EGG PRICE PREDICTION MODEL FOR THE JAPANESE EGG INDUSTRY

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ABSTRACT

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By

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Adequate egg price forecasting is a necessity for business concerns if they are to profitably market eggs. The purpose of this study was to evaluate an egg price prediction model used in the United States as a long range egg price prediction model for the Japanese egg industry. The historical data used was for the six-year time period of 1965 through 1970, and included Tokyo wholesale egg price (yen/kilogram eggs), egg/feed (yen/20 kilogram bag of feed) price ratio, pullet chicks started, number of laying hens, number of laying hens sold, percentage egg production and imported and exported eggs. In addition, seasonality factors, demand situation, projected figures on egg price and egg numbers were calculated for use in the price projection model.

Variables examined in terms of projection feasibility and accuracy were:

1. Pullet chicks started were projected in relation to the Tokyo wholesale egg price occurring two months prior to the actual chick placement. The correlation value obtained indicates that there was a relatively high correlation during the

months March through October but a relatively low correlation November through February. The correlation between egg/feed price ratio and number of pullet chicks started showed less importance than the egg price-pullet chicks started relation.

2. Layer number culled was estimated from the monthly difference of laying hen numbers and the number of pullet chicks started six months previously. This figure was estimated because of a lack of published data. The relationship of estimated layer number sold and the Tokyo wholesale egg price, both occurring in the same month, was calculated. The correlation value was significant ($P \leq 0.05$) in only three of the 12 monthly values calculated. Thus, the importance of actual figures is emphasized and suggests that the number of layers culled be added to the list of statistical data collected about the Japanese egg industry.

3. Demand situation which was determined from the relationship of per capita egg consumption and the Tokyo wholesale egg price. The relationship was compared for the years 1960 through 1966 and the years 1966 through 1970. The trend was for the demand for eggs in Japan to become more inelastic with the price elasticity being -4.55 in 1966 and -2.57 in 1970. If this trend continues and demand becomes highly inelastic, accurate projection of supply becomes very critical in accurate projection of price.

4. Price seasonality which was examined in terms of monthly price fluctuations by the 12 months' moving average technique. Negative factors were calculated for January, May, June, July and August with positive factors being calculated for the other seven months.

Three projection methods to predict the 1971 Tokyo wholesale egg price were compared to check the accuracy of the projection model. The first method utilized the actual egg production number and the actual Tokyo wholesale egg price to project the number of layers culled and the number of pullet chicks started. The second method utilized the actual Tokyo wholesale egg price but with a projected egg production number. The third method utilized projected figures for egg production number and egg price and is the method which would have to be utilized if the egg price in the future 18 months is to be predicted. Comparison of graphic presentations of the three methods indicate that the third method can be adequately utilized to predict the future Tokyo wholesale egg price in Japan.

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INTRODUCTION

As symbolized by per capita consumption of 101 eggs in 1960 to 295 eggs in 1970, the Japanese egg industry has grown rapidly during the last decade. In 1960, 3.2 million farmers kept 44.5 million laying hens; whereas, by 1970 only 1.6 million farmers kept 118.2 million layers. Poultry production has now become one of the most important commodities in Japanese agriculture ranking third behind rice and dairy.

Of key concern to farmers, as well as breeders, hatcheries, feed manufacturers and distributors is egg price. On-farm egg price during the past ten years has fluctuated widely from season to season and year to year. Despite inflation, egg price has gradually declined while per capita egg consumption has increased steadily. To farmers, egg price reflects in their decision making as to expansion, enterprise reduction or consideration of production costs in relation to the egg price-profit picture. To distributors, price level is a reflection of the supply-demand situation in which they must sell eggs smoothly while maintaining a profitable marketing margin. To consumers, egg price is of concern because of the household food budget. To input-suppliers, such as breeders, hatcheries, pullet growers and feed manufacturers, a slight change in price level may

affect severely their sales. If a company on the input-supply side does not anticipate egg price changes, sales may be either long or short and result in loss of profits or business failure.

Thus, adequate egg price forecasting is a necessity for business concerns if they are to profitably market eggs. Therefore, the purpose of this study is to evaluate a modified egg price prediction model used in the United States as a long range egg price prediction model for the Japanese egg industry.

REVIEW OF LITERATURE

Gerra (1959) presented a detailed analyses of the major factors that affect the demand for and supply of eggs in the United States and the quantification in a statistical model of the relationships among those factors. Eleven structural equations (two demand, two supply, two price level, one storage and four identity equations) were formulated to explain the major relationships in the egg industry to supply and price. Based on data for the years 1931-54, excluding 1942-45, demand and supply coefficients were statistically obtained by the method of limited information, which allowed for the simultaneous relationships in the egg industry and by the method of least squares. Coefficients obtained by fitting demand relationships by the simultaneous approach differed more than the least squares results for the comparable demand relationships than that for the supply relationships.

The variables that Gerra (1959) considered in his structural model of the egg economy were as follows:

A. Endogenous variables (variables whose relationship among themselves and with other variables are to be determined from knowledge of variables whose values are assumed to be known).
   1. Civilian domestic disappearance of eggs.
   2. Retail price of eggs.
   3. Farm production of eggs.

4. Average number of layers on farms during the year.
5. Number of pullets raised.
6. Number of layers sold and consumed on farms where produced.
7. Farm price of eggs.
8. Farm production of eggs minus the January-June net into storage movement of shell, frozen and dried eggs (shell equivalent), excluding government stocks.
9. January-June net into-storage movement of shell, frozen and dried eggs (shell equivalent) excluding government stocks.

B. Predetermined variables

1. Consumer disposable income.
2. Retail price of meats, poultry and fish.
3. Retail price of cheese.
4. Retail price of bacon.
5. Retail price of ready-to-eat cereals.
6. Consumers' price index of all items.
7. Average number of eggs produced per layer during the year.
8. Number of hens and pullets of laying age and pullets not yet laying on farms.
9. Difference between civilian domestic disappearance of eggs and farm production of eggs.
10. Mortality of layers plus a balancing residual.
11. Average price of poultry ration.
12. Population eating out of civilian supplies.
13. Number of eggs produced on farms.

14. Unit labor cost of marketing food products.
15. Gain or loss on futures contracts, previous year, speculative long position.

Gould (1970) studied the factors that influence the daily quotations for large, medium, pullet and peewee eggs originating in the New York wholesale market during a five year period (1962 through 1966). To compensate for the effects of different months and seasons, data were grouped into monthly time periods. The single-equation, least squares multiple regression technique, using daily observations, was employed as the method of analysis. Supply-and-demand variables considered important in the pricing of eggs were: retail movement, military purchases, receipts of wholesalers, delivery to breakers and storage holdings. In the daily market, variables selected for use in the models were those considered regular in occurrence and most influential in the determination of daily New York wholesale quotations. Demand variables selected were: estimated retail movement in New York, by size; deliveries to breakers in the East and West North Central regions; and military purchases. The supply variable used was New York Commercial Egg Movement, estimated by size; and comprises the cases of eggs picked up at farms by first receivers in the New York metropolitan area. Conclusions of the study were:

A. Egg market quotations are the result of numerous economic factors acting on their knowledge of these forces. Many of the forces operate daily, while others are important only

periodically. Some can be easily measured, while others are more difficult to measure. The flow of eggs to market or into retail channels, for example, is a daily occurrence that can be rather precisely measured. On the other hand, factors such as inclement weather, strikes and psychological attitudes vary in occurrence and importance and are not readily predictable or measurable.

B. The models devised considered only five of the important variables that influence daily quotations, thus requiring continuous collection of data and exceptional judgment on part of the user.

Masters and Jones (1970) developed a mathematical model to predict short run egg price changes in the Southeast. Least squares multiple regression techniques were used. The objective of the study was to explain weekly changes in the price of Grade A large eggs in the 1967 and 1968 Georgia market. The general model developed to explain weekly egg price changes had the following format:

$$P_1 = f\ (P_o,\ P_h,\ Io/_1,\ So/_1)$$

where P_1 = the average price of large eggs in the current week,

P_o = the price of large eggs on Friday of the previous week,

P_h = the historical average price for the current week based on the preceding six year period.

$Io/_1$ = the weekend inventory position of packers and handlers in the United States for the previous or current week.

$So/_1$ = the average daily surplus or shortage condition of packers and handlers in the Southeast for the previous or current week.

Paremeter estimates were established for both a lagged and non-lagged form of this model. The non-lagged version of the model explained over 90 percent of the average weekly variation in the farm price of eggs in Georgia. The previous Friday's price (P_o) was the most important, accounting for over 80 percent of the price variation. Of the remaining variables in the non-lagged model, only packers' long or short position (S_1) was important, accounting for about 9 percent of the total variation. In the lagged model the historical average price variable (P_h) replaced packers' surplus-shortage position (S_o) as the second most important variable. This implies that the effect of packers' surplus or shortage position on price was not lagged; but it apparently influenced price during the week that the surplus or shortage occurred.

Siebert (1969) developed two mathematical models to predict the egg price in each of two California cities, Los Angeles and San Francisco. The first equations were formulated to estimate Los Angeles and San Francisco prices from New York price and Western egg supply. These equations were:

$$X_1 = b_{o_{(4)}} + b_{1(4)} X_3 + b_{2(4)} X_4$$

$$X_2 = b_{o(4)} + b_{1(4)} X_3 + b_{2(4)} X_4$$

where X_1 = weekly average of the low side of the price range for Los Angeles large grade AA price-to-retailers, delivered-in-cartons,

X_2 = weekly average of the low side of the price range for San Francisco large grade AA egg price-to-retailers, delivered-in-cartons,

X_3 = weekly average of the low side of the wholesale price range for New York large eggs of 75% A quality,

X_4 = weekly per capita supplies of eggs in the West as indicated by Commercial Egg Movement Report of the Market News Service, U.S. Department of Agriculture,

and b_o, b_1, b_2 = regression coefficients for the two models. Results of the regression analysis on the preceding models yielded a correlation coefficient of 0.876 and 0.864, respectively, for the Los Angeles and San Francisco price. Although these correlation coefficients were high, considerable variation was still unexplained. Thus, a second set of equations were developed as follows:

$$X_1 = b_{o(1)} + b_{1(1)} X_4 + b_{2(1)} X_5 + b_{3(1)} X_6$$

$$X_2 \quad b_{o(2)} + b_{1(2)} X_4 + b_{2(2)} X_5 + b_{3(2)} X_6$$

$$X_3 \quad b_{o(3)} + b_{1(3)} X_5 + b_{2(3)} X_6 + b_{3(3)} X_7$$

where X_1 = Los Angeles monthly average price-to-retailers, delivered-in-cartons for large grade AA eggs,

X_2 = San Francisco monthly average price-to-retailers, delivered-in-cartons for large grade AA eggs,

X_3 = California farm price at mid-month,

X_4 = New York monthly average wholesale price for 70% A quality eggs,

X_5 = monthly California per capita egg production,

X_6 = monthly military shell-egg purchases for the United States,

X_7 = United States farm price,

and b_o, b_1, b_2, b_3 = regression coefficients for the three equations. Results of the regression analysis on the preceding models yielded a correlation coefficient of 0.907, 0.901 and 0.928, respectively, for the Los Angeles, San Francisco and California farm price.

Smith and Christensen (1970) utilized least squares multiple regression techniques to estimate the equation farm and parameter values for a short run large brown egg price estimator for the New England region. A series of different models were tested differing in the number and form of the independent variables used. Of the several models tested, two showed particular promise and were reported. The dependent variable (the estimated value) was the New England wholesale weekly average of the daily base price quotation for large brown eggs. The price determining variables used in the analysis were identified as follows (Smith, 1969):

X_1 and X_2 = dummy variables assuming value of zero or one used to reflect market tone which was defined as a classification of sentiment among handlers and represents a concensus of the egg traders' predictions of the direction of price movement (i.e., weak, steady and firm),

X_3 = the New York large white egg Friday quotation, and was used to bring the national supply and demand situation into the model to indicate the pressures of interregional competition,

X_4 = cold storage holdings of eggs in ten major cities and was used in order to provide an indicator of egg supplies,

X_5 = military purchase price of shell eggs for East Coast export,

X_6 = Boston large white egg Friday quotation minus the New York large white egg Friday quotation and was used to partially account for future price changes by indicating interregional forces,

X_7 = the difference between the New York fancy large brown egg Friday quotation and the same quotation on the previous Friday and was selected as an indicator of changes in the marginal supply of brown eggs in New England,

X_8 = the three week moving average of the differences between the Boston large brown weekly average quotation and the Boston medium brown weekly average quotation and was used because medium eggs substitute for large eggs at rates which vary with the price difference which inclusion of this variable was an attempt to allow for such substitution,

X_9 = the Boston brown large Friday quotation minus the New York white large egg Friday quotation and was used as an indication of the seasonality of demand for eggs in New England,

X_{10} = the number of cases of graded large eggs in the New England weekend inventory and was used because quantity of eggs in inventory generally indicates the product available for sale during the next week in addition to fresh receipts.

Model I used weekly observation from time series data of approximately 18 months duration from June, 1966 through December, 1967 and included variables X_1 through X_9. Model II differed from Model I in that Model II was designed to be used on Monday and contained variable X_{10} in addition to X_1 through X_9. The coefficient of determination (R^2) was 0.95 for Model I and 0.96 for Model II. The simple arithmetic means of the estimated prices as compared to actual prices over the test period differed by less than one-tenth of a cent.

An at-the-farm egg price prediction report has been published periodically by Larzelere (1971a) for use by Michigan egg producers. The price report includes a blend price for all eggs produced during a 15-month lay cycle on a quarter (every three months) basis for flocks started the past 15 months (historical fact) and the future nine months (predicted price). The price calculation has been based on the monthly average of the Detroit, Michigan wholesale distributor paying price for grade A large size eggs.

However, included in the egg price prediction model are (Larzelere, 1971b):

1. monthly hatch number for layers,
2. monthly cull number for layers,
3. monthly layer number,
4. monthly rate of lay for egg-type chickens,
5. historical trends of egg production and price levels,
6. seasonal factors and an adjustment for price elasticity of demand.

The price prediction report has been issued several times a year for use by the Michigan poultry industry as an aid in projecting profits for an existing or future laying flock.

OBJECTIVES

1. To evaluate an egg price prediction model used in the United States as a long range egg price prediction model for the Japanese egg industry with the following being supportive:
   a. To investigate the important factors affecting the Japanese egg price.
   b. To evaluate the existing Japanese statistical data in terms of completeness for use in price forecasting.
   c. To understand the Japanese egg price system.

EGG INDUSTRY IN JAPAN--GENERAL STATISTICS

During the last decade numbers of farms having egg production has decreased 65 percent while layer number has increased 2.65 times (Table 1). Within this same time period, 1960 to 1970, per capita egg consumption has increased from 101 to 295 eggs per person. Egg production per layer has improved 16.7 percent during the ten year period, 1960 to 1970. Importation of breeding stock from foreign countries began in 1963.

Egg production has gradually specialized into a few large scale enterprises and middle-sized laying flock producers. In 1971, less than 2 percent of the total producers with more than 1,000 size laying flocks owned 85.4 percent of the layers in Japan (Anonymous, 1971b). One crucial point of the Japanese egg industry is the supply of feed ingredients. In 1969, the dependency of imported feed ingredients was 81.4 percent (Anonymous, 1972b).

Table 1. General statistics of the Japanese egg industry[1]

Year	Farms Producing Eggs Number (thousand)	Farms Producing Eggs Index (1960=100%)	Number of Layers Number (thousand)	Number of Layers Index (1960=100%)	Egg Production (eggs/hen)	Egg Consumption (per capita)	Population (No. People) (thousand)
1955[2]	4,508[3]	117.4	39,590[3]	89.0	176	76	89.276
1960[2]	3,839	100.0	44,500	100.0	204	101	93,419
1965	3,227	84.1	80,090	198.0	219	190	98,275
1966	2,753	76.9	81,240	182.6	224	190	99,056
1967	2,493	64.9	89,030	200.1	227	234	100,243
1968	2,179	56.8	97,500	219.1	230	248	101,408
1969	1,931	50.3	109,910	246.3	234	276	102,648
1970	1,696	44.2	118,200	265.3	235	295	103,720
1971	1,373	35.8	123,906	278.4			

[1]Source: Japan, The Ministry of Agriculture and Forestry (Anonymous, 1971a)

[2]Layers for breeding are included

[3]Numbers are determined on February 1

EGG MARKET SYSTEM IN JAPAN

A. Prefecture surplus-deficit relation, 1955, 1970.

Data on the surplus or deficit status of egg production in an individual prefecture (equivalent to a state in the United States) illustrate how the movement of eggs to the market place between regions has shifted (Figures 1, 2 and 3). The general tendency was for the major city areas to be more deficit while some of the originally deficit areas, even though there is considerable winter snow, have become surplus.

In the mid-1950's, the main egg production prefectures had the following characteristics (Sugiyama, 1971):

1. Located close to the major markets--Tokyo, Nagoya, Osaka, Fukuoka.
2. Located in a relatively fair climate.
3. Located close to the feed mills that had been concentrated near the Pacific Ocean ports.

In the mid-1960's, the main change of surplus-deficit relation had taken place in the southern island, Kyushu. The main island, Honshu, had become industrialized and urbanized, especially on the Pacific Ocean side. As a result, the people on the Kyushu Island were involved more in agriculture with egg production being one of the expanding agricultural enterprises. Another change was the

Island	Hokkaido	Honshu	Honshu	Honshu	Honshu	Honshu
Region	Hokkaido	Tohoku	Kanto	Tozan	Hokuriku	Tokai
Prefecture	1 Hokkaido	2 Aomori	9 Gunma	16 Yamanashi	8 Niigata	21 Gifu
		3 Akita	10 Tochigi	17 Nagano	18 Toyama	22 Aichi
		4 Iwate	11 Ibaraki		19 Ishikawa	23 Shizuoka
		5 Miyagi	12 Chiba		20 Fukui	24 Mie
		6 Yamagata	13 Saitama			
		7 Fukushima	14 Tokyo			
			15 Kanagawa			

Island	Honshu	Honshu	Shikoku	Kyushu	Okinawa
Region	Kinki	Chugoku	Shikoku	Kyushu	Okinawa
Prefecture	25 Shiga	31 Okayama	36 Kagawa	40 Fukuoka	47 Okinawa
	26 Kyota	32 Tottori	37 Tokushima	41 Saga	
	27 Nara	33 Hiroshima	38 Kochi	42 Nagasaki	
	28 Wakayama	34 Shimane	39 Ehime	43 Oita	
	29 Osaka	35 Yamaguchi		44 Kumamoto	
	30 Hyogo			45 Miyazaki	
				46 Kagoshima	

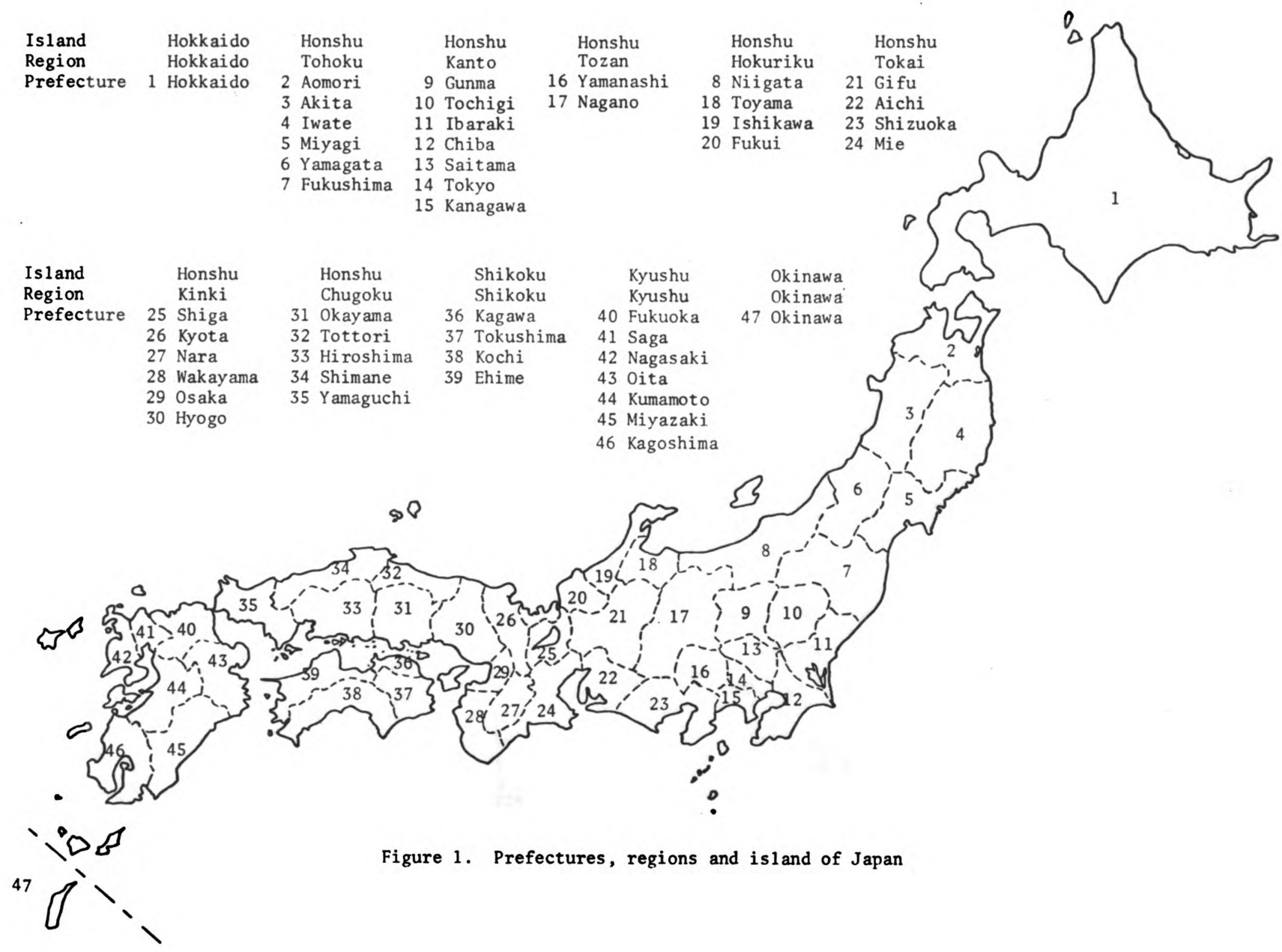

Figure 1. Prefectures, regions and island of Japan

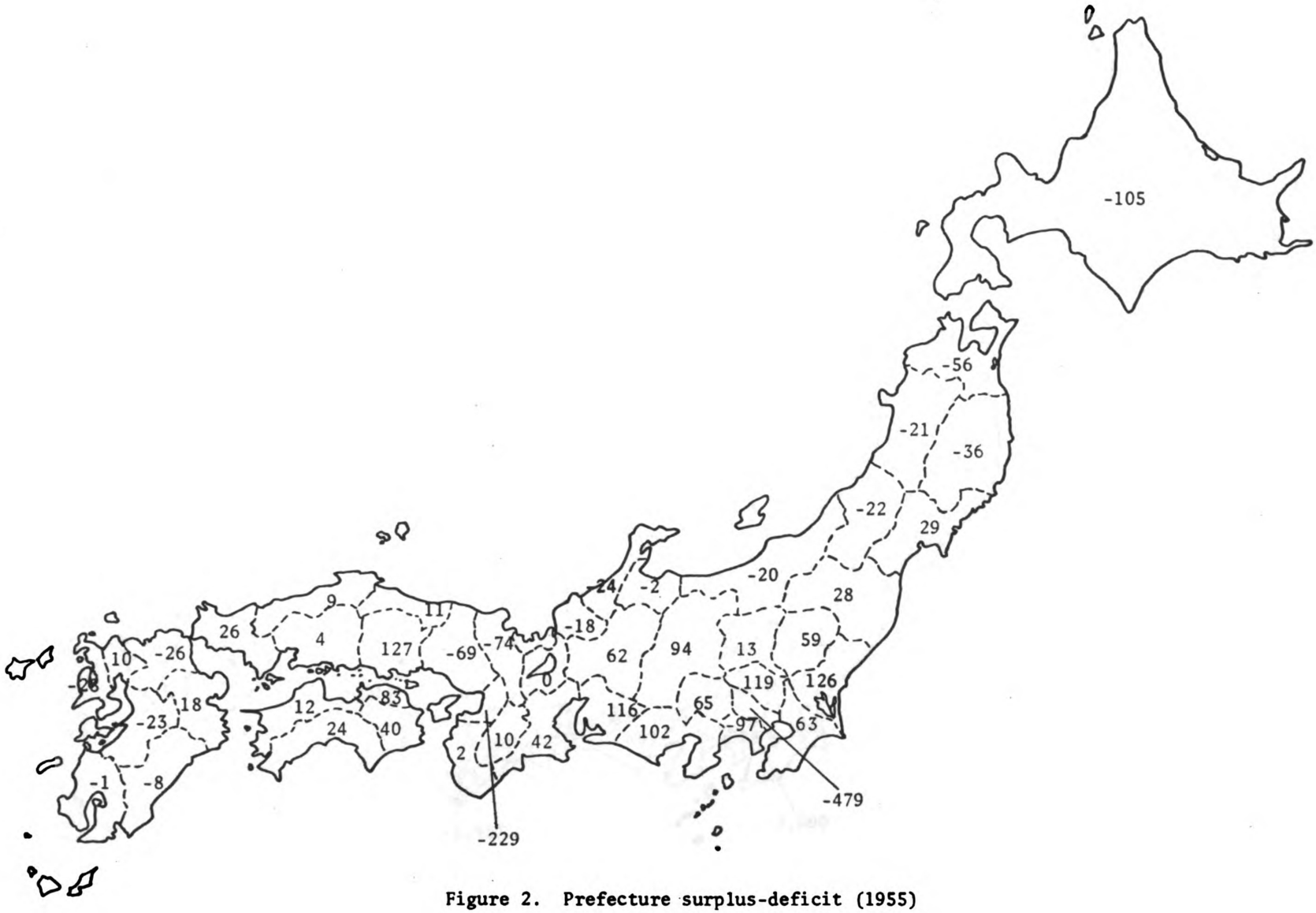

Figure 2. Prefecture surplus-deficit (1955)

Unit: Number of eggs (thousands)

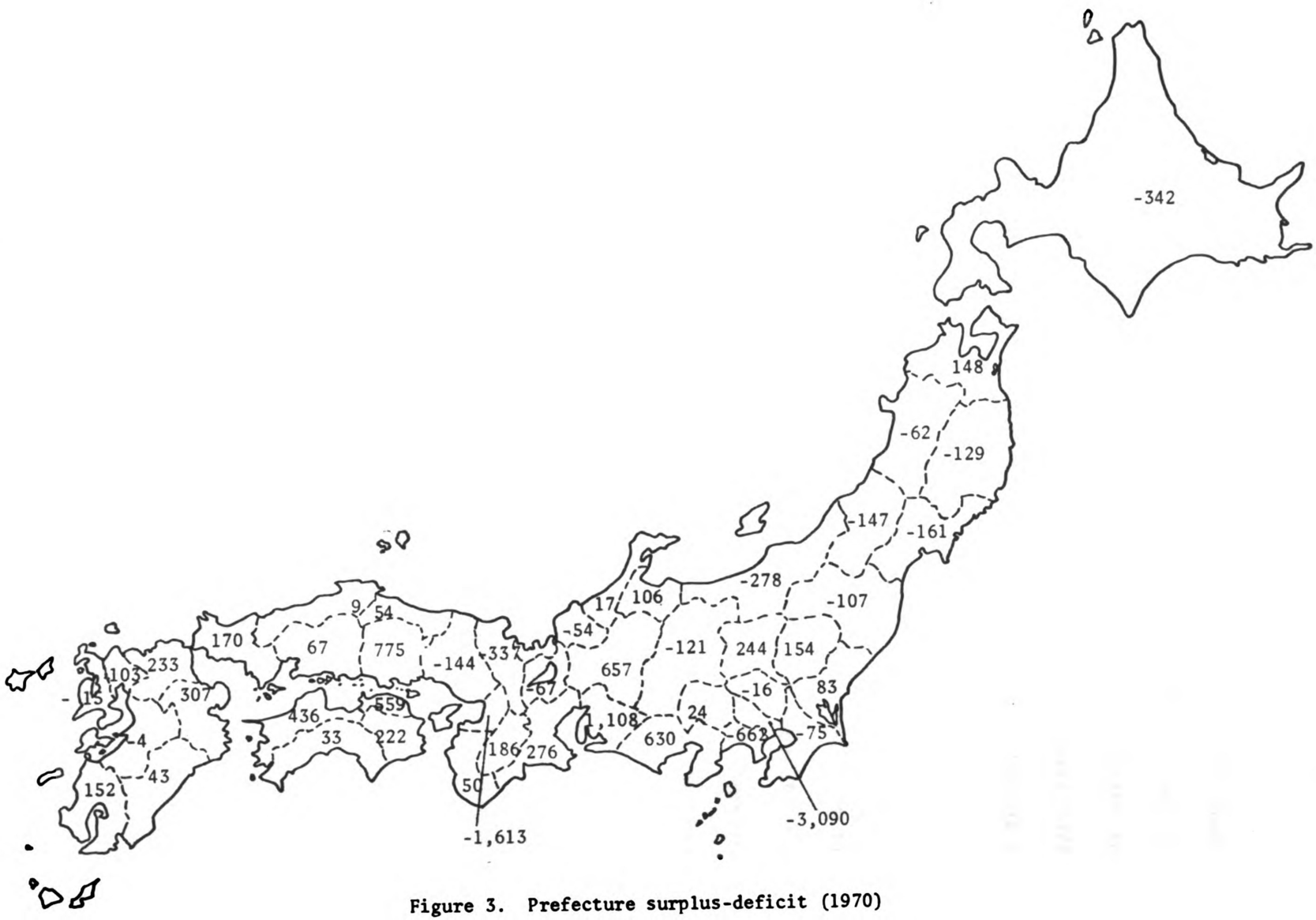

Figure 3. Prefecture surplus-deficit (1970)

Unit: Number of eggs (thousands)

tourist resort areas, such as, the island of Hokkaido and the prefectures of Nagano and Kyoto became more deficit.

The prefectures that are close to the major cities had an expansion in egg production; however, the prefectures in which the major cities are located became more deficit. Despite heavy snow in the winter, the prefectures of Aomori, Toyama and Ishikawa have become surplus, probably because of labor availability and technological advances in housing.

B. Egg flow from production area to 11 major markets.

As shown in Table 2, the flow of eggs from the major production areas to the major markets can be blocked into two separate areas. The northern region (Figure 4) had the five markets of Sapporo, Sendai, Tokyo, Yokohama and Nagoya and the six production areas of Hokkaido, Tohoku, Kanto, Hokuriku, Tozan and Tokai. The southern region had the six markets of Kyoto, Osaka, Kobe, Hiroshima, Kita-Kyushu and Fukuoka and the five production areas of Tokai, Kinki, Chugoku, Shikoku and Kyushu. The division of these two regions, northern and southern, was not completely separate because the Tokai production area provided eggs for markets in both regions as did Kinki, Kanto and Kyushu.

The egg flow to the major markets from the regional production areas illustrate the significance of each market and production area. Tokyo was the most important market in Japan in 1969 with Osaka being the second largest (Table 2). These two markets received 28.1 percent of the total eggs; whereas, the 11 cities accounted for 45.1 percent

Table 2. Percentage egg flow from production area to 11 major markets in 1969[1]

Region of Origin	City										
	Sapporo	Sendai	Tokyo	Yokohama	Nagoya	Kyoto	Osaka	Kobe	Hiroshima	Kita-Kyushu	Fukuoka
	(Percentage)										
Hokkaido	54.0	-	-	-	-	-	-	-	-	-	-
Tohoku	16.8	75.3	0.9	-	-	-	-	-	-	-	-
Kanto	-	14.6	45.0	31.2	-	1.3	0.3	-	-	-	-
Hokuriku	-	-	0.2	-	-	-	-	-	-	-	-
Tozan	-	-	2.4	-	-	-	-	-	-	-	-
Tokai	11.7	-	41.1	63.8	98.6	23.7	2.7	-	-	-	-
Kinki	5.3	-	1.1	-	-	38.3	40.8	58.7	-	-	-
Chugoku	-	-	1.1	-	-	9.3	21.4	18.7	93.2	-	-
Shikoku	-	-	0.6	-	-	19.1	28.2	18.9	4.9	14.9	-
Kyushu	-	-	6.9	2.1	-	5.0	5.8	-	-	82.2	94.6
Percentage of Total Production	1.2	0.8	17.3	2.9	3.0	2.5	10.8	2.1	1.2	1.6	61.7

[1]Source: Japan, The Ministry of Agriculture and Forestry (Anonymous, 1971a)

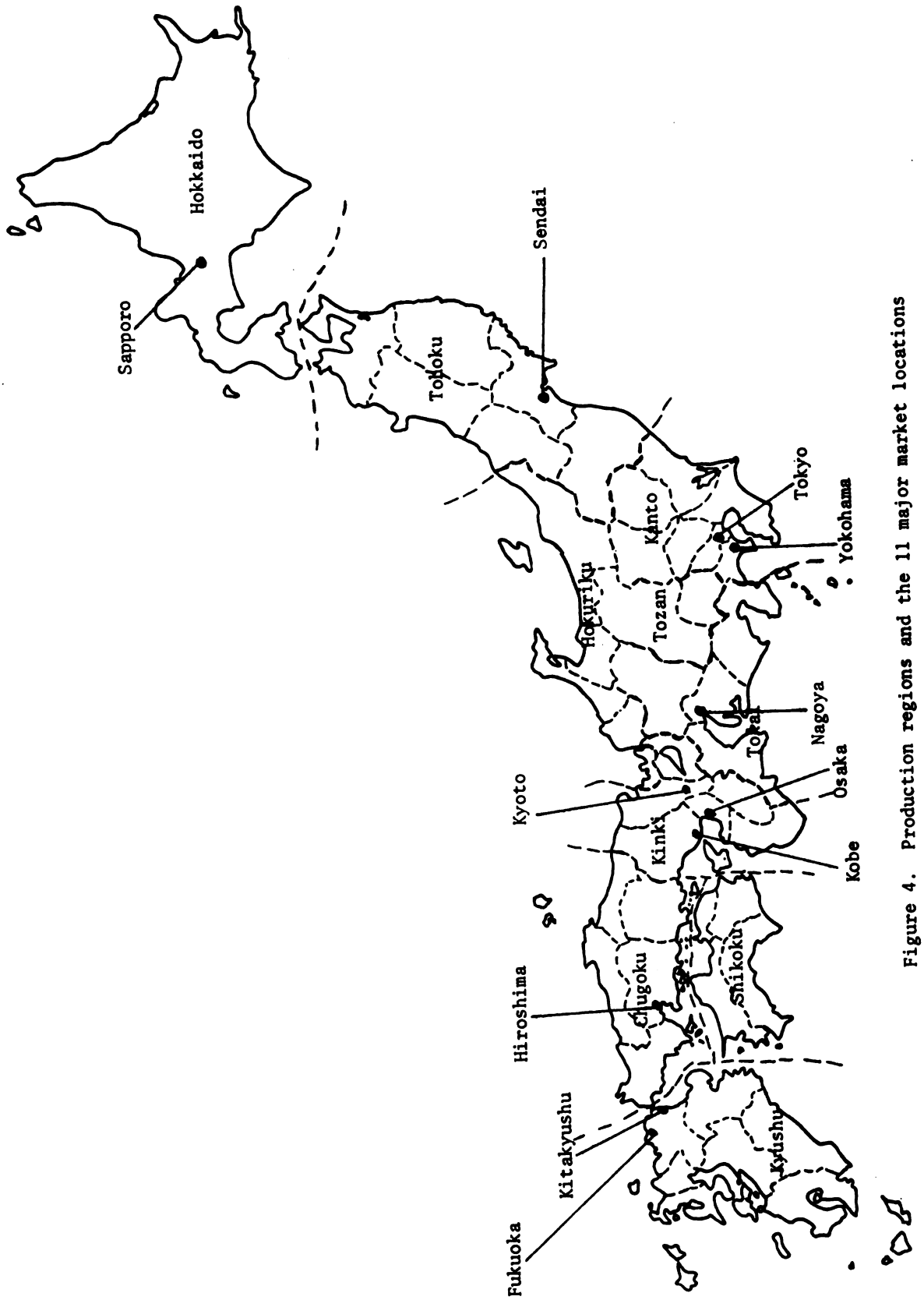

Figure 4. Production regions and the 11 major market locations

of the total eggs. The two major production areas were Tokai and Kanto which produced 39.4 percent of the total eggs.

C. Egg marketing channels.

A survey reported by the Japanese Ministry of Agriculture and Forestry in 1972 (Anonymous, 1972a) illustrated the egg marketing channels and the proportion of egg flow through each channel. The actual survey was conducted during 1968 and included egg marketing organizations and agencies dealing with over ten tons (2,000 pounds/ton) of eggs each year. Imported eggs, eggs used for hatching and those eggs consumed on the farm were excluded. Each organization or agency is defined:

1. General Farm Bureau--A cooperative organization that had four functions: enterprise consultation, purchase of input materials, sale of products and credit for members. Other commodities, such as rice, livestock and vegetables, are also handled.

2. Egg Farm Bureau--A specialized cooperative organization that handled only eggs and usually did not have a credit function.

3. Federal Farm Bureau--A prefectural organization for local General Farm Bureau and Egg Farm Bureau organizations.

4. Egg Marketing Association--A private organization of egg producers.

5. Trucker--An agency that functioned in assembling eggs from producers and transporting the eggs to the market place.

6. Large Scale Independent Producer--A producer that produced over ten tons of eggs and shipped directly to the Egg Markets, Wholesalers or Retailers.

7. Egg Markets--The large city markets, such as Tokyo and Osaka. Two-thirds of the Egg Markets were managed by a national federation of Farm Bureau called "Zennoren." The remaining one-third were private corporations. The function of the Egg Markets was to receive eggs, establish wholesale price and market eggs wholesale to distributors, institutions, retailers or processors. The Egg Market charged one percent of gross sales as a commission.

8. Wholesaler--Was limited mostly to a local area of distributing eggs purchased from the Egg Markets or assemblies to retailers, institutions or processors.

9. Retailer--Included grocery store, super-market, specialized egg store and institutions.

10. Processor--Included the breakers, cake manufacturers and mayonnaise manufacturers.

As shown in Figure 5, in the assembly stage about 30 percent of the eggs produced by the 1.9 million producers were assembled by Farm Bureaus. Another 30 percent were assembled by the Egg Marketing Associations and truckers. However, the largest proportion, 40 percent of the assembly stage, was performed by individual producers, especially large scale independent producors that shipped directly to wholesalers, retailers or processors.

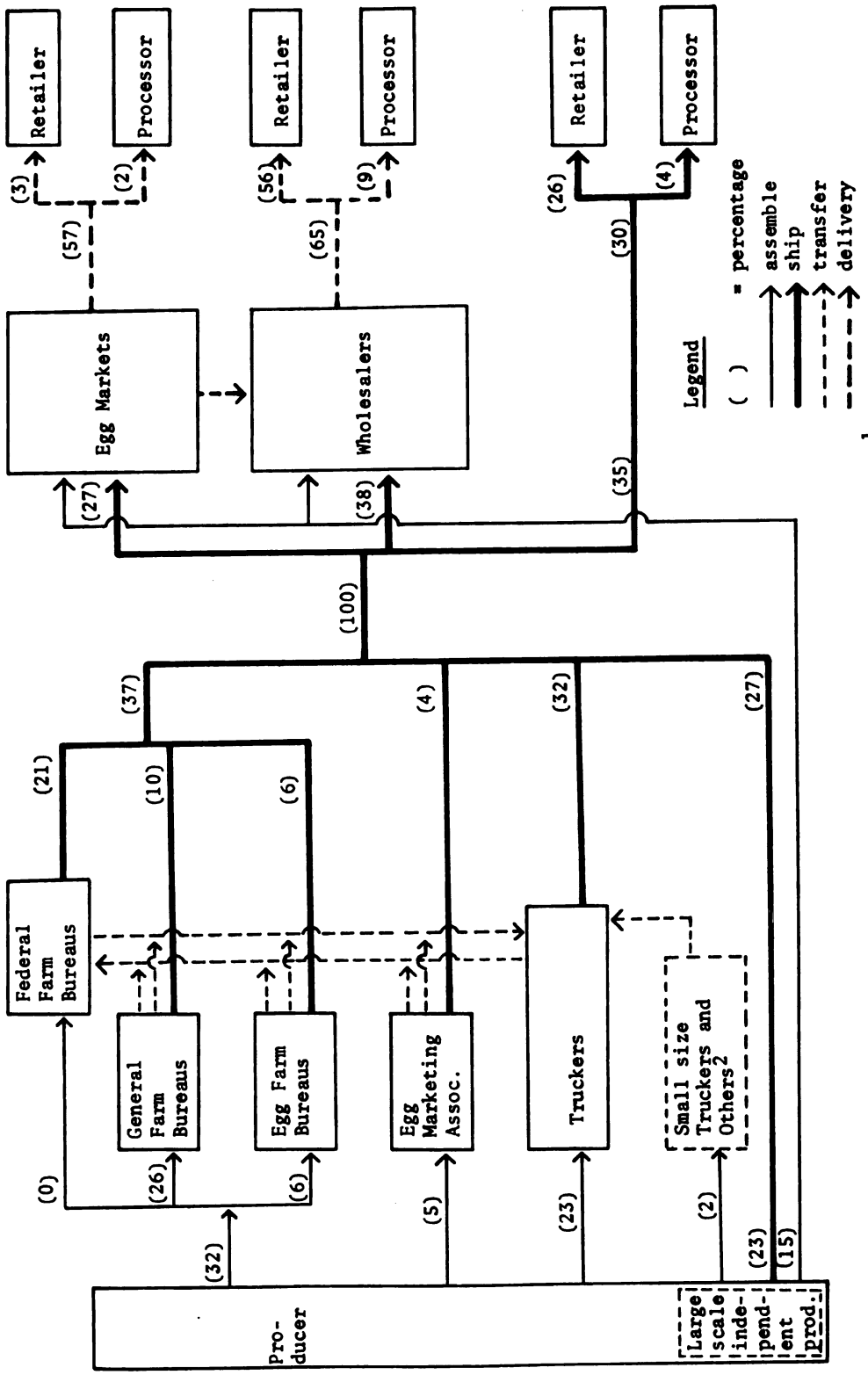

Figure 5. Japanese egg market channels[1]

[1]Source: Japan, The Ministry of Agriculture and Forestry (Anonymous, 1972a).

[2]Dealt with under 10 ton per year.

Approximately 20 percent of the eggs were received by the Egg Markets, primarily from the Federal Farm Bureaus; and over 50 percent of the eggs were received by wholesalers. Wholesalers supplied 65 percent of the total eggs to retailers or processors. The remaining percentage of eggs were shipped directly to retailers or processors. About 50 percent of the large scale independent producers were observed to have a direct connection with the retailing stage. Of the total eggs, 15 percent went to the processing segment.

Egg sizing, grading and packaging practices were not surveyed in this report (Anonymous, 1972a); however, sizing and grading was done at all stages with 40 to 50 percent of the eggs being sold in 10-egg cartons at the retail store.

D. Egg price quotation.

In recent years, quotation prices for wholesale shell eggs have originated from the cities of Sapporo, Sendai, Tokyo, Yokohama, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Fukuoka and Kita-Kyushu (Anonymous, 1971a). These quotations are obtained from the Egg Markets (wholesale receivers) in each city, except Yokohama, and the quotation price is determined from the wholesale receivers' sales price to wholesale distributors. In Yokohama the price is determined from bids of wholesale distributors.

Of the quotations, the Tokyo quotation is the most important because:

1. The Tokyo market is the largest market.
2. The transportation system is centralized in Tokyo.

3. The Tokyo quotation is used by four of the Egg Markets (Zennoren, Toyokeiran, Tokyo Keiran and Yokeishinko). One of these Egg Markets is managed in each city by Zennoren (National Federation of Farm Bureau). Zennoren handles 36 percent of the total egg supply in Japan.

The standard quotation price is expressed as yen per one kilogram of grade "Excellent" eggs in a ten kilogram case. Price differentiation by size is not considered for large, medium and small; but if the ten kilogram case contains extra small eggs, the price is discounted. There is a price differential for quality (usually 2-3 yen/kg between Excellent and First Class grades) with a greater discount being applied in summer than winter months.

EGG PRICE PREDICTION MODEL FOR JAPAN

A. General procedure.

The monthly egg price prediction model followed in this study was that of Larzelere (1971b). The variables and their relationship to each other are shown in Figure 6. The prediction model was considered hypothetical and was evaluated using historical data to predict the 1971 Tokyo wholesale price. The Tokyo wholesale price was the price in yen of one kilogram of "Excellent" grade eggs in a ten kilogram case. Japanese grades and sizes for eggs are:

Grade	Size	
Excellent	Large,	62-74 g/egg
First Class	Medium,	50-62 g/egg
Second Class	Small,	44-50 g/egg
Off-Grade	Extra Small,	36-44 g/egg

The historical data used were for the six year period, 1965 through 1970. This relatively short time period was selected because it was considered to be representative of the presently existing Japanese poultry industry.

The actual monthly historical data used in the various calculations are presented in Tables 3 (Tokyo wholesale egg price), 4 (retail feed price), 5 (egg/feed price ratio), 6 (number of pullet

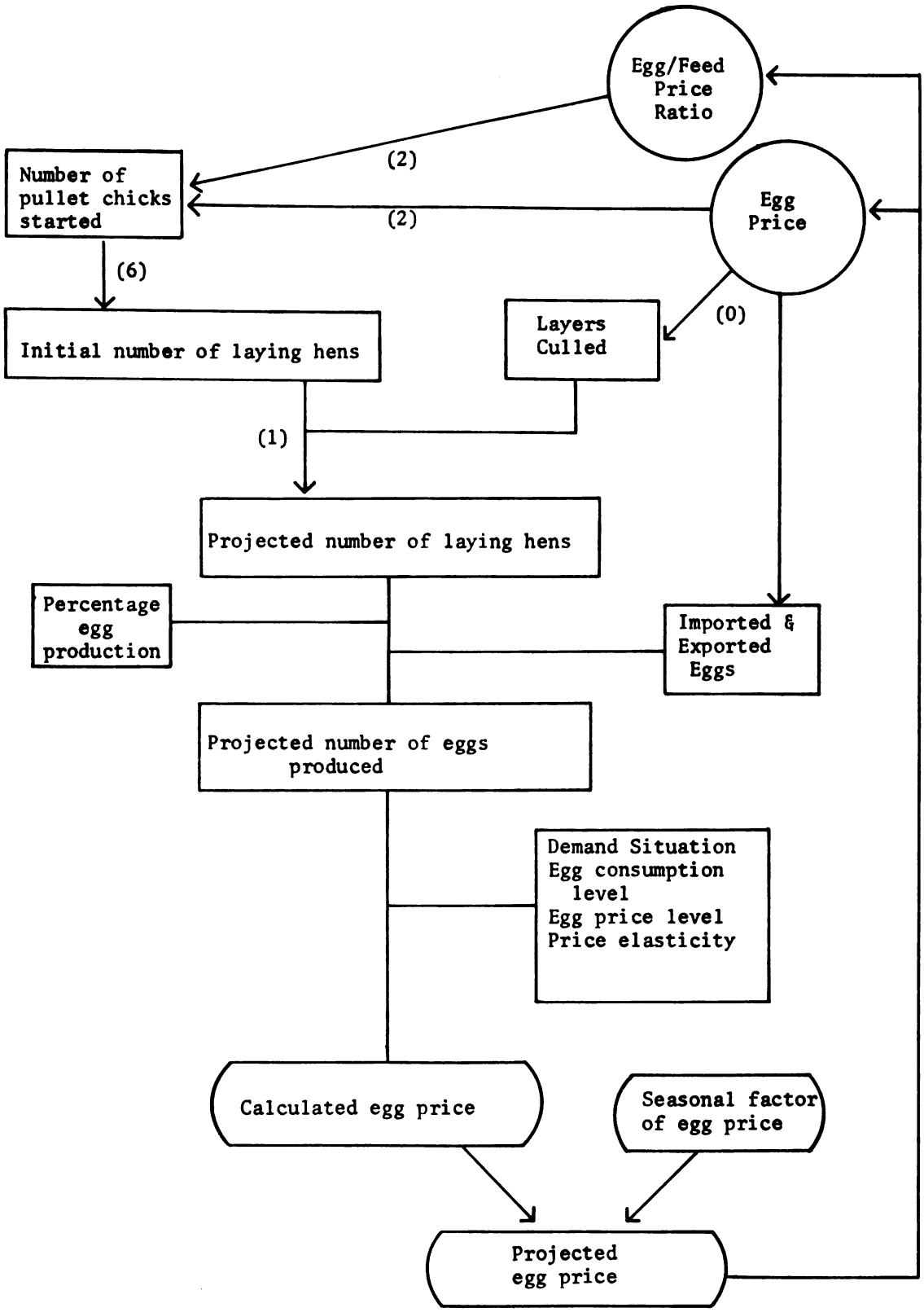

Figure 6. Variables in egg price prediction model

( ) Number indicates monthly time lag.

Table 3. Tokyo wholesale egg price[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	161[2]	171	181	163	151	152	166	190	220	217	228	248	187
1966	228	251	200	199	179	192	170	181	206	207	195	219	202
1967	201	211	204	170	153	155	160	193	214	204	215	235	193
1968	228	250	227	183	180	169	170	178	207	182	210	209	199
1969	176	189	212	179	162	169	160	165	190	209	221	246	190
1970	225	225	209	176	153	159	149	167	181	207	210	248	192
1971	183	195	186	166	160	160	161	192	221	203	208	223	188

[1]Source: Anonymous, 1972c

[2]Yen per one kilogram of egg

Table 4. Retail feed price[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	765[2]	774	778	779	780	780	779	780	780	780	787	793	780
1966	794	795	796	797	797	797	796	796	796	796	796	796	796
1967	796	796	796	795	795	794	795	794	795	794	793	794	795
1968	782	790	789	784	783	783	783	783	783	784	775	774	783
1969	773	773	773	772	773	773	773	773	774	773	772	773	773
1970	773	778	783	805	807	807	808	816	823	843	847	850	812

[1]Source: Anonymous, 1971c

[2]Yen per 20 kilogram of feed

Table 5. Egg/feed price ratio[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	.2104	.2209	.2326	.2092	.1935	.1948	.2130	.2435	.2820	.2782	.2897	.3127	.2897
1966	.2871	.3157	.2512	.2496	.2245	.2409	.2135	.2273	.2587	.2600	.2446	.2751	.2537
1967	.2525	.2650	.2562	.2138	.1924	.1952	.2012	.2430	.2691	.2569	.2711	.2959	.2427
1968	.2915	.3164	.2877	.2334	.2298	.2158	.2171	.2273	.2643	.2321	.2709	.2700	.2541
1969	.2276	.2445	.2742	.2318	.2095	.2186	.2069	.2134	.2454	.2703	.2863	.3182	.2457
1970	.2910	.2892	.2669	.2186	.1895	.1970	.1844	.2046	.2199	.2455	.2479	.2917	.2364

[1] Egg/feed price ration = $\frac{\text{egg price (yen/kilogram of eggs) - Table 3}}{\text{feed price (yen/20 kilogram of feed) - Table 4}}$

Table 6. Number of pullet chicks started[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	6,953[2]	11,299	16,419	14,583	9,842	6,465	4,636	4,505	6,061	7,181	6,805	6,425	101,172
1966	7,967	11,442	17,785	16,907	12,128	8,330	6,992	6,496	7,320	7,900	7,484	6,530	117,281
1967	8,013	11,271	16,222	15,454	11,435	8,173	7,123	7,004	7,759	8,744	8,485	7,393	117,076
1968	8,554	12,270	16,102	16,344	14,905	11,447	9,859	9,223	9,427	10,296	9,308	8,119	136,052
1969	9,814	12,806	17,014	16,502	14,625	11,137	10,205	9,427	9,938	11,040	9,687	8,783	140,978
1970	10,532	13,048	17,835	17,495	15,783	12,185	10,540	9,383	9,933	10,273	8,947	7,696	143,650
Average Percentage	6.85	9.53	13.40	12.86	10.40	7.63	6.52	6.08	6.66	7.33	6.70	5.94	--

[1]Source: Anonymous, 1971d

[2]Unit = thousand birds

chicks started), 7 (number of laying hens), 8 (percentage egg production) and 9 (number of eggs produced). Additional data are listed in the Appendix Tables--1 (number of eggs produced, adjusted for difference in number of days per month), 2 (seasonality of Tokyo wholesale price), 3 (seasonality of number of pullet chicks started), 4 (seasonality of number of laying hens), 5 (seasonality of percentage egg production) and 6 (seasonality of number of eggs produced).

B. Projection of pullet chicks started.

Various factors are involved in a producer's decision making process to determine the number of baby chicks which will be purchased. Included are such factors as labor return, market outlet, egg price, feed cost and chick cost. Of these factors, egg price and feed cost are greatly influential in the profitability of the enterprise. Thus, it is projected that if egg price or the egg/feed price ratio is high, a producer would order more baby chicks and vice versa.

The egg price and egg/feed price ratio occurring two months prior to the actual chick placement were assumed to be the proper ones to use in making calculations. The egg/feed price ratio was equal to:

$$1.\quad (Y_{-12} - Y) = a + b\,(P_{-14} - P_{-2})$$

$$2.\quad (Y_{-12} - Y) = a + b\,(E/Fd_{-14} - E/Fd_{-2})$$

where: Y = monthly number of pullet chicks started

P = monthly Tokyo wholesale egg price

E/Fd = monthly egg/feed price ratio

Table 7. Number of laying hens[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	90,517[2]	88,093	86,520	86,258	85,238	83,429	81,867	80,548	82,888	85,098	85,387	86,106	85,162
1966	83,389	81,237	80,610	80,362	80,613	80,608	80,498	80,123	84,617	88,594	90,143	92,206	83,583
1967	101,945	100,537	101,305	101,359	101,012	100,516	100,705	101,507	104,283	106,313	106,504	107,170	102,763
1968	103,889	102,215	102,623	103,446	103,979	103,510	104,321	105,835	109,636	112,336	114,903	116,615	106,940
1969	115,745	115,530	115,979	116,550	117,096	117,071	116,766	117,405	121,559	123,684	125,657	126,280	119,110
1970	125,394	124,877	124,965	124,842	124,906	125,148	125,178	125,439	129,794	131,248	133,089	133,253	127,350
Average Percentage	8.28	8.17	8.16	8.17	8.17	8.14	8.13	8.15	8.44	8.63	8.74	8.82	--

[1]Source: Anonymous, 1971e

[2]Unit = thousand birds

Table 8. Percentage egg production[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
1965	52.0	57.4	64.1	68.7	67.3	65.3	63.3	61.1	56.9	54.0	53.5	56.2	59.9
1966	53.6	58.3	65.1	69.0	67.8	64.5	65.2	63.2	59.2	57.0	56.0	58.4	61.5
1967	54.6	59.0	65.2	69.5	68.2	66.4	64.6	63.0	59.8	58.3	57.6	59.5	62.1
1968	55.6	58.9	64.8	69.3	68.4	67.0	65.8	64.0	61.7	60.7	60.5	60.9	63.1
1969	57.6	61.3	66.1	70.1	69.2	67.5	66.3	64.8	62.5	61.7	61.6	61.7	64.2
1970	58.2	61.3	66.0	70.1	69.0	67.5	66.3	64.8	63.1	62.6	62.3	62.8	62.4

[1]Source: Anonymous, 1971e

Table 9. Number of eggs produced[1]

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1965	1,459[2]	1,415	1.719	1,777	1,777	1,634	1,608	1,526	1,415	1,424	1,371	1,500	18,625
1966	1,386	1,326	1,626	1,664	1,695	1,561	1,627	1,569	1,504	1,565	1,516	1,669	18,756
1967	1,730	1,662	2,048	2,112	2,136	1,999	2,018	1,985	1,872	1,926	1,843	1,977	23,307
1968	1,795	1,751	2,062	2,150	2,206	2,082	2,127	2,099	2,031	2,112	2,085	2,200	24,694
1969	2,068	1,982	2,376	2,450	2,511	2,370	2,401	2,357	2,279	2,367	2,321	2,417	27,898
1970	2,261	2,144	2,556	2,625	2,672	2,536	2,572	2,521	2,457	2,548	2,488	2,576	29,955
1971	2,469	2,347	2,679	2,701	2,759	2,646	2,634	2,549	2,547	2,608	2,605	2,593	31,137

[1]Source: Anonymous, 1971e

[2]Unit: million eggs

a = intercept

b = slope

-12, -14, -2 = time difference in number of months

A high correlation between Tokyo wholesale egg price and the number of pullet chicks started during months of March through October was observed (Table 10). The same general trend was observed for the relationship between number of pullet chicks started and egg/feed price ratio (Table 11).

From these results, egg price and feed cost were not the only influential factors in determining the number of pullet chicks started. In particular, a relatively low correlation was observed for the months of November through February. Characteristics of the Japanese egg industry which may have an influence are:

1. Periodic culling of the laying flock has been the customary practice rather than replacement of the entire flock at one time.

2. A rapidly expanding industry in terms of layer number, eggs produced per hen and egg consumption per capita (Table 1) has been prevalent in the time period selected for analysis in this study.

3. Pullet chick placements have varied seasonally with an average of 12.22 percent of the chicks being started per month in March, April and May while the average for the other nine months was 7.03 percent (Table 6). However, the average monthly number of laying hens only varied from 8.13 to 8.82 percent.

Table 10. Relationship between number of pullet chicks started and Tokyo wholesale egg price.

Month	Intercept (a)	Slope (b)	Standard Error of Estimation (S.E.)	Coefficient of Determination (R^2)	Correlation Coefficient (r)
Jan.	357.7	19.7	885	.2188	0.468
Feb.	170.0	4.6	760	.0372	0.193
Mar.	151.7	10.3	1,031	.4127	0.642
Apr.	371.8	19.5	763	.7710	0.878*
May	687.4	89.4	1,190	.6495	0.806*
Jun.	1,034.4	42.4	1,257	.4661	0.682
Jul.	1,158.5	48.1	326	.9496	0.975*
Aug.	1,090.2	24.9	716	.6532	0.808*
Sep.	997.9	66.9	197	.9361	0.968*
Oct.	-116.5	-86.3	422	.8781	0.937*
Nov.	629.7	25.8	734	.1555	0.394
Dec.	259.1	2.3	927	.0029	0.054

*Significant $P \leq 0.05$

Table 11. Relationship between number of pullet chicks started and egg/feed price ratio.

Month	Intercept (a)	Slope (b)	Standard Error of Estimation (S.E.)	Coefficient of Determination (R^2)	Correlation Coefficient (r)
Jan.	19,286	451	753	.4245	0.652
Feb.	8,975	208	675	.2410	0.491
Mar.	8,127	149	1,212	.1874	0.433
Apr.	16,281	366	855	.7119	0.844*
May	75,666	671	1,200	.6420	0.801*
Jun.	34,818	1,078	1,243	.4776	0.669
Jul.	38,535	1,212	132	.9918	0.996*
Aug.	22,328	966	779	.5895	0.768†
Sep.	46,395	1,040	135	.9771	0.988*
Oct.	-60,357	- 189	809	.5533	0.744†
Nov.	31,163	815	526	.4812	0.694
Dec.	13,655	344	830	.1992	0.446

†Significant $P \leq 0.10$

*Significant $P \leq 0.05$

C. Projection of number of layers culled.

Statistics on the number of layers culled are not currently available in Japan. Thus, this statistic was estimated from the following equation:

$$Z = (X - X_{+1}) + Y_{-6}$$

where: Z = monthly number of layers culled

X = monthly number of layers

X_{+1} = number of layers one month later than for X

Y_{-6} = number of pullet chicks started six months earlier than for X

The monthly estimate for layers sold is shown in Table 12. From these figures it was obvious that the heaviest culling of the laying flock occurs in the fall months. One explanation for this is that the old hens have to be removed in order to house the new pullets that were started in the late winter and early spring months.

The motivations for a producer to cull hens include the hens' productive efficiency as a direct factor and feed cost, baby chick cost and egg price as exogenous factors. Egg price was assumed to be the most influential exogenous factor. The relationship between Tokyo wholesale egg price and number of layers sold was obtained from the following equation:

$$(Z_{-12} - Z) = a + b\ (P_{-12} - P)$$

where: Z = monthly number of layers culled

P = monthly Tokyo wholesale egg price

a = intercept

Table 12. Estimated number of layers culled

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	21,123[1]	7,112	6,765	8,416	7,420	10,087	4,460	8,803	14,069	14,213	9,134	9,330
1966	6,957	5,199	6,294	6,868	4,103	9,290	8,450	6,624	13,491	15,257	9,868	4,993
1967	8,597	5,775	7,351	8,164	7,684	6,112	7,143	8,562	14,002	15,367	11,006	11,197
1968	5,100	10,539	6,987	8,108	8,964	6,700	7,033	8,337	13,561	13,734	13,212	12,212
1969	10,172	8,774	8,851	9,730	9,327	8,356	9,285	8,598	14,840	14,632	13,871	12,097
1970	10,715	9,337	10,068	10,970	9,447	8,753	10,272	8,698	16,375	15,655	15,513	12,185

[1]Unit: thousand birds

b = slope

-12 = time difference in number of months

Only in three months, January, March and April, was there a significant ($P \leq 0.05$) correlation of Tokyo wholesale price with the number of layers culled (Table 13). In this analysis the inverse relationship observed in the United States (Larzelere, 1972) was not demonstrated in the Japanese data. One explanation for this confusing phenomenon may be the management practice of periodic culling. Apparently, hens were culled by egg production efficiency rather than in relation to the Tokyo wholesale egg price.

D. Projection of number of laying hens for 1970

The projection of the number of laying hens was mathematically calculated as follows:

1. $Z = (X - X_{+1}) + Y_{-6}$
2. $X_{+1} = X - (Z - Y_{-6})$
3. $X = X_{-1} - (Z_{-1} - Y_{-7})$

Where: Z = monthly number of layers culled

X = monthly number of layers

Y = monthly number of pullet chicks started

+1, -6, -1, -7 = time difference in number of months

Two different projections were made. Projection number one was based on calculations using the actual number of laying hens for the previous month; whereas, the second projection was based on calculations using the projected number of laying hens for the previous month.

Table 13. Relationship between number of layers culled and Tokyo wholesale egg price.

Month	Intercept (a)	Slope (b)	Standard Error of Estimation (S.E.)	Coefficient of Determination (R^2)	Correlation Coefficient (r)
Jan.	- 591	116	5,202	.6310	0.794*
Feb.	357	8	3,066	.0318	0.178
Mar.	- 513	- 27	246	.9571	0.978*
Apr.	636	- 48	728	.7712	0.878*
May	405	- 63	2,204	.4121	0.642
Jun.	- 306	28	1,847	.2484	0.498
Jul.	1,294	39	2,337	.0320	0.179
Aug.	358	82	1,307	.4060	0.637
Sep.	413	- 6	1,110	.0368	0.192
Oct.	369	40	1,062	.3507	0.592
Nov.	1,283	3	748	.0094	0.097
Dec.	621	63	3,849	.2166	0.465

*Significant $P \leq 0.05$

The percentage difference between actual and projected numbers show the accuracy of the first projection method. Except for January and February, the percentage difference was less than one percent (Table 14). This indicates that if the previous months' number of laying hens is known, the next months' number can be projected with accuracy. To decrease the large percentage differences for January and February, some adjustment by standard errors of layers sold and/or hatch number projections could be made.

In the case of the second projection method, where the number of laying hens was projected from a projected number, there was a greater percentage difference between the actual and projected number of laying hens (Table 14). Thus, one difficulty of using a projected figure to project another figure is that inaccuracies are also carried in a serial fashion. Thus, the first inaccuracy is carried to the next projection and so forth.

E. Estimation of layer output

Egg output per layer is affected by various factors in terms of a short time range and a long time range. Improvements in genetics and poultry husbandry practices are long range factors; whereas, infectious disease outbreaks, weather conditions and age of layers are short range factors. In the future based on the historical data (Table 8), a higher laying rate is expected in the cooler months than the warmer months with yearly laying rate gradually increasing.

Thus, in estimation of the Tokyo wholesale egg price for 1971, the output per layer was assumed to be one percent higher during the

Table 14. Projected number of laying hens for 1970

Month	Actual Number of Birds	Projected Number of Birds[1]	Percentage Difference From Actual Number	Projected Number of Birds[2]	Percentage Difference from Actual Number
Jan.	125,394[3]	123,446	-1.55	123,446	-1.55
Feb.	124,877	131,408	5.22	129,460	3.67
Mar.	124,965	125,766	0.64	130,349	4.30
Apr.	124,842	124,655	-0.14	130,039	4.16
May	124,906	125,632	0.58	130,829	4.74
Jun.	125,148	124,105	-0.83	130,028	3.89
Jul.	125,178	125,256	0.06	130,136	3.96
Aug.	125,439	125,412	-0.02	130,370	3.93
Sep.	129,794	129,465	-0.25	134,396	3.54
Oct.	131,248	130,204	-0.79	134,806	2.71
Nov.	133,089	131,853	-0.92	135,411	1.74
Dec.	133,253	132,220	-0.77	134,542	0.96

[1]Based on calculations using the actual number of laying hens for the previous month

[2]Based on calculations using the projected number of laying hens for the previous month

[3]Unit = thousand birds

months September through February and 0.5 percent higher during the months March through August than in 1970.

F. Imported and exported eggs.

The total monthly supply of eggs in Japan fluctuates with eggs produced, number of laying hens and eggs traded with foreign countries. During the time period of 1965 to 1970, less than 0.1 percent of the Japanese egg production was exported (Anonymous, 1971b). Thus, egg exports were ignored in the various mathematical calculations made in this study.

Imported eggs in 1965 were less than 0.1 percent of the domestic egg number; however, this had increased to 1.69 percent in 1968 and 2.02 percent in 1970 (Anonymous, 1971b). Most of the imported eggs were in the frozen liquid form (76.8%) in 1970.

As shown in Figure 7, there appears to be a relationship between Tokyo wholesale egg price and the monthly total of imported eggs. Furthermore, it has been reported (Sato, et al., 1972) that a two month time lag exists from the time of ordering product to arrival of the product in Japan. Thus, the relationship of the Tokyo wholesale egg price to egg imports was evaluated as follows:

1. The two months' earlier Tokyo wholesale egg price to the importation of eggs.
2. Same as 1 except that the import figures would immediately be reduced when the Tokyo wholesale egg price reached 210 yen per kilogram egg.

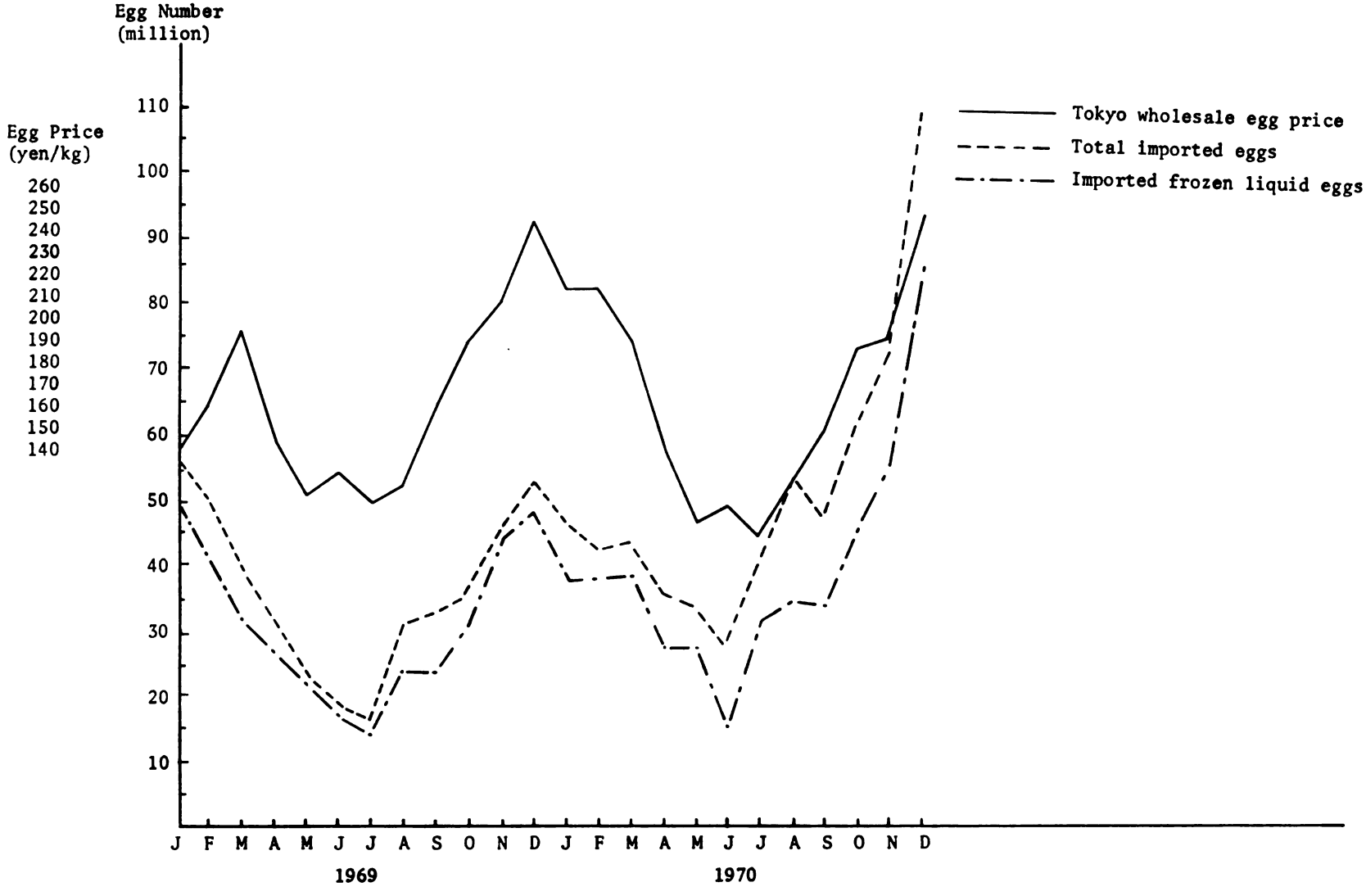

Figure 7. Relationship of Tokyo wholesale egg price and total imported eggs or frozen liquid eggs.

3. The importation of eggs is related to the same month Tokyo wholesale egg price.

The data shown in Table 15 indicate that the imported egg volume in a month has a relationship to the same months' Tokyo wholesale egg price rather than a time delay of two months. Since the same months' Tokyo wholesale egg price is not known in advance, the use of egg imports in projection analysis becomes difficult.

G. Projection of total egg production for 1971.

The projected egg production supply was calculated from the following equation:

$$S = (M \times X) \times R$$

where: S = monthly number of eggs produced

M = number of days in month with adjustment index for difference in days per month of 28 x 1.11
29 x 1.07
30 x 1.03
31 x 1.00

X = monthly number of layers

R = monthly rate of lay

The projection, as shown in Table 16, ranged from a -3.72 percent in February to a +2.58 percent in April with four months, March, June, September and October being lower or higher by less than 0.5 percent.

Table 15. Relationship between Tokyo wholesale egg price and the total imported eggs or imported frozen liquid eggs.

		1969					1970				
	Assumption[1]	Intercept (a)	Slope (b)	Standard Error of Estimation (S.E.)	Coefficient of Determination (R^2)	Correlation Coefficient r	Intercept (a)	Slope (b)	Standard Error of Estimation (S.E.)	Coefficient of Determination (R^2)	Correlation Coefficient r
Total Imported Eggs	1	-18.8	0.2891	8.7	0.3368	0.580*	57.1	0.0018	22.9	0.0018	0.042
	2	-32.2	0.3707	13.1	0.3259	0.571†	42.7	0.0029	30.3	0.0029	0.054
	3	-21.7	0.3074	10.8	0.3979	0.631*	-37.6	0.4762	16.7	0.4762	0.692*
Imported Frozen Liquid Eggs	1	-19.7	0.2692	10.1	0.3472	0.589*	13.1	0.1420	18.6	0.0130	0.114
	2	-38.4	0.3744	9.9	0.3955	0.629*	27.8	0.0612	18.4	0.0409	0.202
	3	-25.1	0.2966	9.5	0.4404	0.664*	-40.5	0.4165	11.8	0.5890	0.767**

[1]See text page 47.

†Significant $P<0.10$

*Significant $P<0.05$

**Significant $P<0.01$

Table 16. Projected number of eggs produced by month in 1971 as compared to the actual numbers reported.

Month	Projected Number Eggs Produced	Actual Number Eggs Produced	Percentage Difference
Jan.	2,419[1]	2,469	-2.02
Feb.	2,508	2,605	-3.72
Mar.	2,687	2,679	0.29
Apr.	2,858	2,782	2.58
May	2,781	2,759	0.79
Jun.	2,735	2,725	0.36
Jul.	2,698	2,634	2.42
Aug.	2,610	2,549	2.39
Sep.	2,613	2,623	-0.38
Oct.	2,603	2,608	-0.19
Nov.	2,608	2,683	-2.79
Dec.	2,646	2,593	2.04

[1]Unit = million eggs

H. Estimation of demand.

Demand for a product is assumed to be primarily determined by price, quantity of supply, consumer disposable income and population. To determine the demand curve for eggs, the relationship between per capita egg consumption and Tokyo wholesale egg price was examined. The consumer disposable income was not considered because the income elasticity of demand for eggs was 0.35135 in 1963 (Anonymous, 1971b). The Tokyo wholesale egg price was adjusted to the "real" price by using the wholesale price index (Anonymous, 1971f).

The relationship between per capita egg consumption and Tokyo wholesale egg price was examined according to the following equation:

$$\frac{P}{W} = a + b\,\frac{Q}{N}$$

where: P = Tokyo wholesale egg price average for the year

W = wholesale price index

Q = total egg consumption per year

N = human population

a = intercept

b = slope

The relationship was examined for the years 1960 through 1966 and the years 1966 through 1970 and is shown in Figure 8. From the two demand curves, it is observed that the demand for eggs in Japan has become more inelastic. From the 1966 through 1970 demand curve, each years' price elasticity was calculated according to Schneider (1962) and was:

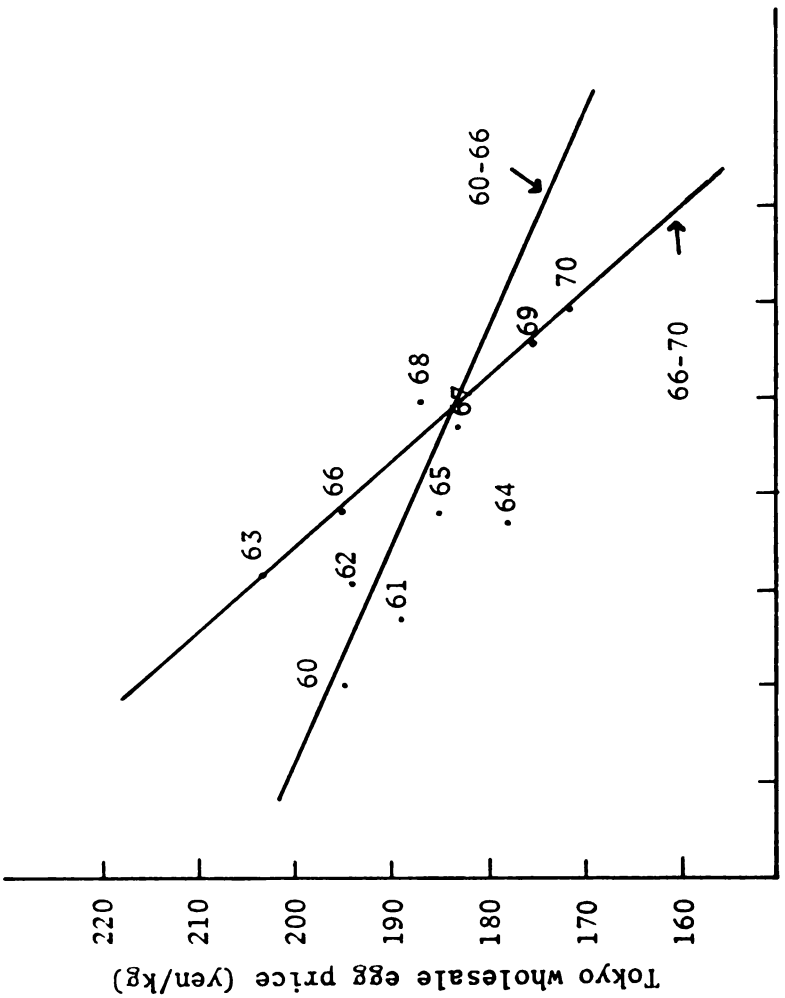

Figure 8. Relationship between adjusted Tokyo wholesale egg price and per capita egg consumption.

Year	Price Elasticity
1966	-4.55
1967	-3.55
1968	-3.33
1969	-2.80
1970	-2.57

Thus, year after year the Tokyo wholesale egg price and per capita consumption relationship has become more inelastic. However, despite this trend, the price elasticity has not reached the level of a one to one relationship.

As shown in Table 1, per capita egg consumption has been increasing--44 eggs in 1967, 14 eggs in 1968, 28 eggs in 1969 and 19 eggs in 1970. However, this statistic as a per capita consumption figure is somewhat misleading because it is calculated as:

$$\frac{\text{total eggs produced + imported eggs - exported eggs}}{\text{total human consumption}} = \text{per capita consumption}$$

It was assumed that all eggs taken to the market place are consumed. In the price prediction model of Larzelere (1971b) egg consumption is estimated from the trend in the level of total egg production. The calculations to obtain the trend by using the 12 months' moving average technique is as follows (Spurr and Bonini, 1967):

$$A = \sum_{i=-6}^{5} X_i \div 12$$

where: A = a 12 month average

X_i = egg production number in a certain month

-6 = time difference in months

The projected egg production level for 1971, shown in Figure 9, is an extrapolated line from the calculated total monthly egg production trend line for 1969 and 1970. Using an estimated human population [formula: human population = (31.11 + 1.03 x last two digits of the year) x 1,000,000], the average egg production of 2,633,000,000 eggs equals 303 eggs per capita in consumption exclusive of imported eggs. At 2 percent, as in 1970, imported eggs would increase the per capita consumption to 312 eggs in 1971.

I. Seasonality adjustment and standard deviation.

Price seasonality was examined in terms of monthly price fluctuations during the 1965 through 1970 six year period. The 12 months' moving average technique was utilized and the calculations were made according to the following equations:

1. $F_s = S \div (\sum_{i=-6}^{5} S_i \div 12)$

2. $P_m = \sum_{i=-6}^{5} P_{ai} \div 12$

3. $P_c = P_m \div F_s$

4. $F_p = P_c - P_a$

where: F_s = monthly seasonal factor associated with egg supply

S = monthly number of eggs produced

P_m = monthly Tokyo wholesale egg price average for a year

P_c = monthly calculated Tokyo wholesale egg price

F_p = monthly seasonal factor associated with Tokyo whole egg price

P_a = monthly actual Tokyo wholesale egg price

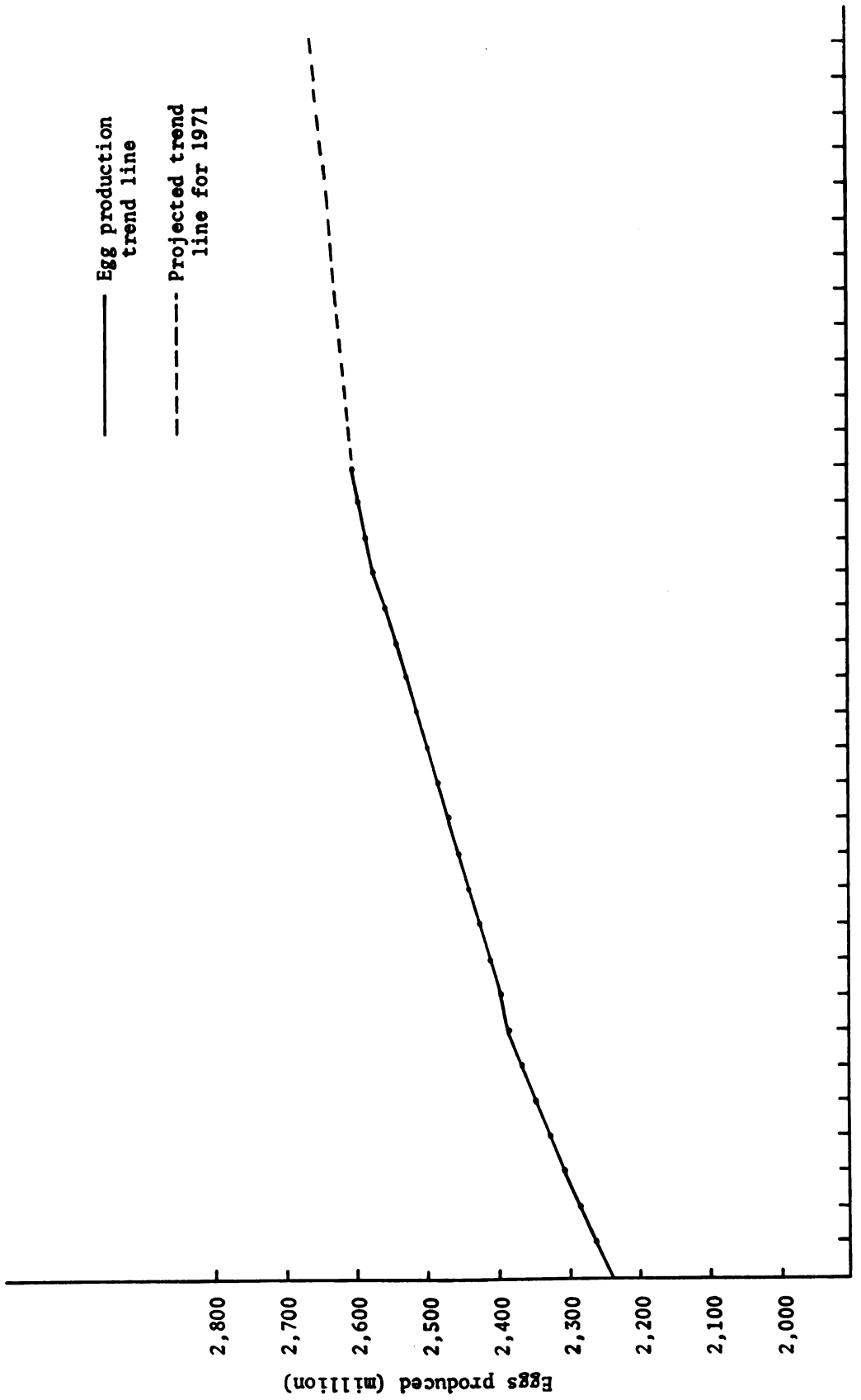

Figure 9. Trend in egg production volume

The average of the monthly seasonal factor for the Tokyo wholesale egg price with the standard deviation is presented in Table 17.

The yearly average of the Tokyo wholesale egg price (P_e) for 1971 was estimated from the monthly Tokyo wholesale egg price average for a year (P_m). Since the yearly averages for "P_m" in 1969 and 1970 were both 190 yen per kilogram eggs, the estimate used for 1971 was 190 yen per kilogram eggs.

J. Projection of Tokyo wholesale egg price.

The monthly Tokyo wholesale egg price was projected using the data presented about supply and demand of eggs in the previous nine sections of the chapter entitled, "Egg Price Prediction Model for Japan." The mathematical procedure for this monthly price projection was as follows:

1. $\hat{F}_s = \hat{S} \div \hat{Q}$

2. $\hat{P}_c = \hat{P}_1 \div \hat{F}_s$

3. $\hat{P}_p = \hat{P}_c \pm (F_p \pm S.D.)$

where: $\hat{F}_s$ = monthly projected seasonal factor associated with egg supply

$\hat{S}$ = monthly projected number of eggs produced

$\hat{Q}$ = monthly projected total egg consumption level

$\hat{P}_c$ = monthly projected calculated Tokyo wholesale egg price

$\hat{P}_1$ = monthly projected egg price level

$\hat{P}_p$ = monthly projected Tokyo wholesale egg price

Table 17. Monthly seasonality factor for the Tokyo wholesale egg price.

Month	Seasonal Factor	Standard Deviation
Jan.	- 6	±16
Feb.	17	±15
Mar.	23	±12
Apr.	5	± 7
May	-14	± 8
Jun.	-20	± 8
Jul.	-27	± 8
Aug.	-18	±11
Sep.	1	±10
Oct.	1	±12
Nov.	9	±12
Dec.	30	±27

F_p = monthly seasonal factor associated with Tokyo wholesale egg price

S.D. = standard deviation

Three separate calculations were made for the 1971 Tokyo wholesale egg price projection and included:

1. A method utilizing the actual egg production number and the actual Tokyo wholesale price to project layers culled and pullet chicks started--Figure 10 and Appendix Table 7.
2. A method utilizing the actual Tokyo wholesale egg price but employing a projected egg production number--Figure 11 and Appendix Table 8.
3. A method utilizing the actual egg production number and actual Tokyo wholesale egg price until December, 1970, with projected figures being utilized from December, 1970, forward--Figure 12 and Appendix Table 9.

As shown in Table 18 and Figures 10, 11 and 12, the projection of the 1971 Tokyo wholesale egg price was relatively close to the actual price, regardless of calculation method, except for the two, two month periods of March-April and August-September. The prediction models generally over-predicted price during the first six months of the year and under-predicted price during the last six months of the year.

One explanation for the March-April discrepancy observed between predicted and actual price may have been an unusual increase

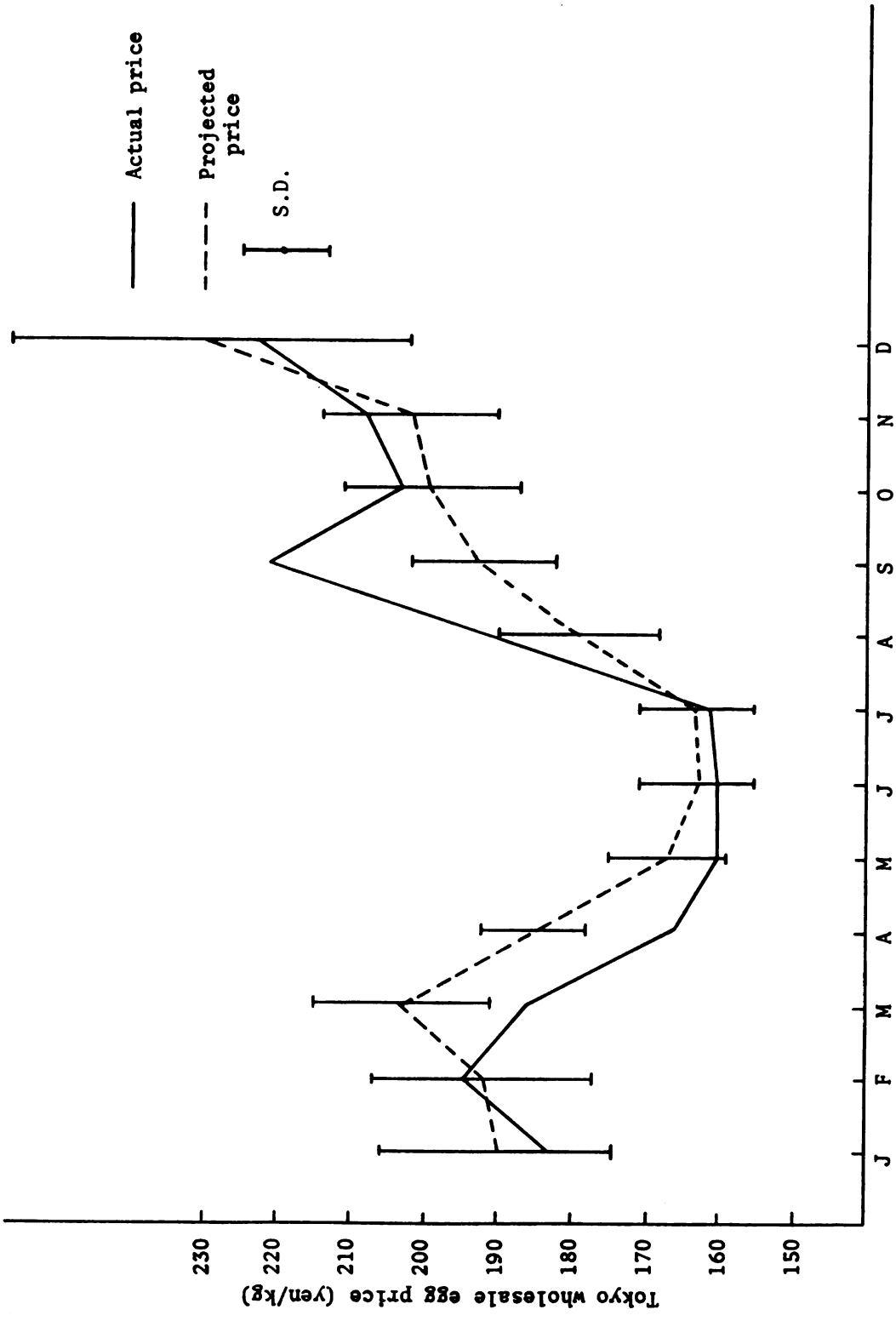

Figure 10. Projection of 1971 Tokyo wholesale egg price--method 1

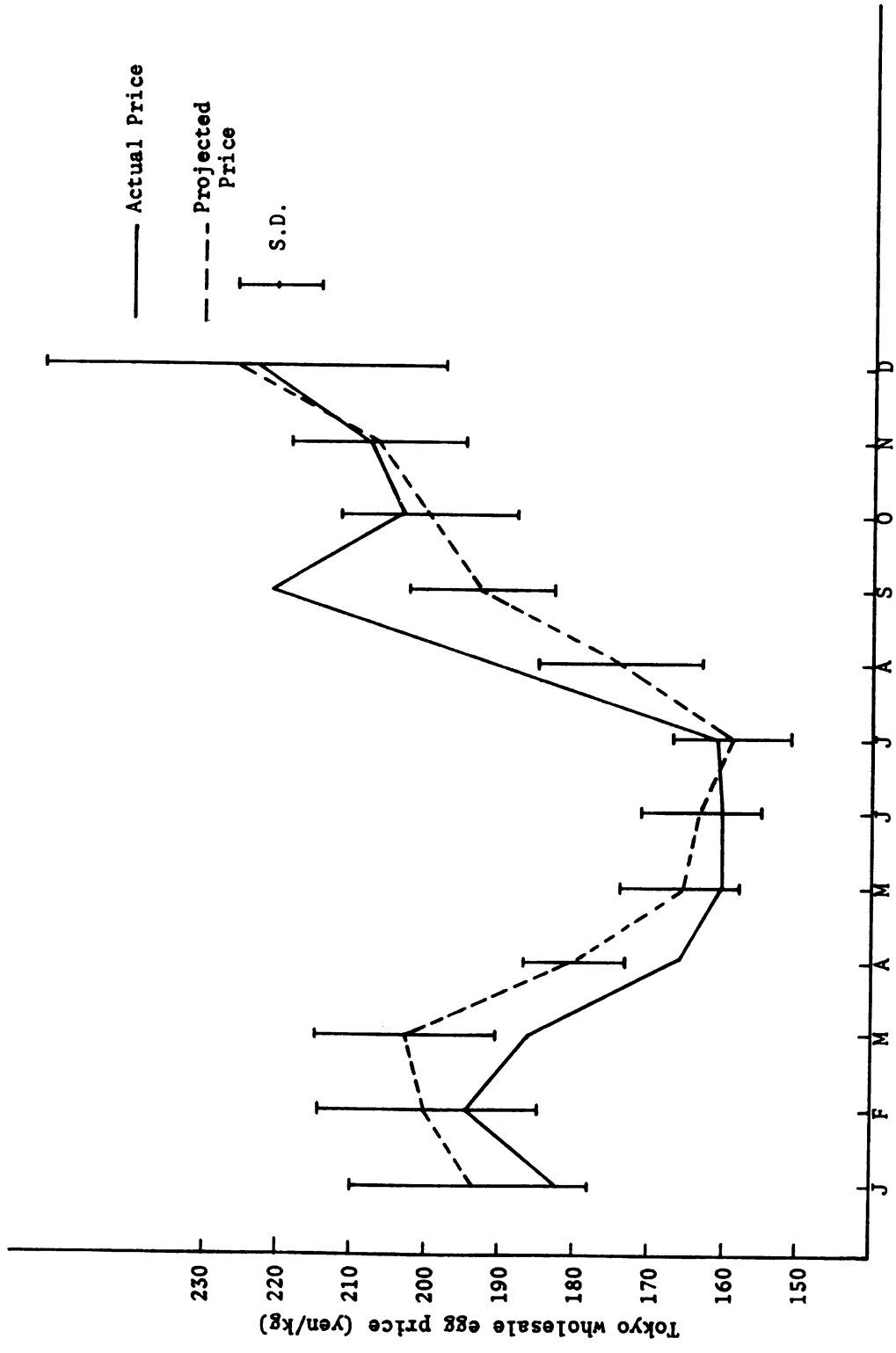

Figure 11. Projection of 1971 Tokyo wholesale egg price--method 2

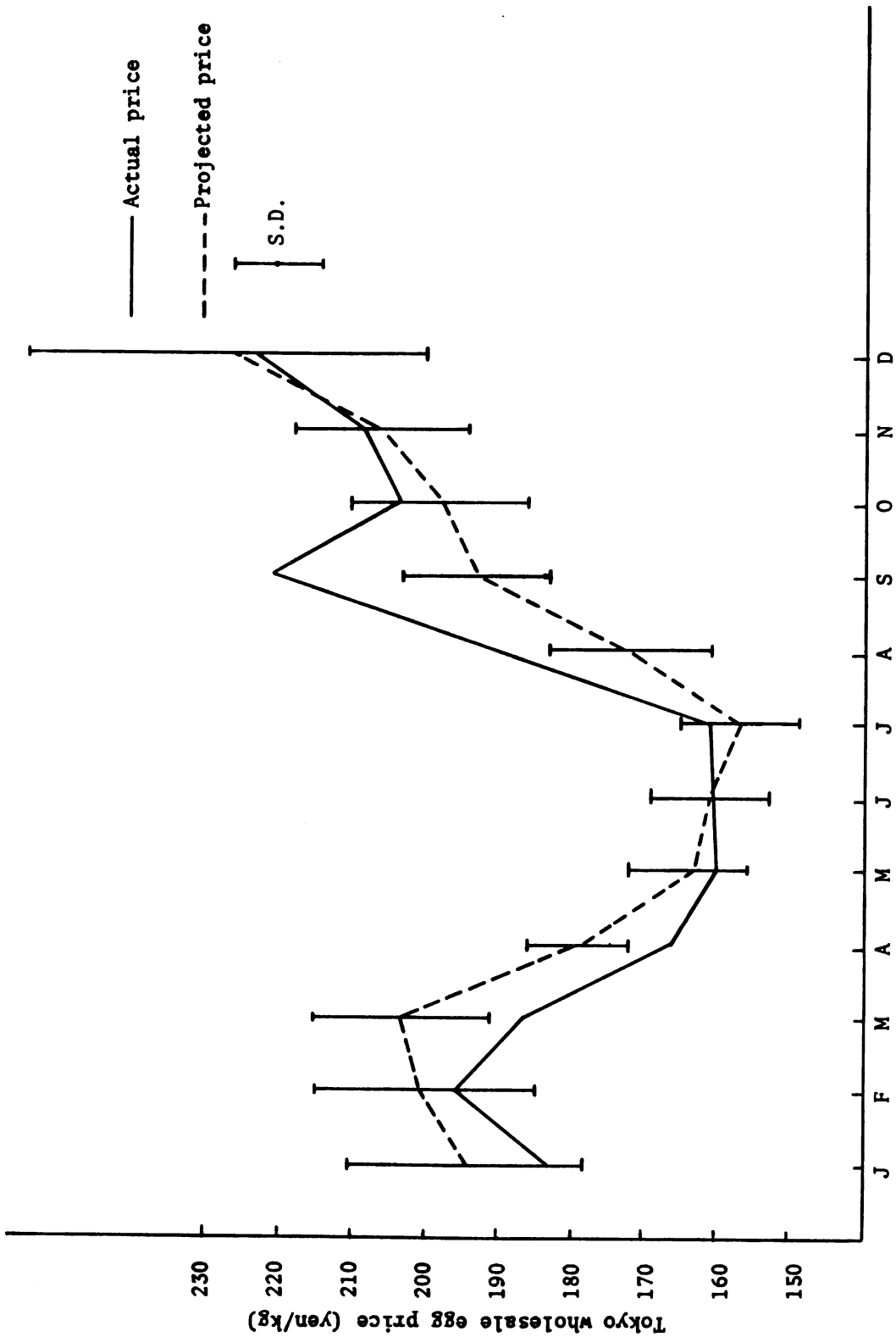

Figure 12. Projection of 1971 Tokyo wholesale egg price--method 3

Table 18. Tokyo wholesale egg price, predicted vs. actual price difference according to method of calculation in 1971.

Month	Actual Price (yen)	Projected Price--Actual Price: Method 1 (yen)	Method 2 (yen)	Method 3 (yen)	Prediction Method Closest to Actual Price: 1 vs. 3 (Method No.)	2 vs. 3 (Method No.)	1 vs. 2 (Method No.)
Jan.	183	7	11	11	1	-	1
Feb.	195	- 3	5	5	1	-	1
Mar.	186	17	17	17	-	-	-
Apr.	166	19	14	13	3	3	2
May	160	7	6	4	3	3	2
Jun.	160	3	3	1	3	3	-
Jul.	161	2	- 2	- 4	1	2	-
Aug.	192	-13	-18	-20	1	2	1
Sep.	221	-29	-28	-28	3	-	2
Oct.	203	- 4	- 3	- 5	1	2	2
Nov.	208	- 6	- 1	- 2	3	2	2
Dec.	223	6	2	4	3	2	2
Monthly Average	188.2	0.5	0.5	-0.3			

in the number of eggs received in Tokyo. In March-April, 1971, 14 percent more eggs were received in Tokyo than for the same time period in 1970. This egg volume was also reflected in egg price because the average Tokyo wholesale egg price for March and April of 1965 through 1970 was 205 and 178 yen, respectively; whereas, in 1971 the price was 186 (March) and 166 (April) yen.

During the August-September, 1971, time period, the average Tokyo wholesale egg price was 192 (August) and 221 (September) yen which was considerably higher than the average price for March (179) and April (203) of 1965 through 1970. This unusually high price apparently resulted from a shortage of supply possibly brought about by an increase in force-molting (Anonymous, 1972d) and a typhoon hitting Southern Japan in early September which interrupted egg transportation (Anonymous, 1971g).

DISCUSSION

In this price prediction model, the projected egg price was calculated from ten variables (Figure 6). The relationships between the variables were obtained from five fundamental statistics--Tokyo wholesale egg price, number of pullet chicks started, number of laying hens, percentage egg production and number of eggs produced. The use of these statistics resulted in a projected Tokyo wholesale egg price which was relatively close to the actual price (Figures 10, 11 and 12). The prediction model generally over-predicted price during the first six months of the year and under-predicted price during the last six months of the year. Perhaps, this model could be improved by including other statistics, such as, number of culled hens, percentage of force-molted hens, egg storage stock level and processed egg volume. Unfortunately, at the present time, these statistics are not available in Japan.

Statistics about monthly pullet chicks started are currently released on a two month delayed basis. Further, the revised number for January through June is issued September of the same year and the revised number for July through December is issued in March of the following year. The monthly statistics for egg price, number of laying hens, percentage egg production and number of eggs produced

are released four times (March, June, September and December) yearly on a three month delay baiss. Other statistics, such as egg production by prefecture and egg movement to the major markets, are released on a three to 12 month delayed basis. Thus, the time delay in release of data creates an egg price projection problem. A monthly release of the previous months' statistical data would improve egg price prediction procedures in Japan.

Another problem which exists is the publication of statistical data at irregular intervals by various private and public agricultural organizations. A more regular publication procedure would benefit companies routinely predicting egg price in Japan.

Despite the limitations imposed by statistical data availability, the price prediction model developed can be used by various egg industry businesses to predict price trends; thereby, increasing their knowledge for baby chick sales potential.

In order to utilize the developed price prediction model in the future, it must be constantly evaluated for accuracy. Only data from the six years, 1965 through 1970, were used in this study because of the major industry changes which had occurred (see Table 1 on the general statistics of the Japanese poultry industry). Undoubtedly, more changes will occur in the future; and of prime importance will be:

1. The growth rate of layer numbers vs. consumption vs. human population.

2. The periodic culling practice which may disappear as the "all-in, all-out" program of layer replacement gains in popularity in the controlled environment housing currently being constructed.

3. The Tokyo wholesale egg price in terms of being a representative egg price for Japan. Although Tokyo is the single largest market, other local markets exist. The Tokyo market movement of eggs sometimes exaggerates the actual supply-demand situation.

4. The price elasticity of demand. If the price elasticity of demand becomes highly inelastic, accurate projection of supply becomes very critical in accurate prediction of price.

SUMMARY

The main objective of this study was to develop a long range monthly egg price prediction model for use by the Japanese egg industry. The historical data used was for the six year time period of 1965 through 1970, and included Tokyo wholesale egg price (yen/kilogram eggs), egg/feed (yen/20 kilogram bag of feed) price ratio, pullet chicks started, number of laying hens, number of laying hens sold, percentage egg production and imported and exported eggs. In addition, seasonality factors, demand situation, projected figures on egg price and egg numbers were calculated for use in the price projection model.

Variables examined in terms of projection feasibility and accuracy were:

1. Pullet chicks started was projected in relation to the Tokyo wholesale egg price occurring two months prior to the actual chick placement. The correlation value obtained indicates that there was a relatively high correlation during the months March through October but a relatively low correlation November through February. The correlation between number of pullet chicks started and egg/feed price ratio showed less importance than the egg price-pullet chicks started relation.

2. Layer number culled was estimated from the monthly difference of laying hen numbers and the number of pullet chicks started six months previously. This figure was estimated because of a lack of published data. The relationship of estimated layer number sold and the Tokyo wholesale egg price, both occurring in the same month, was calculated. The correlation value was significant ($P \leq 0.05$) in only three of the 12 monthly values calculated. Thus, the importance of actual figures is emphasized and suggests that the number of layers culled be added to the list of statistical data collected about the Japanese egg industry.

3. Demand situation which was determined from the relationship of per capita egg consumption and the Tokyo wholesale egg price. The relationship was compared for the years 1960 through 1966 and the years 1966 through 1970. The demand for eggs in Japan apparently become more inelastic with the price elasticity being -4.55 in 1966 and -2.57 in 1970. If this change continues and demand becomes more inelastic, accurate projection of supply becomes very critical in accurate projection of price.

4. Price seasonality which was examined in terms of monthly price fluctuations by the 12 months' moving average technique. Negative factors were calculated for January, May, June, July and August with positive factors being calculated for the other seven months.

Three projection methods to predict the 1971 Tokyo wholesale egg price were compared to check the accuracy of the projection model. The first method utilized the actual egg production number and the actual Tokyo wholesale egg price to project the number of layers culled and the number of pullet chicks started. The second method utilized the actual Tokyo wholesale egg price but a projected egg production number was employed. The third method utilized projected figures for egg production number and egg price and is the method which would have to be utilized if the egg price in the future 18 months is to be predicted. Comparison of graphic presentations of the three methods indicate that the third method can be adequately utilized to predict the future Tokyo wholesale egg price in Japan.

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APPENDIX

Table A1. Number of eggs produced, adjusted for difference in number of days per month.

	Month												
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1965	1,459[1]	1,571	1,719	1,830	1,777	1,683	1,608	1,526	1,457	1,424	1,412	1,500	18,966
1966	1,386	1,472	1,626	1,714	1,695	1,608	1,627	1,569	1,549	1,565	1,561	1,669	19,041
1967	1,730	1,845	2,048	2,175	2,136	2,059	2,018	1,985	1,928	1,926	1,898	1,977	23,725
1968	1,795	1,874	2,062	2,215	2,206	2,144	2,127	2,099	2,092	2,112	2,148	2,200	25,074
1969	2,068	2,200	2,376	2,524	2,511	2,441	2,401	2,357	2,347	2,367	2,391	2,417	28,400
1970	2,261	2,380	2,556	2,704	2,672	2,612	2,573	2,521	2,531	2,548	2,563	2,576	30,496
1971	2,469	2,605	2,679	2,782	2,759	2,725	2,634	2,549	2,623	2,608	2,683	2,593	31,709

[1]Unit: million eggs

Table A2. Seasonality of Tokyo wholesale egg price

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	94.4[1]	99.3	105.7	94.0	84.9	83.7	88.9	98.5	110.3	108.0	111.6	119.9
1966	109.2	119.4	95.8	95.9	86.7	93.8	84.3	91.3	105.5	105.0	100.3	112.8
1967	107.6	111.9	108.3	98.8	81.5	81.3	83.2	99.8	108.3	102.2	107.2	117.9
1968	110.3	119.8	109.4	89.4	88.2	82.9	84.4	90.8	108.2	95.8	110.0	110.8
1969	93.9	101.3	114.9	98.1	88.4	90.6	83.9	84.7	96.1	105.5	112.7	129.9
1970	112.9	114.4	108.2	90.9	78.3	81.3	75.7	87.5	95.7	110.9	113.1	131.1
1965-1967	103.8	110.2	103.3	93.6	84.4	86.3	85.5	96.5	108.0	105.1	106.4	116.9
1968-1970	105.7	111.8	110.8	92.8	85.0	84.9	81.3	87.7	100.0	104.1	111.9	124.0

[1]Percentage for month of the average monthly price

Table A3. Seasonality of number of pullet chicks started

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	82.1[1]	135.6	199.0	177.4	119.9	77.7	54.7	52.6	70.8	82.7	76.6	70.9
1966	85.2	119.8	183.0	172.0	121.5	83.8	70.2	65.2	73.6	80.5	77.3	67.9
1967	84.3	118.3	169.6	161.0	118.2	83.8	72.5	70.8	77.8	87.7	84.5	71.5
1968	82.1	112.5	145.2	145.5	131.2	100.1	85.8	79.6	81.1	88.0	79.4	69.5
1969	85.1	110.7	146.8	141.9	125.0	94.9	86.6	79.6	83.7	92.5	80.7	72.5
1970	86.6	107.1	146.4	143.7	130.3	101.1	88.1	79.0	84.2	88.0	77.6	67.9
1965-1967	83.9	124.5	183.8	170.1	119.9	81.8	65.8	62.9	74.1	83.6	79.5	70.1
1968-1970	84.6	110.1	146.2	143.7	128.8	98.7	86.8	79.4	83.0	89.5	79.2	70.0

[1]Percentage for month of the average monthly number of pullet chicks started

Table A4. Seasonality of number of laying hens

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	104.4[1]	101.2	99.2	99.1	98.4	97.1	96.3	95.4	99.0	102.2	103.2	104.5
1966	103.1	100.5	99.8	99.3	99.3	98.8	98.1	95.8	99.4	102.0	101.7	102.2
1967	106.4	103.0	101.9	100.3	98.5	96.7	95.7	96.3	98.8	100.6	100.7	101.1
1968	100.3	98.4	98.5	98.9	98.9	97.8	97.8	98.4	100.8	102.3	103.7	104.2
1969	101.5	100.4	99.9	99.6	99.2	98.5	97.5	97.4	100.2	101.3	102.3	102.2
1970	101.3	100.3	99.8	99.2	98.7	98.4	98.0	97.7	100.6	101.4	102.4	102.2
1965-1967	104.6	101.6	100.3	99.6	98.7	97.5	96.7	95.8	99.1	101.6	101.9	102.6
1968-1970	101.1	99.7	99.4	99.2	98.9	98.2	97.8	97.8	100.5	101.7	102.8	102.9

[1]Percentage for month of the average monthly number of laying hens

Table A5. Seasonality of percentage egg production

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	87.4[1]	96.5	107.7	115.1	112.5	109.0	105.3	101.4	94.3	89.4	88.5	92.9
1966	88.5	96.0	106.9	113.0	110.6	104.8	105.6	102.2	95.6	92.1	90.5	94.2
1967	88.1	95.3	105.4	112.2	109.9	106.8	103.8	101.1	95.9	93.6	92.4	95.5
1968	89.2	94.3	103.6	110.6	108.9	106.1	104.0	100.9	97.1	95.2	94.8	95.3
1969	90.1	95.9	103.3	109.4	107.9	105.1	103.1	100.7	97.1	95.8	95.7	95.9
1970	90.6	95.4	102.7	109.0	107.1	104.7	102.7	100.3	97.5	96.8	96.3	96.9
1965-1967	88.0	95.9	106.7	113.4	111.0	106.8	104.9	101.6	95.3	91.7	90.5	94.2
1968-1970	90.0	95.2	103.2	109.7	108.0	105.3	103.3	100.6	97.2	95.9	95.6	96.0

[1]Percentage for month of the average monthly egg production percentage

Table A6. Seasonality of number of eggs produced

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1965	93.4[1]	90.1	109.2	112.8	113.1	104.6	103.7	98.9	92.7	93.1	90.1	99.0
1966	93.0	88.8	108.7	110.8	111.9	102.2	105.6	100.0	94.2	95.9	90.9	98.0
1967	95.9	90.4	109.4	111.0	110.5	101.9	101.5	99.5	93.5	96.2	91.9	98.3
1968	90.0	88.4	103.6	107.3	109.2	102.1	103.3	101.0	96.7	99.3	97.0	101.1
1969	93.3	88.5	105.1	107.4	109.0	102.0	102.6	100.0	96.1	99.2	96.7	100.1
1970	93.4	88.0	104.3	106.5	107.7	101.7	102.5	100.0	97.0	100.3	97.7	100.9
1965-1967	94.1	89.7	109.1	111.3	111.8	102.9	103.6	99.5	93.5	95.1	91.0	98.4
1968-1970	92.3	88.3	104.4	107.1	108.7	102.0	102.8	100.4	96.6	99.6	97.1	100.7

[1]Percentage for month of the average monthly number of eggs produced

Table A7. Projection of 1971 Tokyo wholesale egg price--method 1

	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Actual Egg Production (millions)	2,469	2,605	2,679	2,782	2,759	2,725	2,634	2,549	2,623	2,608	2,683	2,593
Estimated Average Egg Consumption	2,610	2,610	2,610	2,630	2,630	2,630	2,640	2,640	2,640	2,650	2,650	2,650
(millions)	.9459	.9980	1.0264	1.0577	1.0490	1.0361	.9977	.9655	.9935	.9841	1.0124	.9784
Estimated Price Level (yen)	185	185	185	190	190	190	190	190	190	195	195	195
Calculated Price (yen)	196	185	180	180	181	183	190	197	191	198	193	199
Seasonal Factor in Price (yen)	+6±16	+7±15	+23±12	+5±7	-14±8	-20±8	-27±8	-18±11	+1±10	+1±12	+9±12	+30±27
Projected Egg Price (yen)	190±16	192±15	203±12	185±7	167±8	163±8	163±8	179±11	192±10	199±12	202±12	229±27
Actual Egg Price (yen)	183	195	186	166	160	160	161	192	221	203	208	223
Difference Projected-Actual (yen)	+ 7	- 3	+17	+19	+ 7	+ 3	+ 2	-13	-29	- 4	- 6	+ 6

Table A8. Projection of 1971 Tokyo wholesale egg price--method 2.

	Month											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Projected Egg Production (millions)	2,419	2,508	2,687	2,858	2,781	2,735	2,698	2,610	2,613	2,603	2,608	2,646
Estimated Average Egg Consumption (millions)	2,610	2,610	2,610	2,630	2,630	2,630	2,640	2,640	2,640	2,650	2,650	2,650
	.9268	.9609	1.0295	1.0867	1.0574	1.0399	1.0220	.9886	.9898	.9823	.9842	.9985
Estimated Price Level (yen)	185	185	185	190	190	190	190	190	190	195	195	195
Calculated Price (yen)	200	193	180	175	180	183	186	192	192	199	198	195
Seasonal Factor in Price (yen)	-6±16	+7±15	+23±12	+5±7	-14±8	-20±8	-27±8	-18±11	+1±10	+1±12	+9±12	+30±27
Projected Egg Price (yen)	194±16	200±15	203±12	180±7	166±8	163±8	159±8	174±11	193±10	200±12	207±12	225±27
Actual Egg Price (yen)	183	195	186	166	160	160	161	192	221	203	208	223
Difference, Projected-Actual (yen)	+11	+ 5	+17	+14	+ 6	+ 3	- 2	-18	-28	- 3	- 1	+ 2

Table A9. Projection of 1971 Tokyo wholesale egg price--method 3.

	Month			
	Jan.	Feb.	Mar.	Apr.
Flock Size, Month Before (thousand)	133,253	132,704	130,704	130,677
Estimated Cull No. Month Before (thousand)	12,593	13,191	9,490	9,715
S.E.	± 3,849	± 5,202	± 3,066	± 246
Estimated Hatch No. 7 Months Before (thousand)	12,044	10,278	9,520	10,200
S.E.	± 1,257	± 326	± 716	± 197
Number of Difference	- 549	- 2,913	- 30	+ 485
Adjusted Difference Number	- 549	- 2,000	- 30	+ 485
Projected Flock Size (thousand)	132,704	130,704	130,674	131,162
Estimated Laying Rate (%)	58.4	61.9	66.3	70.5
Projected Egg Production (million)	2,419	2,508	2,689	2,867
Estimated Average Egg Consumption (million)	2,610	2,610	2,610	2,630
	.9268	.9609	1.0302	1.0901
Estimated Price Level (yen)	185	185	185	190
Calculated Price (yen)	200	193	180	174
Seasonal Factor in Price (yen)	-6±16	+7±15	+23±12	+5±7
Projected Egg Price (yen)	194±16	200±15	203±12	179±7
Actual Egg Price (yen)	183	195	186	166
Difference, Projected-Actual (yen)	+11	+ 5	+17	+13

Table A9. Projection of 1971 Tokyo wholesale egg price--method 3 (continued)

	Month			
	May	Jun.	Jul.	Aug.
Flock Size, Month Before (thousand)	131,162	130,452	131,380	131,910
Estimated Cull No. Month Before (thousand)	11,461	9,157	8,508	11,944
S.E.	± 728	± 2,204	± 1,847	± 2,337
Estimated Hatch No. 7 Months Before (thousand)	10,751	10,085	9,038	10,673
S.E.	± 422	± 734	± 927	± 885
Number of Difference	- 710	+ 928	+ 530	- 1,271
Adjusted Difference Number	- 710	+ 928	+ 530	- 1,271
Projected Flock Size (thousand)	130,452	131,380	131,910	130,639
Estimated Laying Rate (%)	69.3	67.8	66.6	65.1
Projected Egg Production (million)	2,803	2,761	2,723	2,636
Estimated Average Egg Consumption (million)	2,630	2,630	2,640	2,640
	1.0657	1.0498	1.0314	.9984
Estimated Price Level (yen)	190	190	190	190
Calculated Price (yen)	178	181	184	190
Seasonal Factor in Price (yen)	-14± 8	-20± 8	-27± 8	-18±11
Projected Egg Price (yen)	164± 8	161± 8	157± 8	172±11
Actual Egg Price (yen)	160	160	161	192
Difference, Projected-Actual (yen)	+ 4	+ 1	- 4	-20

Table A9. Projection of 1971 Tokyo wholesale egg price--method 3 (continued)

	Month			
	Sep.	Oct.	Nov.	Dec.
Flock Size, Month Before (thousand)	130,639	132,639	133,592	134,520
Estimated Cull No. Month Before (thousand)	9,303	16,714	15,660	16,784
S.E.	± 1,307	± 1,110	± 1,062	± 748
Estimated Hatch No. 7 Months Before (thousand)	13,227	17,667	17,516	15,934
S.E.	± 760	± 1,031	± 763	± 1,190
Number of Difference	+ 3,924	+ 953	+ 1,856	- 850
Adjusted Difference Number	+ 2,000	+ 953	+ 928	- 850
Projected Flock Size (thousand)	132,639	133,592	134,520	133,670
Estimated Laying Rate (%)	63.7	63.2	62.9	63.4
Projected Egg Production (million)	2,619	2,617	2,623	2,627
Estimated Average Egg Consumption (million)	2,640	2,650	2,650	2,650
	.9920	.9875	.9898	.9913
Estimated Price Level (yen)	190	195	195	195
Calculated Price (yen)	192	197	197	197
Seasonal Factor in Price (yen)	+1±10	+1±12	+9±12	+30±27
Projected Egg Price (yen)	193±10	198±12	206±12	227±27
Actual Egg Price (yen)	221	203	208	223
Difference, Projected-Actual (yen)	-28	- 5	- 2	+ 4