 1,708.1 | 36 New York, New York | 9,476.8 |
| 54 Columbia, South Carolina | 552.5 | 37 Hartford, Connecticut | 559.8 |
| 55 Macon, Georgia | 2,422.2 | 38 Providence, Rhode Island | 647.8 |

TABLE XVIII (CONTINUED)

| Area[b] | Surplus (000 cases) | Area | Deficit (000 cases) |
|---|---|---|---|
| 57 Chattanooga, Tennessee | 1,649.1 | 39 Boston, Massachusetts | 3,562.9 |
| 58 Nashville, Tennessee | 199.4 | 41 Newark, New Jersey | 833.3 |
| 59 Memphis, Tennessee | 311.8 | 43 Pittsburgh, Pennsylvania | 2,559.7 |
| 60 Little Rock, Arkansas | 2,660.3 | 44 Baltimore, Maryland | 2,510.3 |
| 62 Jackson, Mississippi | 1,655.1 | 45 Wilmington, Delaware | 96.6 |
| 63 Montgomery, Alabama | 1,061.7 | 46 Washington, D. C. | 1,458.0 |
| | | 47 Richmond, Virginia | 639.4 |
| | | 48 Charleston, West Virginia | 539.6 |
| | | 50 Louisville, Kentucky | 62.2 |
| | | 56 Knoxville, Tennessee | 38.4 |
| | | 61 Baton Rouge, Louisiana | 1,675.4 |
| | | 64 Tampa, Florida | 1,561.0 |
| Total surplus | 50,483.9 | Total deficit[c] | 46,249.0 |

[a]Excluding Alaska.

[b]City listed denotes a principal point of a geographical trading area. The method of analysis used assumed that all surpluses and deficits occurred at these principal points.

[c]Since the only factors used to estimate the consumption of eggs were population estimates by states, national per capita egg consumption and income differentials by states, total egg supply exceed the estimated quantity demanded by 9,535.5 cases. If a complete model had been used, this surplus would have been greatly reduced.

TABLE XIX

ESTIMATED OPTIMUM FLOWS OF COMMERCIAL EGGS FOR THE CONTINENTAL UNITED STATES OVER THE CONVENTIONAL HIGHWAY NETWORK, 1962

| Exporting Regions | 2 Port-land, Oregon | 5 Carson City, Nevada | 6 Helena, Montana | 7 Cheyenne, Wyoming | 8 Denver, Colorado |
|---|---|---|---|---|---|
| 1. Seattle, Wash. | 39.7 | | | | |
| 2. Sacramento, Calif. | | 340.1 | | | |
| 4. Boise, Idaho | | | 80.8 | | |
| 12. Bismark, N. Dak. | | | | | |
| 13. Pierre, S. Dak. | | | | 154.5 | 1,033.2 |
| 14. Lincoln, Neb. | | | | | |
| 15. Wichita, Kan. | | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | | |
| 23. Mason City, Iowa | | | | | |
| 24. Des Moines, Iowa | | | | | |
| 25. St. Louis, Mo. | | | | | |
| 26. Peoria, Ill. | | | | | |
| 28. Milwaukee, Wis. | | | | | |
| 30. Indianapolis, Ind. | | | | | |
| 40. Lewiston, Maine | | | | | |
| 42. Philadelphia, Pa. | | | | | |
| 49. Roanoke, Va. | | | | | |
| 51. Paducah, Ky. | | | | | |
| 52. Raleigh, N. C. | | | | | |
| 53. Charlotte, N. C. | | | | | |
| 54. Columbia, S. C. | | | | | |
| 55. Macon, Ga. | | | | | |
| 57. Chattanooga, Tenn. | | | | | |
| 58. Nashville, Tenn. | | | | | |
| 59. Memphis, Tenn. | | | | | |
| 60. Little Rock, Ark. | | | | | |
| 62. Jackson, Miss. | | | | | |
| 63. Montgomery, Ala. | | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 9<br>Salt Lake City, Utah | 10<br>Phoenix, Arizona | 11<br>Santa Fe, New Mexico | 17<br>Oklahoma City, Oklahoma |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | 834.8 | | |
| 4. Boise, Idaho | 17.7 | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | 483.4 | 243.0 |
| 16. Kansas City, Kan. | | 145.8 | | |
| 22. Minneapolis-St. Paul, Minn. | | | | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 18<br>Tulsa, Oklahoma | 19<br>Ft. Worth-Dallas, Texas | 20<br>San Antonio, Texas | 21<br>Duluth, Minnesota |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | 424.0 | 426.0 | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | 74.2 |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | 885.4 | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 59. Memphis, Tenn. | | | 311.8 | |
| 60. Little Rock, Ark. | | 191.3 | 182.7 | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 27 Chicago, Illinois | 29 Detroit, Michigan | 31 Cleveland, Ohio | 32 Columbus, Ohio |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 2. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | 1,494.8 | | |
| 23. Mason City, Iowa | 4,278.1 | 876.7 | 885.9 | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | 1,084.3 | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | 127.4 | 52.4 |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | 1,655.1 | | |
| 63. Montgomery, Ala. | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 33 Cincinnati, Ohio | 34 Rochester, New York | 35 Utica, New York | 36 New York, New York |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | 453.0 | |
| 14. Lincoln, Neb. | | | | 2,655.2 |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | 1,527.1 | | 1,933.2 |
| 23. Mason City, Iowa | | | 437.4 | |
| 24. Des Moines, Iowa | | | | 1,912.2 |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | 1,287.2 | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | 1,318.5 |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | 224.5 |
| 52. Raleigh, N. C. | | | | 1.8 |
| 53. Charlotte, N. C. | | | | 679.3 |
| 54. Columbia, S. S. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | 141.2 |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | 610.9 |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 37 Hartford, Conn. | 38 Providence, Rhode Island | 39 Boston, Mass. | 41 Newark, N. J. |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | 647.8 | | |
| 14. Lincoln, Neb. | 559.8 | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | 1,831.5 | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | 1,731.4 | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | 833.3 |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 43 Pitts-burgh, Pa. | 44 Baltimore, Maryland | 45 Wilmington, Delaware | 46 Washington, D. C. |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | 1,455.5 | | | |
| 25. St. Louis, Mo. | 904.8 | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | 464.1 |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | 34.9 | | 993.9 |
| 54. Columbia, S. C. | | 552.5 | | |
| 55. Macon, Ga. | | 861.2 | | |
| 57. Chattanooga, Tenn. | | | 96.6 | |
| 58. Nashville, Tenn. | 199.4 | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | 1,061.7 | | |

TABLE XIX (CONTINUED)

| Exporting Regions | 47 Rich-mond, Va. | 48 Charles-ton, W. Va. | 50 Louis-ville, Ky. | 56 Knox-ville, Tenn. | 61 Baton Rouge, La. | 64 Tampa, Fla. |
|---|---|---|---|---|---|---|
| 1. Seattle, Wash. | | | | | | |
| 3. Sacramento, Calif. | | | | | | |
| 4. Boise, Idaho | | | | | | |
| 12. Bismark, N. Dak. | | | | | | |
| 13. Pierre, S. Dak. | | | | | | |
| 14. Lincoln, Neb. | | | | | | |
| 15. Wichita, Kan. | | | | | | |
| 16. Kansas City, Kan. | | | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | | | |
| 23. Mason City, Iowa | | | | | | |
| 24. Des Moines, Iowa | | | | | | |
| 25. St. Louis, Mo. | | | | | | |
| 26. Peoria, Ill. | | | | | | |
| 28. Milwaukee, Wis. | | | | | | |
| 30. Indianapolis, Ind. | | | | | | |
| 40. Lewiston, Maine | | | | | | |
| 42. Philadelphia, Pa. | | | | | | |
| 49. Roanoke, Va. | | | | | | |
| 51. Paducah, Ky. | | | 62.2 | | | |
| 52. Raleigh, N. C. | 639.4 | | | | | |
| 53. Charlotte, N. C. | | | | | | |
| 54. Columbia, S. C. | | | | | | |
| 55. Macon, Ga. | | | | | | 1,561.0 |
| 57. Chattanooga, Tenn. | | 539.6 | | 38.4 | | |
| 58. Nashville, Tenn. | | | | | | |
| 59. Memphis, Tenn. | | | | | | |
| 60. Little Rock, Ark. | | | | | 1,675.4 | |
| 62. Jackson, Miss. | | | | | | |
| 63. Montgomery, Ala. | | | | | | |

TABLE XX

ESTIMATED OPTIMUM FLOWS OF COMMERCIAL EGGS FOR THE CONTINENTAL UNITED STATES OVER THE COMPLETED INTERSTATE HIGHWAY SYSTEM

| Exporting Regions | 2 Port-land, Oregon | 5 Carson City, Nevada | 6 Helena, Montana | 7 Cheyenne, Wyoming | 8 Denver, Colorado |
|---|---|---|---|---|---|
| 1. Seattle, Wash. | 39.7 | | | | |
| 3. Sacramento, Calif. | | 340.1 | | | |
| 4. Boise, Idaho | | | 80.8 | | |
| 12. Bismark, N. Dak. | | | | | |
| 13. Pierre, S. Dak. | | | | 154.5 | 1,033.2 |
| 14. Lincoln, Neb. | | | | | |
| 15. Wichita, Kan. | | | | | |
| 16. Kansas City, Kan. | | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | | |
| 23. Mason City, Iowa | | | | | |
| 24. Des Moines, Iowa | | | | | |
| 25. St. Louis, Mo. | | | | | |
| 26. Peoria, Ill. | | | | | |
| 28. Milwaukee, Wis. | | | | | |
| 30. Indianapolis, Ind. | | | | | |
| 40. Lewiston, Maine | | | | | |
| 42. Philadelphia, Pa. | | | | | |
| 49. Roanoke, Va. | | | | | |
| 51. Paducah, Ky. | | | | | |
| 52. Raleigh, N. C. | | | | | |
| 53. Charlotte, N. C. | | | | | |
| 54. Columbia, S. C. | | | | | |
| 55. Macon, Ga. | | | | | |
| 57. Chattanooga, Tenn. | | | | | |
| 58. Nashville, Tenn. | | | | | |
| 59. Memphis, Tenn. | | | | | |
| 60. Little Rock, Ark. | | | | | |
| 62. Jackson, Miss. | | | | | |
| 63. Montgomery, Ala. | | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 9<br>Salt Lake City, Utah | 10<br>Phoenix, Arizona | 11<br>Santa Fe, New Mexico | 17<br>Oklahoma City, Oklahoma |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | 980.6 | | |
| 4. Boise, Idaho | 17.7 | | 5.7 | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | 268.8 | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | 208.9 | 243.0 |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 18<br>Tulsa, Oklahoma | 19<br>Ft. Worth-Dallas, Texas | 20<br>San Antonio, Texas | 21<br>Duluth, Minnesota |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | 424.0 | 617.3 | 83.2 | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | 74.2 |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | 311.8 | |
| 60. Little Rock, Ark. | | | 984.9 | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 27 Chicago, Illinois | 28 Detroit, Michigan | 31 Cleveland, Ohio | 32 Columbus, Ohio |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | 145.8 | | |
| 22. Minneapolis-St. Paul, Minn. | | 883.9 | | |
| 23. Mason City, Iowa | 4,278.1 | 456.4 | 885.9 | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | 1,084.3 | | | |
| 28. Milwaukee, Wis. | | 885.4 | | |
| 30. Indianapolis, Ind. | | | 127.4 | 52.4 |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | 1,655.1 | | |
| 63. Montgomery, Ala. | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 33 Cincinnati, Ohio | 34 Rochester, New York | 35 Utica, New York | 36 New York, New York |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | 32.7 | |
| 14. Lincoln, Neb. | | | | 2,655.2 |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | 1,527.1 | | 2,544.1 |
| 23. Mason City, Iowa | | | 857.7 | |
| 24. Des Moines, Iowa | | | | 1,912.2 |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | 1,287.2 | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | 1,318.5 |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | 224.5 |
| 52. Raleigh, N. C. | | | | 1.8 |
| 53. Charlotte, N. C. | | | | 679.3 |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | 141.2 |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 37 Hartford, Conn. | 38 Providence, Rhode Island | 39 Boston, Mass. | 41 Newark, N. J. |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | 647.8 | | |
| 14. Lincoln, Neb. | 559.8 | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | 1,831.5 | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | | | | |
| 25. St. Louis, Mo. | | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | 1,731.4 | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | | | |
| 54. Columbia, S. C. | | | | |
| 55. Macon, Ga. | | | | |
| 57. Chattanooga, Tenn. | | | | 833.3 |
| 58. Nashville, Tenn. | | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | | | |

TABLE XX (CONTINUED)

| Exporting Regions | 43 Pittsburgh, Pa. | 44 Baltimore, Maryland | 45 Wilmington, Delaware | 46 Washington, D. C. |
|---|---|---|---|---|
| 1. Seattle, Wash. | | | | |
| 3. Sacramento, Calif. | | | | |
| 4. Boise, Idaho | | | | |
| 12. Bismark, N. Dak. | | | | |
| 13. Pierre, S. Dak. | | | | |
| 14. Lincoln, Neb. | | | | |
| 15. Wichita, Kan. | | | | |
| 16. Kansas City, Kan. | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | |
| 23. Mason City, Iowa | | | | |
| 24. Des Moines, Iowa | 1,455.5 | | | |
| 25. St. Louis, Mo. | 904.8 | | | |
| 26. Peoria, Ill. | | | | |
| 28. Milwaukee, Wis. | | | | |
| 30. Indianapolis, Ind. | | | | |
| 40. Lewiston, Maine | | | | |
| 42. Philadelphia, Pa. | | | | |
| 49. Roanoke, Va. | | | | 464.1 |
| 51. Paducah, Ky. | | | | |
| 52. Raleigh, N. C. | | | | |
| 53. Charlotte, N. C. | | 34.9 | | 993.9 |
| 54. Columbia, S. C. | | 552.5 | | |
| 55. Macon, Ga. | | 861.2 | | |
| 57. Chattanooga, Tenn. | | | 96.6 | |
| 58. Nashville, Tenn. | 199.4 | | | |
| 59. Memphis, Tenn. | | | | |
| 60. Little Rock, Ark. | | | | |
| 62. Jackson, Miss. | | | | |
| 63. Montgomery, Ala. | | 1,061.7 | | |

TABLE XX (CONTINUED)

| Exporting Regions | 47 Richmond, Va. | 48 Charleston, W. Va. | 50 Louisville, Ky. | 56 Knoxville, Tenn. | 61 Baton Route, La. | 64 Tampa, Fla. |
|---|---|---|---|---|---|---|
| 1. Seattle, Wash. | | | | | | |
| 3. Sacramento, Calif. | | | | | | |
| 4. Boise, Idaho | | | | | | |
| 12. Bismark, N. Dak. | | | | | | |
| 13. Pierre, S. Dak. | | | | | | |
| 14. Lincoln, Neb. | | | | | | |
| 15. Wichita, Kan. | | | | | | |
| 16. Kansas City, Kan. | | | | | | |
| 22. Minneapolis-St. Paul, Minn. | | | | | | |
| 23. Mason City, Iowa | | | | | | |
| 24. Des Moines, Iowa | | | | | | |
| 25. St. Louis, Mo. | | | | | | |
| 26. Peoria, Ill. | | | | | | |
| 28. Milwaukee, Wis. | | | | | | |
| 30. Indianapolis, Inc. | | | | | | |
| 40. Lewiston, Maine | | | | | | |
| 42. Philadelphia, Pa. | | | | | | |
| 49. Roanoke, Va. | | | | | | |
| 51. Paducah, Ky. | | | 62.2 | | | |
| 52. Raleigh, N. C. | 639.4 | | | | | |
| 53. Charlotte, N. C. | | | | | | |
| 54. Columbia, S. C. | | | | | | |
| 55. Macon, Ga. | | | | | | 1,561.0 |
| 57. Chattanooga, Tenn. | | 539.6 | | 38.4 | | |
| 58. Nashville, Tenn. | | | | | | |
| 59. Memphis, Tenn. | | | | | | |
| 60. Little Rock, Ark. | | | | | 1,675.4 | |
| 62. Jackson, Miss. | | | | | | |
| 63. Montgomery, Ala. | | | | | | |